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

CHARLES SINGER, M.A. M.D. F.R.C.P.

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

J. ARTHUR THOMSON, M.A. LL.D.
Regius Professor of Natural History in the University of Aberdeen

A. N. DISNEY, M.A. B.Sc
F. IAN G. RAWLINS

FELLOWS OF THE SOCIETY

A. B. RENDLE, M.A. D.Sc. F.R.S. F.L.S.
Keeper, Department of Botany, British Museum

AND

RALPH ST. JOHN BROOKS,
M.A. M.D. D.P.H. D.T.M. & H. (CAMB.)

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

FOR THE YEAR
1921

TO BE OBTAINED AT THE SOCIETY'S ROOMS
20 HANOVER SQUARE, LONDON, W.1
OF MESSRS. WILLIAMS & NORGATE, 14 HENRIETTA STREET, LONDON, W.C.2
AND OF MESSRS. DULAU & CO., LTD., 34 MARGARET STREET, LONDON, W.1

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Any Omissions or Errors in this List should be notified to the Secretary.

LIST OF FELLOWS

OF THE

Royal Microscopical Society

(*Corrected to November 30th*, 1921.)

ORDINARY FELLOWS.

* *Fellows who have compounded for their Annual Subscriptions.*

Elected.

1915 Abraham, Mrs. L. A. Johnston Abraham.
59, *Cambridge-terrace, Hyde Park, W.2*

1892 Abraham, Rev. Nendick.
King Edward-avenue, Scottsville, Maritzburg, Natal, S. Africa.

1894 Abrams, Albert, M.D.
2135, *Sacramento-street, San Francisco, Cal., U.S.A.*

1919 Abushady, Ahmed Zahy, L.M.S.S.A.
21, *Cairn-avenue, Ealing, W.5*

1893 Adair, Thomas Stewart, M.D., C.M., Edin.
Storthes-Hall-asylum, Kirkburton, near Huddersfield.

1918 Adams, Basil.
Lynwood, Cromwell-road, Beckenham.

1893 Adams, Charles, M.D.
33, *Bellevue-place, Chicago, Ill., U.S.A.*

1920 Adams, Frederick, M.Inst.C.E.
4 *Calle de Panuco, Mexico City, Mexico.*

1893 Adams, James.
Comely-park, Dunfermline, N.B.

1918 Agate, Charlton S., B.Sc., etc.
Engineering Staff, Marconi Works, Chelmsford.

1892 Aikin, Charles Edmund, M.R.C.S., L.S.A.
Pentre Felin, Llangollen, Denbighshire, North Wales.

1918 Ainslie, Maurice Anderson, Instructor Commander, R.N.
Royal Naval College, Greenwich, S.E.10, and 69, *Shooters-hill-road, Blackheath, S.E.3*

Elected.

1906 Aitken, Henry James.
24, *Oakley-square, N.W.*1

1914 Akehurst, Sydney Charles.
69, *Bowes-road, Palmers Green, N.*13

1913 Allan, Mark J.
"*Ludgershall,*" *Roslyn-street, Middle Brighton, Victoria, Australia.*

1905 *Allis, Edward Phelps, jun., C.E., LL.D., F.L.S., F.Z.S.
Palais Carnolès, Menton, Alpes Maritimes, France.

1919 Alston, Richard A., A.M.C.T.
4, *Colley-street, Chester-road, Stretford, Manchester.*

1920 Altof, Mrs. Bertha.
Innespee, Alberta, Canada.

1906 Andrews, Cuthbert Otto Ralph.
47, *Red Lion-street, Holborn, W.C.*1

1921 Angers, Captain Arthur, A.M.I.F.E.
Bristol-road, Wavertree, Liverpool.

1912 Angus, Herbert Francis.
73, *Bushwood, Leytonstone, E.*11

1911 Armstrong, Frank.
78, *Deansgate, Manchester.*

1912 Ash, Lieut. Edward C.
Dallinghoo Hall, Wickham Market, Suffolk.

1909 Ashe, Albert.
55, *Warrior-square, Southend-on-Sea.*

1913 Aubin, Percy Adrian.
10, *Elizabeth-place, St. Helier, Jersey.*

1912 Audas, James W., F.L.S.
"*Correa,*" 580, *Malvern-road, East Prahran, Melbourne, Victoria.*

1921 Baddeley, William Henry Lloyd.
29, *Church-crescent, Church-end, Finchley, N.*

1920 Bagnall, Richard Siddoway, F.R.S.E., F.L.S.
Rydal Mount, Blaydon-on-Tyne.

1909 Bagshaw, Walter.
17, *Hereford-road, Harrogate.*

1894 *Bailey, Charles, M.Sc., F.L.S.
Sandhurst, St. Mary Church, Torquay.

1908 Baird, Thomas Stewart, F.I.O., F.S.M.C., D.B.O.A.
54, *St. Enoch-square, and* 34–36, *Queen-street, Glasgow.*

1915 Baker, Arthur.
Davenport Lodge, Pelham-road, Gravesend, Kent.

1885 Baker, Frederick Henry, F.L.S.
167, *Hoddle-street, Richmond, Victoria, Australia.*

1894 Baker, Frederick William Watson.
313, *High Holborn, W.C.*1

1914 Baker, Wilfred E. Watson.
313, *High Holborn, W.C.*1

Elected.
1882 Bale, William Mountier.
83, Walpole street, Kew, Victoria, Australia.
1895 Barnard, Joseph Edwin, F.Inst.P.—Hon. Secretary.
Park View, Brondesbury-park, N.W., and Royal Societies Club, St. James's-street, S.W.1
1913 Barratt, Thomas Franklin.
Bellmoor, Hampstead Heath, N.W.
1921 Batchelor, Arthur James.
151, Casewick-road, W. Norwood, S.E.27
1874 Bate, George Paddock, M.D., F.R.C.S.E., M.R.C.S., *Surgeon-Lieut.-Col. Army Medical Reserve.*
2, King Edward-road, Hackney, E.9
1920 Bates, George Frederick, B.A., B.Sc.
66, Craigie-road, Perth.
1920 Bates, James J. G.
Derbyshire Royal Infirmary, Derby.
1918 Baxter, Charles, C.E.
Cleveland-house, Bradford-road, Shipley.
1913 Bayliss, Professor William Maddock, D.Sc., F.R.S.
St. Cuthbert's, West Heath-road, Hampstead, N.W.3
1899 Beale, Peyton Todd Bowman, F.R.C.S
"Oaklands," Hythe, Southampton.
1915 Beattie, William.
8, Lower Grosvenor-place, S.W.1
1885 *Beck, Conrad, C.B.E.
68, Cornhill, E.C.3
1899 Beck, Horace Courthope.
Lister Works, Weedington-road, Kentish Town, N.W.5
1879 *Bell, Francis Jeffrey, M.A., F.Z.S. *Emeritus Professor of Comparative Anatomy and Zoology in King's College, London, Corresponding Member Linnean Society of New South Wales, Honorary Member Manchester Microscopical Society.*
11, Aberdeen-chambers, 43, Great-Marlborough-street, W.1
1910 Berridge, Miss Emily Mary, D.Sc., F.L.S.
7, The Knoll, Beckenham, Kent.
1918 Berry, John Leslie.
151A, New-street, Burton-on-Trent.
1913 Bestow, Charles Horton.
Melford-house, Upper Clapton, N.E.
1921 Bharadwaja, Pandit Yajnavalkya, M.Sc., M.R.A.S. *Senior Professor of Biology and Botany, St. John's College, Agra, India.*
1919 Bhatia, Bihari Lal, M.Sc., F.Z.S., *Professor of Zoology.*
Department of Zoology, Government College, Lahore, India.
1912 Billinghurst, Humphrey Godwin.
76, Lebanon-gardens, Wandsworth, S.W.18
1918 Blackmore, Herbert George.
23, Gloucester-gardens, W.2
1899 Bliss, J.
Boar Bank Hall, Grange-over-Sands, Lancashire.

Elected.
1903 *Blood, Maurice, M.A., F.C.S.
51, *Winchester-avenue, Kilburn, N.W.*6
1916 Bocock, C. Hanslope, F.E.S.
The Elms, Ashley, Newmarket.
1918 Bois, Sir Stanley.
12, *Fenchurch-street, E.C.*
1889 Booth, Miss Mary Ann.
60, *Dartmouth-street, Springfield, Mass., U.S.A.*
1862 Borradaile, Charles.
3, *Norfolk-terrace, Brighton.*
1920 Bowell, Ernest W., M.A., M.R.C.S., L.R.C.P.
21, *Princess-road, South Norwood, S.E.*25
1921 Bowtell, Alexander James.
123, *Dalston-lane, E.*8
1914 Boyer, Charles S., A.M.
6140, *Columbia-avenue, Philadelphia, Pa., U.S.A.*
1910 Bracewell, Geoffrey Alfred.
2, *Bingley-road, Heaton, Bradford, Yorkshire.*
1921 Bradbury, J. G.
1, *Hogarth-hill, Finchley-road, Hendon, N.W.*11
1920 Bradford, Philip G., A.M.I.Mech.E.
Crown Hotel, Greasbro, near Rotherham.
1918 *Bradshaw, Thomas Buller, J.P.
Millways, Launceston, Cornwall.
1914 Brand, Felix.
37 & 38, *Hatton-garden, E.C.*1
1915 Brewster, Frank.
Criminal Intelligence Office, Simla, India, and The "Dingle," Simla.
1890 Briant, Lawrence, F.C.S., *Mem. Soc. Public Analysts.*
24, *Holborn-viaduct, E.C.*1
1905 Bridge, John William.
Brewer-street, Maidstone.
1921 Brislee, Francis Joseph, D.Sc., F.I.C.
Holmfield, Church-road, Roby, Lancs.
1908 Brooks, Theodore, B.A. (Cantab.), F.R.G.S., *Member of the Academy of Natural Sciences, Philadelphia, U.S.A., Member of the Entomological Society of America.*
Calle 5, Esquina 4, Vedado, Habana, Cuba.
1887 Browne, Edward Thomas, F.Z.S.
Anglefield, Berkhampstead, Herts.
1911 Browning, Sidney Howard, L.R.C.P., M.R.C.S.
22, *Harley-street, W.*1
1920 Brumwell, Harold.
c/o Messrs. Searle, Ltd., Great Brak River, Cape Province, South Africa.
1920 Bull, Henry H. J.
The Bungalow, Haddenham, Bucks.
1912 Bullamore, Geo. W.
Walden-cottage, Albury, Herts.

Elected.
1920 Bullock-Webster, Rev. Canon George R.
17, Gordon-square, W.C.
1919 Bumsted, William Frederick.
16, Conway-avenue, Toronto, Canada.
1920 Burgess, Arthur Savell, M.A., M.B., B.Ch.
c/o Provincial Medical Officer, Kumasi, Gold Coast, West Africa.
1918 Burke, George Edwin.
Box 476, Colorado Springs, Colorado, U.S.A.
1920 Burns, John Marsh.
London Joint City and Midland Bank, Ltd., Windsor.
1913 Burns, Nesbitt, B.A., M.B., B.Ch.
The Lodge, Highbridge, Somerset.

1921 Caffyn, Charles Henry.
32, *Falkland-road, Hornsey, N.*8
1910 Caird, William John.
Schoolhouse, Sandhaven, Fraserburgh.
1920 Cannon, Herbert Graham, B.A., F.Z.S.
Zoology Department, Imperial College of Science and Technology, and 62, *Stockwell-park-road, Stockwell, S.W.*9
1913 Capell, Bruce J.
10, *Castelnau, Barnes, S.W.*13
1920 Carleton, H. M., B.A.
Physiology Laboratory, The University, Oxford.
1891 Carlier, Edmond William Wace, M.D., B.Sc., *Professor of Physiology, Mason University College, Birmingham.*
Morningside, Granville-road, Dorridge, near Birmingham.
1880 *Carruthers, William, Ph.D. F.R.S., F.L.S., F.G.S.
44, *Central-hill, Norwood, S.E.*19
1910 Carter, John Arthur, M.I.M.E.
6, *Temple-road, Stowmarket, Suffolk.*
1920 Carter, J. Thornton, F.Z.S.
*University College, Gower-street, W.C.*1, *and The Grange, Middle Green, Langley, Bucks.*
1920 Cathcart, Eryk Hayman.
Metherell Moor-house, Beaworthy, North Devon.
1861 *Cattley, Edward Abbs.
Officer Str[t]. 5, *lodg.* 15, *St. Petersburg, Russia.*
1918 Cattley, Major Robert, M.B., C.M., B.Sc., etc.
43, *Main-avenue, Heworth, York.*
1903 Chapman, Alfred Chaston, F.R.S., F.I.C., F.C.S.
8, *Duke-street, Aldgate, E.C.*3

Elected.

1892 Chapman, Frederick, A.L.S., *Palæontologist to the National Museum, Melbourne; Hon. Palæontologist, Geological Survey, Victoria; President, Microscopical Society, Victoria; Lecturer and Demonstrator in Palæontology, Melbourne University.*
"*Croham Hurst,*" *Threadneedle-street, Balwyn, near Melbourne, Victoria, Australia.*

1921 Chapple, William R.
8, *Branscombe-gardens, Winchmore-hill, N.*

1921 Charles, John H. V.
Biochemical Department, Nobel's Explosives Co., Ltd., Ardeer Factory, Stevenston, Ayrshire, N.B.

1909 Cheavin, Captain W. H. S., F.C.S., F.E.S.
*Middlesex Medical College, Berners-street, W.*1

1904 Cheshire, Professor Frederic John, C.B.E., F.Inst.P., *Director of Technical Optics, Imperial College of Science and Technology, South Kensington, S W.*7
23, *Carson-road, West Dulwich, S.E.*

1885 Clark, Joseph.
Hind Hayes, Street, S.O., Somerset.

1917 Clemence, Walter, M.I.Mech.E.
1, *Park-terrace, Nottingham.*

1914 Clibborn, Lt.-Col. John, C.I.E., B.A.
87, *Victoria-street, S.W.*1

1907 Clowes, William Archibald, F.Z.S.
*Duke-street, Stamford-street, S.E.*1

1919 Coghill, Douglas.
The Dominion Laboratory, Sydney-street, Wellington, New Zealand.

1920 Collins, William G.
The Cambridge & Paul Instrument Co. Ltd., Chesterton-road, Cambridge.

1908 Connell, John Gibson.
Biology Department, Glasgow Provincial Training College, Cowcaddens-street, Glasgow, and 22, *Bellwood-street, Glasgow.*

1919 Constantine, Rev. Allan W., B.A.
Grafton Lodge, Muizenburg, Cape Peninsula, South Africa.

1921 Cooke, Harold D. R., B.Sc.
Sydenham-house, Pearl-street, Saltburn-by-Sea.

1920 Cooke, William Edmund, M.D., F.R.C.P., D.P.H.
Ashfield-house, Aspull, Wigan, Lancs.

1921 Coombs, Rev. W. Monaghan.
48, *Dalton-street, Hulme, Manchester.*

1875 Cowan, Thomas William, F.L.S., F.G.S.
Sutherland-house, Clevedon, Somerset.

1921 Crawley, Walter C., B.A., F.E.S.
29, *Holland-park-road, W.*14

1881 Creese, Edward James Edgell, F.Z.S.
3, *Goswell-villas, London-road, Newbury, Berks.*

Elected.
1884 *Crisp, Lady Catherine.
5, Lansdowne-road, Notting-hill, W.
1921 Crowther, Cole Willard Weeton, A.C.I C.
Canada Carbide Co., Ltd., Shawinigan Falls, Quebec, Canada.
1891 Crowther, Henry.
Curator, The Museum, Leeds.
1919 Curties, Charles Lees.
244, *High Holborn, W.C.*1
1921 Cutting, Ernest M., M.A., F.L.S.
125, *Tredegar-road, Bow, E.*
1913 Cuzner, Edgar.
36, *Trothy-road, Bermondsey, S.E.*1

1920 Da Fano, Corrado, M.D., L.D.
*King's College, Strand, W.C.*2
1914 Daniels, Major William Cooke.
1916 Davies, Alfred T.
Avon-house, Keynsham, near Bristol.
1908 Davies, Daniel.
c/o Messrs. McGruer, Davies & Co., Timaru, New Zealand.
1921 Davis, Archibald A.
"*Rochdale*," 1, *Kings-road, Henley-on-Thames.*
1915 Denne, Mark Thomas, O.B.E.
74, *Hornsey-lane, Highgate, N.*6
1921 Depew, Ganson.
Marine Trust Co. Building, Buffalo, N.Y., U.S.A.
1920 Derry, D. C. L.
North Bank, Oakleigh-park, N.
1885 De Witt, William G.
88, *Nassau-street, New York, U.S.A.*
1904 Dibdin, William Joseph, F.I.C., F.C.S.
31, *Idmiston-road, West Norwood, S.E.*27
1918 Digby, Miss Lettice.
Kings Ford, Colchester.
1913 Dinsley, Lieut. Alfred, R.A.O.C.
"*Carlton*," *Ince-avenue, Great Crosby, near Liverpool.*
1886 Disney, Alfred Norman, M.A., B.Sc.
14 *Wilton-crescent, Wimbledon, S.W.*19
1918 *Dixon, Miss Annie.
43, *Pine-road, Didsbury, Manchester.*
1896 Dixon, Walter.
38, *Bath-street, Glasgow.*
1892 Dixon-Nuttall, Frederick Richard.
Ingleholme, Eccleston-park, near Prescot, Lancashire.
1919 Dovey, Ernest Roadley, A.R.C.S.
Government Laboratory, Hongkong, China.
1907 Dowdy, Sidney Ernest, M.P.S.
1, *Belton-villas, Hill-road, Dovercourt, Essex.*

Elected.

1918 Downes, Harold, M.B., C.M., L.R.C.P., etc.
Ditton Lea, Ilminster, Somerset.

1919 Drescher, Theodore Bausch.
149, *Westminster-road, Rochester, N.Y., U.S.A.*

1919 Drew, Aubrey H., D.Sc.
Imperial Cancer Research Fund, 8–11, *Queen-square, W.C.*1

1910 Dumat, Frank Campbell.
26, *Standard Bank-chambers, Johannesburg, Transvaal, South Africa.*

1894 Duncan, Cecil Cooke, F.I.C., F.C.S.
The County Chemical Laboratory, Shire Hall, Worcester.

1911 Duncan, Francis Martin, F.R.P.S., F.Z.S.
37A, *Belsize-square, N.W.*3

1921 Dunkerly, John S., B.Sc., Ph.D.
Zoology Department. The University, Glasgow.

1919 *Dunn, Gano, A.I.E.E.
J. G. White Engineering Corporation, 43, *Exchange-place, New York, U.S.A., and* 20, *Washington-street, New York.*

1919 Dunn, Reginald.
90, *Lorne-road, Clarendon-park, Leicester.*

1920 Durand, Alexandre.
16, *Rue Casimir Delavigne, Havre, France.*

1910 Earland, Arthur.
Aviemore, 34, *Granville-road, Watford, Herts.*

1907 Eastham, John W., B.Sc. (Edin.).
Vernon British Columbia.

1912 Edwardes, Seabury.
Burma Excise Department, Moulmein, Lower Burma.

1899 Elliott, Oliver Thomas, M.P.S., Ph.C.
c/o Messrs. Philip Harris & Co., Edmund-street, Birmingham, and The Rowans, Lloyd's-street, Small Heath.

1920 Enna, Fini G. A.
c/o S. A. Cortume Carioca, Penha, Brazil.

1886 Ewell, Marshall D., M.D.
749, *Tate-avenue, Memphis, Tenn., U.S.A.*

1897 Eyre, John William Henry, M.D., M.S.Durh., D.P.H., F.R.S.E. —President, *Professor of Bacteriology in the London University.*
*Bacteriological Laboratories, Guy's Hospital, S.E.*1
62, *Wimpole-street, W.*1, *and The Warren, Tulse-hill, S.W.*2

1921 Falkner, Herbert John.
3, *Abbey-crescent, Torquay.*

1883 *Fawcett, John Edward.
Heron-court, Farnham, Knaresborough.

Elected.

1883 Fellows, Charles Sumner.
107, Chamber of Commerce, Minneapolis, Minnesota, U.S.A.

1917 Fendick, Ernest A.
Wicklewood, 22, Finedon-road, Wellingborough.

1909 Ferguson, Arthur Duncan.
British Guiana Bank, Georgetown, Demerary, British Guiana.

1904 Fischer, Charles Edward Max, M.D., *Associate Professor of Biology, Histology, and Embryology, College of Physicians and Surgeons of the University of Illinois, Memb. Amer. Microscopical Soc., Memb. of the Amer. Assoc. for the Advancement of Science.*
Suite 1320–2, 25, E. Washington-street, Chicago, Ill., U.S.A.

1866 *Fitch, Frederick George.
34, *Hamilton-terrace, N.W.8*

1902 Flatters, Abraham.
Syddal-cottage, Bramhall, Cheshire.

1919 Fleuret, John B.
47, *Walsingham-road, Hove.*

1921 Flower, John W.
35, *Surrey-street, Strand, W.C.2*

1921 Foster, Holly George.
Aston-villa, Burton Joyce, Notts.

1917 Fotheringham, William, J.P.
Hillhead, Lerwick, Shetland.

1921 Frith, James Stretton, A.I C., A.R.S.I.
308, *West Ferry-road, Millwall, E.14*

1912 Gadd, Arthur.
115, *Atwood-road, Didsbury, near Manchester.*

1918 Garbutt, Ernest Chalders.
York-house, St. Ives, Cornwall.

1902 Gardner, William.
292, *Holloway-road, N.7*

1911 Garforth, Sir William Edward, LL.D.
Snydale Hall, Normanton.

1919 Garnett, John Benbow.
309, *Oxford-road, Manchester.*

1920 Gatenby, James Bronté, B.A., B.Sc., D.Phil.(Oxon), D.Sc. (Lond.).
Professor of Zoology, Trinity College, Dublin.

1920 Gauntlett, H. Leon, M.R.C.S., L.R.C.P., F.Z.S., F.E.S.
45, *Hotham-road, Putney, S.W.15*

1921 Ghosh, Professor Ekendranath, M.Sc., M.D., *Professor of Biology.*
Medical College, Calcutta, India.

1921 Ghosh, Professor P. N., M.A., Ph.D.
97, *Finborough-street, S.W.10*

Elected.

1902 Gibson, Joseph.
Elmfield, Psalter-lane, Sheffield.

1919 Gibson, William H., M.B.E., D.Sc.
York-street Flax Spinning Co., Ltd., York-street, Belfast.

1892 Gifford, James William.
Oaklands, Chard, Somerset.

1921 Gillings, Horace Clifford.
48, *Hertford-street, Cambridge.*

1899 Gleadow, Frank.
Bakeham-house, Englefield Green, Surrey.

1912 Glover, Samuel.
Olive Mount, St. Ann's, St. Helens, Lancashire.

1910 Gooding, Henry Cornish.
Ipswich-street, Stowmarket, Suffolk.

1908 Gordon, David.
Care of D. & W. Murray, Ltd., Adelaide, South Australia.

1909 Gordon, Fred. William.
18, *East 64th Street, New York City, U.S.A.*

1920 Graham, Joseph, B.Sc.
Glen Hurst, Corbridge-on-Tyne.

1919 Grant, Ernest Henry.
3 *and* 4, *Great Winchester-street, E.C.*2

1904 Griffiths, Waldron.
1, *Cecily-hill, Cirencester.*

1910 Grundy, James.
96, *Teignmouth-road, Cricklewood, N.W.*2

1912 Gurrin, Gerald Francis.
59, *Holborn-viaduct, E.C.*1

1902 Güssow, Hans Theodore.
Chief, Division of Botany, Dominion Experimental Farm, Ottawa, Canada, and 43, *Fairmount-avenue, Ottawa, Canada*

1910 Gwynne-Vaughan, Dame Helen Charlotte Isabella, D.Sc., F.L.S., *Professor of Botany, Birkbeck College, E.C.*4
93, *Bedford-court-mansions, W.C.*1

1919 Hadfield, Sir Robert A., Bart., D.Sc., F.R.S., F.Inst.P.
22, *Carlton-house-terrace, S.W.*1

1893 Hägler, Elmer Ellsworth, M.D.
The Hägler Building, 401, *East Capitol-avenue, Springfield, Illinois, U.S.A.*

1914 Halford-Roberts, Stanley.
9, *Sandwell-crescent, West Hampstead, N.W.*6

1912 Hall, Rev. C. A.
"*Woodburn,*" *Clynder, Dumbartonshire.*

1921 Hall, John Thomas, L.D.S., R.C.S.
Stoke Prior, Poole-road, Bournemouth.

1920 Hall, T. D. Tuton.
Technical School, Rochdale.

Elected.

1921 Hall, William Ewart.
64, Northampton-road, Wellingborough.

1885 Hallam, Samuel Robinson, L.S.A. (Lond.), L.M.S.S.A.
*586, Old-Kent road, S.E.*1

1920 Hallowes, Kennett Knight, M.A., F.G.S., A.R.S.M., A.Inst.M.M., *Assistant Superintendent, H.M. Geological Survey of India.*
27, Chowringhill, Calcutta, India, and 50, *Regent's-park-road, N.W.*

1919 Hampshire, Percy.
5, Kensington-terrace, Leeds.

1914 Harding, H. Bertram, F.L.S.
77, Hannah-street, Porth, Glam.

1919 Harper, Captain Raymond Sydney, M.R.C.S., L.R.C.P., R.A.M.C.
4, Adelaide-crescent, Hove.

1905 Harris, Charles Poulett, M.D. (Lond.), M.R.C.S., L.R.C.P.
192, Lower Addiscombe-road, Croydon, S.E.

1920 Harris, William Charles, F.C.S.
Tayside, Mill Park, Hornchurch, Essex.

1915 Hartland, Albert J.
22, Cambridge-rd., King Williams Town, Cape Province, S.A.

1867 *Hartree, William, Associate Inst. C.E., F.Z.S.
Holmwood, Torquay.

1911 Hartridge, Hamilton, M.A., M.D.
King's College, Cambridge.

1897 Hassall, John, M.D., M.R.C.S., &c.
Ingleside, Mouldsworth, near Chester.

1910 Hately, John Craig.
70, Board of Trade, Chicago, Ill., and Galewood, Lake Geneva, Wiss., U.S.A.

1919 Hawksley, Charles Worthington.
*83, Wigmore-street, W.*1, *and* 13 *Alma-square, St. John's-wood, N.W.*8

1916 Hazeldine, Frederick James.
Barnfield, South Godstone, Surrey.

1909 Heath, Charles Emanuel.
*178, Loughborough-road, Brixton, S.W.*9

1909 Heath, Ernest.
Clidga, Sennen, Cornwall.

1899 Heaton, John, F.C.S.
Southcliffe, Roker, Sunderland.

1917 Hensman, Leonard Newton, Ph.C., M.P.S.
*2, Killarney-road, Wandsworth, S.W.*18

1920 Hepworth, John, M.R.C.S., L.R.C.P.
Plestor House, Selborne, Hants.

1889 Hepworth-Collins, Walter, F.G.S., F.C.S.
Junior Constitutional Club, Piccadilly, W.

1920 Herbert, W. J. S.
22 Beaufort-street, Brynmawr, Brecknockshire.

Elected.
1891 Heron-Allen, Edward, F.R.S., F.L.S., F.G.S., F.Z.S., M.R.I.A., etc.
33, Hamilton-terrace, N.W.8, and "Large Acres," Selsey-bill, Sussex.
1921 Hewison, Rev. G. H., M.A.
Marr Vicarage, Doncaster.
1910 Hewlett, Richard Tanner, M.D., F.R.C.P., D.P.H.
Professor of Bacteriology. Bacteriological Laboratory, King's-college, Strand, W.C., and 12 Colinette-road, Putney, S.W.15
1921 Higginson, Richard William.
21 Prince of Wales-road, Kentish Town, N.W.5
1904 Hill, Cyril Francis, M.Inst.M.M.
Druids-croft, Kinnaird-avenue, Bromley, Kent.
1881 *Hill, Joseph Alfred, F.L.S.
St. Bees, Northumberland-road, Leamington.
1920 Hill, W. Basil, F.C.S.
Eastfield, Stockton-lane, York.
1906 Hiscott, Thomas Henry.
16, Woodville-road, Ealing, W.5, and 5, Stone-buildings, Lincoln's Inn, W.C.
1917 Hitchins, Alfred Bishop, Ph.D., D.Sc., A.M.
c/o Ansco Co., Research Laboratory, Binghampton, N.Y., U.S.A.
1921 Hogben, Lancelot T., M.A., D.Sc.
Imperial College of Science and Technology, South Kensington, S.W.7
1921 Holder, J. T.
114 Pepys-road, S.E.14
1921 Holt, Alfred, F.C.S.
76 Nipper-lane, Whitefield, near Manchester.
1920 Hornyold, Professor Alfonso Gandolfi, D.Sc.
Professor Agregardo of the Marine Biological Laboratory, Porto-Pi, Palma de Mallorca, Spain, and Instituto Español, de Oceanografia, Fomento, 7, Madrid.
1918 Hort, Edward C., F.R.C.P.
8, Harley-street, W.1
1921 Horton, William.
17 Grove-park, Liverpool.
1918 Hoseason, William Sandford.
Dockmaster's Office, Alexandra Dock, Bombay, India.
1891 Howard, A. Dashwood, B.A., M.D., M.R.C.S., L.R.C.P.
"The Corner," Hampton-hill, Middlesex.
1917 Howard, Henry J.
6, College-road, Norwich.
1918 Hughes, Owen Lloyd.
Ael-y-Bryn, Henllan, Trefnant, Denbighshire, N. Wales.
1913 Hughes, R. H. Pullen.
Alexander-house, 141, Duke-street, Southport.
1911 Huish, Charles Henry.
"The Limes," 79, Station-road, Redhill, Surrey.

Elected.

1921 **Humphery, William Overton, M.I.M.E., P.A.S.I., M.R.San.I.**
Pudding Norton, Fakenham, Norfolk.

1921 Hunt, Reginald J. H.
2 *Blawith-road, Harrow.*

1913 Hurrell, Harry Edward.
25, *Regent-street, Great Yarmouth.*

1920 Hutchinson, Alfred, M.A., B.Sc.
Manesty, Saltburn-by-Sea, Yorks.

1867 Ingpen, John Edmund.
21, *Wrotham-road, Broadstairs.*

1920 Ireland, William Jabez.
6, *Hurlingham-road, Fulham, S.W.*6

1903 Ives, Frederic Eugene, F.R.P.S., *Member of the Franklin Inst., N.Y., Camera Club, and American Microscopical Soc.*, F.A.A.A.S.
1327, *Spruce-street, Philadelphia, Pa., U.S.A.*

1901 Johnson, Charles Harold, M.D., C.M., F.R.C.S.E.
22, *The Ridge, Canterbury, near Melbourne, Victoria, Australia.*

1912 Johnston, Thomas Harvey, M.A., D.Sc., F.Z.S.
Professor of Biology, The University of Queensland, Brisbane, Australia.

1918 Jones, Sir Bertram Hyde, K.B.E.
Ilgars, Runwell, Wickford, Essex.

1910 Jones, William Llewellyn.

1885 Karop, George C., M.R.C.S.
Inniscorrig, Beltinge-road, Herne Bay.

1910 Keeley, Frank J., B.S., E.M., *Member of the Council, Academy of Natural Sciences, Philadelphia; Vice-Director, Mineralogical Section, Academy of Natural Sciences, Philadelphia.*
Box 25, *Merion Station, Penna, U.S.A.*

1919 Keen, Percy Frederick.
64, *Fairholt-road, Stamford-hill, N.*16

1918 Kidd, Robert Hicks.
Marlborough-house, Newbury, Berks.

1912 King, Mrs. Cecil.
33, *Evelyn-gardens, South Kensington, S.W.*7

1909 Kirby, Edwin Henry.
The Sungei Bahru Rubber Estates, Ltd., Home Division, Alor Gaja, Malacca.

1905 Kitchin, Joseph.
The Mount, 53, *Park-hill-road, Croydon.*

1897 Klein, Sydney Turner, F.L.S., F.R.A.S., F.E.S.
Lancaster-lodge, Kew-gardens, Surrey.

1913 Koch, Victor M. E.
c/o Messrs. Carl Zeiss, 153, *West 23rd Street, New York, U.S.A.*

Elected.
1920 Lamb, Morris Charles, F.I.C.
176, Tower-Bridge-road, S.E.1
1915 Lambert, Joseph, F.R.H.S., F.P.C.
68, Dartmouth-road, Cricklewood, N.W.2
1918 Lancaster, Henry C.
39, Ladbroke-grove, Holland-park, W.
1920 Langeron, Maurice C. P., *Docteur en Médicine, Chef de Laboratoire á la Faculté de Médicine de Paris.*
15, Rue de l'Ecole de Médicine, Paris, France.
1865 Lankester, Sir Edwin Ray, K.C.B., M.A., LL.D., F.R.S., F.L.S., F.Z.S., *Hon. Fellow of Exeter College, Oxford.*
44, Oakley-street, Chelsea, S.W.3
1887 Latham, Miss Vida Annette, M.D., D.D.S.
1644, Morse-avenue, Roger's-park, Chicago, Ill., U.S.A.
1919 Lauwers, Walter H. M., F.P.S.L.
77, Rue Lamoriniere, Antwerp, Belgium.
1919 Lawrie, Leslie G.
Stornoway, Holden-road, Kersal, Manchester.
1912 Lawson, Peter.
"Jesmond," Nella-road, Fulham-palace-road, Hammersmith, W.6
1921 Lazlo, Henry G. de.
3 Palace-gate, Kensington, W.8
1914 Leeson, John Rudd, J.P., M.D., F.L.S., F R.A.S.
Clifden House, Twickenham.
1921 Le Souëf, Leslie Ernest.
Trinity College, Parkville, Victoria, Australia.
1919 Lissimore, Norman.
Ryde Villa, Dixon's-green, Dudley, and The Clinical Laboratory, 10, Princes-square, Harrogate.
1920 Loxton, Samuel Ernest, F.R.A.S., F.G.S.
Icknield Little Aston, near Sutton Coldfield, Staffs.
1921 Ludford, Reginald James, B.Sc., F.B.H.S.
1, Oakfield-road, Southgate, N.14, and University College, W.C.1

1916 *McEwen, Alfred.
Craig Avel, Tarrytown-on-the-Hudson, New York, U.S.A.
1921 McFarlane, Miss Mabel Jeannette, B.Sc.
55, Springbank-street, Glasgow.
1894 Macintyre, John, M.B., C.M., F.R.S.E.
179, Bath-street, Glasgow.
1919 Mackay, Rev. A. F. Gordon.
The Manse, Mecklenburg, New York, U.S.A.
1910 McKeever, Frederick Leonard
P.O. Box 210, Penticton, British Columbia.
1904 MacKenzie, John Ross, F.C.S.
Woodleigh, Selborne-road, Barbourne, Worcester.

Elected.

1921 McLatchie, John Drummond Pryde. M.B., C.M.
34, *Welbeck-street, W.*1

1884 McMurrich, J. Playfair, M.A.
Anatomical Laboratory, University of Toronto, Toronto, Canada.

1919 Macpherson, Angus Duncan, M.B.
18, *Cornwall-mansions, Chelsea, S.W.*10

1911 Mansfield-Aders, Walter, Ph.D.
Zanzibar, East Africa.

1909 Mapp, Charles Richard, B.Sc.
37, *Montpellier-terrace, Cheltenham.*

1920 Marchment, Reginald Henry.
10, *High-road, Wood Green, N.*

1896 Marshall, William John.
96, *Emlyn-road, Wendell Park, W.*12

1904 Mason, Francis Archibald.
29, *Frankland-terrace, Leopold-street, Leeds.*

1921 Mathews, Harold J. C., F.C.S.
Bridge End Brewery, Burnley.

1921 Matthews, Ernest Channing-, F.R.G.S., *Member of the Royal United Service Institution.*
Jesus College, Cambridge, and Authors' Club, 3 *Whitehall-court, S.W.*1

1920 Maulik, Professor Samarendra, M.A., F.Z.S.
Zoological Laboratory, The University, Calcutta, India.

1921 Maurice, Edmund.
48, *Gordon-mansions, W.C.*1

1892 Maw, William Henry, C.E., F.R.G.S.
18, *Addison-road, Kensington, W.*

1879 *Mercer, A. Clifford, M.D.
324, *Montgomery-street, Syracuse, N.Y., U.S.A.*

1899 Merlin, Augustus Alfred Cornwallis Eliot.
3, *Cleveland-gardens, West Ealing, W.*13

1901 *Metheny, Samuel Alexander Sterrett, B.A., M.D.
Peermont, New Jersey, U.S.A.

1877 Michael, Albert Davidson, F.L.S., F.Z.S., F.R.H.S.
The Warren, Studland, near Swanage, Dorsetshire. (*See Honorary Fellows.*)

1921 Mignot, Ernest A.
33, *Ferme Park-road, Stroud Green, N.*4

1895 Millard, Edgar James, F.C.S.
35–42, *Charlotte-street, E.C.*2

1891 Miller, John Albert, M.Sc., Ph.D., F.C.S., *Chemist to the State of New York.*
44 *and* 45, *Lewis Block, East Swan-street, Buffalo, N.Y., U.S.A.*

1920 Mills, Albert Edward, F.C.S., M.P.S.
8, *George-street, Bath.*

1912 Mills, Frederick William, F.L.S.
Flying Hall, near Robin Hood's Bay, Yorks.

Elected.
1907 Minns, John Edward, M.S.C.I.
32, *North-street, Taunton, Somersetshire, and* 5, *North Town-terrace, Taunton.*
1905 Moffat, Eliezer.
75, *High-street, Chatham.*
1911 Mond, Robert Ludwig, M.A., F.R.S.E., F.Inst.P., F.C.S., F.Ph.S., F.G.S., F.Z.S.
Combe Bank, Sevenoaks, Kent.
1916 Moore, Professor Benjamin, M.A., D.Sc., F.R.S.
4, *Tackley-place, Oxford.*
1921 Moore, Harold, O.B.E., B.Sc., F.I.C., F.Inst.P.
*Lindsey-house, Lloyd's-place, Blackheath, S.E.*3
1897 Moore, Harry, *Curator, Public Museum, Clifton-park, Rotherham.*
12, *Whiston-grove, Moorgate, Rotherham.*
1851 Moreland, Richard, M.Inst.C.E.
4, *Highbury-quadrant, Highbury, N.*5
1896 Moreton-Parry, Lewis.
163, *Oakfield-road, Everton, Liverpool.*
1918 Morrish, William J., M.D., etc.
"*Westleigh,*" *Thrale-road, Streatham-park, S.W.*16
1918 Mortimer, Hugh Hamilton.
15, *Mulgrave-road, Croydon.*
1915 Mosley, Frederick Ormrod.
University College, Reading, and "*Whernside,*" *Basingstoke-road, Reading.*
1914 Mumford, Major E. Moore, M.Sc.
75, *High-street, Chorlton-on-Medlock, Manchester.*
1900 Murphy, Albert John, F.C.S.
2, *Dorset-square, N.W.*1
1919 Murray, James Alexander, M.D., Hon. Secretary.
Director, Imperial Cancer Research Fund.
8, *Queen's-square, W.C.*1

1914 Nall, Rev. George Herbert.
18, *Dean's-yard, Westminster, S.W.*1
1915 Naylor, George, F.B.O.A., F.I.O.
52, *Cavendish-place, Jesmond, Newcastle-on-Tyne.*
1890 *Nelson, Edward Milles.
Beckington, near Bath, Somersetshire.
1921 Newmarch, Edgar Ribton.
"*Westbury,*" *The Drive, Walthamstow, E.*17
1911 Noad, Lewis.
7, *King's Bench-walk, Temple, E.C.*
1899 Norman, Albert, L.R.C.P. and L.R.C.S. Edin.
35, *Coleherne-road, Earl's Court, S.W.*10
1921 Norman, Albert.
New Haw, Weybridge.

Elected.

1920 Oakden, Charles H., F.R.P.S.
Hamilton House, W.C.

1887 Ochsner, A. J., Ph.D., M.D.
2106, *Sedgwick-street, Chicago, Ill., U.S.A.*

1883 Offord, John Milton.
8, *Culmington-road, West Ealing, W.*13

1907 Ogilvy, James Wilson.
18, *Bloomsbury-square, W.C., and* 21, *Ravensdale-mansions, Crouch-end, N.*

1878 O'Hara, Lieut.-Colonel Richard.
West Lodge, Galway.

1919 Oppenheimer, Captain Frank, I.M.S., M.B., Ch.B.
c/o Messrs. Grindlay & Co., Bombay, India.

1897 Orueta y Duarte, Domingo de
Lagasca 116, *Madrid, Spain.*

1900 Oxbrow, Alfred William.
7, *Old Haymarket, Norwich.*

1879 Oxley, Frederick.

1912 Palmer, Henry, J.P., F.R.G.S.
The Hill, Skelton-in-Cleveland, Yorks.

1910 Palmer, Thomas Chalkley, *President of Delaware County Natural History Society, Vice-Director, Biological Section, Academy of Natural Sciences of Philadelphia.*
Media, Delaware Co., Penn., U.S.A.

1919 Parish, Rev. Herald.
191, *Stamford-street, Brooks's Bar, Manchester.*

1920 Parker, James Gordon, Ph.D., F.I.C.
176, *Tower-bridge-road, S.E.*1

1890 *Paterson, Mrs. Catherine Childs.
15, *Compayne-gardens, N.W.*6

1907 Paulson, Robert, F.L.S.
Glenroy, Cecil-park, Pinner, Middlesex.

1898 Payne, Arthur E. T.
Physiological Laboratory, University of Melbourne, Victoria, and Scotsburn, Toorak, Melbourne, Victoria.

1884 *Peek, The Honourable Lady.
Widworthy Court, Honiton.

1898 Pillischer, Jacob.
88, *New Bond-street, W.*1

1911 Pinchin, Ernest Alfred, B.Sc. (Lond.), F.I.C.
36, *Sternhold-avenue, Streatham-hill, S.W.*2

1906 Plaskitt, Frederick James Wade.
15, *Uxbridge-road, Rickmansworth, Herts.*

1907 Pledge, John Harry.
72, *Nibthwaite Road, Harrow, Middlesex.*

1919 Poignand, Rev. Cecil W., M.A.
The Beccles, Walsham-le-Willows, nr. Bury St. Edmunds

Elected.

1897 Pollard, Jonathan.
10, *Porteus-road, Paddington-green, W.*2

1902 Poser, Max.
16, *Vick Park B., Rochester, N.Y., U.S.A., and c/o Bausch & Lamb, St. Paul-street, Rochester, N.Y., U.S.A.*

1867 Potter, George.
10, *Priestwood-mansions, Highgate, N.*6

1919 Pougher, Ernest W., M.M.A.E.
93, *Manchester-road, Chorlton-cum-Hardy, Manchester.*

1892 Pound, Charles Joseph.
Director, Stock Experiment Station, Yeerongpilly, Queensland, Australia.

1880 Powell, Thomas Hugh.
Emsdale, Greenham-road, Muswell-hill, N.

1921 Poyser, W. A.
2420, *Catherine-street, Philadelphia, Pa., U.S.A.*

1898 Radley, Percy Edward, F.Z.S.
Nesta, Broxbourne, Herts, and The Metric Publishing Co., 329, *High Holborn, W.C.*1

1919 Ramana-Sāstrin, Vedāranyešvara Vaidyanātha, M.A., Ph.D., F.L.S., F.Z.S., F.R.H.S., F.R.A.S., F.R.Met.Soc., F.P.S.L., Mem. Brit. Astron. Ass., Mem. Royal Astron. Soc. of Canada, Mem. London Math. Soc., M.R.A.S.
Vedaraniam, Tanjore, Dt., South India, and 1, *Sami Pillai-street, Choolai, Madras. N.C., South India.*

1896 Ranken, Charles, F.C.S.
11, *Stockton-road, Sunderland.*

1921 Rau, A. Subba, B.A.
*Department of Zoology, University College, W.C.*1

1920 Rau, Venkata, M.A.
Department of Agriculture, Bangalore, India, and c/o Messrs. Coutts & Co., Bankers, Strand, W.C.

1917 Rawlins, Francis Ian Gregory.
White Waltham Grove, near Maidenhead, Berkshire.

1912 Rees, W. Eric, F.S.M.C.
Clovelly, Bedford-road, Newport, Mon.

1910 Reid, Alfred, M.B., D.P.H., B.Hy. Durh., M.R.C.S. Eng., L.R.C.P., *Government Medical Officer.*
Kuala Lumpur, Selangor, Federated Malay States.

1920 Reid, Duncan James, M.B., C.M.
20, *Blakesley-avenue, Ealing, W.*5

1897 Remington, John Stewart, M.R.A.C., F.C.S., F.L.S.
Aynsome-house, Grange-over-Sands, R.S.O., Lancashire.

1899 Rheinberg, Julius.
23, *The Avenue, Brondesbury-park, N.W.*

Elected.

1893 Richardson, Frederic William, F.I.C., F.C.S., *County Analyst, Bradford, and Oak Lea, Menston, Yorkshire.*

1916 Richardson, John.
12, *Sutherland-gardens, East Sheen, S.W.*14

1921 Roberts, William James David.
21, *Penn-road, N.*1

1908 Robertson, James A.
Skerryvore, Holmfield-avenue, Cleveleys, near Blackpool.

1921 Robertson, Thomas E., F.C.I.P.A., A.F.R.Ae.S., A.M.I.E.E.
Hazlitt House, 43–46, *Southampton-buildings, Chancery-lane, W.C.*2

1921 Robins, Edmund Arthur.
"*Gorran,*" *Cassiobury-park-avenue, Watford, Herts.*

1910 *Robins, Herbert George, F.R.G.S.
Toms Farms, Wankie, S. Rhodesia, South Africa.

1917 *Robinson, Miss Nancy M.
Glassel House, Glassel, Aberdeenshire.

1899 Rogers, George Henry James.
2, *Bower-terrace, Tonbridge-road, Maidstone.*

1921 Room, H. W. Reginald.
Sunnymead, Lansdown-road, Bromley, Kent.

1911 Ross, John Pilkethly, M.P.S.
Care of Messrs. Stella and Co., Esplanade-road, Bombay, India.

1918 Ross, Sydney W.
Michelmersh, Romsey, Hants.

1883 *Rosseter, Thomas B.
6, *Salisbury-road, St. Stephen's, Canterbury.*

1918 Rowley, Frank, M.I.M.M.
21, *Buckland-crescent, Hampstead, N.W.*3

1917 Ryland, Lieut.-Colonel Alfred W.
Glen Hurst, Watling-street-road, Fulwood, Preston.

1921 Sachs, Leonard, M.P.S.
Box 969, *Pretoria, S. Africa.*

1921 Saguchi, Professor Sakae.
Kanazawa Medical School, Kanazawa, Japan.

1921 Sahni, C. L., M.B., B.S.
c/o Messrs. Henry S. King & Co., 9, *Pall-mall, S.W.*1

1919 St. John-Ward, Henry.
Brebner School, Bloemfontein, Orange Free State, South Africa.

1918 Salmon, Walter
17, *The Grove, Eccles, Lancs.*

1892 *Salomons, Sir David Lionel, Bart., J.P., M.A., D.L., F.R.G.S., F.G.S., F.Z.S.
49, *Grosvenor-street, W.*; *and Broomhill, Tunbridge Wells.*

Elected.

1909 Saxton, Thomas R., Assoc.M.Inst.C.E.
*43, East Bank, Stamford-hill, N.*16

1898 Scales, F. Shillington, M.A., M.D., B.C. (Cantab.).
Redcourt, Adams-road, Cambridge.

1880 Scott, Dukinfield Henry, M.A., D.Sc., Ph.D., LL.D., F.R.S., F.L.S.
East Oakley-house, Basingstoke, Hants. and Athenæum-club.

1916 Scott, Joseph Henry.

1909 Scott, Walter.
Nant-y-Coed, Conway, Carnarvonshire.

1913 Scott, Wm., F.R.C.V.S.
Friarn House, Bridgwater.

1900 Scourfield, David J., F.Z.S.
*63, Queen's-road, Leytonstone, E.*11

1907 Scriven. Charles R.
Kingscote, Furze-hill, Burgh-heath, Surrey.

1919 Seager, John Horsford.
1, St. Mary's-road, Faversham, Kent.

1917 Sears, R. S. W.
*1, Lisson-grove, Marylebone. N.W.*1

1921 Sen, Lolitmohan, M.B., D.P.H., D.T.M.
*c/o Messrs. Grindlay & Co., 54. Parliament-street. S.W.*1

1918 Seymour-Jones, Alfred.
"Pendower," Wrexham.

1921 Seymour-Jones, F. L.
414, West 118th-street, New York, N.Y., U.S.A.

1902 Sharpe, Charles James.
*130, Fenchurch-street, E.C.*3

1885 *Shelley, Major A. D. G., R.E. (Retired).

1910 Sheppard, Alfred William, F.L.S.
*c/o Longmans, Green & Co., 39, Paternoster-row, E.C.*4

1909 Sheppard, Edward James.
*137, Kennington-road, Lambeth, S.E.*11

1920 de Sibour, Le Vicomte, F.Z.S.
c/o Messrs. Morgan Grenfell & Co., 22, Old Broad-street, E.C.

1909 Sidwell, Clarence J. H.
46. Ashbourne-grove, East Dulwich. S.E.

1921 Sierra, J. M.
*Biological Laboratory, Cadby Hall, Kensington, W.*14

1912 Simpson, Norman Douglas, B.A.
Maesbury, Cavendish-road, Bournemouth.

1916 Singer, Charles, M.A., M.D.
*5, North-grove. Highgate, N.*6

1910 Sinha, J. C., J.P., Honorary Presidency Magistrate.
c/o Jones & Co., Solicitors, 6, Old Post Office-street, Calcutta.

Elected.

1918 Skepper, Harry Godfrey.
"Lindum," Brothertoft-road, Boston, Lincs.

1917 Smith, Joseph, F.S.A.A.
28, *Altom-street, Blackburn, Lancashire.*

1908 Smith, Theodore White.
920, *North Michigan-avenue, Illinois, U.S.A.*

1906 Smith, Thomas James.
Braeside, Bosworth-road, New Barnet.

1897 Soar, Charles David, F.L.S.
10, *Westmoreland-road, Barnes, S.W.*13

1920 Sonntag, Charles F., M.D., Ch.B.
80*a*, *Belsize-park-gardens, N.W.*3

1918 Springall, Hubert F.
The Friars, King's Lynn.

1903 Spry, Robert, Lieut.-Commander, R.N.
83, *Mount-Gold-road, Plymouth.*

1882 Squance, Major Thomas Coke, M.D., M.S., F.R.S.E.
The Cottage, Newbiggin, Aysgarth, S.O., Yorks.

1909 Stewart, Thomas S., M.D.
1736, *Spruce-street, Philadelphia, Pa., U.S.A.*

1900 Stiles, Matthew Henry.
10, *Avenue-road, Doncaster.*

1921 Stobart, Captain Henry Francis.

1867 Stoker, George Naylor.
Fairfield, Lessar-avenue, Clapham-common, S.W.

1914 Strachan, James, F.Inst.P.
71, *Blenheim-place, Queen's Cross, Aberdeen.*

1912 *Stringer, Edward Belcher.
Egerton-lodge, Bromley, Kent.

1871 Stuart, John.
3, *North-side, Clapham-common, S.W.*4

1921 Stump, Dan M., B.S., M.E.
5451, *Monroe-street, Chicago, Ill., U.S.A.*

1918 Sutcliffe, Herbert.
The Research Laboratory, Petaling, Federated Malay States.

1920 Sutherland, Donald, M.A.
"Golden Hurst," 20, *Carmunnock-road, Cathcart Glasgow.*

1919 Swainson-Hall, R., F.L.S.
Poste Restante, Casa de Senor Joao Martins, Cabinda Portuguese Congo, S. W. Africa.

1906 Swift, Mansell James.
81, *Tottenham-court-road, W.*1

1889 Sykes, Mark Langdale.
Eversley cottage, Coombe Down, Bath.

Elected.
1911 Tabor, Charles James, F.R.A.I.
The White House, Knott's-green, Leyton, Essex.
1891 *Talmage, James Edward, D.Sc., Ph.D. F.R.S.E., F.G.S., *Professor of Geology, University of Utah, Salt Lake City, Utah, U.S.A.*
The Deseret Museum, Salt Lake City, Utah.
1900 Taverner, Henry.
Wrekin House, 319, *Seven-Sisters-road, Finsbury-park, N.*4
1919 Taylor, Albert.
32, *William-street, Ryecroft, Ashton-under-Lyne.*
1915 Taylor, Frederick H.
County Bank, Chorley, Hants.
1891 Terry, Edwin, F.C.S.
Sunbury House, 374, *Brixton-road, S.W.*9
1921 Thapar, Professor Gobind Singh, M.Sc., F.R.M.S.
Canning College, Lucknow, India.
1885 *Thomson, J. Arthur, M.A., LL.D., F.R.S.E., F.Z.S., *Regius Professor of Natural History in the University of Aberdeen.*
Natural History Department, Marischal College, University, Aberdeen, and Castleton House, Old Aberdeen.
1881 Thomson, William.
Royal Institution Laboratory, 79A, *Princess-street, Manchester.*
1920 Thorne, Captain Ralph G. A., B.A.
82, *Ashley-gardens, S.W.*1
1912 Tierney, Clarence, M.S., D.Sc.
"*Netherton*," *Coulsdon, Surrey.*
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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

MARCH, 1921.

TRANSACTIONS OF THE SOCIETY.

I.—CONTRIBUTIONS TO THE STUDY OF THE OÖGENESIS OF PATELLA.

By REGINALD JAMES LUDFORD, B.Sc.(Lond.), F.R.M.S.,
Zoology Department, University College, London.

(*Read February* 16, 1921.)

TWO PLATES.

INTRODUCTION.

RECENT work on oögenesis has shown that the part played in this process by the various cytoplasmic inclusions varies considerably in different organisms. Mitochondria and the Golgi apparatus have been shown to be present in nearly all animal cells studied by modern methods; and although there is occasionally some doubt about the mitochondria, both categories of cellular inclusions are probably present in the undifferentiated germinal epithelial cells from which ova and spermatozoa arise. In the complex series of changes which take place during oögenesis the mitochondria increase in number by fission and spread throughout the cell, and either they remain unaltered in the mature ovum, as in certain Molluscs, or a part of the mitochondrial content of the cell may be converted into yolk bodies, as has been described in *Ascaris* (*8*),* *Apanteles* (*4*), *Rana and Lepus* (*7*). In young Ascidian oöcytes, according to Hirschler (*9*), there is present a granular body, the chondriome, from which is formed the mitochondria and also yolk nuclei.

The Golgi apparatus of most animals in the youngest oöcytes is excentrically disposed, and consists of a number of rods or

* The italic figures within brackets refer to the Bibliography at the end of the paper.

batonettes surrounding the archoplasm (*7*). With the growth of the egg, the individual rods increase by binary fission and spread through the cytoplasm. The young Ascidian oöcyte contains (*8*) five or fewer dome-shaped or hollow spherical Golgi elements—"the primary diffuse condition." As the oöcyte grows these come together and form a net-like structure—"the complex condition"—and then later they become once more scattered in the cytoplasm—"the secondary diffuse condition."

The Golgi elements may or may not undergo transformation. In *Grantia* (*5*), *Helix* (*2*), *Limnæa* (*3*), *Apanteles* (*4*), and *Lepus* (*7*) the apparatus probably takes no *direct* part in yolk formation. In *Rana* (*7*) the elements seem to be swollen with a yolk substance, and in Ascidian oöcytes (*8*) many of the Golgi elements enlarge and become fused to swollen mitochondria to form complex yolk bodies.

Apart from the influence of the mitochondria and Golgi apparatus, yolk granules are formed in some cases as the result of metabolic processes in the ground cytoplasm. This is the case in the sponge, *Grantia compressa* (*5*), where they seem to develop as small vacuoles in the cytoplasm. These yolk spheres are easily distinguishable from the mitochondria, which are few in number and much larger.

Besides yolk bodies, oil globules have been described in some eggs. Thus in *Ascaris* (*8*), where mitochondria enlarge to form the yolk spheres, fat granules are developed as the result of metabolism in the ground cytoplasm. However, in other eggs, e.g. those of Ascidians, which have been specially examined for fat granules, none have been found (*9*). The black colorization with osmic acid techniques in such cases is due to the presence of lipin in the Golgi elements, mitochondria or yolk bodies.

Previous Work on Oögenesis in Patella vulgaris.

Gatenby and Woodger in a recent paper (*7*) refer to oögenesis in *Patella*. They describe the spreading out of the Golgi apparatus during growth of the egg, and refer to its part in yolk formation. "However the yolk spheres may be formed, be it from the mitochondria, archoplasm, or simply in the ground cytoplasm, the Golgi elements later become stuck upon the surface of many, if not all, of the yolk spheres and form a most important part of the yolk substance."

It was with a view to ascertaining the nature of this process that the investigation here described was carried out, at the suggestion of Dr. J. Brontë Gatenby and under his supervision, in the Department of Zoology of University College, London. My thanks are due to Dr. Gatenby for his advice and helpful criticism throughout this research.

TECHNIQUE.

The method adopted in this investigation was to remove small portions of the ovary from lightly chloroformed animals and to drop the pieces into capsules of various fixatives. Those used included Kopsch, Mann-Kopsch, Cajal, Da Fano, Flemming-without-acetic, Zenker-without-acetic, Champy-Kull and Hermann. Of these the clearest pictures of the Golgi apparatus were obtained with the Mann-Kopsch method—i.e. fixation in corrosive osmic for two or three hours, then washing in distilled water and transferring to 2 p.c. OsO_4 for fourteen days. Slides of material prepared in this way were stained in acid fuchsin and differentiated in warm picric acid after the method of Altmann. The Golgi elements are then stained black. The developing yolk granules appear first as a dark brownish coloration amongst the Golgi elements, larger and older ones are darker, and the mature spheres are of a deep brownish black coloration. The mitochondria appear as red granules, as do also the plasmosomes of the nucleus.

If before staining with acid fuchsin slides are treated with turpentine for about a quarter of an hour, the black appearance due to true fats is removed, owing to the oxidizing properties of the turpentine. The yolk bodies then appear as colourless spheres, to the sides of which are attached the Golgi elements, still of a deep black colour, which shows them to be of a special lipoid constitution.

In *Limnæa* preparations made by the Mann-Kopsch method and stained with Altmann's acid fuchsin, Gatenby describes reddish mitochondria and black Golgi elements and quite separate yolk granules, which are of a yellowish-brown colour with a greenish tinge due to the osmic acid. In *Patella*, however, no yolk granules distinct from Golgi elements are found, so that while in Kopsch preparations of the mature eggs of *Limnæa* the Golgi elements are black, and the yolk bodies yellowish to brown, in *Patella* the complex yolk bodies, consisting of Golgi elements and yolk bodies combined, are of a deep black colour. In such preparations the mitochondria appear as pale brown granules not at all clearly distinguishable. The difference in colour in the yolk bodies in the two cases appears to be due to the superior olein content of the *Patella* yolk body.

The mature eggs of *Patella* prepared by the Mann-Kopsch method and treated with turpentine show just beneath the egg membrane, and again around the nucleus, layers of black granules whose histo-chemical reactions show them to be of a lipoid nature, though not true fat; as will be described later, they are derived from the Golgi elements of the yolk granules. The same granules are shown by other fixatives which preserve the Golgi apparatus.

The methods of Cajal and Da Fano, which depend upon silver impregnation, do not give such clear and definite pictures of the apparatus as those previously mentioned, and preparations made by these methods were used chiefly as controls.

Although the mitochondria show quite well in Mann-Kopsch preparations stained with acid fuchsin, they show more clearly with Flemming-without-acetic, or Zenker-without-acetic fixation and iron haematoxylin staining. By these methods the mitochondria stain a deep black. The cytoplasm is of a pale bluish grey colour, much darker in the youngest oöcytes. The nucleoli are black, as well as the mitochondria, while the Golgi elements in those cases where they stain are black also. In slides untreated with turpentine the yolk appears as deep brown coloured spheres.

The Ovary of Patella.

The ovary of *Patella* is situated on the ventral side of the visceral mass. According to Davis and Fleure (*1*), "in very young forms it is practically a pouch, the cavity of which is cœlomic. This cavity is lined by germinal epithelium, which, with its underlying tissue, grows in as folds, some of which unite into trabeculæ, thus converting the pouch into a mass of sex cells covering the connective basis. As the gland grows in each season towards maturity it pushes forward, sometimes as far as the level of the

EXPLANATION OF PLATE I.

Lettering.—C., connective-tissue basis of trabecular wall; CH., chondriome granule (granules comprising the mitochondrial complex of the cell): GA., Golgi apparatus; GE., individual Golgi element or batonette; GE.1–GE.4, Golgi elements during the various stages of yolk formation; GF., fragments of the Golgi elements broken off from the fully-formed yolk spheres; M, mitochondria; N., nucleus of egg; NC., nurse cell or yolk cell; NCT., nucleus of connective-tissue cell of the trabecula; NE., solid material extruded from the nucleus; NL., nucleolus of egg; NM., nuclear membrane of egg; NN., nucleus of nurse cell; OC., oöcyte; OV., ovum; V., vitelline membrane; Y, yolk sphere; *Ya*–*Yd*., successive stages in the development of a yolk sphere; YS., yolk sphere of nurse cell.

Fig. 1.—Portion of the trabecula of the ovary, showing developing oöcyte (OC.) and nurse cells (NC.). F.W.A. and iron hæmatoxylin.

Fig. 2.—Young oöcyte with Golgi apparatus (GA.) in concentrated condition. De Fano and Mann's methyl-blue eosin.

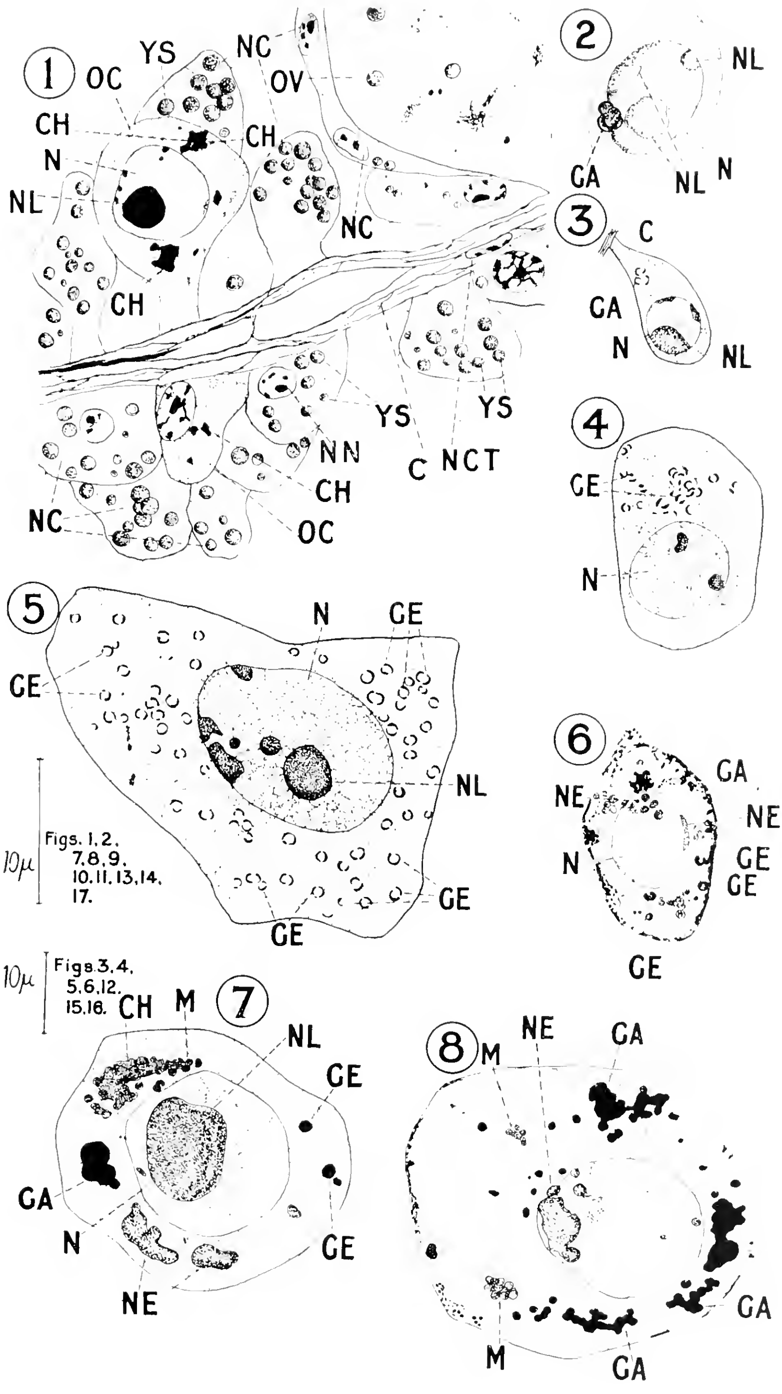
Fig. 3.—Similar young oöcyte from a Mann-Kopsch-Altmann preparation, showing the Golgi apparatus after treatment with turpentine.

Fig. 4.—Slightly older oöcyte, with the Golgi elements (GE.) beginning to disperse. Technique as fig. 3.

Fig. 5.—Oöcyte with the Golgi elements (GE.) spreading out in the cytoplasm. M.K. with turpentine.

Fig. 6.—Young oöcyte, showing the emission of solid nucleolar material (NE.). Mann-Kopsch-Altmann.

Figs. 7, 8.—Young oöcytes between the stages shown in figs. 4 and 5, illustrating the formation of yolk as the Golgi elements disperse. M.K.A.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œsophageal pouches, and often extends across the median line towards the right side." At different seasons of the year the ovary varies considerably in size, and it seems peculiarly liable to overgrowth. Ova are extruded by rupture of the ovary wall into the cavity of the right kidney whence they pass to the exterior. There are no accessory sexual organs.

The breeding season is in the autumn. Boutain found sexual maturity to be reached in September at Roscoff, but Davis and Fleur regard it as somewhat later at Aberystwyth (*1*).

Nutrition of the Young Oöcytes.

Fig. 1, Plate 1, shows a portion of one of the trabeculæ of the ovary. In the middle is the connective tissue basis, the cells of which do not show at all clearly in Flemming-without-acetic preparations stained with iron alum hæmatoxylin; but with fixatives containing acetic acid, and methyl blue staining, the trabecula is seen to be composed of rather long narrow cells with elongated nuclei, bound together by connective tissue fibres. On either side of the partition thus formed are attached the undifferentiated cells of the germinal epithelium with characteristic elongated nuclei, the young developing oöcytes and numerous yolk containing nurse cells. At OC. is seen a cell which has just commenced to differentiate and acquire the characteristics of an oöcyte. Its cytoplasm is stained differently from that of the neighbouring cells, and it contains several black granules. Similar cells of Mann-Kopsch preparations show a concentrated Golgi apparatus, as in fig. 2. With the F.W.A. and iron hæmatoxylin technique the cytoplasm of the young oöcytes stains a blue colour, while that of the neighbouring cells is almost colourless. This difference in staining properties seems to be due to the very active metabolism in the cytoplasm at this stage, when the cell is preparing for growth, as with its subsequent enlargement the cytoplasm stains a pale colour.

During the primary stages of growth the young oöcyte, attached to the trabecula, is surrounded by nurse cells containing yolk granules. As it grows out into the lumen of the ovary certain of the yolk cells separate from the connective tissue of the trabecula and come to surround it, forming a temporary follicle, as is seen in the cell OV. At first these "follicle" cells contain numerous yolk granules, but they are evidently used up in providing nourishment for the developing egg, for in oöcytes which have just separated off from the trabecula and come to lie freely in the lumen, nurse cells are found surrounding them, as in fig. 13, but in such cases it is not usual to find much yolk. It would seem probable that this substance has been acted upon by enzymes and become converted into a liquid which can be absorbed through the wall of the oöcyte. As the oöcyte continues development the yolk cells surrounding it appear to dwindle in size, and eventually they disappear from its surface. The mature oöcyte is surrounded by a well-marked vitelline membrane.

Intra Vitam Examination of the Oöcytes.

When living eggs are examined microscopically two types of cytoplasmic inclusions are distinguishable, large clear bodies, the yolk spheres, and smaller granular ones, the mitochondria. Eggs from animals which had been lightly chloroformed were smeared on slides and treated with various staining reagents. The large yolk bodies, in common with fat compounds, were stained red by alcoholic solutions of scarlet red and Sudan III, but they were not coloured by the other reagents used. The mitochondria were stained a pale green colour by Janus green, and methyl green, and a purple colour by dahlia: the other stains were without effect. A 1 p.c. solution of potassium permanganate, 1 p.c. acetic acid and iodine solution produced no appreciable change; but with 90 p.c. alcohol the yolk spheres underwent a shrinking, so that they appeared somewhat like crenulated blood corpuscles. This was evidently due to something being dissolved out. Most probably this substance is a lecithin-like body, as lecithin is known to be present in the yolk spheres of most animals, and is soluble in alcohol.

Although Janus green does in some cases stain the Golgi apparatus (*6*), it was without effect in the material examined.

The Golgi Apparatus and its Function in Oögenesis.

In the youngest oöcytes the Golgi apparatus consists of a number of rods or batonettes of a semi-lunar shape arranged around the archoplasm. In Plate I, fig. 2 and fig. 3, are shown cells at this stage. The former is drawn from a preparation by Da Fano's silver impregnation method, and the latter from a Mann-Kopsch preparation. In both of these cells the large nucleoli (plasmosomes) are a distinguishing feature of the nucleus. As the cell grows certain of the Golgi elements begin to spread out away from the archoplasm, but others appear to remain attached to it for a time, and to initiate the process of yolk formation. In fig. 4 is shown a cell with the Golgi batonettes just commencing to disperse. This is drawn from a Mann-Kopsch preparation which has been treated with turpentine to remove the blackened fat. The archoplasm is therefore colourless. In fig. 8, however, which has not been treated with turpentine, the whole of the compact part of the Golgi apparatus appears black, showing that a fatty substance has been already formed at this stage. The batonettes which are seen moving away from the archoplasm in fig. 4 multiply by fission and spread throughout the cytoplasm. As they do so they lead to the formation of yolk spheres. The archoplasm also seems to break up into several portions, each of which becomes an active centre for the formation of yolk and the spread of batonettes which carry on the same process. In fig. 8, which is drawn under a lower power than fig. 7, several such groups of yolk bodies are seen, as are also scattered elements which are forming yolk bodies.

It is during the early stages of this process of the spreading out of the Golgi apparatus and yolk formation that a peculiar nuclear phenomenon is to be observed. The large plasmosomes to which attention was directed in the youngest oöcytes, fragment under peculiar conditions, and there is during subsequent stages an emission of nucleolar material. This is shown in fig. 6 and fig. 8. The exact nature of this process I am still investigating, and hope to describe later.

Gradually the Golgi batonettes spread throughout the cytoplasm. At fig. 5 is shown a cell in which they are much dispersed. The yolk bodies appear colourless, as all the fat has been dissolved out. If the fat is not removed from the cell, but is stained with osmic acid, the eggs at this stage appear as shown in fig. 9. This cell shows the gradual formation of fat under the influence of the Golgi elements. At GE.1 are seen single batonettes. At GE.2 several are seen together, and between them the cytoplasm stains a dark colour. At GE.3 the yolk body has increased in size and the Golgi elements have spread out over its surface. From the examination of various eggs at this period of growth it seems that the Golgi batonettes come to almost completely surround each yolk sphere. When fully formed the yolk bodies stain a deep black with osmic acid, as seen at GE.4 and at Y. in fig. 10.

It is impossible to say with certainty whether the fatty substance of the yolk bodies is formed within the archoplasm or in the cytoplasm. Owing to the manner in which the apparatus as a whole stains black when the dispersal of the batonettes commences, it seems that this must be due to the archoplasm becoming laden with fat; but the case of those yolk spheres which are formed under the influence of scattered batonettes is very difficult to settle. It may be that each batonette as it leaves the archoplasm carries away a small portion of that substance, which grows and becomes swollen with fat, but it is impossible to verify this from my preparations.

New yolk bodies continue to be formed throughout oögenesis. At fig. 10 is shown a portion of the periphery of an egg at an advanced stage of development. Many of the yolk spheres are completely formed, but others are to be distinguished at various stages of growth, and there are also scattered batonettes.

The successive stages in the development of the yolk bodies are denoted by the letters *Ya*, *Yb*, *Yc*, *Yd* and Y., the last being the completed yolk sphere. In this cell mitochondria are to be seen scattered throughout the cytoplasm.

When each yolk sphere is completely formed, the investing sheath of Golgi elements begins to break up, and the fragments pass either outwards to the periphery, where they form a layer under the vitelline membrane, or else towards the nucleus, around which they form a covering. The breaking away of the Golgi elements is shown in fig. 11, which also shows the collecting of the fragmented portions at the periphery. At fig. 12 is shown a portion of the periphery of a full-grown egg. The yolk bodies are all much the same size; between them are mitochondria and fragmented portions of the Golgi apparatus, and similar pieces are seen forming layers underneath the egg membrane and around the nucleus. Fig. 11 shows a similar portion of an egg from which the fat has been dissolved. It is here seen that although the greater part of the Golgi elements have become dispersed from the peripheral yolk bodies, yet a few batonettes still remain attached. In no preparation examined have I found eggs in which the whole of the apparatus elements have been broken away from the yolk bodies.

The Mitochondria.

The chondriome or mitochondrial complex of the cell is represented in the youngest oöcytes by several irregular-shaped masses which stain a deep black with iron hæmatoxylin after Flemming-without-acetic fixation, or red with acid fuchsin after fixing

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EXPLANATION OF PLATE II.

Fig. 9.—Older oöcyte than that in fig. 8, showing the behaviour of the Golgi elements (GE.1-GE.4) during yolk formation. Chondriome granules are seen dividing to form mitochondria (M.). Ditto.

Fig. 10.—Portion of the periphery of an older oöcyte, showing the formation of yolk spheres (*Ya*-Y.) at the periphery of the cell. Ditto.

Fig. 11.—Portion of the periphery of a full-grown oöcyte, with a peripheral layer of fragmented Golgi elements (GE.) and yolk spheres (Y.), with portions of the Golgi apparatus still adhering; fully-grown mitochondria in the cytoplasm. M.K.A. with turpentine.

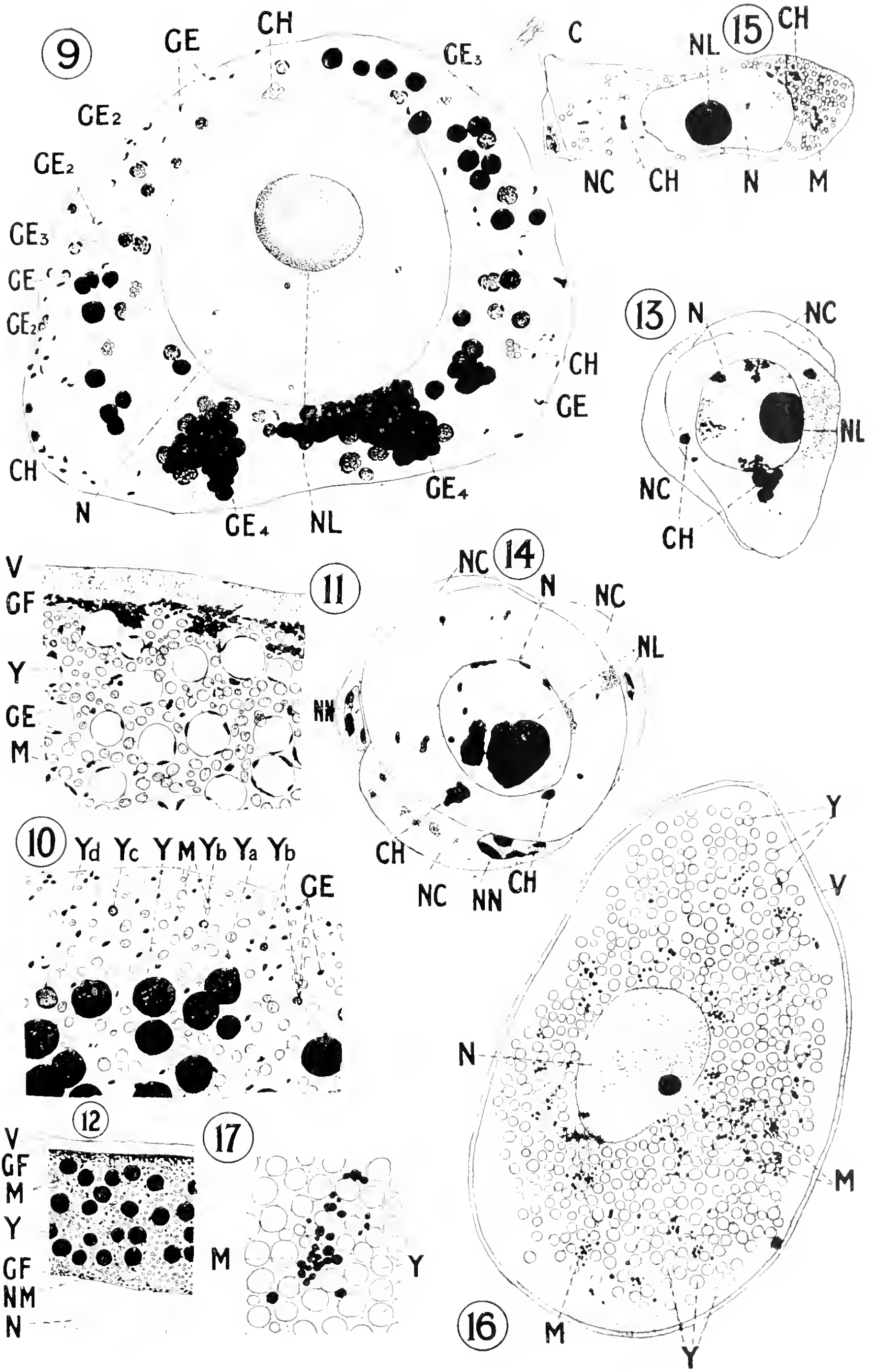
Fig. 12.—Peripheral region of a full-grown oöcyte untreated with turpentine, drawn under a lower power than fig. 11.

Figs. 13, 14.—Young oöcytes slightly older than that shown in fig. 2, showing the chondriome granules (CH.) and the temporary follicle of nurse cell (NC.). F.W.A. and iron hæmatoxylin.

Fig. 15.—Oöcyte at about the same stage of development as shown in fig. 8, showing the yolk spheres (Y.) scattered in the cytoplasm and the mitochondria (M.) beginning to spread out in the cell. F.W.A. and iron hæmatoxylin.

Fig. 16.—Older oöcyte, with fairly evenly-distributed yolk spheres (Y.) and a number of centres of actively-dividing mitochondria (M.). F.W.A. and iron hæmatoxylin.

Fig. 17.—One of the groups of actively-dividing mitochondria (M.) shown in fig. 16, under a higher power. F.W.A. and iron hæmatoxylin.


9
GE
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GE₂
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in osmic acid. Such granules are shown in the young oöcytes at CH. in Plate I, fig. 1, and in Plate II, figs. 13 and 14. While the oöcyte grows and increases in bulk, these granules become dispersed in the protoplasm. During the early stages of oögenesis they seem to remain almost inert while the Golgi apparatus is actively dividing and spreading out, so influencing the formation of yolk spheres throughout the cell. In fig. 9, which shows the yolk bodies scattered on all sides of the nucleus, the chondriome is represented by a few small granules in process of division. The same thing is shown again in fig. 15, which represents a somewhat later stage, drawn under a lower magnification. The yolk bodies here shown as colourless spheres, owing to the fat having been abstracted by the turpentine, are seen widely distributed, but the mitochondria are represented by a few slowly dividing granules. The same process is seen again in fig. 9, which shows the various stages in the formation of yolk granules; the Golgi elements are well advanced in their activities, while the chondriome consists of a few small groups as before.

Not until the yolk bodies are well distributed in the oöcyte do the mitochondria commence active division. Fig. 16 represents an oöcyte at this stage. The yolk bodies are seen occupying the greater part of the cell, and in the cytoplasm amongst them are the groups of actively dividing mitochondria, shown in black. At fig. 17 one of these groups is drawn under a high magnification. It shows some small granules in process of fission, others having grown larger, spreading out from the centre of distribution and continuing to divide as they do so. Eventually they become scattered fairly regularly amongst the yolk spheres in all parts of the oöcyte, as is shown in fig. 11 at M.

It would seem that during their growth the mitochondria became somewhat swollen with reserve food products intended to supply energy, after fertilization, for the development of the embryo.

That the mitochondria take no direct part in the formation of yolk I conclude from the following observations. Yolk bodies are formed directly under the influence of the Golgi rods. There is no fusion of Golgi elements with mitochondria, but the latter remain separate throughout oögenesis. They do not become active in the cell until the process of yolk formation is well advanced, and there is no evidence of mitochondria becoming swollen to form yolk bodies, the latter bodies staining differently and always being considerably larger than the biggest mitochondria.

Discussion.

In considering the rôle of Golgi apparatus and mitochondria in oögenesis it is of interest to bear in mind what so far has been discovered concerning their behaviour in the cell. Although there are differences in form and behaviour in different organisms, in all investigations by modern methods (see the writings of Fauré-Fremiet, Gatenby, Hirschler, Meves, Sjoväll and Weigl, etc.) it has been found that they have the following characteristics in common :—

1. They appear to be constituted of a living protoplasmic basis, impregnated with or enclosed by some kind of lipoid substance which is not a true fat. The chemical composition of this substance is not the same in Golgi apparatus and mitochondria, as is shown by their staining reactions.

2. They are capable either of independent movement within the cell or are carried about by streaming movements of the cytoplasm ; sometimes we see them dispersing from a centre, other times coming together to form a compact mass of granules.

3. They grow evidently by assimilating the necessary food substances from the cytoplasm, and increase in numbers by fission : sometimes multiple fission in the case of the Golgi apparatus.

4. When cell division is about to take place, the mitochondria and Golgi apparatus become spread out more or less evenly in the cytoplasm, so that when division actually occurs each daughter cell has approximately the same number of each category of cytoplasmic inclusion.

It will be noticed that many of the activities of the mitochondria and Golgi apparatus are characteristic of independent living organisms—a similarity which has led some writers to compare them to the symbiotic algæ living in some Protozoa, or to bacteria living in a culture medium.

The exact behaviour of the mitochondria and Golgi apparatus during oögenesis differs in detail in most cases which have been investigated. That of *Limnæa*, studied by Gatenby, is one of the simplest (*3*). In this Mollusc mitochondria appear in the oöcyte in the form of granules on one side of the nucleus. They may possibly be formed under its influence as the result of the emission of some nuclear stimulus. These mitochondria spread out around the nucleus and become fairly regularly distributed throughout the cell. During growth some enlarge more rapidly than others, and all do not attain the same size.

The Golgi apparatus of *Limnæa* in the earliest stages resembles that of *Patella*, shown in Plate I, fig. 2. The archoplasm breaks up and each Golgi element as it disperses carries away with it a small piece of that substance. The archoplasm only divides by binary fission after it has become studded with a number of Golgi elements. The yolk bodies are formed under the influence of the Golgi element, as is the case in *Patella*.

In *Helix* (*2*) the mitochondria also appear as a cloud of granules adjoining the nucleus. During dispersal they pass through a stage when they appear as small flocculent masses, but later they acquire typical granular form. Yolk bodies are probably formed the same way as in *Limnæa* and *Patella*.

The earliest stages in the development of the mitochondria of *Patella* are very similar to what has been described in Ascidian oöcytes by Hirschler (*9*). He finds in the youngest oöcytes round oval granules which comprise the chondriome or mitochondrial complex of the cell. They are coloured red in Mann-Kopsch preparations stained by Altmann's method. These bodies increase in size, and at their peripheries granular mitochondria appear and spread out in the cytoplasm. While this is taking place stalk-like processes arise connecting the chondriome bodies with the nuclear membrane, and it seems that some substance passes out from the nucleus along the stalks into these bodies, as at their centres, which are capsule-like at this stage, granules are seen which resemble the fine granules of the nuclear network.

From the chondriome bodies arise also yolk nuclei. They attain their maximum size before the Golgi elements begin to spread out in the cell; then as these latter organs begin to disperse the nuclear stalks break down and the yolk nuclei disintegrate and eventually disappear altogether. In *Patella* the mitochondria appear to develop as the result of the breaking up of the granular bodies seen in the youngest oöcytes; there are no connecting stalks seen between these granules and the nucleus. It is interesting, however, to note that there is an extrusion of solid nucleolar substance into the cytoplasm.

The Golgi apparatus is described by Hirschler in the Ascidian oöcyte as at first consisting of five or fewer granules. They increase in size and collect into small heaps, and eventually become joined together by black threads to form a complex net-like body, which he terms the complex stage. Hirschler sees in this the preparation for a nuclear division which does not take place. He quotes, in support of his views, the researches of Deinecka, who showed that in young nerve cells capable of division, and also in the meristematic cells of pavement epithelia, the Golgi apparatus is in the concentrated condition, while in older cells incapable of division it is in the diffuse state.

When the ' yolk nucleus ' has reached its maximum growth and the mitochondria are being dispersed in the cell, the Golgi apparatus breaks up to form a small cloud of particles about the size of a mitochondria, but distinguished from them in the Mann-Kopsch preparations by the difference in colour. The individual Golgi elements extend throughout the cell and decrease in number towards the end of oögenesis owing to their conversion into yolk. Individual elements fuse with swollen mitochondria to form a complex yolk body.

In Ascidian oöcytes, then, according to Hirschler, we have a case of the Golgi element itself being converted into yolk. This also happens to a certain extent in *Patella*, but at the end of oögenesis a large number of the elements appear to be discarded where their function is fulfilled and they form peripheral layers of lipoid substance outside the nucleus and inside the vitelline membrane, while others seem to remain attached to the sides of the yolk spheres.

From a consideration of a number of cases of oögenesis it is evident that the Golgi apparatus and mitochondria are quite distinct, although there seems to be a decided relationship of function between them. They seem to be semi-independent, but probably under the controlling influence of the nucleus, so that the cell as a whole is a complex unified system. Any attempt to explain the metabolism of the cell must take into consideration the part which each cell organ plays and the relationship of function which exists between them: a task which in the light of our present knowledge must be confessed to be an impossibility.

Although both Golgi apparatus and mitochondria are present in the youngest oöcytes they do not always develop concurrently. In *Limnæa* (3) the latter organs spread out in the cytoplasm slightly more rapidly than the former; however, in *Patella* the mitochondria do not begin to disperse until the Golgi elements are well spread throughout the cell. In the Ascidian egg the dispersal of mitochondria has progressed considerably before the Golgi apparatus passes out of the net-like complex condition; but the mitochondrial content as a whole is smaller in bulk than that of the Golgi apparatus, the reverse is the case in *Limnæa*. These differences appear to be related to the part the cytoplasmic organs play in the formation of yolk. In the Ascidian oöcyte it is the mitochondrial granules which enlarge, become swollen with yolk, and combine with the Golgi elements; but in *Patella* the Golgi elements influence the formation of yolk, and the mitochondria play no direct part in the process, so that they do not become active in the cell until yolk formation is much advanced.

The exact function of mitochondria and Golgi apparatus is still a matter of controversy. Meves and Duesberg think that the former may be the bearers of the hypothetical cytoplasmic organ-forming substance which determines the development of the various parts of the body during organogeny, but owing to the diversity of behaviour of these cytoplasmic bodies in different organisms this view seems hardly likely. I have not studied organogeny in *Patella*, but from a perusal of the literature and investigation of the oögenesis it seems to me much more likely that the mitochondria and Golgi apparatus are especially concerned with the general metabolism of the cell at certain stages of growth. Their spreading out in the growing oöcyte is probably to be accounted for as a means of influencing the cytoplasm, and also as a preparation for equal distribution when the cell divides in embryogeny. It would seem that not the least important part of their function during oögenesis is the formation and storage of food for the development of the embryo. Variations in their behaviour in different organisms are most likely related to the different conditions of nutrition to which the growing oöcyte is subjected. Further research alone will solve this problem of biology.

Summary.

I. *Nutrition of the Young Oöcyte.*

1. The young oöcyte arising from an undifferentiated cell of the germinal epithelium is surrounded by nurse cells containing yolk granules.

2. As the oöcyte grows and extends outwards into the lumen of the ovary it becomes surrounded by some of these nurse cells, which form a temporary follicle.

3. The yolk granules of the nurse cells are completely used up in providing nourishment for the growing oöcyte, and at quite an early stage in its development the nurse cells disappear from its surface.

II. *Golgi Apparatus and Vitellogenesis.*

1. In the youngest oöcytes the Golgi apparatus consists of a number of curved rods surrounding the archoplasm.

2. Probably in the archoplasm, yolk is formed under the influence of the Golgi rods, and while this is taking place other Golgi elements divide and spread out in the cytoplasm, thus leading to the formation of scattered yolk granules.

3. The archoplasm breaks up and disperses in the cell. Probably each Golgi element as it moves away from the archoplasm carries with it a small portion of the latter, and this becomes distended as the result of fatty yolk being formed within it.

4. Scattered groups of Golgi elements continue the process of yolk formation until the egg is filled with spherical yolk bodies surrounded by Golgi elements.

5. When the yolk bodies are completely formed the surrounding layer of Golgi elements breaks up, and fragments pass out into the cytoplasm and come to form a peripheral layer underneath the vitelline membrane, and another layer around the nucleus.

6. Throughout the process of yolk formation there is an extrusion of nucleolar material from the nucleus into the cytoplasm.

III. *Mitochondria.*

1. The mitochondria are represented in the youngest oöcytes by several irregular-shaped granules.

2. As the oöcyte grows these granules become spread out in the cell.

3. They remain comparatively inert until the process of yolk formation is well advanced; they then begin to divide, to form typical granular mitochondria, which become fairly regularly distributed in the cytoplasm.

4. Mitochondria in *Patella* take no direct part in yolk formation.

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II.—THE REDUCTION OF OSMIC ACID BY LIPOIDS.

By J. R. Partington and D. B. Huntingford.

(*Read November* 17, 1920.)

The use of osmic acid in microscopy for staining fats and allied substances has long been applied. The material is immersed in a dilute aqueous solution of osmic acid; reduction of the latter occurs, and a deep black substance is deposited. In the case of olein globules the black stain penetrates the drop completely, and extrudes on treatment with turpentine. The composition of the black substance has been variously stated to be metallic osmium (*1*),* a lower oxide (*2*), or a lower hydroxide, such as $Os(OH)_4$. At the suggestion of Dr. J. B. Gatenby the authors decided to attempt an analysis of a small amount of the material placed at their disposal. This had been prepared in the following way:—Pieces of tissue were placed in a clear 2 p.c. aqueous solution of osmic acid (osmium tetroxide, OsO_4). After a few days' use the solution became black. The liquid could be filtered without losing its colour, so that the substance is in the state of colloidal solution. On addition of a little chromic acid, or potassium dichromate solution, a fine black powder deposited, which could be filtered off and washed without passing back into colloidal solution. The filtered solution sometimes contains a little unchanged osmic acid, according to the completeness of reduction of the solution. In the particular solution used, a little osmic acid was still present before washing. The black precipitate was dried on the filter paper in a desiccator over sulphuric acid for ten days. A slight greenish tinge possessed by the moist substance disappeared on drying, and the product was a pure black powder, easily detached from the paper. The powder was not heated during the drying process.

For various reasons it was assumed that the material so obtained was the same as that present in the stained fat globules, but further experiments with osmic acid and pure olein *in vitro* are in progress which will decide this point conclusively.

From its method of preparation the material might contain the following substances: Metallic osmium; lower oxides of osmium;

* The italic figures within brackets refer to the Bibliography at end of the paper.

water, either in combination or absorbed by the solid; and, finally, chromium compounds from the chromic acid used in precipitation. The absence of chromium was shown by fusing the residue from the experiments described below with sodium carbonate and potassium nitrate, dissolving the mass in water, adding dilute sulphuric acid and hydrogen peroxide, and shaking with ether. No trace of blue colour was detected in the ether.

The carefully weighed black substance was placed in a porcelain boat in a hard glass tube through which a current of carefully purified hydrogen was passed. When all the air was displaced from the apparatus the powder was heated. The water contained in the substance was driven off, and was collected in a carefully weighed phosphorus pentoxide tube. If the powder consists of metallic osmium and water, the loss in weight of the boat and substance, after cooling, should be exactly equal to the gain in weight of the phosphorus pentoxide tube. If, however, the substance contains an oxide of osmium, the increase in weight of the phosphorus pentoxide tube will be greater than the loss in weight of the boat, since water will be formed from the oxygen contained in the substance. The gain in weight of the tube will now be made up of two parts: (1) The water originally contained in the powder as such; (2) the water formed from the oxygen in the powder, the weight of which may be calculated from the loss in weight of the powder and the total weight of water formed. It was found that more water was formed than corresponded with the loss in weight of the powder, and the ratio of oxygen to osmium in the latter was found to be 2 : 1. The material is therefore osmium dioxide, OsO_2, and not metallic osmium. Water was also present; but although the composition corresponded closely with the formula $OsO_2 5H_2O$—and a hydrated oxide has been described by former experimenters (*3*)—the exact state of this water cannot at present be decided with certainty.

The experimental details were as follows: Hydrogen was generated from a considerable quantity of pure electrolytic zinc and hydrochloric acid (1 vol. of pure concentrated acid to 4 vols. of water) in a bottle provided with a dropping funnel for the acid and a run-off tubulure at the bottom. Admission of air was therefore reduced to a minimum. The gas was freed from acid spray and vapour by bubbling slowly through caustic soda solution in a wash bottle, and was roughly dried in a calcium chloride tower. To remove all traces of oxygen from the gas it was next passed through a heated tube containing platinized asbestos, and the moisture was then completely removed by passing through a long tube containing calcium chloride in the first part and phosphorus pentoxide in the second part. The two materials were separated by a column of glass wool.

The purified hydrogen was next passed through a hard glass-tube containing the black substance carefully weighed into a porcelain boat. The gas was allowed to pass through this for ten minutes to displace air, and the tube containing platinized asbestos was heated to redness, and was kept heated throughout the rest of the experiment. The gas was allowed to pass for another ten minutes, and the tube containing the substance was then connected with a carefully weighed U-tube with glass stopcocks, containing phosphorus pentoxide. The combustion tube was then heated to redness and maintained at a red heat for fifteen minutes, with hydrogen passing through. A guard tube containing calcium chloride was attached beyond the weighed phosphorus pentoxide tube to prevent any possible diffusion of moisture from the air. Since dry hydrogen or air was always passing through the apparatus when the stopcocks of the P_2O_5 tube were open, it was not necessaryto use a P_2O_5 guard tube, and calcium chloride was sufficient.

The tube was allowed to cool in the current of hydrogen until it was possible to handle it, and the hydrogen was then displaced by a current of dry air passing for half an hour. The possibility that some water was formed by catalytic action of metallic osmium when the hydrogen was displaced by air, was negatived by repeating this part of the operation with a weighed phosphorus pentoxide tube attached. No increase in weight of this tube was found. After the hydrogen had been displaced by air the boat and the drying tube were weighed.

Since the entrance of air into the apparatus was of no account except after the tube containing platinized asbestos, ordinary rubber stoppers were used up to this point. The connexion between the drying tube after the platinized asbestos and the hard glass tube containing the boat was made by a small rubber stopper. Minute quantities of air might leak into the apparatus by diffusion through this stopper. Experiments showed that when the tube was heated under the same conditions as in the actual experiment, but without the boat, there was, in fact, a very slight gain in weight of the phosphorus pentoxide tube. After the whole apparatus had become perfectly dried by long passage of hydrogen, this increase in weight was practically constant for the period of operations described, and amounted in total to 0·00081 grm. This weight was subtracted from the gain in weight of the tube in the actual experiment. We are inclined to the opinion, from previous experience in similar work, that this correction is probably smaller than would have been the case if glass joints had been used under the conditions of the experiment, so that more complicated apparatus would not have offered any advantages.

The results of the single experiment, which it was possible to carry out with the small amount of material at our disposal, are given below:—

		Grm.
Weight of boat + osmium compound before experiment	=	3·18265
,, ,, after ,,	=	3·16766
Weight of boat alone	=	3·14585
Loss of weight of substance	=	0·01499
Weight of residual osmium.	=	0·02188
Weight of P_2O_5 tube before experiment	=	22·27879
,, after ,, . . .	=	22·29508
Weight of water derived from substance = 0·01629 − 0·00081	=	0·01548

Let p = weight of water contained in substance, and q = weight of oxygen contained in substance. Then $p + q = 0·01499$, and $p + \frac{9}{8} q = 0·01548$. Hence, $p = 0·01107$ and $q = 0·00392$. From these figures, and the weight of the osmium, the following ratios are found:—

—	Weight	Weight/Atomic (or molecular) Weight	Ratio
Oxygen . .	0·00392	0·000245	2·1
Osmium . .	0·02181	0·000114	1·0
Water . . .	0·01107	0·000615	5·4

These figures indicate that the black substance is a hydrated form of osmium dioxide, OsO_2Aq. They would point to an approximate formula $OsO_2 5H_2O$. Such a substance has been described, but we are not sufficiently convinced that the amount of water contained in the solid was that corresponding with a definite hydrate; the degree of desiccation of the material was too arbitrary to allow of any such conclusion being drawn. If the small amount of material be taken into account, we believe, on the other hand, that the results are definitely in favour of the dioxide, and in any case they definitely negative the hypothesis that the black material is metallic osmium.

The properties of osmium dioxide have recently been described by O. Ruff and H. Rathsburg (*3*), but the material dealt with by these experimenters does not appear to have had properties at all like those of our substance. They state that a colloidal solution is formed, but the precipitated substance passed again into solution on washing. Two solid forms are described, one pyrophoric—or even spontaneously explosive when dry—and a second stable form, OsO_2, $2H_2O$, reduced almost explosively by hydrogen, and oxidized rapidly by oxygen. The older experiments of Berzelius (*4*) pointed to a substance of much greater stability, and we are inclined to think that the material used by Ruff and Rathsburg may have contained some organic matter used in the reduction, and that its properties were modified by this substance. In later experiments we hope to be able to examine more definitely the properties of osmium dioxide, and of the black substance used in this experiment, and also the action of different reducing materials on osmic acid. The latter experiments may be of value in differentiating tissues under the microscope. Since the subject appeared to be extremely obscure, and the statements contradictory, we thought it would be of interest to record the results of our experiments at the present stage.

SUMMARY.

The black substance formed by the reduction of osmic acid by olein in tissue-staining was found to be a hydrated form of osmium dioxide, OsO_2, and not metallic osmium, as has sometimes been stated.

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III.—A NEW METHOD OF TREATING AND MOUNTING CELLOIDIN SECTIONS.

By E. J. Sheppard, F.R.M.S.

(*Read November* 17, 1920.)

The following observations and description of my work regarding the treatment of "Celloidin Sections" will I feel sure prove of interest to those who have to do section-cutting of tissues which it is necessary to embed in this material. The method so far as I am aware is quite new, and one which introduces "great simplicity" by condensing a branch of micro-technique, at times very tedious and lengthy, into one where such qualities are conspicuous by their absence.

Owing to the difficulty of removing most of the anilin dyes from celloidin it is the custom with but few exceptions to stain *in toto* prior to embedding.

Probably the best and most simplified method in use at the present moment for cutting celloidin sections is the so-called "dry-cutting method," fully described in the sixth edition of "Bolles Lee Vade Mecum." This is doubtless a valuable method, but one requiring a large amount of time apart from that actually taken for the infiltration of the tissue, and possesses the great drawback of the annoying condition known as "frilling" which has to be contended with during manipulation of the sections when cut.

The method which I shall put before you is not the result of my purposely setting out to discover or devise a new and simplified process, but on the contrary came about by my endeavour to mount some celloidin sections in "Euparal Media" by adopting the usual procedure that is required for mounting in "Canada Balsam."

I was somewhat surprised to find that this could not be done, or at least not without some difficulty, which in my endeavour to try and overcome brought about the following highly interesting result.

Having cut a number of sections by the ordinary "wet method" I cleared a few of these by immersing in "Oil of Thyme." One of these was lifted out of the oil with the aid of a section-lifter and stretched out evenly upon the centre of a micro-slip; the superfluous oil was drained away and the remainder soaked up by the use of filter paper. I then dropped a few drops of "Euparal Mountant" upon the section and found that it was immediately turned milky. I thought at first that this was due to my accidentally breathing across the slide or possibly an excess of moisture in the air. This is not an infrequent occurence when mounting in "Euparal" under such conditions, particularly in the winter or upon damp days. This is however easily and quickly dispersed by slightly warming over the spirit flame, which I proceeded to do, but to my surprise this milkiness could not be removed by this means, and no amount of continued warming had the desired effect. After trying a few methods to get rid of the milkiness without success, I came to the conclusion that the action of the "Oil of Thyme" upon the celloidin possibly produced a change which made "Euparal" an unsuitable mountant, and therefore nothing could be done but to use "Canada Balsam" in its place.

As the refractive index of canada balsam in this case was higher than I wished for the sections under treatment, I left the matter for a while in order to think over other possible causes which might have produced the milkiness. After some amount of meditation the thought occurred to me that knowing it was possible to mount direct from 95 p.c. spirit into "Euparal" I wondered if the latter would act as a clearing agent for celloidin.

To my agreeable surprise and satisfaction I found that this *was* the case. It remained only then to take the sections out of the spirit on a lifter, transfer to the centre of the slide, spread them out evenly, add a few drops of "Euparal," and cover with cover-glass, and the preparation was so far finished.

Occasionally however, according to the amount of moisture present in the atmosphere, or if one should accidentally breath across the slide, a varying amount of milkiness may spread on the surface of the "Euparal" before the cover-glass is applied; but in this case, as previously mentioned, it is at once dispersed by a slight amount of warmth carefully regulated over the spirit flame. It will be seen that as a result of this favourable action of "Euparal" applied direct to celloidin sections taken from spirit, that the use of a special cleaning agent prior to mounting is not required; a most valuable saving of time and manipulation is thus brought about.

There appears to be a *very slight* solvent action upon the celloidin by the "Euparal," but this need not in the least be feared; on the contrary it has a most desirable effect, so far that, owing to this very slight action, any "frilling" or "puckering" of the sections which may be apparent when they are spread out upon the slide almost immediately disappears, and the section is consequently flatted down and "partially cemented" as soon as the

"Euparal" is added. This latter condition is easily made apparent by any adjustment that may be made upon the cover-glass for the purpose of centring same; the section will be found to remain perfectly adherent however much movement is applied. Indeed for the purpose of testing the amount of adherence of the section to the slip, I have frequently moved the cover completely off and reapplied same without the least undesirable movement or disarrangement of the section.

In conclusion, I feel sure that this method of handling sections that have been cut from celloidin-embedded material will prove of great value to all microtomists. I have placed under the microscope for examination a section of the developing teeth of a fœtal kitten doubly stained and mounted in the manner described; there are others on the table which can be inspected by hand.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology, Evolution, Heredity, Reproduction, and Allied Subjects.

Transmission of Induced Eye Defects.—M. F. GUYER and E. A. SMITH (*Journ. Exper. Zool.*, 1920, **31**, 171–223, 4 pls., 7 figs.). In previous experiments pregnant rabbits and pregnant mice were treated with fowl serum sensitized, respectively, to the crystalline lens of the rabbit and of the mouse. It was found that antenatal defects in the lenses of the young could be secured in this way. Thus, in rabbits treated during pregnancy with fowl serum sensitized to rabbit lens, some of the young showed eye defects, such as opacity of the lens and partial or, less frequently, complete liquefaction of the lens. Similar results were obtained with mice of the genus *Peromyscus*. The present paper deals with more experiments on rabbits, and includes an account of the transmission through successive generations of eye defects originally induced in the rabbits by means of lens-sensitized fowl serum. The defects in the eyes were mostly concerned with some sort of liquefaction of the lens.

A certain effect is produced which may be transmitted, even to the sixth generation, without any subsequent treatment with the sensitized sera. The modifications were extracted through the male line, thus eliminating all possibility of the condition in later generations having been due merely to placental transmission from the blood of affected mothers. The authors feel that the evidence establishes a clear-cut case of the inheritance of a specific modification produced by extrinsic factors.

It is not entirely clear whether the result should be reckoned primarily as an example of the inheritance of a somatic modification—

* The Society does not hold itself responsible for the views of the authors of the papers abstracted. 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, etc., which are either new or have not been previously described in this country.

that is, a change produced in the lens of the uterine young which in turn has induced a change in the lens-producing constituents in the germ-cells of these young—or as simultaneous changes in the eyes and in the germ-cells of the young. In either case the inference is that there is some constitutional identity between the substance of the mature organ in question and its material antecedents in the germ.

J. A. T.

Amnion-formation in Bats.—A. CELESTINO DA COSTA (*Mem. Soc. Portugaise Sci. Nat.*, 1920, **3**, 1–51, 3 pls.). The formation of the amnion in *Miniopterus schreibersii* shows the following phases: (1) The appearance of a closed cavity in the embryonic disc, the upper wall of which is the primordial amnion; (2) the rupture of this wall and the disappearance of the primordial amniotic cavity, which is replaced by a tropho-ectoblastic space: (3) the formation of an amnion and a definitive amniotic cavity with ectoblastic folds. In some other bats, *Murinus* and the Noctule, it is the same, except that the primordial amniotic cavity is less definite. The primordial type of amniogenesis in Mammals, like that of *Miniopterus*, is seen in guinea pig, *Galeopithecus*, *Tatusia*, and Primates. The primitive cavity disappears, and is replaced by a cavity limited by the amniotic folds in Microchiroptera, pig, rat, and mouse. The primitive cavity may be absent or only hinted at, as in *Gymnura*, mole, *Tupaia*, *Tarsius*, rabbit, and Carnivores. As Hubrecht showed, the amnion and the trophoblast are independent. J. A. T.

Case of Human Synophthalmia.—SIXTO DE LOS ANGELES and ANASTACIA VILLEGAS (*Philippine Journ. Sci.*, 1920, **16**, 99–107, 2 pls.). Description of a case of male synophthalmia bilentica in an almost full-term fœtus, probably of eight months. It is very remarkable in the apparent absence of the external nares, the representation of the mouth by a small triangular opening about 1·5 mm. in diameter, the presence of a snout-like dark-coloured structure above the oral aperture, the peculiarly shaped ears situated almost horizontally at the anterior part of the neck, and the absence of the median walls in the fused orbital cavity. J. A. T.

Piebald Spotting in Dogs.—C. C. LITTLE (*Journ. Heredity*, 1920, **11**, 1–4, 3 figs.). Two cases are reported which give direct evidence as to the origin of spotted individuals, and suggest that a spotted race may arise from a self race by mutation without passing through a series of minute gradations directed by selection. J. A. T.

Hereditary Tendency to form Nerve Tumours.—C. B. DAVENPORT (*Proc. Nat. Acad. Sci.*, 1918, **4**, 213–4). Multiple neurofibromatosis is a rather rare condition, characterized by the appearance of numerous sessile or stalked swellings or tumours of varying consistency and size, containing one or more nerve fibres, or, if more deeply seated, enlargements of the perineurium of nerve trunks. They are due to cell proliferations of the connective-tissue sheaths of nerves. The course of the disease is influenced by metabolic changes in the body—e.g. those associated with puberty and pregnancy, or by zymotic diseases. Associated with the tendency to form tumours is the production of pigmented spots or patches on the skin, of a café-au-lait colour. The disease may occur without a break for several generations, and is equally apt to come down the male and the female line. Consequently, it looks as though the hereditary factor is a dominant one. In each affected fraternity about 50 p.c. of the individuals are affected. The fact that neurofibromata have an inheritable basis strengthens the view that cancers in general have such a basis. J. A. T.

Heredity of Susceptibility to a Transplantable Sarcoma.—C. C. LITTLE (*Science*, 1920, **51**, 467–8). From experiments with Japanese waltzing mice it is concluded provisionally (1) that there is hereditary susceptibility to the growth of a transplanted sarcoma, to which common mice are not susceptible: (2) that from three to five factors, probably four, are involved in determining the susceptibility; (3) that for susceptibility the simultaneous presence of these factors is necessary: (4) that none of these factors is carried in the sex (X) chromosome: and (5) that these factors Mendelize independently of one another. J. A. T.

Inheritance of Tremor.—E. BERGMAN (*Hereditas*, 1920, **1**, 98–106). Hereditary tremor consists in small, rapid, involuntary, and rhythmic contractions of certain groups of muscles, especially in the hands and arms. It is usually present without intermission except during sleep and perfect rest. It is usually increased by motion and exercise. The tremor may be rather rapid (eight to ten vibrations a second) or comparatively slow (three to four vibrations a second). A case is discussed where the tremor occurred in four members of a family in three generations, and apparently behaved as a dominant. J. A. T.

Inheritance of Genotypical Deaf-mutism.—H. LUNDBORG (*Hereditas*, 1920, **1**, 35–40). Deaf-mutism may be acquired or innate. Acquired deaf-mutism may originate *in utero* or after birth. Consequently "congenital deafness" is not always heritable. In the past there has not been sufficient care taken to discriminate between genotypical, or innate, and phenotypical, or acquired, deaf-mutism. Trying to make this discriminatian, Lundborg has arrived at the conclusion that there is constitutional or genotypical deaf-mutism, and that it behaves as a recessive and monohybrid character. He criticizes and rejects Plate's theory that deaf-mutism is a dihybrid character, requiring two factors to bring it about. Lundborg pleads, however, for an extension of precise enquiry in regard to this important case. J. A. T.

Polydactyl Negro Twins.—C. H. DANFORTH (*Amer. Journ. Phys. Anthropol.*, 1919, **2**, 147–65). A comparison of the left hands of polydactyl negro twin infants (possibly uniovular in origin) with the left hand of a normal white infant for reference. In several respects the three infants showed like departures from what is generally considered as the normal adult condition. The extra digits were found to present the elements of a normal finger in a shortened and more or less abortive condition. The twins exhibited a marked similarity in respect to the friction ridges, the muscles and the arteries; some similarity in the distribution of nerves; and practically no resemblance in regard to the veins. Of the forty-nine points in which one or another of the three hands differed from the other two, the twins were alike in thirty-five, while each twin differed from the other twin and agreed with the control in seven different points. If 50 p.c. be deducted for indirect effects of the extra digits and for racial factors, the twins would still resemble each other two and a half times as much as either one resembled the control. It would seem therefore that heredity is the principal factor involved in the variations in question. J. A. T.

Resemblance and Difference in Twins.—C. H. DANFORTH (*Journ. of Heredity*, 1919, **10**, No. 9, 1–6). The close similarities of some twins and the differences of others are commonly explained on the assumption that there are two kinds of twins, those arising from a single ovum, and those derived from two separate and independent ova, the former being closely alike, the latter often very unlike. But Thorndike has found that many twins that are undoubtedly biovular in origin resemble each other more than they resemble their other brothers and sisters. Three questions are asked:—1. Are the resemblances of uniovular twins confined to certain traits, or does the similarity pervade their whole being? 2. Apart from environmental differences, how great is the similarity that may be expected between biovular twins? 3. How great are the differences that may be expected to appear in uniovular twins? To the first question it is answered that the resemblances are fundamental; but this may be due not to some general quality that the two individuals have in common, but rather to the sum of the many similar special traits which, added together, give the individual his character. This will account for cases where in spite of close similarity there are differences in some traits. To the second question it is answered that biovular twins will on the whole resemble each other to a degree about equal to the average for all children of the same family, but this may be increased by the sameness of the nurture. The data, however, are apt to lead astray, because twins who do not closely resemble one another tend to be overlooked. Differences in uniovular twins may be due to the same cause as the differences between the two sides of the body. Wilder has suggested that if a twin is developed from part of an ovum while the ordinary individual is developed from all of it, twins should be more symmetrical than ordinary individuals.
J. A. T.

Heredity in Rabbits, Rats and Mice.—W. E. CASTLE (*Publications Carnegie Inst. Washington*, 1919, **288**, 1–56, 3 pls.) 1. The hooded character in piebald rats is a Mendelizing character, but selection, either in the plus direction or in the minus direction, is marked by a consistent advance in the mean of the character. It appears, therefore, that selection can permanently change racial characters which Mendelize. Crossing the plus-selected hooded race with the non-hooded wild race reduces the grade of the hooded character, undoing in a measure the work of selection. Crossing the minus-selected race with the same wild race results in a shifting in a plus direction. 2. White-spotting in rabbits—the occurrence of wholly unpigmented areas in the skin and in the hair thereon—occurs in two forms, one recessive and the other dominant in crosses with the same race of unspotted rabbits. Experiments point to to the conclusion that genetic variability by minute gradations is a reality, precisely as Darwin assumed it to be, and this fact allows races to be altered steadily and permanently by selection, either natural or artificial, as Darwin also assumed to be the case. In short, unit-characters, while exhibiting Mendelian inheritance, are often greatly modified by crosses, and can be modified by selection alone, unattended by crossing. 3. Red eyes and yellow colour in the common rat (*Mus norvegicus*) are due to linked genes, and the same is true of pink eyes and yellow colour. The linkage between red-eyed yellow and albinism is stronger still. On the chromosome theory the genes for albinism and for red-eyed yellow are extremely close to each other in the same chromosome: and the gene for pink-eyed yellow, while lying in the same chromosome, is at some distance from the genes for albinism and red-eyed colour. But this abstract hardly does more than indicate the general scope of the paper. J. A. T.

Female Reproductive Organs in some Falconidæ.—MAX KOLLMANN (*Bull. Soc. Zool. France*, 1919, **44**, 43–52, 3 figs.). About a hundred cases are known where there is some development of gonads on the right side of a bird. The frequent statement that there is no right ovary is too sweeping. Kollmann has found six cases of a bilateral ovary and a persistent right Wolffian duct in adult Falconidæ (*Accipetor nisus*, *Astur palumbarius*, and *Tinnunculus tinnunculus*). Whether the right ovary may be functional or whether an ovum liberated from the right ovary could reach the left oviduct remains uncertain. Chapellier reports a case of two oviducts as well as two ovaries in a duck, but this is extremely rare. J. A. T.

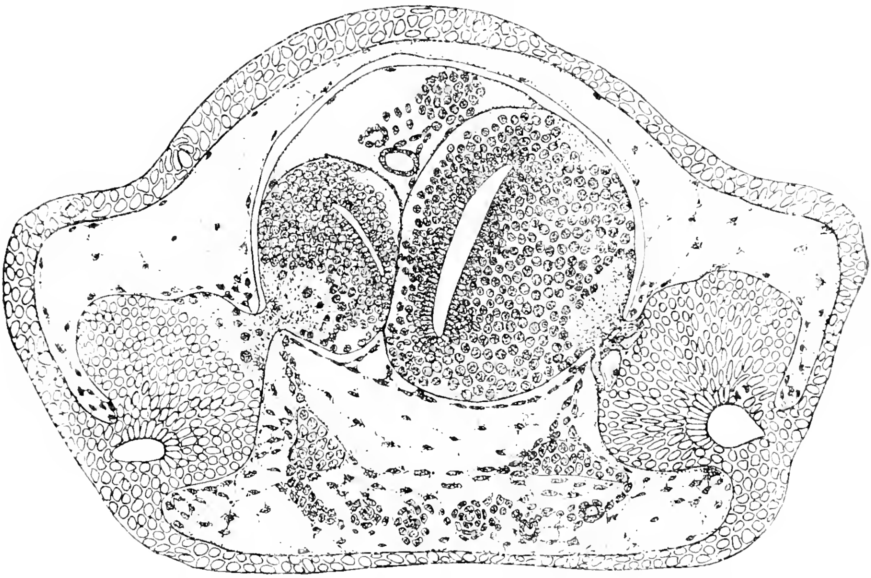
Brachydactyly in Fowls.—C. H. DANFORTH (*Amer. Journ. Anat.*, 1919, **25**, 97–115, 5 figs.). In certain strains of poultry (and probably in pigeons) there is a close correlation between brachydactyly (involving the size and number of bones in the feet) and the presence of feathers on the "tarsi." The evidence from the development shows that while the size and number of skeletal elements are determined by the length of the embryonic toe, there is no causal relation between toe length and feathering. The data seem to indicate, on the contrary, that brachydactyly, feathering of the tarsi, and probably syndactyly are all dependent on one and the same factor. No attempt is made to postulate the nature of this factor, but it is suggested that a study of the early functioning of the endocrine glands in normal and abnormal embryos might throw some light on the question. No correlation could be detected between either of the characters referred to and polydactyly or comb form. J. A. T.

A Hereditary Complex in the Domestic Fowl.—C. H. DANFORTH (*Genetics*, 1919, **4**, 587–96). Evidence is presented that brachydactyly, syndactyly and leg-feathering (or "ptilopody"), at first sight apparently distinct and unrelated, are in reality the product of a single gene or a single combination of genes. J. A. T.

Transplanting Limbs of Amblystoma Embryo.—S. R. DETWILER (*Journ. Exper. Zool.*, 1920, **31**, 117–69, 2 pls.). When the anterior limb is excised and re-implanted to the same embryo at distances ranging from 1–7 segments posterior to the normal position, there is a corresponding decrease in the function of these limbs as they are implanted more and more remote from the normal situation. Shifting the limb does not effect a corresponding shifting of the segmental nerve contribution. If the limbs be so far posterior to the normal situation that they receive no innervation from the normal limb level of the cord, they receive their main innervation from segments anterior to the transplanted limb rather than from segments corresponding to the position of the limb. The gradual decrease of function seems to be correlated with the segmental nerve supply; the function being more perfect when the innervation is from the limb level. As the distance from the normal increases the time required for initial limb reflexes increases. It looks as if the transplanted limb rudiment had a guiding influence on the nerve contribution. The positive reaction toward this influence appears to be greater in the nerves coming from the normal limb level of the cord. The architecture of the nerve distribution within the transplanted limb is the same as that in the normal limb. Gradually increasing the distance between the normal position and the transplanted limb brings about a gradual increase in the number of reduplicated appendages. The reduplication is manifestly non-adaptive. J. A. T.

Transplanted Limbs and their Innervation.—S. R. DETWILER (*Proc. Nat. Acad. Sci.*, 1919, **5**, 324–31, 2 figs.). Additional limbs transplanted 3–5 segments posterior to the normal intact limb of the Amblystoma embryo never attain the completeness of function attained by limbs in the same relative position with the normal limb extirpated. Although such limbs may be well supplied with peripheral nerves, derived from segments of the cord posterior to the normal limb level, their greatly impaired movements appear to be a consequence of their inadequate supply of central efferent neurones, which run apparently only as far as the normal limb level, where they discharge into the somatic motor centres of the normal intact limb. The generally restricted and non-adaptive movements which these limbs do exhibit upon stimulation are probably effected through more or less imperfectly connected intraspinal, intersegmental correlation neurones of the levels from which peripheral innervation is derived. J. A. T.

Regeneration of Fore-Brain in Amblystoma Larvæ.—H. SAXTON BURR (*Journ. Comp. Neurology*, 1916, **26**, 203–11, 4 figs.). Experiments show that the fore-brain of Amblystoma larvæ will not regenerate when it and its functional end-organ are completely extirpated. The healing of the wound results in the formation of a curtain across the interventricular foramen derived from the ependyma lining the neural tube. If, on the other hand, the fore-brain is removed without removing the end-organ, the nasal placode, the presence of the latter acts as a stimulus to the regeneration of a new telencephalon through the ingrowth of the optic nerve. The pallial region of the telencephalon is regenerated in all cases owing to the stimulus afforded by the forward growth of axones from lower centres in the brain and cord. These ingrowing



Transverse section through embryo of Amblystoma one and a half months after the operation, showing the regenerating telencephalon as the result of the presence of the nasal placode.

axones stimulate a mass of neuroblasts at the posterior margin of the interventricular foramen. In three and a half months the new cerebral hemisphere could not be distinguished from its fellow. J. A. T.

Development of Japanese Giant Salamander.—DAN DE LANGE, Jun. (*Tijdschr. Nederland. Dierk. Ver.*, 1916, **14**, 224–372, 8 pls.). A study of the development of *Megalobatrachus maximus* during the first eighteen days, especially as regards the anterior region. The cephalogenesis or protogenesis includes the formation of the head to behind the auditory vesicle and the branchial region, with the exception of the greater part of the protochordal plate. The somatogenesis or deutogenesis leads to the formation of the anterior half of the trunk, including the protochordal plate. The urogenesis or tritogenesis, which is not discussed, leads to the formation of the posterior half of the trunk and the tail. Stomodæum, primordium of brain, and the sensory organs of the head are formed *in situ* by the cephalogenesis; the protochordal plate is of mixed origin, being in part somatic. The anterior head-mesoderm or primary mesoderm, from which arise the mesodermic head-organs in front of the hyomandibular cleft, is entirely due to cephalogenesis. A detailed account is given of what happens on each day.

J. A. T.

Development of Vertebral Column of Megalobatrachus.—J. P. De Gaay Fortman (*Tijdschr. Nederland. Dierk. Ver.*, 1918, **16**, 121–62, 2 pls., 10 figs.). In this giant salamander there is a hint of an intervertebral cleft. In the place of the spinous processes there are closing pieces of connective tissue, which are continued into the arcualia of two vertebræ and form by their union the pre- and post-zygapophyses. Between the centra there is no cartilaginous joint, but a broad ring of connective-tissue cartilage. This is continued far into the centrum and forms eventually a very delicate cartilaginous zone. The intervertebral cartilage arises in the notochord itself, which is constricted intra-vertebrally and continued inter-vertebrally. The vertebræ of Amphibia are referable to fish vertebræ in which there has been fusion of two arcualia. Half of the first segment forms cartilage, which takes part in forming the condyles and the bases of the arcualia of the first vertebra. The boundary between occipital and atlas is in this first half-segment. The first vertebra is, as regards arcualia, more than one vertebra, for three sclerotome halves share in its making. Parts of the atlas and of the condyles are the equivalents of Albrecht's pro-atlas.

J. A. T.

Eel with Left Eye in Lower Jaw.—C. E. Droogleever Fortuyn-van Leyden (*Tijdschr. Nederland. Dierk. Ver.*, 1918, **16**, 271–9, 6 figs.). A curious abnormality in a common eel about 30 cm. in length. The left eye was situated on the under surface of the lower jaw, a little to the left of the middle line, and had a normal structure. At the spot where the left eye should have been there was a small dimple. It is probable that the optic vesicle grew out anteriorly and towards the ventral surface, instead of laterally; that it reached and traversed the anterior mesodermic mass; and that it continued growing until it reached what afterwards became the epidermis of the lower jaw. It is probable that the epidermis reacted to form a lens and cornea. It is probable that the primordia of the eye-muscles, applying themselves at a very early stage to the capsule of the eye, were gradually led as they developed to their extraordinary final position.

J. A. T.

Eye-displacement in Pleuronectids.—Otto Thilo (*Zool. Anzeiger*, 1920, **51**, 119–42, 12 figs.). In young flounders, plaice, and the like, the two eyes are for a considerable time symmetrically disposed, one on each side of the head. The young fishes swim vertically till they are 10–15 mm. long, when they lie on one side on the sand. At this stage the lower eye may be lost by friction. It may be noted that there are blind genera (*Soleotalpa*, *Apionichthys* and others). The friction of the sand causes cramp-like contractions of the eye-muscles, which lift the eye to the other side of the head. The change takes place in three days or so. Its mechanism is analysed. The gap is filled with supporting tissue, partly ossified. The musculus rectus externus degenerates relatively to the others—a secondary effect of the displacement. There is great mortality during the migration of the eye. The importance of the paper is in its analysis of the factors actually operative in the moving of the down-turned eye to the up-turned side. J. A. T.

b. Histology.

The Neurone.—H. B. Ferris (*Psychological Bulletin*, 1918, **15**, 257–63). A review of numerous recent papers on the neurone. L. S. Ross regards the trophospongium of the crayfish (*Cambarus*) as a nutritive and supporting, non-nervous framework extending in from without. Ramon y Cajal believes that the Golgi net in cells of the cerebral cortex represents a canalicular system filled with a lipoid-containing substance. It is noted by A. M. Pappenheimer that the Golgi net has not been observed in the living cell, though it occurs in preparations of most kinds of cells. Nissl-bodies are generally believed to consist of a nucleo-protein containing iron, which is elaborated by the nucleus. Some observers claim that they can see them in the living cell; others regard them as precipitation products. E. V. Cowdry finds that "chromophile" cells in the nervous system are usually shrunken as a whole and as regards their nucleus; the condition is not an artefact, or pathological, or senile. M. Flesch finds abundant "chromophile" cells in the Gasserian ganglion, larger than the normal cell, and fewer in young than in old. M. R. and W. H. Lewis observe that mitochondria change in shape, size and number, and that they move about and may pass from one cell to another. N. C. Nicholson notes the differences in the mitochondria of different cells of the central nervous system of the white mouse. M. De G. Thurlow believes that there is a definite mitochondrial-cytoplasmic ratio. The evidence from various sources seems to show that mitochondria are definite, discrete, formed elements found in all kinds of cells, and at all ages, and are chemically a lipoid albumen. They are not related genetically to the neurofibrils, Nissl-bodies, or the Golgi net. They are connected with the fundamental metabolic processes that occur in cells, possibly with respiration. J. A. T.

Motor Nuclei and Roots in Brain of Fishes.—C. J. Van der Horst (*Tijdschr. Nederland. Dierk. Ver.*, 1918, **16**, 168–270, 16 pls., 37 figs.). An elaborate study relating to a great variety of types, showing that the position of the motor nuclei and roots has often considerable taxonomic value, and showing that their position and displacement bear out, on the whole, the theory of neurobiotaxis—that the main dendrites grow out towards, and the whole body of the ganglion cell is displaced in the direction of the centre of stimulation, while the axis-cylinder grows away from the centre of stimulus or the source from which stimuli radiate. J. A. T.

Effect of Ions on Ciliary Motion.—J. Gray (*Proc. Cambridge Phil. Soc.*, 1920, **19**, 313–4). A large number of experiments show that if the concentration of hydrogen ions is only slightly greater than normal, the cells (of mussel gills) can react to the environment, and recovery takes place in the acid solution. In stronger acid, however, recovery only takes place on removing the gills to a more alkaline solution. In still stronger acid the cells become opaque and are killed. Mussel gills exposed to an abnormally high concentration of hydroxyl ions behave in a remarkable way. In such solutions the ciliary action is either not affected at all or proceeds at an abnormally rapid rate, but the individual cells of the ciliated epithelia break away from each other and move about in the solution owing to the movement of their cilia. A number of experiments show that sodium, potassium, calcium, and magnesium are all necessary to maintain gill fragments in a normal state of ciliary activity for a protracted period, viz. four days. If one or more metals are omitted, the individual cells of the ciliated epithelia show the same disruptive phenomenon as in sea-water of abnormally high concentration of hydroxyl ions. J. A. T.

c. General.

Comparative Study of Rodent Brains.—L. Reisinger (*Zool. Anzeiger*, 1920, **51**, 107–9, 4 figs.). A comparison of the brains of rabbit, squirrel, rat, and guinea-pig, which show close similarity, although the animals differ much in apparent intelligence. There is certainly no close correlation between convolutions and intelligence. The point is made that if there is sufficient cranial space there is no need for convolutions. Many small rodents may have a relatively large brain, though this is almost smooth. J. A. T.

Variations of Pit Viper.—Joan B. Procter (*Proc. Zool. Soc.*, 1918, 163–82, 5 figs.). An account of the variation of the principal characters of the Central and South American pit viper, *Lachesis atrox*. With this species *L. lanceolatus* is synonymous, and of this species *L. affinis* Gray, *L. jararaca* Wied., and *L. jararacussu* Lacerda are varieties. The more northern form *L. affinis* is most primitive in its markings, and from it the patterns of the markings of the others may be derived. J. A. T.

The Urodele Vomer.—Inez Whipple Wilder (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 349). A study of the vomer in *Spelerpes*, *Diemyctylus*, and *Amblystoma*. During the metamorphosis in *Spelerpes* the vomer shows (1) an anterior and lateral extension as a plate-like reinforcement of the floor of the nasal region; (2) an extension of the median part, mainly in a posterior direction, through the fusion of the bases of a new series of teeth which appear at this time in the roof of the mouth; and (3) the absorption of the larval vomerine teeth of the ridges that bore them, so that this region also becomes thin and plate-like. J. A. T.

Pectoral Fin of Eusthenopteron.—Branislav Petronievics (*Ann. Mag. Nat. Hist.*, 1918, **2**, 471–6, 2 figs.). A description of the skeletal structure of this fossil fish and a discussion of its homology with the tetrapod limb. The posterior bifurcation of the fourth axonost may be a remnant of a more primitive stage in which the fourth axonost was composed of two separate ossifications, the paired fins of *Eusthenopteron* being evidently the reduced archipterygium type of Gegenbaur (uniserial rather than biserial). J. A. T.

Phylogeny of the Orthobiont.—CHARLES JANET (*Sur. la Phylogénèse de l'Orthobionte, Limoges*, 1916, 72 pp., 6 tables, 8 pls.). According to the author the primitive organism was a Phyto-zoo-flagellate with both photosynthetic and animal modes of nutrition. This primitive organism differentiated into Phyto-flagellates (holophytic), leading on to plants, and Zoo-flagellates (holozoic), leading on to animals. The successive generations of a flagellate include: (1) A "merism" consisting of groups of monoplastid individuals enclosed in a cyst (a "blastea"); and (2) a "merism" consisting of a multitude of free monoplastid individuals (a "plethea"). Among the free monoplastids there is an occurrence of special gametes which unite in pairs to form zygotes. These multiply by bipartition. All the progeny of a given zygote before fresh gametes occur constitute a "holobiont"; a direct line from one zygote to a new zygote constitutes an "orthobiont." The orthobiont of the primitive flagellate consists of an alternation of encysted blasteas and sporadic pletheas, and the author's idea is that the orthobiont of any organism consists of a succession of blasteas and pletheas homologous to the blasteas and pletheas constituting the orthobiont of the primitive flagellate. The author shows how this works out, as it seems to him to do, in cases like *Volvox*, *Fucus*, a liverwort and an insect. The thesis is illustrated by numerous finely drawn figures, indicating the supposed homologies, and by ingenious comparative tables. J. A. T.

Physiological Analysis of Behaviour.—H. B. TORRY (*Journ. Animal Behaviour*, 1916, **6**, 150–9). The behaviour of *Paramecium* in the presence of an obstruction in its path shows a succession of motor reflexes orientated with reference to the source of stimulation. Are these and other precise responses that organisms make to directive stimuli the outcome of selection whether of individual reactions or of individuals themselves? "On the contrary, evidence is accumulating in favour of the view that organisms respond typically without trials: that what have been called, by a figure of speech, trials are actually definite responses to stimuli that are neglected by the observer; that behaviour is the resultant of many stimuli of which the directive stimulus is but one: that, in fact, the tropic response is rigidly determined as to direction by factors which complete analysis may be expected in all cases to bring to light." J. A. T.

Large Size of Abyssal Animals.—A. SOKOLOWSKY (*Schrift. Zool. Stat. Büsum*, 1919, **1**, 15–18, 1 fig.). Attention is directed to the tendency of abyssal animals to attain very large size, e.g. *Macrocheira* (*Kæmpfferia*) *kæmpfferi*, the giant crab which may measure 11 feet from the tip of one forceps outstretched to the tip of the other. There are large deep-water fishes, like oar-fish; large Cephalopods: and the well-known hydroid *Monocaulus imperator* may rise to a height of about eight feet. Some deep-sea animals, not in themselves very large, are relatively gigantic compared with their relatives in shallow water, as may be well illustrated by the sea-slater, *Bathynomus dœderleini*, and even by some very large Foraminifera. The chief cause is probably that the stillness of the great depths allows of great extension of body without risks. J. A. T.

Prolongation of Life and Vigour.—W. HARMS (*Zoolog. Anzeiger*, 1920, **51**, 161–8). In some worms, e.g. the Palolo worm, and in other cases, there is a natural evasion of senile degeneration by surrendering a large part of the body. In *Hydroides* an artificial removal of the ageing abdominal segments gives the worm a new lease of life. Another method is the artificial implanting of testes, which Harms found to be efficacious in guinea-pigs. After sexual vigour had quite waned it was restored by ingrafting a piece of young testes. The restoration of sexual vigour lasts for some time. J. A. T.

Tunicata.

Test Vesicles in Tunicates.—CASWELL GRAVE (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 350). The fully developed tadpole larva of *Amaroucium constellatum* has about sixty spherical multicellular test vesicles. They arise as elongated evaginations from four median sagittal elevations of the ectoderm, but they become free in the larval tunic and resemble Echinoderm blastulæ. When the metamorphosis begins they migrate to the external surface of the tunic and begin to proliferate tunic material. They are concerned with the formation and regulation of the common tunic of the colony, and continually produce new cells. They do not increase or decrease in number during the life of the colony. No structural connexion with ascidiozooids was made out. The vesicles are organs of the colony as a whole, but they are all derived from the individual by which the colony is founded. They persist, however, long after the primary zooid has lost its identity. J. A. T.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Regeneration of Arm of Octopus.—MATHILDE M. LANGE (*Journ. Exper. Zool.*, 1920, **31**, 1–40, 8 pls.). When an arm of *Octopus vulgaris* is cut off the edges of the wound curl inwards; the axial nerve protrudes; bleeding sets in after five to six hours; the protrusion of the axial nerve disappears; an epithelial healing occurs. A knob appears with a thin rod-like appendage. New suckers appear on the regenerated piece proper, and at the obtuse end of the arm stump. The first new chromatophores appear about three or four weeks after operation. All new tissues, with the exception of the dermal connective tissue (which is probably developed from the primary blastema due to the agglutinated blood-corpuscles) are produced in regeneration from the pre-existing tissues of the same kind. J. A. T.

γ. Gastropoda.

New Chitons.—EDWIN ASHBY (*Trans. Proc. R. Soc. S. Australia*, 1919, **43**, 66–73, 1 pl.). Definition of a new sub-genus, *Zostericola*, differing from *Stenochiton* (*sensu stricto*) in that the shell is short and broad instead of being elongated and narrow. It possesses the highly-polished and unsculptured surface and minute girdle-scales so distinctive of the true *Stenochiton*, and it lives on the same plants, the sea-grasses. The new sub-genus is erected for the reception of *Stenochiton pilsbryanus* Bednall. A description is also given of *Kopionella* g.n., which differs from *Plaxiphora* in having peculiar oar-headed girdle bristles or spicules, and an elevated recurved tail-valve with terminal mucro; and from *Frembleyana* in the peculiar bristles and in the slits in the median valves being centrally situated, and in the sinus being much narrower, especially in the tail-valve. J. A. T.

New Australian Chitons.—EDWIN ASHBY (*Trans. Proc. R. Soc. S. Australia*, 1919, **43**, 394–404, 2 pls.). Descriptions of *Notoplax porcina* sp. n., from Gulf St. Vincent; *Acanthochiton maxillaris* sp. n., from S. Australia, a beautiful and striking form with a row of exceptionally large milk-white pustules, suggesting a row of rounded teeth set in a jaw; *A. gatliffi* sp. n.; and two new sub-species of *Callistochiton antiquus*. J. A. T.

Revision of Genus Loricella.—EDWIN ASHBY (*Trans. Proc. R. Soc. Victoria*, 1919, **43**, 59–65, 1 pl.). A description of the two species of this genus of Polyplacophora—*L. angasi* H. Adams and Angas, and *L. torri* sp. n., both Australian. The genus may be near *Lorica*, as is suggested by the cleft in the girdle and by the character of the tail-valve, but its large head and the small foot, together with its markedly distinct girdle, suggest that the relationship may be more superficial than real. The girdle is clothed with peculiar bilobed scales, like grains of wheat set on end, either transparent and glassy or opaque white. Between these there are strange "spear-heads," which push through to about eight times the length of the scales. They look like cylindrical pointed spear-heads of porcelain. They grow into coarse hairs or tubes, and give off more "spear-heads" as buds. A single stalk may have as many as six "spear-heads." Their function is obscure. J. A. T.

Spermatogenesis in Gastropods.—VICTOR SCHITZ (*Arch. Zool. Expér.*, 1920, **58**, 489–520, 12 figs.). In *Cerithium*, *Bittium*, and *Turritella* there is a typical and an atypical spermatogenetic cycle, the latter resulting in spermatozoa with a bundle of long cilia. In the typical cycle the chromatin forms the head; in the atypical it degenerates and disappears. In the atypical cycle the rôle of the idiozome remains obscure: in the typical cycle it serves as a "vehicle" for the transport of the anterior pole of the nucleus of the spermatid, the derivative of the central corpuscle. It afterwards slips along the tail with a blob of protoplasm and disappears. The idiozome is the same as the "nebenkern" of Pulmonates; it is not mitochondrial in origin, as

Fauré-Frémiet has stated; it is more probably an organite of the cell. The mitochondria take part in the typical series in forming the middle piece; in the atypical series they form the envelope of the body of the

1, 3, 5, ripe spermatozoa of the typical series, 2, 4, 6, ripe spermatozoa of the atypical series, in *Cerithium*, *Bittium*, and *Turritella* respectively.

spermatozoon. No intranuclear rodlet was found. The central corpuscles of the typical series form the axial filament and the caudal flagellum. The proximal corpuscle forms finally a little ring between the nucleus of the head and the tail; the distal corpuscle descends along the tail as a minute granule. In the atypical series the central corpuscles form the axial body and the caudal cilia, which together correspond to the intracellular and extracellular fibrils of other Prosobranchs. J. A. T.

Eyes of Gastropods.—HANNA EISENMANN (*Zool. Anzeiger*, 1920, **51**, 143–58, 10 figs.). A comparison of the eyes of terrestrial Gastropods (*Helix* and *Arion*) and fresh-water Gastropods (*Paludina*) as regards shape, lens and retina. The eye is spherical in *Helix* and *Arion*, an elongated pear-shape in *Paludina*. The innervation is rather different. The differences in lens, retina, cornea and external envelope are discussed. J. A. T.

Arthropoda.

a. Insecta.

Fertilization in the Honey-Bee.—GEORGE H. BISHOP (*Journ. Exper. Zool.*, 1920, **31**, 225–65, 3 pls., 3 figs.). The drone is not sexually mature at the time of emergence of the imago, but grows for at least 9 to 12 days. The sperm and the mucus of the accessory gland change in character and behaviour as development goes on. They remain separate till copulation. The partition separating them from the ejaculatory duct, consisting of the chitinous lining of the blind end of that duct, does not break through until copulation. Then the sperm and mucus are forced out of their receptacles by contraction of the muscular walls of these organs. The musculature of the whole base of the gland is so arranged as to cause, on violent contraction, the shutting off of the distal portion of the gland from the proximal by a muscular valve. The mucous content is thus closed off from its outlet through the ejaculatory duct: at the same time sperm is allowed to pass through the vas deferens and basal portion of the gland into the ejaculatory duct. This spermatic fluid is thus the first to be ejaculated. The mucus follows, forcing all the sperm out, and coagulating into a plug. The penis is torn out in copulation. The bulb and elastic end of the ejaculatory duct do not act as a spermatophore, although after copulation, and while still attached to the queen, they may hold what remains of mucus. The drone's reproductive organs are very easily stimulated to contraction; picric acid solution inhibits this, other acids provoke it. J. A. T.

Insemination of Queen-Bee.—GEORGE H. BISHOP (*Journ. Exper. Zool.*, 1920, **31**, 267–86, 2 figs.). The result of copulation is not the immediate filling of the final sperm reservoir, the seminal receptacle of the queen, but the reception of the spermatic fluid (from the seminal vesicles of the drone) and the mucus (from his accessory glands). The spermatozoa alone enter the spermotheca, all of them in about six and a half hours. Their progress is not wholly passive; it is possibly guided by chemotaxis. The mucus forces up the spermatic fluid and by coagulation seals up the torn end of the copulatory organ, preventing back flow. A description is given of the face-to-face coition, the tapering end of the ejaculatory duct adjoining the bulb being everted through the bulb into the vagina. The alternate contractions of circular and longitudinal muscles of the seminal vesicles and accessory glands bring about ejaculation—first of the sperms only and then of mucus. The queen breaks off the everted copulatory organ, usually close behind the bulb, by crawling or flying in a circle round the drone, and returns with it to the hive. It becomes dislodged or is pulled away by the bees in the hive within a few hours. The mucus is absorbed in the oviduct; the sperms pass by the sperm-duct to the spermotheca. J. A. T.

Nest of Solitary Wasp, Crabo cephalotes.—CECIL WARBURTON (*Proc. Cambridge Phil. Soc.*, 1920, **19**, 296–8). Observations on a small colony in a log of elmwood kept in the author's garden at Cambridge as an example of a woodpecker's nest. The cavity was gradually filled with the "sawdust" of the burrows in the wood. Conspicuous on the sawdust were numerous Syrphid flies, especially *Syrphus balteatus*, used as food. There was no attempt to seal or mask the tunnels. There was nothing to prevent any enemy from entering. The main tunnels were clear, and penetrated the wood for several inches, with abrupt turnings on no definite plan. From these proceeded side galleries in which were found "sawdust," the débris of flies, and the brown cocoons containing the fully-fed wasp larvæ. J. A. T.

Inheritance of Silkworm Characters.—MAUDE L. CLEGHORN (*Proc. Zool. Soc.*, 1918, 133–46). The inheritance of the visible colour character of the cocoons is clearly Mendelian. The inheritance of the invisible univoltine and multivoltine character (dominant when inherited by the females, recessive in males) does not appear to be quite Mendelian, but it may be that the sex-limited descent affects the inheritance, and that there is really no failure in segregation of the unit characters.
J. A. T.

Origin of Gynandromorphs.—T. H. MORGAN and C. B. BRIDGES (*Publication* 278, *Carnegie Inst. Washington*, 1919, 1–122, 4 pls., 70 figs.). A study of gynandromorphs (combining male and female characters, it may be both gonadial and somatic) in *Drosophila melanogaster*, on which numerous experiments have been made. Many of the gynandromorphs were hybrids of known sex-linked characters, i.e. characters whose genes are carried by the sex chromosomes. By adding to such crosses additional characters whose genes lie in other than the sex chromosomes, it has been possible to prove that the male and female parts of the gynandromorph differ by the sex chromosomes alone, i.e. both male and female parts contain the same autosomal group. It was possible, in consequence, to show that these gynandromorphs are not due to partial fertilization (Boveri), or to polyspermy (Morgan), but to chromosomal elimination (Morgan). Chromosomal elimination means that at an early stage in embryonic development one of the daughter chromosomes of one of the X's fails to pass over to one of the daughter plates, and accordingly gets left out of that nucleus. In consequence, one of the two cells will contain only one X chromosome, and produce male parts, while the sister cell with two daughter X chromosomes will produce female parts. The evidence that elimination of this kind takes place rests on cases in which the X chromosome derived from the father contains different self-linked genes from those borne by the X chromosome derived from the mother.

A logical consequence of the proof that the gynandromorphs arise through elimination is that they should all start as females, i.e. as XX individuals. A second logical consequence is that, starting as an XX individual, the male parts will be XO, and not XY as in the normal male. A striking fact in regard to these gynandromorphs is that the male and female parts and their sex-linked characters are strictly self-determining, each developing according to its own constitution. No matter how large or how small the region is, it is not interfered with by the aspirations of its neighbours, nor is it over-ruled by the action of the gonad.

In 88,000 flies there were found 40 gynandromorphs, or 1 to 2,200. The fact that most of the mosaics include large regions of the body may mean that elimination takes place more often during the first or second division of the segmentation nucleus, but it may also mean that when smaller regions are involved the gynandromorph would be more often overlooked. Both gonads of the same individual are always alike—i.e. both are testes or both are ovaries—even when the external markings of the abdomen are male on one side, female on the other. This finds its explanation in the assumption that the germ-plasm of *Drosophila*, as in some other flies, arises from a single cell. This cell, arising after elimination, must be either a spermatogonium or an oogonium. Courtship has been watched in a number of flies that were partly male and partly female. Many of them are indifferent; some react as males, others as females.

The only other theory besides elimination that the authors have found it necessary to employ in accounting for the gynandromorphs of *Drosophila*, where the genetic evidence makes the analysis possible, is the theory of binucleated eggs. This applies to two gynandromorph silkworms described by Toyama. Gynandromorphs in birds and mammals are discussed, along with a number of peculiar conditions. That genetic factors determine the sex-condition in certain types does not in itself prove that there may not be influential environmental or nurtural factors in other types. J. A. T.

The Second-Chromosome Group of Mutant Characters in Drosophila melanogaster.—C. B. Bridges and T. H. Morgan (*Publication* 278, *Carnegie Inst. Washington*, 1919, 123–304, 7 pls., 17 figs.). This paper deals with thirty-nine mutant races whose genes lie in the "second chromosome" (arbitrarily defined as that which carries the gene for black and other related genes). The point of the investigation is mapping out of the loci of the various genes in the chromosome in question—a remarkable triumph of experimental analysis. Thus, "star eye" has its gene at the extreme "left" of the chromosome, "purple eye" has its gene at the centre near that of black, the "speck" character has its gene near the right end, and "curved" has its position at the right of the central group. Apart from the localization of genes, the authors discuss the "modifiers" of characters, autosomal and balanced lethals, and the variations in the amount of crossing-over due to specific genes and to such factors as age and temperature. J. A. T.

Inherited Linkage Variations in Second Chromosome of Drosophila.—A. H. STURTEVANT (*Publication* 278, *Carnegie Inst. Washington*, 1919, 307–41). In a female of *Drosophila melanogaster* (*ampelophila*) that came from a stock collected in Nova Scotia, the author found two genes that influence the amount of crossing-over in the second chromosome. Crossing-over, it may be recalled, is the interchange of blocks of genes between two homologous chromosomes lying apposed. Each of the genes in question, in females heterozygous for it, decreases the amount of crossing-over in the region in which it lies. The author indicates where the genes have their locus in the chromosome. Neither of these two genes causes any change in the usual condition of no crossing-over in males. J. A. T.

Modifying Genes.—T. H. MORGAN (*Publication* 278, *Carnegie Inst. Washington*, 1919, 345–88, 1 pl., 15 figs.). Notch wing is a dominant character in some females of *Drosophila melanogaster*, and is caused by a dominant gene in the sex chromosome. In addition to its dominance, the gene produces a recessive lethal effect, killing every male that carries the gene. Notch females are heterozygous for the Notch gene, i.e. one X chromosome carries the gene for Notch, the other X chromosome carries its normal allelomorph. The latter saves the female from the lethal effect of the Notch gene. It has been shown by Morgan that mass selection on this character, carried out for twenty-four generations, results in a change in the character in the direction of the selection. It is also shown ingeniously that the changes brought about by the selection are due to the presence in the stock of a recessive modifying factor in the second chromosome. Notch females homozygous for this factor give the "selected group." Those heterozygous for it, or lacking it altogether, give the atavistic or original group. J. A. T.

Minute Structure of Diptera.—P. E. KEUCHENIUS (*Tijd. Nederland. Dierk. Ver.*, 1917, **16**, 1–52, 3 pls.). Description of the minute structure of the reproductive organs, Malpighian vessels, fatty tissue, epidermis and muscle in *Tipula oleracea*, *Eristalis tenax*, *E. arbustorum*, *Beris clavipes*, *Lucilia cæsar*, and *Chironomus annularis* (?). The ovarioles consist of terminal filaments, terminal chamber, and follicles, or of terminal chamber and follicles, or of follicles only. In the cells of the youngest follicles of *Beris* and *Lucilia* there is merely indifferent nucleoplasm which may form the nuclei of ova or may be absorbed by the growing ova without ever forming a true nucleus. An account is given of the three spermothecæ, the receptacula, the seminal canal, the uterus, the vagina, and the occasional accessory glands. The Malpighian tubules show a secreting synctium without cell walls. The fatty tissue is heterogeneous, even in the same animal. There is sometimes (*Eristalis*) an intimate contact between liparocytes and œnocytes. The epidermis is usually very delicate and its nuclei are often difficult to find; in *Beris* it is structureless; in *Chironomus* it is well developed. In *Eristalis arbustorum* the muscles show not only a terminal insertion, but also a lateral attachment to the epidermis. Different forms of striped muscle are described. J. A. T.

Lygocerus Hyperparasite of Aphidius.—MAUD D. HAVILAND (*Proc. Cambridge Phil. Soc.*, 1920, **19**, 293–5). Plant-lice are frequently parasitized by certain Braconidæ of the family Aphidiidæ, of which *Aphidius* is a good example. The parasite oviposits in the hæmocœle of the aphis, and the larva, during development, consumes the viscera of the host. At metamorphosis nothing remains but the dry skin, within which the *Aphidius* spins a cocoon for pupation. At this stage the *Aphidius* itself is apt to be parasitized by certain Cynipidæ, Chalcidæ and Proctotrypidæ. Thus the Proctotrypid *Lygocerus testaceimanus* Kieff. is a hyperparasite of *Aphidius salicis* Hal., parasite of *Aphis saliceti* Kalt., from the willow; and *L. cameroni* Kieff. is a hyperparasite of *Aphidius ervi* Hal., parasite of *Macrosiphum urticæ*, from the nettle. The author communicates her observations on the life-history of these two species. J. A. T.

Pharyngeal Musculature of Larvæ of Dytiscus marginalis.—WALTER SPEYER (*Zool. Anzeig.*, 1920, **51**, 243–50, 4 figs.). A detailed description, in some ways extending that of Rungius (1911). An analysis is given of the dorsal dilators (eight in number), the ventral dilators, the circular muscle, and the longitudinal musculature. Attention is directed to the bristles borne by the pharyngeal intima and their probable function. J. A. T.

Synapsis in Cockroach.—LANCELOT T. HOGBEN (*Proc. Roy. Soc.*, 1920, B, **91**, 305–29, 3 pls.). A study of oogenesis and spermatogenesis in Periplaneta. The chromosomes do not divide in the pre-meiotic mitoses, as they pass to the polar ends of the spindle; in the telophase, they become attenuated before passing into the reticulate condition, but do not display any evidence of cleavage. The splitting of individual chromosomes begins in the prophase, the separation of the halves being a process of progressive differentiation: cleavage is completed before they adopt the equatorial position in the metaphase. Counts in the metaphase confirm Morse's view that there are two accessory chromosomes in the female cells and an unpaired heterochromosome in the male. The accessory chromosomes in the female behave in all respects like autosomes.

In its earliest stages the heterotype prophase differs from the pre-meiotic reticulate nucleus in the organization of the chromatin in the form of elongated, finely beaded filaments, forming an intricate tangle. The polarized leptotene threads of the early bouquet are present in the full diploid number. Parallel conjugation of leptotene threads takes place in the bouquet stage at the point of maximal contraction. The diplotene loops of the post-synaptic spireme become straightened and abbreviated, in anticipation of their transformation into heterotype chromosomes. In both cases two of the bivalents retain their looped condition till the transformation of the remainder has already made considerable progress, and it is suggested that the differential rate of metamorphosis of annular heterotype chromosomes has given rise to the appearance that the latter are formed through the union of the free ends of a diplotene loop. The heterotype chromosomes are formed by the opening out of the shortened diplotene rods along the line of cleavage, so as to assume eventually the form of stretched rings.

From the fact that, in the oocyte, the splitting of the diplotene filaments appears to correspond with the plane in which conjugation takes place, it is inferred that segregation of homologous chromosomes is effected in the heterotype mitosis. The elimination of "chromatin" particles in the diffuse stage of the oocyte nucleus has been fully investigated; it has been shown that the formation of yolk is consequent upon the elimination of material from the plasmosome, and the suggestion is made that similar nuclear particles in other animals arise from the plasmosome. J. A. T.

Respiration in Dragon-fly Larvæ.—HANS WALLENGREN (*Lunds Univ. Årsskrft.*, 1915, **11**, No. 11, 3–12). In water with normal oxygenation the oxygen content of the tracheal air is always lower, and the CO_2 content the same as or a little higher than that of the water used in the respiration. The difference can be explained according to the laws of diffusion. The tracheal air varies with the oxygenation of the water, but has always less oxygen. From the tracheal gills the oxygen diffuses into the large dorsal and ventral tracheæ. By the breathing movements, the body movements, the contractions of the walls of the respiratory part of the intestine, as also by diffusion, the oxygen passes into the finer branches and is absorbed by the blood, the tissue-bathing fluid, and the cells themselves. The carbon-dioxide given off by the cells is dissolved in the tissue-bathing fluid and the blood, and only a small part passes into the tracheal system; the rest diffuses from the blood through the skin, the tracheal gills, and the wall of the respiratory part of the intestine directly into the gut. When the insect gets into respiratory difficulties, the oxygen percentage in the tracheal air sinking below 4 p.c., certain reflexes are put in operation and the larva comes to the surface. When they increase the percentage of oxygen in the tracheal air to about 12 p.c. (high above the normal in sub-aquatic life) the larvæ return from the surface. J. A. T.

Maturation of Parthenogenetic Ova of Aphis palmæ.—V. D. DE BAEHR (*La Cellule*, 1920, **30**, 317–49, 1 pl.). In the oogonia there are always eight chromosomes. These are reduced in the synaptic prophase to four bivalent or diakinetic chromosomes. In the maturation these are analysed into their components, and, since no maturation-spindle is formed, these remain in the nucleus. Eight simple chronosomes are seen, as in the oogonia. This may be compared to the first maturation-division in the male germ-cells or in the winter ova. But in the parthenogenetic ova there is no mechanism for transporting the dissociated chromosomes in opposite directions. The single maturation mitosis which is realized in these ova corresponds to the ordinary second maturation-division and not to the first. J. A. T.

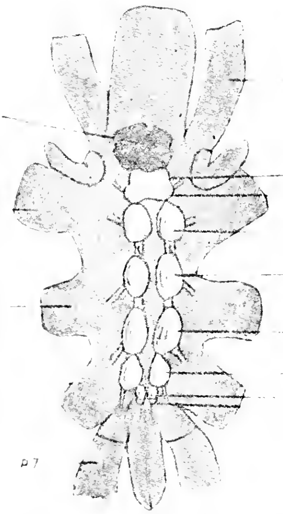
Aphids of the Rose and other Plants.—EDITH M. PATCH (*Bull. Maine Agric. Station*, 1919, **282**, 205–48). For many years after Linnæus gave "the" rose aphid the specific name of *rosæ*, this term proved sufficiently elastic to embrace all the large green and pink aphids found upon this host. Just how many of these there may prove to be when the subject has been more thoroughly studied it is still too soon to say. But it is certain that there are at least three species of *Macrosiphum* common on the rose in Maine, and that each of these has pink and green varieties. The three are *M. rosæ* proper, which does not migrate; *M. solanifolii*, which migrates to the potato; and *M. pseudorosæ* sp. n., which migrates to ragworts. Eleven more new species of *Macrosiphum* are described, and a key to forty eastern American species is given. There is also a continuation of the food-plant catalogue of the Aphididæ of the world, extending from the dogwood to the nightshade family. J. A. T.

Formosan Termites.—MASAMITSU OSHIMA (*Philippine Journ. Sci.*, 1919, **15**, 319–83, 13 pls., 5 figs.). In Formosa there are three termites which injure wooden structures: *Leucotermes flaviceps*, *Coptotermes formosanus*, and *Odontotermes formosanus*. A pair of mature individuals of *Coptotermes* is able to start a new colony: in a newly established colony, egg-laying begins 5–13 days after swarming; an individual lays 1–4 eggs a day; the eggs hatch in 24–32 days; the soldier develops from the egg laid by the queen; this species attacks lime mortar, but its principal food is cellulose. The termite-proof concrete layer is entirely satisfactory in preventing the entrance of termites from the ground; teak and cypress pine are immune; the resistance of timber is not due to hardness or weight, nor to the inorganic compounds in it, but to organic compounds which can be extracted by benzine or alcohol—namely, sequiterpene alcohol. As camphor green oil contains 25 p.c. of sequiterpene alcohol it is entirely satisfactory as a preventive for buildings. The anthracene oil fractionated from coal tar is effective in preventing the damage of *Odontotermes formosanus*. J. A. T.

δ. Arachnida.

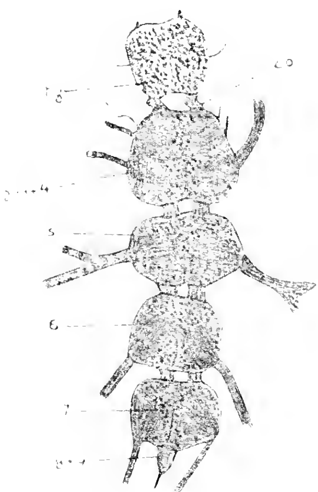
Sensory Setæ of Arachnids.—FRIEDERICH DAHL (*Zool. Anzeig.*, 1920, **51**, 215–9). Stiff tactile setæ, innervated at their base, issuing through fine pores in the cuticle, occur in all Arachnids. Thicker, firmly imbedded, spine-like structures, without a nerve at their root, are probably protective. The fine hairs of *Argyroneta* prevent the animal being wetted. But there is another type of seta, delicate and very mobile, always arising from a pit. They are peculiar to Arachnids. They move at a breath; they vibrate at a sound. They sometimes occur in regular lines. Dahl called them "auditory setæ" in 1883; Kræpelin used the term "trichobothria." Dahl regards them as percipient of sounds. J. A. T.

Structure of Pantopoda.—J. C. C. LOMAN (*Tijdschr. Nederland. Dierk. Ver.*, 1917, **16**, 53–102, 1 pl., 24 figs.). Much assistance in investigation was obtained by feeding *Phoxichilidium femoratum* and *Nymphon rubrum* on *Tubularia* heads which had been coloured with neutral red (a chemical union, unlike colouring with methylene-blue, which is physical). There are usually two kinds of corpuscles in the colourless blood—so-called "hæmocratera" and leucocytes. The larvæ,



Nervous system of very young larva of *Phoxichilidium*; *h.g.*, cerebral ganglion; *p* 1–*p* 7, appendages; 2–9, ganglia.

Nervous system of full-grown larva.



Nervous system of adult male; *co.*, commissure.

like the adults, are keen parasites on hydroids and the like, using their proboscis in ingestion. A description is given of ovary, nervous system, and larval appendages. Marked shortening of the trunk of the body is associated with marked concentration of the nervous system, which may show a fusion of the second and third ganglia with the fourth. The author holds the view that Pantopods are nearer to Crustaceans than to Arachnids, and that Pantopods and Crustaceans have diverged from an Annelid stock. J. A. T.

ε. Crustacea.

Respiratory Organs of a West Indian Land Crab.—C. C. Nutting (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 350–1). In *Ucides caudatus*, found at Antigua in a mangrove swamp, partly aquatic and partly terrestrial in habit, the branchial chamber is divided into an upper pulmonary portion and a lower branchial portion, the two separated by a shelf attached to the branchiostegite. Three brush-like flagella attached to the maxillipedes serve to moisten the edges of the gills. The upper chamber is lined by a highly vascular membrane with villi. On the body-wall proper, projecting into the pulmonary chamber, there is a large turgid S-shaped body (perhaps a big blood sinus) and a number of enigmatical rigid capitate rods. This type seems to be midway between Gecarcinus and Birgus. J. A. T.

Permeability of the Gut in Crayfish and Snail.—H. J. Jordan and H. J. Lam (*Tijdschr. Nederland. Dierk. Ver.*, 1918, **16**, 281–92). In *Astacus* there is a semi-permeable membrane lining the intestine; in *Helix pomatia* there is diffusion of salts and sugar in accordance with the laws of osmosis. A gut may show (1) pure osmosis, (2) diosmosis or diffusion, and (3) absorption. The last depends on cellular activity. The absorbed material is found in vacuoles in the absorbing cells. So far as is known they are never the same as the substances to which they are changed by digestion. Foodstuffs are removed from the lumen of the gut into the wall of the intestine, but not from the body cavity into the gut. In the snail the special absorbing area is the mid-gut gland. Glucose produced elsewhere by digestion may pass into other parts of the gut-wall, but this is not true absorption. In the mid-gut gland of *Astacus* there is also true absorption. J. A. T.

Studies on Oniscoidea.—Karl W. Verhoeff (*Zoolog. Anzeiger*, 1920, **51**, 169–89). The term larva may be applied to the stages between the throwing off of the embryonic sheath (long before the end of the marsupial period) and the complete differentiation of the principal parts of the seventh pair of legs and the first pleopod. It is probable that all Oniscoidea have three larval stages. There is considerable diversity among species and considerable variety within a species (e.g. *Porcellio scaber*) as regards the length of the embryonic development and larval stages. The brood-chamber or marsupium is made by five pairs of brood-plates or ovostegites which arise near the base of the first five legs. It has a mechanically protective function, but it admits of a large brood, it allows the brood to get advantage of the respiratory current, and it prevents desiccation. It has very slight nutritive significance. The cotyledons are evaginations of the delicate opercular covering of the brood-sac and assist in the respiration. A marsupium is formed for each brood, and some species have three broods in a year. A young form must live for at least a winter before it is mature. The two pairs of accessory hepatic tubes have in terrestrial Isopods a primary function as stores for the yolk left over from the embryonic period. An account is given of the development of monostigmatic and polystigmatic tracheal systems. We cannot do more than indicate the scope of a paper rich in detailed results. J. A. T.

Studies in Asellidæ.—E. G. Racovitza (*Arch. Zool. Exper.*, 1920, **58**, *Notes et Revue*, 79–115, figs. 52–84). A study of the North American species *Asellus communis*, which shows a strange combination of highly specialized and very primitive characters. Likewise a study of the structure and development of the first and second pleopods of Asellidæ, which have come into the service of reproduction. The first pleopod of the male is reduced to two undivided joints, a sympodite and an exopodite. It is absent in the female. The second pleopod of the male consists of an undivided sympodite, a slightly modified biarticulate exopodite, and a biarticulate or undivided endopodite transformed into a copulatory organ. In the female it is an unjointed fusion of sympodite and exopodite. J. A. T.

Early Development of Rock-barnacle.—H. C. Delsman (*Tijdschr. Nederland. Dierk. Ver.*, 1917, **15**, 419–520, 15 pls., 8 figs.). The ovum of *Balanus balanoides* is among the largest of Cirripede ova; it is the richest in yolk; its segmentation is mainly unequal. From the fertilized ovum four yolkless micromeres are constricted off, marking the separation of ectoderm and endoderm. Then follows the division of the yolk-containing macromere into two approximately equal cells. At the sixth cleavage each of the two yolk-cells gives off a small yolkless cell, a mesoblast. Further divisions of the yolk-cells lead to the primordium of the mid-gut. The four micromeres form a cap growing round the yolk-cell or yolk-cells. Their divisions are equal. Gastrulation is epibolic, the micromeres growing round the endoderm. The blastopore is diametrically opposite the animal pole. At the completion of the epibole there are two yolk-cells. Most of the mesoblast arises from ectodermic micromeres at the margin of the blastopore; the entomesoblast has been already referred to. A remarkable feature is the origin of the proctodæum from the distal end of the stomodæal invagination. The number of chromosomes in the somatic cells is thirty-two. J. A. T.

Appendage of Sex-intergrade of Daphnia longispina.—A. M. Banta and Mary Gover (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 348–9). Every detail of the first leg which is subject to sexual modification is also subject to intermediate development. Any portion may show any condition from a slight departure from the type of the normal female to an approximation to the typical male. The different portions of the same individual appendage may show a range from fully female to moderately male in character, or from an intermediate condition to a fully male condition. There is, however, a certain amount of correlation between the degree of maleness and femaleness manifest in the different portions of the same appendage. J. A. T.

Egg-envelope in Centropages hamatus.—WERNER BUSCH (*Zool. Anzeig.*, 1920, **51**, 201–5, 5 figs.). In this Copepod the typical ovum (*Ovum hispidum*) shows a number of spine-like hollow processes of the envelope, very variable in number and shape. The fresh-laid ovum is spherical, and shows a delicate and transient plasmic membrane. Within this the cytoplasm of the egg forms by retraction and secretion the definitive envelope with its processes. The sea-water is the liberating stimulus. J. A. T.

New Species of Clavella on Cod.—W. HAROLD LEIGH-SHARPE (*Journ. Marine Biol. Assoc.*, 1920, **12**, 332–8, 9 figs.). The author bases a new species, *Clavella iadda*, on specimens of a parasitic Copepod collected by Michael G. L. Perkins from cods. Compared with *C. sciatherica*, the body is less globose, longer than wide; the ovisacs are tapering; there is a posterior trilobate genital process (as in *C. irina* Wilson, but less pronounced); the cephalothorax is comparatively short, little curved, and in line with the second maxillæ; the bulla is widest at the apex of the sphere, not at the base as in *C. sciatherica*; and there is a slight difference in the mandibles. The ducts and apertures of the renal excretory organs can be made out with great clearness on the base of the second maxillæ. A provisional key to the species of *Clavella* is submitted. J. A. T.

Cambrian Trilobites.—R. ETHERIDGE, JUN. (*Trans. Proc. R. Soc. S. Australia*, 1919, **43**, 373–93, 2 pls.). An attempt to put in order the remains of Cambrian Trilobites. There is seldom more than a portion of a cephalon or pygidium preserved. In addition to the minute *Agnostus elkedraensis* there is perhaps only one well-preserved form, that known as *Ptychoparia alroiensis*. J. A. T.

Annulata.

Early Development of Scoloplos armiger. — H. C. DELSMAN (*Tijdschr. Nederland. Dierk. Ver.*, 1916, **14**, 383–498, 6 pls., 5 figs.). In this Polychæt the segmentation is very typical. Four quartettes are formed. The first gives rise to the apical spot and the trochoblasts. The second gives rise anteriorly to the secondary trochoblasts, a small portion of the trunk ectoderm, and the stomodæum; and posteriorly to almost the whole of the trunk ectoderm. The third gives rise anteriorly to the stomodæum and ectomesoderm, and posteriorly to the ventral ectoderm (neurotroch) and more ectomesoderm. The fourth quartette gives rise anteriorly to the endoderm and posteriorly to the entomesoderm. The other macromeres form the endoderm. Although the egg is one of the largest Polychæt eggs as yet studied, there is not very abundant yolk. The endomeres are relatively small. The process of gastrulation is neither epibole nor embole, but it is nearer the latter. There is a somewhat irregular inward-gliding of endomeres, which arrange themselves to line the lumen. The early primordium of the larval pharynx is like that of the radula-sac in Molluscs. The anus is late of appearance and has no relation to the blastopore. There is a suppression of the free-swimming trochophore stage; what hatches out is a miniature worm. J. A. T.

Tropisms of Earthworm.—L. H. Bittner, G. R. Johnson, H. B. Torrey (*Journ. Animal Behaviour*, 1915, **5**, 61–5). Tropism hypotheses agree in excluding the conception of orientation by trial reactions. Fundamental to all of them is the conception of orientation by means of movements that, with reference to a given source of stimulation, are *predictable* as to direction. The conception of the "method of trial" has been used to supplement tropism theories. Experiments with earthworms have shown that photic stimulation, far from inducing random movements, immediately calls forth reactions in a definitely predictable direction. Like the sow-bug (*Porcellio*) the earthworm must be placed in that group of organisms whose orientation to light is determined essentially by movements that are predictable as to direction, and hence neither random movements nor "trials." J. A. T.

Nematohelminthes.

Nematodes of Clean Earth.—J. G. de Man (*Tijdschr. Nederland. Dierk. Ver.*, 1917, **16**, 103–19). An account of a collection of fifteen species from clean earth at Atna in Norway. The total list of Nematodes from similar habitats in Norway is now twenty-eight; the new collection includes *Dorylaimus consobrinus* sp. n. J. A. T.

Free-living Nematodes from Mountain Lakes of Peru.—G. Steiner (*Revue Suisse Zool.*, 1920, **28**, 11–44, 22 figs.). From lakes Huaron and Naticocha, at a height of 5140 metres above sea-level, a collection of free-living Nematodes was made, including *Plectus naticochensis* sp. n., *Monohystera* (*Monohystrella*) *godeti* sp. n., *Aphelenchus naticochensis* sp. n., *Dorylaimus incæ* sp. n., and eleven other forms, all of which are described. J. A. T.

Habronema in Horses.—Lionel B. Bull (*Trans. Proc. R. Soc. S. Australia*, 1919, **43**, 85–141, 3 pls.). A granulomatous condition found most frequently affecting the external mucous membranes of the horse in Southern Australia is due to the presence of the larval stages of three species of *Habronema*, a genus of Nematodes. The tissue reaction following the introduction of the larva gives rise to a characteristic tumour. The larvæ are only to be found in lesions up to three weeks' duration. Evidence suggests that they are deposited on moist surfaces by *Musca domestica*, which acts as the intermediate host of *H. muscæ* and *H. megastoma*. When deposited on the external mucous membranes the larvæ appear to be capable of pushing their way through the membrane and of entering the submucosa. On other parts the larvæ suffer desiccation unless there is some exudation of blood or serum, such as may be produced by biting flies like *Stomoxys calcitrans*. It appears that *H. megastoma* is chiefly responsible for the infection. "Swamp cancer" is a similar granuloma which may be due to *H. microstoma* possibly introduced by *Stomoxys*. It may be that much the same is true in regard to "Leeches" in North America and "Bursattee" in India. The adult Nematodes occur in the stomach, and it is important to get them expelled and to get rid of loose horse-dung. J. A. T.

Hereditary Resistance to Heterodera schachtii.—H. NILSSON-EHLE (*Hereditas*, 1920, **1**, 1–34, 4 figs.). The first article in this new journal of genetics, published by the Mendelian Society of Lund, deals with resistance to this eel-worm. In contrast to what is true in other cereals there are among barleys striking variations in resistance to *Heterodera schachtii*, for which some kinds are susceptible, others quite immune. Both states are heritable. The quality of immunity behaves as a dominant unit character: there is typical segregation in the second and third filial generations. The quality of immunity can be combined with other qualities in the usual Mendelian fashion. Even infected plants of barley are not greatly damaged, but it is very different with oats and wheat. Therefore the cultivation of susceptible barleys is to be avoided, since it implies fostering the Nematodes in the soil, and thus lessening of the yield of oats and wheat afterwards sown in the same ground. Several of the best barleys of South Sweden are susceptible. It is practicable by crossing to attach to the good qualities of these kinds the quality of immunity, replacing that of susceptibility. Thus barleys may be grown which will favour the yield in other cereals. J. A. T.

Important Nematode Parasite of Chickens.—JAMES E. ACKERT (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 331–2). A study of the development of *Ascaridia perspicillum*, which matures in the small intestine of chickens. The female may contain 1200 eggs. These develop in the intestine, showing larvæ in nine days. Eggs containing larvæ give rise to free motile larvæ in twenty-eight hours or so if they are ingested. After three days' sojourn in the chick's intestine the larvæ have doubled their length. J. A. T.

Observations on Gordius.—G. W. MÜLLER (*Zool. Anzeig.*, 1920, **51**, 225–9). In small pools which dry up in summer large numbers of *Parachordodes tolosanus* were found, sometimes seventy coiled together. Most came from a Carabid beetle, *Pterostichus niger*; some from *Nebria picicornis*, also a Carabid. The larvæ may survive the winter in damp mud, and the same may be true of late-laid eggs. It does not seem to be true of adults. Larvæ occur in larvæ of *Dytiscus* which are probably infected directly. Larvæ (probably of *Parachordodes*) were also found in an Enchytræid (*Fridericia*), and there were *Gordius*-larvæ in larvæ of Limnobiidæ (*Pedicia rivosa* and *Dicranota* sp.), which may feed on *Fridericia*. But no pupæ or adults were found in the adult Limnobiidæ. The author's general view is that the whole development may take place simply without an intermediate host before the definitive beetle-host is reached. J. A. T.

Structure and Development of Gordius robusta.—H. G. MAY (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 332–3). There is no complicated metamorphosis in this parasite of Locustidæ, but the larval cuticle and the hooks of the proboscis are shed at the end of the parasitic period. The adult cuticle is formed from differentiated parts of the hypoderm cells; the bristles are part of the fibrous cuticle. The intestine is never open anteriorly. Muscles and parenchyma arise from mesenchyme cells; the parenchyme cells form a solid mass filling nearly every space in the body. The nerve cord is derived from two rows of cells in the larva which enlarge and pass inward; the brain is derived from a ring of cells in the base of the proboscis. The gonads appear as two rows of cells dorsal to the intestine, and grow into solid strands not covered by epithelium. J. A. T.

Structure and Development of Paragordius varius.—G. H. MAY (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 335). The development of this parasite of crickets is like that of *Gordius robustus* in essential features. The bristles are derived from the homogeneous layer of the adult cuticle, not from the fibrous layer. There is an opening from the anterior end of the intestine to the anterior end of the body when the larval cuticle is shed. The ovaries are surrounded by parenchyma, and double mesenchyme mesenteries are formed, which are quite absent in *Gordius robustus*. J. A. T.

Life-cycle of Acanthocephala.—H. J. VAN CLEAVE (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 330). In the stomachs of white-fish heavily infested with *Echinorhynchus coregoni* there were Amphipods (*Pontoporeia* sp.) which contained larvæ of *E. coregoni*. In a species of *Hyalella* there were larvæ of *E. thecatus*, and young small-mouthed black bass fed on infected *Hyalella* developed a heavy infestation of *E. thecatus*. There is probably an intermediate Vertebrate host between *Hyalella* and the definitive fish-host. J. A. T.

Intestinal Parasites in One Hundred Sick Filipino Children.—FRANK G. HAUGHWOUT and FÉ S. HORRILLENO (*Philippine Journ. Sci.*, 1920, **16**, 1–73, 1 fig.). Of the hundred children ninety-two were infected with one or more parasites. Under one year the incidence was 66·6 p.c.; between the first and second years, 73·6 p.c.; all the children between two and thirteen years were parasitized; the earliest case of parasitism was in a child of seven months. No Protozoon of proved pathogenic effects was found, but the incidence of *Spirochæta eurygyrata* (without significant consequences) was notably high (61 p.c.). Infections with *Trichuris* and *Ascaris* were serious. Hookworm occurred in 12 p.c. of the cases. No Cestodes or Trematodes were found.
J. A. T.

Platyhelminthes.

Placocephalus javanus in Siam.—TOKIO KABURAKI (*Records Indian Museum*, 1920, **19**, 39–40). This land Planarian, fairly common in the Malay Archipelago (Java, Sumatra, Singapore), is now recorded from Siam. It is protandrous and may multiply by transverse fission. J. A. T.

Notes on Japanese Triclads.—TOKIO KABURAKI (*Annot. Zool. Japon.*, 1917, **9**, 325–33). A Triclad frequenting the King-Crab, previously described as *Procerodes limuli*, is raised to the rank of a new genus, *Ectoplana*, differentiated by the spacious vestibule receiving directly the two oviducts. A description is given of *Polycelis ijimai* sp. n., and a key to Japanese marine and fresh-water Triclads. J. A. T.

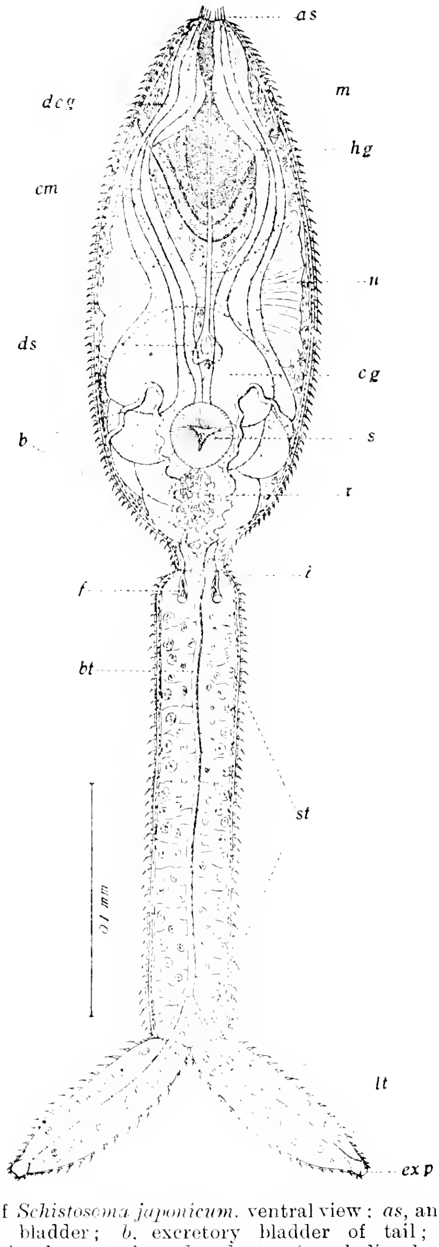
Notes on Japanese Triclads.—Tokio Kaburaki (*Annot. Zool. Japon.*, 1918, **9**, 443–9, 5 figs.). The spermatophore in *Planaria virida* is formed in the vesicula seminalis and the adjoining parts of the vas deferens impar; the capsule consists of an eosinophil substance. In various species of *Planaria* there are alternate periods of asexual multiplication by fission and sexual reproduction. A curious case of budding was observed in *Sorocelis sapporo*; the mother individual, with well-developed genital organs, bore on its left side in the pharyngeal region two branch-like buds—one an additional posterior body-part, and the other an additional anterior part. The latter was practically an entire young individual connected to the mother by the tail-end.
J. A. T.

New Japanese Polyclads.—Megumi Yeri and Tokio Kaburaki (*Annot. Zool. Japon.*, 1920, **9**, 591–8, 5 figs.). A description of *Neostylochus fulvopunctatus* g. et. sp. n., from between tide-marks at Misaki. It has an oval body, no tentacles, marginal eyes confined to the frontal region, a true seminal vesicle, a prostate gland dorsal to the seminal vesicle, a slender tubular penis, and a single large accessory vesicle on the vagina. It is intermediate between *Stylochus* and *Idioplana*. A key to Stylochid genera is given. Another new form, from the coast of Hatakejima, is *Prosthiostomum trilineatum* sp. n., very distinctive in its coloration. J. A. T.

Eyes and Orientation of Planarians.—W. H. Taliaferro (*Journ. Exper. Zool.*, 1920, **31**, 59–116, 18 figs.). The eye of *Planaria maculata* is a typical Turbellarian eye, consisting of accessory cells forming the pigment cup and the sensory cells or retinulæ. Each retinula consists of three regions—the nucleus-bearing region, the middle region and the rhabdome—which show a striking resemblance to the three regions of the vertebrate retinula—namely, the myoid, the ellipsoid, and the rhabdome. The orientation of *Planaria maculata* is negative to light, and accurate in relation to a horizontal beam of light. Orientation is, under certain conditions, direct; but trial movements are at times functional in the process of orientation. An account is given of numerous experiments bearing on this orientation to light. J. A. T.

New Trematode from Frog's Bladder.—John E. Guberlet (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 331). A brief description of *Gorgodera circava* sp. n., from the cloacal bladder of *Rana catesbiana*. The parasite occurs firmly fastened to the wall of the bladder by the ventral sucker, which is surrounded by a distinct circular sheath. The gonads are described. J. A. T.

Life-history of Gape-worm.—B. H. Ransom (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 330–1). Out of 679 turkeys, 22·5 p.c. were infected with *Syngamus trachealis*; out of 635 chickens from the same market none harboured the parasite. Full-grown chickens are very resistant. Infection may persist in the soil for a long time; eggs and larvæ were kept alive in most media for over eight months at a temperature of about 50° F. When eggs containing larvæ were fed to



Cercaria of *Schistosoma japonicum*, ventral view: *as*, anterior spines; *b*, excretory bladder; *b*, excretory bladder of tail; *cg*, cephalic glands; *cm*, circular muscles; *dcg*, ducts of cephalic glands; *ds*, digestive system; *exp*, excretory pore; *f*, flame cell; *hg*, head gland; *i*, island in excretory bladder; *lt*, lobe of the tail; *m*, mouth; *n*, nervous system; *st*, stem of tail; *s*, ventral sucker.

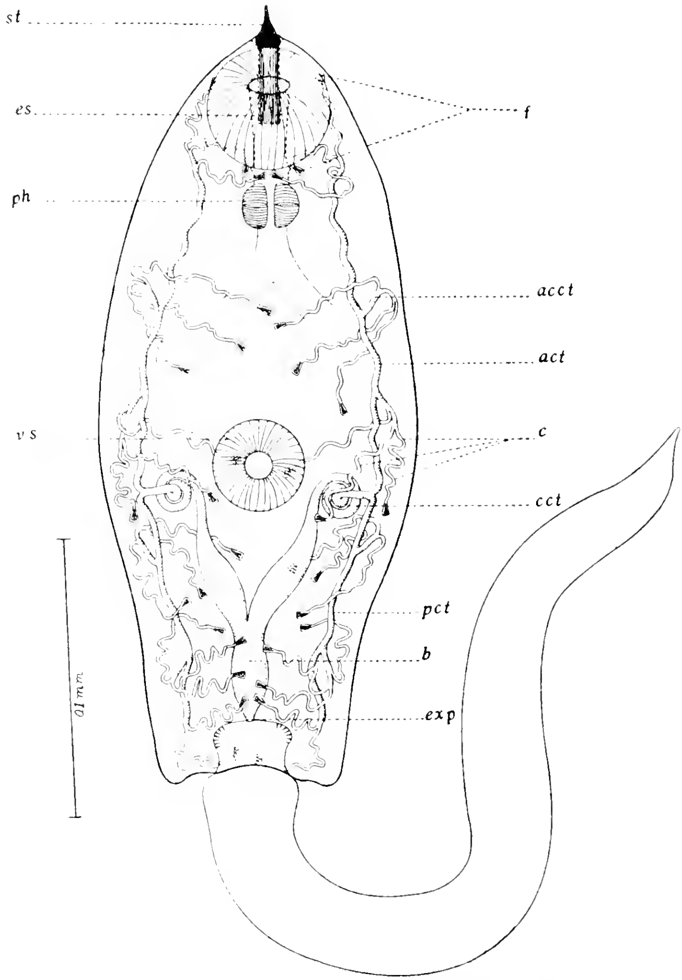
young chickens the young worms were found in the lungs within a week. The two sexes are coupled while still very small (2·25 mm. in length). The females were mature in the trachea (15 mm. long) two weeks after the eggs from which they developed were swallowed.

J. A. T.

Leucochloridium problematicum.—T. B. Magath (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 333–4). This is a new species of a remarkable genus, found in *Planorbis trivolvis* and *Succinea retusa* in Iowa. The sporocysts are 1·4 cm. long and 0·33 cm. wide, pointed at both ends, markedly different from those of the European *L. macrostomum*. The mature sporocyst projects from the tentacle of the snail and is connected to immature ones in the liver. Inside a sporocyst are about one hundred larvæ, 2·2 mm. in length, with oral and ventral suckers. An interesting feature is that Laurer's canal opens into the excretory duct near the excretory pore. J. A. T.

Cercaria of Japanese Blood Fluke.—William W. Cort (*Univ. California Publications, Zoology*, 1919, **18**, 485–507, 3 figs.). The cercariæ of *Schistosoma japonicum* Katsurada are very variable in length, according to the degree of extension. The body may be 0·9 to 0·21 mm. The whole surface of the body and the tail is covered with backward-pointing cuticular spines. Beneath the delicate cuticula are outer circular and inner longitudinal layers of muscles, and inside these a very thin layer of parenchymatous tissue enswathing the organs. The tail is an effective muscular organ, readily lost when the cercaria begins to penetrate into its host. A description is given of the excretory system, of the bilobed central nervous system, of the very rudimentary digestive system, of the oral sucker and cephalic glands. When freed from the sporocyst the cercaria swims in the water for a short time, vibrating both the body and the tail. If it touches a surface it immediately adheres and starts a looping movement—an alternate taking hold and loosening of the ventral sucker and the anterior tip. It butts with the spines at the tip and produces a slight opening in tissue. The cephalic glands appear to have a cytolytic action. In short the larvæ is well adapted to penetrate the skin of its definitive host. As is well known it enters the skin of men working in the rice-fields. J. A. T.

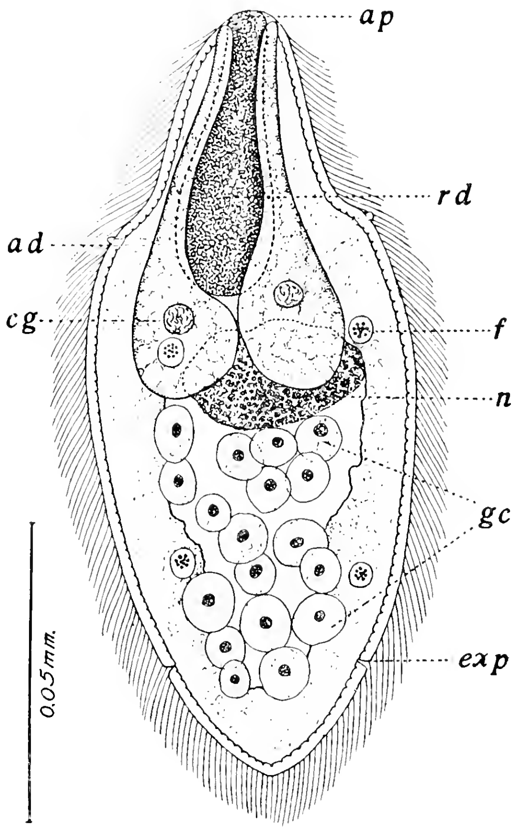
Excretory System of a Stylet Cercaria.—William W. Cort (*Univ. California Publications, Zoology*, 1919, **19**, 275–81, 1 fig.). An account of the excretory system of *Cercaria polyadena* Cort from various species of *Lymnæa*. The method of division of the capillary groups supports the hypothesis that each capillary group is formed in the development of the system by longitudinal divisions of a single flame cell. According to this hypothesis an excretory system of the fully developed *Cercaria polyadena* passed through a stage in which it was composed only of the bladder, the common collecting tubes, and the anterior and posterior collecting tubes, each of which received three capillaries from three flame cells, making a total of twelve flame cells. The capillaries of these flame cells would correspond to the accessory collecting tubes of the fully developed system. In further development each of these flame cells with its capillary first divided into two flame cells and capillaries, one going to the dorsal and the other to the ventral



The excretory system of *Cercaria polyadena*, ventral view; body spines, stylet, and cystogenous glands are not shown; *acct*, accessory collecting tube; *act*, anterior collecting tube; *b*, bladder; *c*, capillary; *cct*, common collecting tube; *exp*, excretory pore; *f*, flame cell; *os*, oral sucker; *pct*, posterior collecting tube; *ph*, pharynx; *st*, stylet; *vs*, ventral sucker.

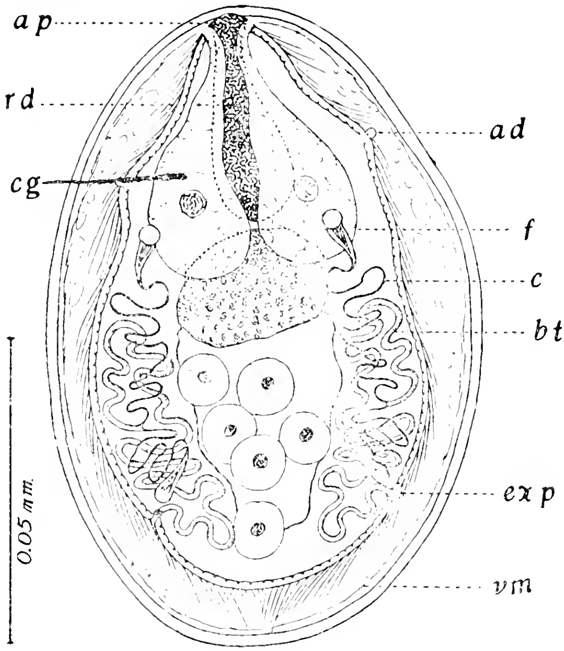
side of the body. One of these two flame cells again divided, making the groups of three found in the fully developed system in which the common collecting tubes, entering the horns of the bladder, receive twelve accessory collecting tubes, each joined by a group of three capillaries—the "2 by 6 by 3" type. The light thrown on affinities by the excretory system is discussed. J. A. T.

Eggs and Miracidia of Human Schistosomes.—WILLIAM W. CORT (*Univ. California Publications, Zoology*, 1919, **18**, 509–519. 7 figs.). In *Schistosoma mansoni* the position of the miracidium within



Miracidium of *S. mansoni*, from glandular surface; *ad*, anterior ducts; *ap*, anterior papilla; *cg*, cephalic gland; *exp*, excretory pore; *f*, flame cell; *gc*, germ cell; *n*, central nervous mass; *rd*, rudimentary digestive sac.

the egg may be either with the anterior papilla toward the spine or away from the spine. The shell is very tough and resistant. When liberated the miracidium swims actively, rotating on its long axis. Penetration into the intermediate host may be facilitated by the secretions of the large unicellular cephalic glands. These may dissolve the tissue or neutralize the secretions of the host. The central nervous system is an oval, slightly irregular mass lying about the centre of the body: it was called a viscus or stomach by Holcomb. The excretory pores are located on each side of the body near the posterior end. Four large flame cells are present. In cross-section the larva is round, but the cephalic glands lie nearer one surface of the body, while the central nervous body and rudimentary digestive sac lie nearer the other. These surfaces may be called respectively glandular and neural. The egg and miracidium of *S. japonicum* are smaller than those of *S. mansoni* or *S. hæmatobium*. The spine may be absent in as many as 50 p.c.



Miracidium of *S. japonicum* within the egg, from glandular surface: *ap*, anterior papilla; *rd*, rudimentary digestive sac; *ad*, anterior duct: *cg*, cephalic gland; *f*, flame cell; *c*, capillary from flame cell; *bt*, bladder tubule; *exp*, excretory pore; *vm*, vitelline membrane. Five germ cells are shown.

of specimens of eggs from one and the same case of Japanese schistosomiasis. The egg-shell begins to swell soon after the egg is placed in water, and it bursts by splitting because of the swelling. The freed miracidium differs in many details, e.g. the proportionately smaller cephalic glands, from that of *S. mansoni*. Some good figures are given. J. A. T.

Development of Digenic Trematodes and the Continuity of the Germ Plasm.—L. Kathariner (*Zool. Anzeig.*, 1920, 5 . 220–3). From the fertilized ovum is formed the somatic tissue of the miracidium and the undifferentiated germ cells found in the interior. In the sporocyst some of the germ cells form another sporocyst generation: others remain as germ cells; and some of them give rise to rediæ. There is no parthenogenetic development of ova arising from somatic cells: there is a continuity of the germ cells, all descended from the fertilized egg cell. This view has been corroborated in a recent paper by Dolleus (1919). J. A. T.

Incertæ Sedis.

Larval Colonies of Pectinatella.—STEPHEN R. WILLIAMS (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 339). Balloon-shaped, ciliated, larval colonies are set free from the gelatinous mass of the adult, and after swimming about for a time, attach themselves by mucous secretions to any convenient surface, especially one facing downwards. In laboratory conditions, through defective nutritive conditions, the young colonies, which have on an average four polyps, degenerate successively to three and two polyps, and then to one. When the rest have gone the mucous attachment of the survivor elongates: the polyp drops off and dies. J. A. T.

Echinoderma.

Regeneration of Arms in Asterina gibbosa.—GIUSEPPE ZIRPOLO (*Boll. Soc. Nat. Napoli*, 1915, **28**, 119–20). There is in this starfish a ready regeneration of excised arms—even when all the five arms are removed. There is a slight decrease in the regenerative capacity as the number of arms to be regrown increases. The rapidity of the regeneration varies, e.g. with size: it is greater in spring than in winter (as 0·03 per day in spring to 0·01 per day in winter). J. A. T.

Abnormalities in Arms of Asterina gibbosa.—GIUSEPPE ZIRPOLO (*Boll. Soc. Nat. Napoli*, 1916, **29**, 3–16, 2 pls.). The occurrence of abnormalities in the arms of this starfish is frequent. Thus there may be four arms or six. The bifurcation of an arm is recorded. The number of madreporic plates is variable. A supernumerary arm is usually normal in structure. Fine photographs are given. J. A. T.

Anomalous Specimens of Asterina gibbosa.—GIUSEPPE ZIRPOLO (*Boll. Soc. Nat. Napoli*, 1919, **32**, 63–70). Records of three specimens with four arms and four with six arms. Full details are given in regard to the madreporic plate, the mouth plates, and the evidences of regeneration. J. A. T.

Anomalous Starfishes.—GIUSEPPE ZIRPOLO (*Boll. Soc. Nat. Napoli*, 1916, **29**, 49–58, 1 pl., 3 figs.). Records and figures of a specimen of *Chætaster longipes* with four arms, of another with one of the five arms deeply bifurcate, and of a specimen of *Hacelia attenuata* with four very regular and symmetrical arms, without any trace of lesion or cicatrix. J. A. T.

Abnormalities in Starfishes.—GIUSEPPE ZIRPOLO (*Boll. Soc. Nat. Napoli*, 1917, **30**, 20–29, 4 figs.). In *Echinaster sepositus* Gray there is very frequently some abnormality in the arms. Thus there may be six or one may be bifurcated. Figures of these are given. In *Asterias glacialis* O. F. Müller variations in the number of arms are much less frequent. Some abnormalities show excess, e.g. six arms, and some show defect, e.g. four arms. The abnormality is sometimes due to a regenerative process; thus the bifurcation of an arm in consequence of some longitudinal lesion may result in six arms. J. A. T.

Three Madreporic Plates in Astropecten aurantiacus.—GIUSEPPE ZIRPOLO (*Boll. Soc. Nat. Napoli*, 1919, **32**, 71–6, 1 fig.) Three quite distinct madreporic plates were found in a specimen of this starfish, a large one and two smaller ones. They communicated independently with the stone canal. J. A. T.

Partial Regeneration in Astropecten aurantiacus.—GIUSEPPE ZIRPOLO (*Publ. Stazione Zool. Napoli*, 1918, **2**, 169–75, 1 pl., 2 figs.). A case in which the loss of two arms has been followed by the growth of a small one at one spot and a mere cicatrix at another. In this way forms with four arms may arise. J. A. T.

Anomalous Forms of Astropecten aurantiacus. — GIUSEPPE ZIRPOLO (*Boll. Soc. Nat. Napoli*, 1918, **31**, 100–9, 8 figs.). Instances of three, four, and six arms. The three-armed form is due to the loss of two arms and the absence of regeneration. The four-armed forms are due (*a*) to the loss of one arm and the absence of regeneration; (*b*) to the loss of one arm and the regeneration of one only; and (*c*) to the loss of three arms and the regeneration of two only. The six-armed form is probably the outcome of hyper-regeneration. When the lesion does not affect a large part of the region of the disc, there may be a regeneration of either one arm or of two. J. A. T.

Regeneration of Arms in Sea-urchin.—GIUSEPPE ZIRPOLO (*Boll. Soc. Nat. Napoli*, 1919, **32**, 45–50, 1 fig.). A record of a specimen of *Sphærechinus granularis* in which a deep depression in the test near the aboral pole shows a distinct zone of regenerated plates. J. A. T.

Cœlentera.

New Species of Hydra.—ED. BOECKER (*Zool. Anzeig.*, 1920, **51**, 250–6, 1 fig.). It has been proposed by P. Schulze to divide the genus Hydra into *Clorohydra* Sch., *Hydra* L. s. str., and *Pelmatohydra* Sch. In the genus *Hydra* s. str. six species have been recognized differing in their cnidoblasts, habit, sex-condition, shape of testes and embryotheca. The author describes a new form, *H. ovata* sp. n., the term referring to the shape of the larger adhesive cnidoblasts (large glutinants or streptolines). It comes nearest to Schulze's *H. stellata*. J. A. T.

Porifera.

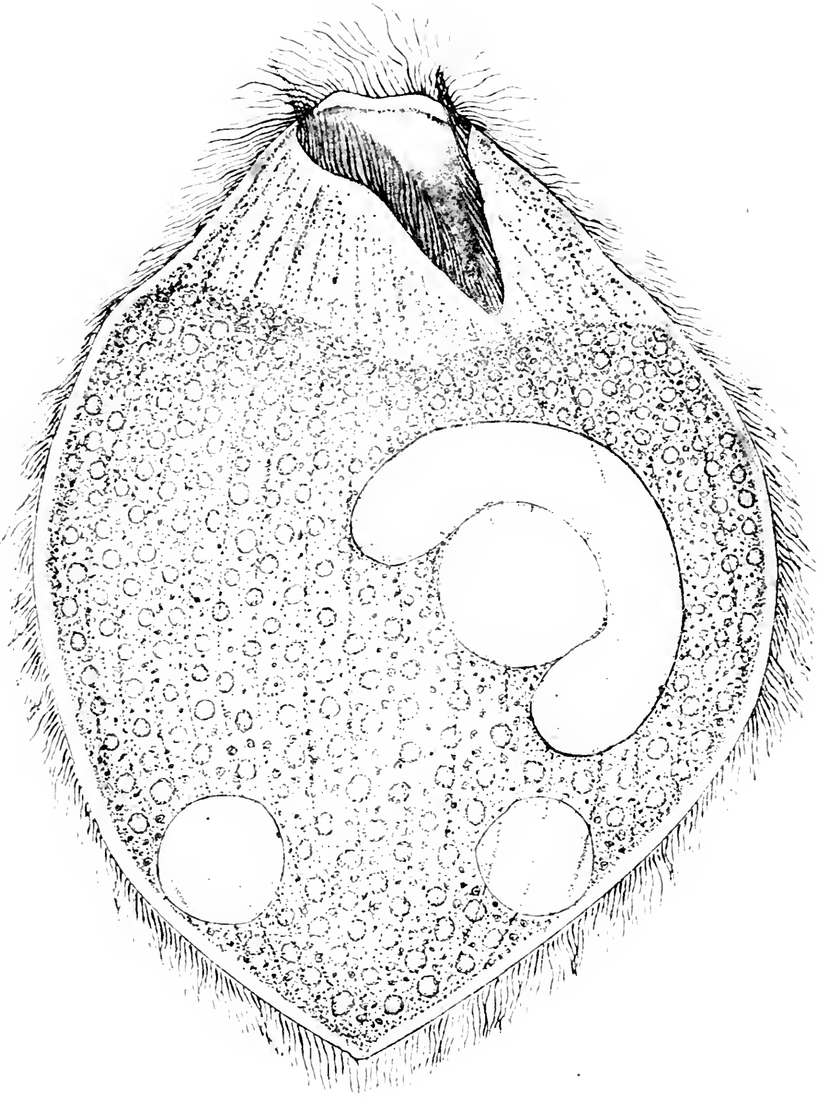
Species and Sponges.—H. V. Wilson (*The Scientific Monthly*, 1919, 349–57). Racial features often vary up and down, apparently in response to the environment, in such a way as is possible only to easily alterable species-plasms. One comes to symbolize the latter after the fashion of chemistry as complexes of atoms, molecules, and radicals. Thus we may think of radicals which lose or gain atoms or simple molecules in response to environmental (external or internal) conditions. The radical thus varies up or down, and with it the features of the resulting organism. The graded series met with in sponges are equally describable in the language of the gene theory. It may be that the visible material particles (chromatin masses) with which "characters" are associated are not determinants but differentiations—as indeed the first conspicuous differentiations that are made by the idioplasm in the course of the chains of events which lead to the appearance of particular characters. Close series of species are in a measure phylogenetic, but in some cases the terms of the series represent only different degrees in the response to the environmental stimuli, which related idioplasms have carried out independently of one another. J. A. T.

Genera in Sponges.—H. V. Wilson (*Journ. Elisha Mitchell Sci. Soc.*, 1919, 15–19). A discussion of the genus *Tetilla*, and a plea for the recognition of large heterogeneous genera (groups built up round a type embodying a certain combination of well-marked features or characters) with included groups of types forming subgenera. A middle way must be found between (*a*) combining genera so that groups are formed too heterogeneous to be of use, and (*b*) splitting up genera on the plan that each genus shall represent only a particular combination.
J. A. T.

Sponges of North Carolina.—W. C. George and H. V. Wilson (*Bull. Bureau Fisheries*, 1919, **36**, 131–9, 11 pls.). An account of seventeen sponges from Beaufort Harbour and vicinity, including *Spirastrella andrewsii* sp. n.: *Poterion atlantica* sp. n., which begins as a boring sponge and becoming free grows very large; *Suberites undulatus*, which may be massive or branched: *Tetilla laminaris* sp. n.; *Reniera tubifera* sp. n.; *Esperiopsis obliqua* sp. n., with very varied habit from incrusting to branching; *Phlœodictyon nodosum* sp. n., where the skeleton is not a reticulum of distinctly chalinine spiculo-fibres: *Phoriospongia osburnensis* sp. n., incrusting an Alcyonarian; and other new species of *Axinella*, *Acanthella*, *Aplysilla*, and *Hircinia*. An interesting form is *Pleraplysilla latens* sp. n., which occurs in the form of thin colourless incrustations on oyster shells. Its skeleton consists of simple independent fibres made of sand-grains and the like held together by a little spongin.
J. A. T.

Protozoa.

New Balantidium.—Walfrido de Leon (*Philippine Journ. Sci.*, 1919, **15**, 389–408, 1 pl., 5 figs.). An account of *Balantidium haughwouti* sp. n. from the intestinal tract of a fresh-water snail, a species of



Balantidium haughtoni sp. n. Average length, 50 μ.

Ampullaria, common in the Philippine Islands. It is a voracious organism, like a miniature balloon, moving evenly and gracefully with a slight rotary motion, but assuming varied shapes (like amœbæ) when under constraint. The most remarkable feature is the enclosure of the micronucleus within the meganucleus. Its normal position is at the concavity on one side, but it may be actually enclosed. At other times it may wander out into the cytoplasm. The actual enclosure may imply a type of nuclear division of a rather new and remarkable kind, or a process of nuclear re-organization comparable to endomixis. The anterior end of the animal is a blunted cone, excavated ventrally into a funnel, at the base of which there is the cytostome with a ciliated cytopharynx. There are two well-defined contractile vacuoles. J. A. T.

Trypanosome associated with Fatal Disease in the Carabao.—FRANK G. HAUGHWOUT and STANTON YOUNGBERG (*Philippine Journ. Sci.*, 1920, **16**, 77–87, 3 pls., 2 figs.). A male Philippine carabao, which died with severe hæmorrhage, hæmaturia and other symptoms, showed polymorphic trypanosomes which were nearer to *Trypanosoma theileri* than to other forms. A description is given of the form, which by reason of its large size and certain peculiarities in the relations of nucleus and parabasal body is well suited for cytological study. A watch must be kept for the recurrence of this trypanosome. J. A. T.

Strombidium viride.—E. PENARD (*Revue Suisse Zool.*, 1920, **28**, 1–9, 9 figs.). As in *S. mirabile* there is in *S. viride* a cuirass of very minute hexagonal plates. The peristome shows a crown of ten to eleven strong membranellæ. The cytoplasm is filled with zoochlorellæ and trichocysts which can be made to explode. There are two very minute micronuclei beneath the large spherical or ovoid macronucleus. There are no true contractile vacuoles, but there are vacuoles in connexion with an annular equatorial canal, and this canal is in relation with a special tube or canal issuing from the depth of the peristomial depression and pursuing a somewhat intricate "figure eight" course. This has to do with the formation of a new individual by a process like internal budding. This interesting Infusorian is found among plants in the clear water of ditches, but it is not common. J. A. T.

Vitality in Infusorians.—GARY N. CALKINS (*Journ. Exper. Zool.*, 1920, **31**, 287–305, 1 chart and 2 diagrams). It has been shown that *Uroleptus mobilis* after conjugation has an initial optimum vitality which gradually diminishes with age until the protoplasm finally decays from the exhaustion of metabolic activities. An analysis of seventeen series, all representing the same original protoplasm, shows that the differences between them as regards vitality are due to the age of the parents at the time of conjugation, or rather, to differences in vitality at different periods of the life-history. All series with an extremely low vitality come from parents which were in the period of old age at the time of conjugation. All series with high vitality, on the other hand, came from parents in the period of youth at the time of conjugation. So far as the experiments have gone there is no evidence that continued in-breeding has any deleterious effect on the vitality of the stock. But there is some evidence that congenital weakness due to old age conjugation is inherited by the later offspring. J. A. T.

Life-history of Sarcocystis tenella.—JOHN W. SCOTT (*Proc. Amer. Soc. Zool.* in *Anat. Record*, 1920, **17**, 332). Lambs with ewes have been reared in a screened cage, insect-free except for a few small transient gnats, and with a cement foundation preventing the ingress of mice or other animals that serve as hosts of the parasite. Nevertheless the muscles of the lambs were infected. It is probable that the life-history is a direct one, and that infection takes place by means of food recently contaminated with fresh fæces from an infected sheep or lamb. There may be a hitherto scarcely suspected, probably sexual, stage of *Sarcocystis tenella* in the intestine of the host. J. A. T.

BOTANY.

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

Including Cell-Contents.

Chondriome of Plants and Pigment-formation.—A. GUILLIERMOND (*Rev. Génér. Bot.*, 1919, **31**, 635–770, 36 pls., 36 text-figs., 1 table). The author concludes his study of the physiology of the plant-cell by an account of the chondriome, the origin of the chromoplastids, and the formation of xanthophyll and carotin-pigments. His conclusions are based upon observations of the epidermal cells of the flowers, bracts and fruits of numerous plants, but the clearest results were obtained with the flowers of *Iris germanica* and tulip. The cytoplasm appears to be a homogeneous and hyaline substance holding in suspension a chondriome composed of granular mitochondrias, rod-like bodies, and chondriocontes of various forms, all of which travel rapidly in the cytoplasmic currents towards and away from the nucleus. The chondriocontes appear to be of a semi-fluid nature, since they are continually changing their shape. In addition to the chondriome, the cytoplasm also contains small fatty or lipoid granules. The mitochondrias are the most fragile constituents of the chondriome, and respond rapidly to alterations in conditions of pressure, temperature, compression, etc. In hypotonic solutions they swell and are transformed into vacuolar structures causing the cytoplasm to have a spongy or alveolar appearance. This behaviour partly explains the difficulty of observations made upon fixed and stained material. In their morphological, physiological and histo-chemical characters the mitochondrias of plant-cells appear to be identical with those of animal-cells. The author has proved that globules of fat, starch, and pigments of xanthophyll and carotin are formed by the chondriocontes, and they themselves are ultimately transformed into chloroplasts. During cell-decay the chondriocontes are transformed into chondriomites or granular mitochondrias, but in some cases they form fatty globules, which fuse and are the final constituents of the dying cell.

These results confirm those of Fauré-Fremiet and other writers, and show that the cytoplasm is a fundamental substance, probably in the condition of a colloidal jelly, and that the chondriome is one of the most frequent elements of the cytoplasm, and plays a predominant part in elaboration of cell-contents; they likewise prove the elaborative function of the mitochondrias. The xanthophyll and carotin pigments are formed either in the chondriocontes or in the chloroplasts, or by the metamorphosis of the chloroplasts. The formation of the pigments is usually accompanied by the appearance of starch-grains and globules of fat, but there is no evidence to show that this has any direct connexion with the pigment. The latter appears in three forms: (*a*) diffuse and composed of indistinct granules, (*b*) distinctly granular, (*c*) crystalline. All the observations tend to prove that the plastids are a variety of mitochondrias which are differentiated at a very early stage and adapted to a special function. With very few exceptions the pigments are formed directly and without any previous formation of chlorophyll. Pigment-formation in plants resembles that recently noticed in certain animal-cells.

S. GREVES.

Microsporogenesis in Datura.—C. E. O'NEAL (*Bull. Torr. Bot. Club*, 1920, **47**, 231–41, 2 pls.). The author has studied the cytology of *Datura Stramonium*, with special reference to the Mendelian theory. The writer confirms Bönicke's statement that this species has twelve bivalent chromosomes, and finds that the parts of the latter which are cut from the spireme thread form twisted loops or rings, or less often assume a U-shape; from this time until the telophose of the second division they do not lose their individuality. The most striking feature of these chromosomes is their remarkable uniformity of size, but no basis can be found for any Mendelian characters which would result in the occurrence of mutants. The exact results obtained by breeders appear to be due to unusual regularity in the formation and behaviour of the chromosomes.

S. G.

Statocytes of Wheat.—T. L. PRANKERD (*Bot. Gaz.*, 1920, **70**, 148–52, 4 figs.). The statocytes of the wheat-haulm are of two types —smaller ones containing movable starch-grains, and larger ones containing a single movable crystal of calcium oxalate; both types are found at the nodes. The rate of fall of the crystal in the largest type is much greater, and the period of migration less than in the case of those statocytes containing starch-grains. The author suggests that the nodes of wheat should be regarded as sense-organs of a high degree of evolution, and that in all future studies as to the reaction of the plant to gravity this point of view should be considered.

S. G.

Structure and Development.

Vegetative.

Stem-anatomy of Dioon.—L. M. LANGDON (*Bot. Gaz.*, 1920, **70**, 110–25, 3 pls., 4 figs.). In the stem of *Dioon spinulosum* there are three types of medullary rays: (1) uniseriate rays, which are one cell in width and several cells deep; (2) multiseriate rays, which are two or more cells wide and of variable depth; (3) broad foliar rays or leaf-gaps. The fibro-vascular elements of the latter, together with those of their connexions with the secondary wood, have peculiar, irregular, scalariform tracheids, which curve down until they become inserted in the fibrous elements of the main stele. The regular pitted vessels are diverted sideways parallel to the leaf-trace. Both the scalariform and pitted vessels exhibit a marked sliding growth. Each leaf or leaf-scale has seven to nine strands, the two inner of which take a direct vertical course to the under side of the petiole; the rest pass obliquely upwards to the cortex and base of the leaf, forming two characteristic girdles. The two direct strands may also unite with two dorsal strands at the base of the petiole, so that in the older seedling and adult stem the whole of the fibro-vascular system may be reducible to the two main horizontal strands and their associated lateral traces. S. G.

Internal Stomata in Fruits.—H. F. Bergman (*Bull. Torr. Bot. Club*, 1920, **47**, 213–21, 9 figs.). The author has examined the fruits of various species of Ericaceæ, and also of *Crinum asiaticum*, *Symphoricarpos racemosus*, and *Canna* sp., and finds that stomata are present in the endocarp; the guard-cells contain chloroplasts, and the stomata are of the same type as those on the other parts of the same plants, except that they have a tendency to be misshapen. Observations carried out under different conditions of light, humidity, and temperature prove that in most cases these internal stomata remain always open, and are no longer functional, but are hereditary survivals of the leaves which have been modified to form the carpels. S. G.

Physiology.

Formation and Utilization of Fats in Germination and Maturation.—E. F. Terroine (*Ann. Sci. Nat.* (*Bot.*), 1920, **10**, No. 2, 1–63). The most striking feature in the physiology of these two inverse processes in oily fruits and seeds is the symmetry of the mechanism involved. During germination the first process in the formation of neutral fats is saponification accompanied by the production of fatty acids; in the lipogenesis which immediately precedes maturation of the fruit or seed neutral fats and free fatty acids accumulate. In germination saponification results through the agency of a lipase which is only active if sufficient water is present; in lipogenesis the same results can only be brought about if the seed or fruit is dry. In germination the formation of fat is accompanied by a regular decrease in the iodine index, thus pointing to the prior production of the less saturated fatty acids. In lipogenesis the regular increase of the iodine index indicates that the less saturated fatty acids are formed at a later stage. During germination fats are formed from carbohydrates, and the same appears to be true during lipogenesis. In germination saccharose is the first sugar formed, and the only sugar present in the ripe, resting seed is saccharose. Thus the first and final stages in the formation and utilization of fats are clear, but so far there is no evidence as to the intermediate stages, and at no stage has it been possible to detect the presence of such bye-products as glycerine. This uncertainty as to the intermediate metabolism should form a fruitful subject for future investigation. S. G.

General.

Relative Effectiveness of Cross- and Self-fertilization.—Y. Emoto (*Journ. Coll. Sci. Tokyo*, 1920, **43**, No. 4, 1–31, 4 tables, 2 pls.). A large number of plants were examined in order to ascertain the relative effects of cross- and self-fertilization upon the formation of fruit and seed. In eight species examined xenogamy produced the best results in fruit formation: in only one case—viz. in *Tritonia aurea*—was geitonogamy more effective. The same results were obtained in connexion with the size of the fruits and the number of seeds, except that in three cases longer fruits were formed on geitonogamous or autogamous plants. In most species the seeds were heaviest in xenogamitic fruits, but in *Primula sinensis* geitonogamy produced the best seeds, and in one variety of *Brassica*, in *Toona*, *Hyacinthus*, *Freesia Leichtlini*, and *Tritonia aurea*, the heaviest seeds were obtained from self-fertilized flowers. The germination of seeds from xenogamous fruits was more certain in every instance except in *T. aurea*, where geitonogamous seeds were most productive. The author therefore concludes that xenogamy is relatively of greater importance than either geitonogamy or autogamy. S. G.

CRYPTOGAMS.

Pteridophyta.

Contributions towards a Knowledge of the Anatomy of the Genus Selaginella.—J. C. TH. UPHOFF (*Annals of Botany*, 1920, **34**, 493–517, 13 figs.). An investigation of the anatomy of the root. Summing up his work, the author says that *Selaginella* is a remnant of a group of primitive vascular plants, and therefore is of great interest morphologically. Some living allies of *Selaginella* have true roots, though not very different anatomically from stems (*Lycopodium*): and some have no true roots (*Psilotum*). Generally the root is simple in construction and differs from the stem, the former lacking the lacunæ and trabeculæ of the latter. There is no important anatomical difference between aerial and terrestrial roots. The difference of the outer tissue is due to environmental circumstances. Physiologically both kinds of roots have the same characteristics in the same degree; both are negatively heliotropic. Roots with root-cap always have root-hairs, which are very rare in case of roots without a root-cap. In all species the root originates with regard to the stem exogenously; the branching is monopodial. Some species, when bruised, form small stems instead of rhizophores: these suggested to many investigators that the latter are leafless stems; but the anatomy shows that these branches have the same construction as a stem and are positively heliotropic, whereas so-called rhizophores have the construction of a root and are negatively heliotropic. The vascular system is monarch; the endodermis and pericycle are always present. The phloem shows the same arrangements as in the stem, although its elements are less abundant. The xylem is composed of one group of protoxylem and usually a well-developed metaxylem. The thick-walled tissue which follows the three layers of thin-walled cells of the periphery of the terrestrial roots apparently belongs to the hypodermis. A. GEPP.

Gall-like Formation on Antrophyum semicostatum Bl.—K. GIESENHAGEN (*Ber. Deutsch. Bot. Ges.*, 1917, **34**, 802–7: see also *Bot. Centralbl.*, 1918, **137**, 168). On the margin of a frond of

Antrophyum semicostatum occurred pockets of tissue, from each of which protruded a brown egg of some insect. As the eggs were all empty, it was not possible to determine the genus and species, nor did the material show the developing stages of the pockets. The cells of the spongy parenchyma press closely on the egg with broad surface, whereas otherwise the inner leaf-cells develop excrescences: the development of the cells is thus directly influenced by the insect egg. E. S. GEPP.

Fern-hybrid Asplenium Ruta-muraria L. × septentrionale (L.) Hoffm.: A misinterpreted plant.—S. MURBECK (*Bot. Notiser*, 1916, 257–62; see also *Bot. Centralbl.*, 1918, **138**, 69). The above hybrid is described in detail, having been often wrongly diagnosed in literature. It is recorded from Sweden (Gestrikland, Medelpad), Norway (Hardanger), and Tyrol (entrance to the Oetztal). E. S. G.

Contributions to the Flora and Plant-geography of Australia: Part I., Pteridophyta, Gymnospermæ, Monocotyledoneæ.—K. DOMIN (*Biblioth. Bot. Stuttgart*, 1915, **85**, 554, 117 figs. in text, 18 pls.: see also *Bot. Centralbl.*, 1918, **138**, 4–12). A report on the collections made by the author in Queensland and N. S. Wales in 1909 and 1910. The present part includes the Pteridophytes, treated systematically. References to literature, figures, synonyms, geographical distribution in general are given for each species, together with a complete record of its Australian distribution. Endemic species are described. The author expounds his views on the relationship of species, basing them on the large mass of material collected. Important details are included concerning the manner of life of the plants (height, frequency, substratum, epiphytic growth, etc.), and their significance for mankind. The systematic treatment is founded on the methods of Diels, Christ, and Christensen's Index. Contrary, however, to the opinion of these authors, the genus *Notholæna* is united with *Cheilanthes*. The number of new species of ferns is extraordinarily large. Eight species of Lycopodiales are recorded, with old and new varieties. E. S. G.

Remarks on Pteridophytes from Baden.—W. ZIMMERMANN (*Allg. Bot. Zeitsch.*, 1916, **22**, 32–56; see also *Bot. Centralbl.*, 1918, **138**, 26). A preliminary list of new varieties and forms, to be followed by a critical work on Baden Pteridophytes. *Aspidium Filix-mas* sub-var. *ursinum* is the name given to the German approximation-form which has arisen in our latitudes, possibly from var. *paleaceum* Moore. *Polypodium disjunctum* Rupr. is no independent species, but merely a shade-form (lus. *disjunctum*) of *A. Robertianum* Luerss. In the upper Black Forest occurs a form of *Aspidium Dryopteris* seeking shelter from too great illumination (lus. *insolatum*). *Aspidium Phegopteris* var. *acutum* has acute pinnule-margins; var. *setosum* has xerophil tendencies. A new luxuriant form, var. *pulcherrimum* of *Asplenium Trichomanes*, occurs between Oberried and St. Wilhelm; var. *dubium* of the same species is probably a cross between var. *typicum* Luerss. and var. *pachyrachis* Chr. New forms of *Equisetum* are also described.

E. S. G.

Bryophyta.

Early Stages in the Development of the Sporophyte of Sphagnum subsecundum.—Geo. S. Bryan (*American Journal of Botany*, 1920, **7**, 296–303). The young sporophytes were dissected out of the archegonium, and the following summary is given:—1. The fertilized egg divides by a horizontal wall into two approximately equal cells. A filament of cells—six or seven in number—is usually formed before longitudinal divisions occur. 2. In the material studied the first transverse wall cannot be traced with certainty in the older stages; hence no exact statement can be made as to the contribution of each of these two cells in the development of the sporophyte. 3. It is reasonably certain that apical growth occurs. 4. The basal portion of the young sporophyte may have walls appearing in a regular or in an irregular order. As a result of the former process there is developed a long, slender type of young sporophyte; as a result of the latter, a shorter, bulbous type. 5. The number of primary segments, i.e. segments formed by walls transverse to the axis of the archegonium, has not been found to exceed twelve. 6. A considerable number of very young sporophytes show basipetal disintegration. In conclusion, the early embryogeny of *Sphagnum* is nearer to that of the Jungermanniales than to that of Anthocerotales, though the endothecial origin of the sporogenous tissue in Sphagnales and Anthocerotales has been much insisted on as evidence of affinity. A. Gepp.

Segmentation of the Apical Cell and Position of the Leaves in Mosses.—E. M. Merl (*Flora*, 1917, **109**, 189–212, 13 figs.: see also *Bot. Centralbl.*, 1918, **138**, 25–6). In the twenty-seven species examined the majority showed the position of the youngest septum of the apical cell to be in an a-nodal direction. Marked exceptions are *Barbula paludosa* (in part) and *Fontinalis* (always). A principal argument against Seckt's assumption of the original "parallel" arrangement of the inner to the outer edge of the youngest segments is that in most of the mosses examined the inner edge actually intersects the other; and further, that this mode of division occurs in many mosses together with the recognized course of segmentation, which, however, encroached somewhat in an a-nodal direction. No definite connexion was found between the different stages of the encroachment of the wall and the relationship and position of the species. In the case of species showing both kinds of segmentation the type in which the inner edge does not intersect with the outer is confined to the more tender shoots. The youngest septum is already inclining in an a-nodal direction. The form of the septum which divides the apical cell from the youngest segment is not an even surface, but appears much crumpled and twisted awry. It is precisely this peculiarity of the segment edges which lends to the apical cell its usual peculiarly twisted form. Crumpling of the septa occurs also in mosses in transverse walls of rhizoids grown in the dark. The encroachment in an a-nodal direction in any segmentation layer and the whole form, so peculiarly twisted, of the segments play a large part in the leaf arrangement of mosses. The amount of the torsion would be probably governed by the same factors as in the spirotrophic growth of the growing point of *Pandanus*. Experiments were not made with regard to this point. The leaf arrangement depends on the mode of cell-division in the apex. E. S. GEPP.

Calyptra-formation on the Sporogonium of Aneura pinguis Dum. —CH. BENEDICT (*Notizbl. Kgl. Bot. Gart. Berlin-Dahlem*, 1917, **7**, 78–80; see also *Bot. Centralbl.*, 1918, **37**, 214). The record of a capsule of *Aneura pinguis* in Von Flotow's herbarium, in which the calyptra did not remain at the base of the seta, but had been carried up with the sporogonium as in mosses. This abnormality has never been recorded hitherto. E. S. G.

Bavarian Liverworts.—F. FAMILLER (*Denkschr. Kgl. Bayer. Bot. Ges.*, 1917, **13**, n.f. 7, 153–304; see also *Bot. Centralbl.*, 1918, **137**, 215). The object of this paper is to record all liverworts found up to the present in Bavaria, and where they occurred. The author includes only authentic records, after a careful personal examination of all collections. Numerous notes on the biology and ecology are interspersed among the records of species. The author divides Bavaria into six geographical areas, and shows the distribution of the species over these areas in a table. He also compares the liverworts of neighbouring countries with those of Bavaria, and shows the richness in species of the latter. E. S. G.

Hepaticæ Baumgartnerianæ Dalmaticæ.—V. SCHIFFNER (*Oesterr. bot. Zeitschr.*, 1916, **66**, 337–53, 13 figs. in text; see also *Bot. Centralbl.*, 1918, **138**, 87–8). A treatment of the liverworts of the South Dalmatian Islands. Few species occur in the wooded districts. The stems, however, of bushes in copses are covered with a luxuriance of *Cololejeunea minutissima*, and from the branches hang *Leptodon*, *Neckera*, *Usnea*, and *Frullania Tamarisci*. Few liverworts occur in the rocky districts. Eight species of *Riccia* are recorded, of which *R. crystallina* L. sub. sp. *austrigena*, from Lagosta, is a novelty. Its principal characteristics are very narrow air-spaces, pale grey-green colour; median furrow generally very distinct towards the apex of the frond-lobes; spores prickly in profile. It is possibly a good southern species. The differences between *Riccia Henriquesii* Lev. and *R. Michelii* Rad. are shown in figures. In the new variety *intermedius* of *Sphærocarpus texanus* the spores occupy a middle position between the type and *S. Michelii* Bell. The material of *Dichiton calyculatum* Schiffn. proves the justice of separating this species from *D. gallicum*. The position of *Dichiton* near *Lophozia* is certainly wrong. The Cephaloziellaceæ, a new family of Douin and Schiffner, are most nearly allied to Ptilidiaceæ. The former is distinguished from the Trigonanthaceæ Spr. principally by the totally different kind of perianth, a character on which Spruce laid most weight. One character, common to all Cephaloziellaceæ—namely, that the seta of the sporogonium is always composed of four cell-series—is found in no other group of liverworts. Rare species which occur on the South Dalmatian Islands are—*Southbya stillicidiorum*, *Lophozia turbinata*, *L. heterophylla*, *Scapania aspera*, *Marchesinia Mackayi*, *Anthoceros dichotomus*. E. S. G.

Contributions to the Moss-flora of the Pyrenees.—F. Kern (*Jahresb. Schles. Ges. Vaterl. Kultur*, 1914, 34–40; see also *Bot. Centralbl.*, 1918, **137**, 329). An historical account of bryological investigation in the Pyrenees. The species of the mountainous region are mostly the same as in Prussian Silesia. Unfortunately the Spanish side is too little known, the author recording only forty-two Bryales and ten Hepaticæ. A new species is *Grimmia pyrenaica*, a dwarf species with the habit of a *Weisia* and allied to *G. cæspiticia*.

Contributions to the Moss-flora of the Salzburg Alps.—F. Kern (*Jahresb. Schles. Ges. Vaterl. Kultur.*, 1915, 24–35; see also *Bot. Centralbl.*, 1918, **137**, 329). Many species are recorded. A new variety of *Hymenostomum tortile* var. *alpinum* is described. *Mnium Blytii* is a new record for the district. *Trichostomum Fleischeri* Bauer is regarded as belonging to *Tortella tortuosa*. E. S. G.

Thallophyta.

Algæ.

Ionic Phase of the Sea.—A. H. Church (*The New Phytologist*, **18**, 1919, 239–47). An account of the physico-chemical constitution of the sea, with special reference to the fact that the sea is the sole food-solution of the marine phytoplankton and algæ, and is the medium in which all the cytoplasmic organisms of the sea have been evolved. The generally accepted hypothesis, that living plasma originated directly from sea-water itself, is discussed. Protoplasm is non-molecular, as also is a larger proportion of sea-water. The ionic phase of the sea is one of inconceivable complexity. Colloidal cytoplasm absorbs ions, not molecules. The connexion between the ions of carbonic acid and those of water are of special biological interest, as under the influence of solar radiation they would seem to have led to the evolution of autotrophic pelagic life, by the formation of simple carbohydrates. Beyond the introduction of solar energy it is not possible to draw any sharp line between living and non-living reactions in the sea. A. Gepp.

Peridinium Güstrowiense sp. n. and its Variation Forms.—E. Lindemann (*Arch. Hydrobiol. u. Planktonk.*, 1916, **11**, 490–5; see also *Bot. Centralbl.*, 1918, **137**, 310). During an examination of the shallow waters in the neighbourhood of Güstrow, in Mecklenburg-Schwerin, the author found in a small, quiet woodland lake a new species of *Peridinium* in large quantity. It is specially interesting by reason of its series of variation forms. Three of these are described and figured: f. *typica*, f. *intercalatum*, and f. *latissime intercalatum*. Besides these there are two "form-deviations," in which an approach to *P. Willei* Huitf.-Kaas may be detected. E. S. Gepp.

Causes of a Brown Colouring of the Water in a Pond of the Experimental Fishery Station at Aneboda in South Sweden.—E. Naumann (*Intern. revue Hydrobiol. u. Hydrogr.*, 1913–14, **6**, 7–11; see also *Bot. Centralbl.*, 1918, **137**, 391–2). In the summer of 1912 this pond was coloured chocolate-brown by a fine brown detritus, partly from the moor, partly from the fragments of past plankton-maxima and the remains of undevoured fish food. In the summer of 1911 the same pond was coloured brown through a maximum development of *Trachelomonas volvocina* Ehr. Another pond showed a green colouring from *Chlamydomonas* and species of *Trachelomonas*. E. S. G.

Green Marine Plankton Alga, Meringosphæra.—A. Pascher (*Ber. Deutsch. Bot. Gesell.*, 1917, **35**, 170–5, 2 figs.; see also *Bot. Centralbl.*, 1918, **137**, 167). Investigations by the author and by Schiller confirm the author's previous conviction that *Meringosphæra* belongs to the Heterokontæ. He gives the following description:—*Meringosphæra* reproduces itself by four non-motile, endogenously formed autospores. Sometimes it forms endogenous, strongly silicated, two-shelled cysts. *Meringosphæra* is placed in the Heterokontæ and not in Chlorophyceæ, on account of the cell morphology, siliceous membrane, disc-shaped chromatophores with high carotin content, deficiency of pyrenoids, each of starch, and the formation of endogenous, 2-shelled, siliceous cysts. It is distantly related to *Halosphæra*, more closely to *Pseudotetrædron*, *Centritractus*, *Aurosphæra*, *Echinosphæridium*, and perhaps to *Acanthosphæra*. *Meringosphæra* is the second of the marine green plankton algæ to be excluded, like *Holosphæra*, from Chlorophyceæ. E. S. G.

Remarks on the Composition of Marine Phytoplankton.—A. Pascher (*Biol. Centralbl.*, 1918, **37**, 312–5; see also *Bot. Centralbl.*, 1918, **137**, 310–11). Fresh-water phytoplankton is remarkable for its enormous richness in Chlorophyceæ. This character is absent from marine phytoplankton, in which few green species other than Flagellates have been published. *Oocystis* occurs in brackish water, but not in the sea. *Pelagocystis* does not belong to Chlorophyceæ. *Halosphæra* and *Meringosphæra* must be excluded from Chlorophyceæ for the following reasons:—*Halosphæra* has a siliceous membrane, a paucity of pyrenoids in the disc-shaped chromatophores, a lack of starch, swarm-spores with two unequal cilia, two-shelled siliceous aplanospores, and similar large cysts; *Meringosphæra* has a siliceous membrane, disc-shaped chromatophores without pyrenoids or starch, and endogenous two-shelled siliceous cysts—all of which characters prevent their inclusion in Chlorophyceæ. No marine species of plankton algæ belonging properly to Chlorophyceæ has been hitherto recorded. The author places *Meringosphæra* and *Halosphæra* in Heterokontæ, and this group, together with Bacillariales and Chrysomonadineæ (including Silicoflagellatæ and Coccolithophoraceæ), in Chrysophyta. Marine phytoplankton, apart from fissile plants, is formed from the two stems of the brown algæ, Chrysophyta (Chrysomonadinæ in a wide sense, Pterospermaceæ, Bacillariales, Heterokontæ) and Pyrrhophyta (Desmomonadales, Cryptomonadales, Dinoflagellatæ, Cystoflagellatæ). E. S. G.

Coccolithophoridæ.—H. Lohmann (*Vortrag Deutsch. Zool. Ges.*, 1913, 23rd Jahresversamml. Bremen; see also *Bot. Centralbl.*, 1918, **137**, 390–391). The number of the cilia is without systematic importance. A table shows the vertical distribution of the most important genera. Certain interesting forms are discussed, notably *Heimiella excentrica*, which is covered with coccoliths; *Syracosphæra prolongata*; and the diatoms *Brenneckella lorenzini* and *B. Kohli*, which form a colony with *Pontosphæra sessilis*. E. S. G.

Quantitative Investigations of Formations of Organisms on the Surface of Water: I., Euglena sanguinea.—E. NAUMANN (*Intern. Rev. Ges. Hydrobiol. u. Hydrogr.*, 1915–16, **7**, 214–21, 4 pls.: see also *Bot. Centralbl.*, 1918, **137**, 391). The species in question, *E. sanguinea*, forms a bright to brown-red cover over the entire surface of the water, and along quiet banks it lies in red streaks. In quiet bays *Euglena* forms small red patches on the surface. The species which form this mass in the ponds of Aneboda in South Sweden are enumerated. E. S. G.

Common Diatoms.—THOS. K. MELLOR (*London: W. Wesley and Son*, 1920, 16, pls. A–G). A series of seven plates containing 400 original drawings from all parts of the world, with an introduction and a general index. The intention is to aid the amateur and to popularize the study of Diatoms. A. GEPP.

Green Oysters in Denmark in 1911–12.—C. G. J. PETERSEN (*Intern. Revue ges. Hydrobiol. u. Hydrogr.*, 1915–16, **7**, 39–41; see also *Bot. Centralbl.*, 1918, **137**, 392). In the new cemented basin for the storage of oysters in the Limfjord in Denmark occurs *Navicula ostrearia* both in blue-green and in colourless forms, which are connected by intermediates. This alga is certainly not the cause of the green colouring of the oyster-gills, for but few examples of it were found in the intestine, and indeed it often passes alive through the oyster. Also the alga was not plentiful in the basin. The colouring matter of the diatom is known to be very easily extracted, while that of the oyster gills is not dissolved by alcohol, ether, hot water or nitric acid, though it loses its colour in an alkaline solution. The author believes that the green colour of the oyster gills is not caused by digestion of *N. ostrearia*, but rather from constituents in the water. E. S GEPP.

Bacillariales from the Neighbourhood of Würzberg.—A. MAYER (*Kryptog. Forsch. hrsg. Bayer. Bot. Ges.*, 1917, 41–7; see also *Bot. Centralbl.*, 1918, **137**, 310). A list of 102 species, three of which are new to Bavaria: *Diploneis oculata* Cl., *Nitzschia apiculata* Grun., and *N. Clausii* Hantzsch. Many other rather rare species are recorded. E. S. G.

Bacillarieæ of the Jaszoe Fish-ponds.—I. L. LACSNY (*Bot. Közlém.*, 1917, **16**, 12–20, figs. in text; see also *Bot. Centralbl.*, 1918, **137**, 341). The two ponds in question lie in the Tapolcza valley in the district Abauj Torna; one of these is very shallow and covered with "bloom." The author records eighty-two species, of which two species and four varieties are new. The paper is written in Magyar. E. S. G.

Note on a New Alga, Leptobasis caucasica mihi, followed by a Critical Revision of the Genus Microchæte Thur.—A. A. Elenkin (*Bull. Jard. Imp. Bot. Pierre le Grand*, 1915, **15**, 5–22, 14 figs.; see also *Bot. Centralbl.*, 1918, **137**, 151–2.) This paper is written in Russian, with a French résumé. A new species of Cyanophyceæ is described from the environs of Gagry in the Caucasus, found in 1912 on stones in a river. It much resembles *Microchæte striatula* Hy, but is distinguished by certain pronounced characters. The author has made a special study of the genus *Microchæte*, and is of the opinion that the species should be divided into three groups, which he considers distinct genera:—(1) *Microchæte* (Thur. p.p.) Elenk., which consists of species allied to the genus *Calothrix*: *M. grisea* Thur., *M. vitiensis* Asken., *M. robusta* Setch. et Gardn. (2) *Coleospermum* Kirchn., which consists of species allied to *Aulosira*: *C. Goeppertianum* Kirchn., *C. tenerum*, *C. diplosiphon*. (3) *Leptobasis* Elenk., containing *L. caucasica*, *L. striatula*, *L. tenuissima*. The most marked character of this genus is in the shape of the filament, which is enlarged towards the apex and diminished gradually towards the base. This singular and remarkable character is only found in certain of the Scytonemaceæ. The genera *Microchæte*, *Coleospermum* and *Leptobasis* are obviously distributed among different sections of Hormogoneæ. *Microchæte*, which is allied to *Calothrix*, goes into the Rivularieæ sub-tribe Trichophoreæ, although it lacks a long hair. The positions of the genera *Coleospermum* and *Leptobasis* in Hormogoneæ is quite uncertain, and they are therefore placed provisionally in Scytonemaceæ. E. S. G.

Hormogonial Cyanophyceæ of the Middle Saale Valley.—G. Schmid (*Hedwigia*, 1917, **58**, 342–57, 1 fig.; see also *Bot. Centralbl*, 1918, **137**, 311–2). A list of twenty-one Cyanophyceæ observed by the author in Jena. The width of the filaments is considered an important systematic character and is given for each species. Colour and, in many cases, the direction of torsion of the filaments round their axis are regarded as useful in determining species. The method of observing the torsion is described. E. S. G.

The Story of a "Water-bloom."—H. Ammann (*Arch. Hydrobiol. u. Planktonk.*, 1916, **11**, 496–501; see also *Bot. Centralbl*, 1918, **137**, 294). In the year 1907 some carp were introduced into the Wesslingsee from a pond which contained *Anabæna macrospora*. As a result such an enormous mass of this alga appeared in the Wesslingsee, in which before 1907 no special algal growth had ever been observed, that the fish culture was nearly ruined. The author found a dead fish of 4 lbs. weight washed up on the bank which had its gills entirely glued together with *Anabæna*. The appearance of the lake during the years of water-bloom, 1908–12, is described. A marked rise in the quantity of oxygen contained in the water was caused by the *Anabæna*.

E. S. G.

Contribution to a Study of Polymorphism and of Monstrosities in Desmidiaceæ.—F. Ducellier (*Bull. Soc. bot. Genève*, 1915, **7**, 73–118, 31 figs., 3 pls.; see also *Bot. Centralbl.*, 1918, **138**, 86). The polymorphism of *Euastrum Didelta* is described and discussed. The forms with divergent young semi-cells are called by the author "mixed forms." Nine intermediate forms are figured. These are followed by the monstrosities. The material examined came from Col des Gets, Piora and Bisanne. E. S. G.

Contribution to a Study of the Desmid Flora of Switzerland. —F. Ducellier (*Bull. Soc. bot. Genève*, 1916, **8**, 2nd Sér., 29–79, figs. in text; see also *Bot. Centralbl.*, 1918, **138**, 38). An addition to previous work on the subject by the author. A large number of species and groups are discussed critically and figured in detail; and one new variety and many new forms are described. The Col du Simplon is rich in species of *Penium*. E. S. G.

New Species of Spirogyra.—William J. Hodgetts (*Annals of Botany*, 1920, **34**, 519–24, 1 pl. and 5 figs.). A description of *Spirogyra colligata*, a new species from King's Norton, Worcestershire, with special discussion of the remarkable clamp-connections which develop between the contiguous pairs of cells of the filament. These clamps are short open cylinders, bisected by a median septum or diaphragm, and appearing like the letter H in optical longitudinal section. In each compartment of the clamp is firmly set the end of an adjacent cell. Conjugation in this species is both scalariform and lateral, and also terminal (apparently a unique feature). A. Gepp.

Studies in the Conjugation of Spirogyra ternata.—Mabel L. Merriman (*Bull. Torrey Bot. Club*, 1920, **47**, 9–20, 3 figs.). An intensive study of one species of *Spirogyra*, with tables of measurement of successive cells of two conjugating filaments, male and female, showing the dimensions of three sorts of cells—conjugating, tumid (but not conjugating), non-conjugating (vegetative)—and their ratios to one another: and showing also the measurements of the outer and inner walls of the cells, where the curvature of the filaments was greatest. This is a preliminary paper; and all deductions as to potency of cells, formation of conjugating tubes, and other problems are reserved for a future paper. A. G.

Flagellates and Algæ of the District around Birmingham.—W. B. Grove, B. Muriel Bristol and Nellie Carter (*Journal of Botany*, 1920, **58**, Supplement III., 55). A list compiled from records made by the late Prof. G. S. West during the years 1906–1919, together with recent collections and determinations by Mr. W. J. Hodgetts. The list is extensive, and comprises 192 genera, 736 species, and numerous varieties. Subdivided the numbers are as follows:—Flagellata (13 gen., 33 sp.); Myxophyceæ (27 gen., 85 sp.); Peridinieæ (5 gen., 14 sp.); Bacillarieæ (35 gen., 154 sp.); Chlorophyceæ (112 gen., 450 sp., inclusive of 22 gen. and 196 sp. of Desmidiaceæ). A. G.

Fresh-water Algæ of Devonshire.—G. T. Harris (*Report and Trans. Devonshire Association, Plymouth*, 1920, **52**, 263–75). A list of thirty-five Myxophyceæ, eighty-two Chlorophyceæ, two Rhodophyceæ, and four Desmidiaceæ collected by the author in various localities in Devon, and determined by him. Special notes are given on certain of the more interesting records. E. S. GEPP.

Algæ of the Zehlaubruch from a Systematic and Biological Standpoint.—F. STEINECKE (*Schrift. Physik.-ökon. Ges. Königsberg*, 1916, **56**, 138 pp., 32 figs. in text, 1 pl.: see also *Bot. Centralbl.*, 1918, **138**, 18–22). The area in question is a tract of high moorland 31 km. S.E. of Königsberg in Prussia, which has been secured by E. Prussian naturalists as a natural preserve. The conditions are primeval, and all formations, etc., are to be found undisturbed by cultivation. The author visited the moor one to three times every month from April, 1913, to June, 1914, and obtained very good results. He records 270 species and 50 varieties of algæ, together with their morphological conditions, locality, and references in literature. Two new genera and ten new species are described, besides a number of new forms. *Euglena elongata* Schewiakoff is new to Europe. Other records are new to Germany, and many are rare species. The biological standpoint is fully discussed. The conditions obtaining in the low moorland, the intermediate, and the high are described, with the characteristic algal features of each. Nutrition, periodicity, sexual reproduction and other interesting subjects are fully dealt with. E. S. G.

Plant-world of Two Moorland Areas in Upper Swabia, with Regard to the Micro-organisms.—G. SCHLENKER (*Jahresh. Ver. Vaterländ. Naturk. Württemberg*, 1916, **72**, 37–120; see also *Bot. Centralbl.*, 1918, **138**, 28). The areas examined are the Dornachried, lying between Blitzenrente and Wolpertswende, 580 metres above sea-level, in the Ravensburg district, and the Dolgenried, 575 metres above sea-level, in the Saulgau district. The botanical records include Cyanophyceæ, Conjugatæ, Diatoms and Chlorophyceæ. The paper appears to be a preliminary one, but notes are appended on colouring, growth-forms, etc. Many rare species are recorded, a considerable number of alpine ones, and a few northern. E. S. G.

Fresh-water Algæ from Caucasus and Turkestan.—K. M. STRØM (*Nyt. Mag. f. Nat.-videnskab.*, May, 1919, **57**, 14 pp., 1 pl.). A list of seventy-one species collected by Prof. N. Wille in 1897. The Desmids are poorly represented. The predominating genus is *Cladophora*. *Chroococcus* and the Oscillatoriaceæ are fairly well represented. Three new varieties of Desmid species are described. E. S. G.

Fresh-water Algæ from Tuddal in Telemark.—K. M. STRØM (*Nyt. Mag. f. Nat.-videnskab.*, June, 1919, **57**, 53 pp., 3 pls.). A list of species collected by the author in the summer of 1919 in the higher mountains of S. Norway. The area investigated was that of which the Tuddal hotel (3100 ft.) forms the centre, and includes the Gausta-mountain (6000 ft.). It has a southern exposure, and most of it is situated near or above the forest-limit. Three small lakes were examined for plankton, which, however, proved of little interest. Only *Sphærocystis Schroeteri* was really abundant. *Elakatothrix gelatinosa* is recorded.

previously known only from W. Norway and England. An account of thirty different associations at elevations varying from 5000 ft. to 2700 ft. is given. The total number of species recorded in the area is 300, exclusive of diatoms, but would be largely increased by a systematic investigation of the Myxophyceæ, and by an autumn collection. The author concludes that at moderate altitudes in S. Norway (not exceeding 4000 ft.) almost as many algæ occur as in the lowlands, the richness or poverty of the alga-flora depending largely upon the geologic formations and the rain and snowfall. Many of the Desmids were of distinctly western types, a few were arctic or alpine. Many are rare, and two are new to science. E. S. G.

Development of Batrachospermum moniliforme.—H. Kylin (*Ber. Deutsch. Bot. Gesell.*, 1917, **35**, 155–64, 7 figs.; see also *Bot. Centralbl.*, 1918, **137**, 152–3). An account of the nuclear division of *B. moniliforme* in connexion with its reproduction. Various accounts of the process in that genus have been put forward, and the author hopes to decide which is correct. His conclusions are as follows:—The spermatangia mother-cells are not to be distinguished from the vegetative cells. The young spermatangium possesses a small nucleus, in which is a nucleolus surrounded by a light halo. In the ripe spermatium this halo is lacking, and it appears now as if the nucleus were composed of about ten granules. From this the author concludes that the nucleus of the ripe spermatium goes through a later prophase condition, as in the other Florideæ. Schmidle's assertion that the spermatium nucleus divides after adhesion to the trichogyne was not proved with certainty. Whether the occurrence of two nucleus-like granules points to a true nuclear division, or has its origin merely in a dissolution of the nucleus, was not determined. On the ground of other observations, however, the author believes in a mitotic division. At the fusion of the two sexual nuclei in the carpogonium they are in a resting stage. The spermatium nucleus, however, on issuing from the spermatangium is in a later prophase condition; the male nucleus at the time of fertilization, on the other hand, is in a resting stage. From this the author concludes that in the interval a nuclear division took place, and he considers Schmidle's view really correct. Further, he found no indication of a trichogyne nucleus, though Davis records one. Past investigations seem to show that normally the Floridean trichogyne contains a nucleus. Thus *Batrachospermum* forms an exception, which is explained by its low state of development. The author then describes the first division of the zygote nucleus. Nothing was observed of the prophase stages until the nucleus was in the diakinesis stage of a reduction-division. If the interpretation of the first phase as a heterotypic division be correct, the second phase would be the homotypic, and the four cells from which the gonimoblast is developed would be homologous with the four tetraspores which arise after a reduction-division. Also, the differences in the development of the gonimoblast in *Batrachospermum* as compared with that of *Nemalion* indicate the lower state of development of the former. The spore germination is alike in both genera. Schmidle's assertion that the unicellular hairs of *B. moniliforme* lack a nucleus is incorrect. Each hair possesses a small nucleus, which is easily demonstrated by iron-hæmatoxylin. E. S. G.

Alternation and Parthenogenesis in Padina. — J. J. WOLFE (*Elisha Mitchell Sci. Soc.*, 1918, **34**, 78–109. 1 pl., tables). An account of experiments carried out on *Padina variegata* Vickers, with a view to duplicating the work of W. D. Hoyt on *Dictyota*. The same method was adopted as in Hoyt's work, cultures being started in aquaria and transferred later to the harbour at Beaufort, N.C. The development of the various cultures is described in detail, and is also set forth in tabular form. The author summarizes his results as follows:—1. Tetraspores produce only male and female plants. The numbers are approximately equal, even when the spores are from the same plant and grown on the same shell. Sex is therefore predetermined, probably, in the reduction-division of the tetraspore mother-cell. 2. Eggs when fertilized produce tetrasporic plants only. There is thus an alternation of a sporophyte generation which is an entirely distinct individual, with the gametophytic generation consisting of two separate plants, the one bearing eggs, the other sperms. 3. Unfertilized eggs divide freely, producing a cell-body of varying size, which however invariably fails to mature. There is thus in *Padina* parthenogenetic germination, but no parthenogenetic reproduction. E. S. G.

Marine Algæ of Guernsey.—LILIAN LYLE (*Journal of Botany*, 1920, **58**, Supplement II., 53 pp., 6 figs.). This paper consists of a list of the marine algæ of the island, together with an account of certain ecological factors, a discussion of types in relation to habitat and climate, economic uses, etc. A summary of previous lists is followed by a systematic enumeration of all the known species, collected by the author and others. The total number recorded is 350 species and 78 varieties and forms, including many novelties for the Channel Islands, a few for Britain, and one species and one form new to science. The list contains a few critical notes on the structure, development, habitat, distribution, systematic value, etc., of certain species founded on the author's observations. In the section devoted to ecological factors she describes the physical position of the island, tides, currents, nature of the substratum, configuration of the coast, salinity, and temperature. Four distinct types of vegetation are found, which coincide in each case with certain climatic conditions; the dominant species of each are given and each type is discussed. The zones or belts are distinctly traceable, though they vary considerably in width and occasionally even disappear. Each zone is discussed separately, and the littoral algæ and lichens are set out in tabular form. Under the heading "Composition of the Flora" the two elements of the marine vegetation are pointed out: the northern, which is derived from the North Atlantic and extends to the Norwegian Polar Sea; the southern, which includes species from the Mediterranean, Indian Ocean, Brazil, W. Indies, etc. The species representing both elements are enumerated. Finally, a section is devoted to economic considerations. Up to the present only two portions of our coast have been treated from the ecological point of view: Clare Island and the neighbouring shores of Clew Bay, by Mr. A. D. Cotton; and Guernsey in the present paper. E. S. G.

Studies of Algæ of the Adriatic. — V. SCHIFFNER (*Wiss. Meeresunters. N.F. Abt. Helgoland*, 1916, **11**, 129–98, 133 figs. in text;

see also *Bot. Centralbl.*, 1918, **137**, 294). The studies consist of a series of articles dealing with various algological questions. The genus *Leathesia*, including *Corynophlœa*, is worked out afresh and the structural development described, as is also that of *Myriactis* and *Elachista*. The distinguishing generic characteristics are given of *Enteromorpha*, *Cladophora*, *Contarinia*, *Cruoriella*, *Peyssonellia*, and *Phyllophora*. *Rhodochorton membranaceum* Hauck, and *Chantransia minutissima* Hauck, are united under the name *Rhodochorton Hauckii*. The systematic position of *Chondria tenuissima* and *Alsidium Helminthochortos* is made clear, and the antheridia of the latter are described. Five new species and three new forms of existing species are described. *Pringsheimia scutata* is recorded for the first time from the Mediterranean region. A special section, "Contributions to a Knowledge of the Marine Summer Vegetation of Trieste and Rovigno," contains the ecological observations. E. S. G.

Physicological Contributions.—W. A. Setchell and N. L. Gardner (*Univ. California Public. Bot.*, 1920, **7**, 279–324, pls. 21–31). The authors describe and discuss critically one new genus and seventeen new species, and form seven new combinations to denote previous species or varieties, all belonging to Chlorophyceæ. The new genus *Internoretia* is proposed for a new endophyte found growing within the membranes of *Porphyra naiadum*. Its reproduction not having been determined, it is among the numerous form-genera of uncertain position and is placed provisionally among the Chætophoraceæ. It resembles *Pseudodictyon* Gardner, from which it differs in forming solid filaments several cells in thickness. *Gomontia Bornetii* nov. nom. represents plants hitherto included under *G. polyrhiza* B. & F., which have the shorter and broader type of sporangium, and blunt, simple or slightly branched rhizoids. All the species here described are the novelties included in the author's "Marine Algæ of the Pacific Coast of North America: Part II., Chlorophyceæ." E. S. G.

Marine Algæ of the Pacific Coast of North America: Part II., Chlorophyceæ.—W. A. Setchell and N. L. Gardner (*Univ. California Publ. Bot.*, 1920, **8**, 139–374, pls. 9–33). The second part of this work is here presented, the first having been devoted to the Myxophyceæ. Pending the publication of the other two parts, no explanation nor introduction is issued. Keys are given to orders, families, genera and species, followed in each case by a diagnosis, references to literature, and valuable critical notes on history, structure, systematic position, geographical problems, etc. Thirty-four genera are represented. The novelties were published previously in a separate paper. E. S. G.

Fungi.

Research on the Sexuality of Phycomyces nitens.—Grete Orban (*Beih. Bot. Centralbl.*, **36**, Abt. 1, 50 pp., 2 pls., 20 figs.; see also *Hedwigia*, 1920, **62**, Beiblatt, 21–22). The writer follows on the steps of Blakeslee's work on Mucorini. She finds + and − mycelium in *Phycomyces*, and is able to distinguish them by differences in growth, etc. The processes of growth and copulation between the gametes is described, and the behaviour of the plant when that is impossible owing to the absence of the conjugating hyphæ. A. LORRAIN SMITH.

Phytophthora Meadii sp. n. on Hevea braziliensis.—W. McRAE (*Mem. Dept. Agric India*, 1918, **9**, 219–73, 3 pls.). The disease caused by the fungus manifests itself as fruit-rot, an abnormal leaf-fall, and a rot of the tapped surface. The author gives a full description of the development of the fungus itself; he finds that fertilization is similar to that described by Pethybridge in *P. erythroseptica*: viz. that the oogonial branch grows through the antheridium. McRae contrasts the fungus with *Phytophthora Faberi* on Cacao fruit, and describes the points in which they differ. He discusses the dissemination of the fungus, the loss sustained by growers, and the preventive measures that are advisable. A. L. S.

Galactinia amethystina (Phill.) Wakef.—E. M. WAKEFIELD (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 375). The species here described has been published as *Ascobolus amethystinus* by Phillips and later as *Galactinia Phillipsii* by Boudier. The specific name *amethystinus* has therefore been restored. It is characterized by its deep purple colour and by the purple-coloured spores. A. L. S.

Pyronema lætissimum Schröt. from Silesia.—A. LINGELSHEIM (*Hedwigia*, 1916, **58**, 153–5, 1 fig.). In a full description of the fungus the author gives notes on the colouring substance of the hyphæ. He concludes that it belongs to the Carotin group, which has been found in other fungi, Uredineæ, Pezizaceæ, etc. A. L. S.

Rare Pezizaceæ from Bavaria.—S. KILLERMAN (*Hedwigia*, 1917, **59**, 234–5). Killerman records the finding of *Pyronema lætissimum* in early spring. He compares it with *Peziza pluvialis* and *Pyronema domesticum*. Several other known species were found. A. L. S.

New Locality for Sarcosoma globosum.—S. KILLERMAN (*Hedwigia*, 1918, **59**, 313–8, 2 figs.). The author gives a full description of the fungus and of the habitat among moss in fir woods. He found it in Bavaria. A. L. S.

Mycological Contributions: I., Ascomycetes.—K. BOEDYN and C. VAN OVEREEM (*Hedwigia*, 1918, **59**, 307–12). The authors found a brightly coloured *Humaria*, in which they determined the colouring substance as a Carotinoid. They describe the fungus as *Humaria carota* sp. n. They found Carotin crystals also in *Ascophanus pinicola* sp. n. A. L. S.

Ascomycetous Fungi of Human Excreta.—CHARLES B. FAIRMAN (*Lyndonville, New York*, 1920, 1–11, 1 pl. 3 figs.). The author discusses the various fungi that have been identified as occurring in excreta. He calls attention to the difficulty of determining isolated spores. A list has been drawn up by him of Ascomycetous forms, fifteen of which have been described at various times. The author gives a figure and description of a new species, *Cylindrocolla fæcalis* (Hyphomycete). A. L. S.

New Discinella.—W. D. Buckley (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 346–7). The new species was found at Slough in May 1920, growing among moss under *Ulex*. It approaches nearest to *D. Menziesi* Boud., but is smaller and pearl-grey with a touch of pink, as contrasted with the rose colour of the former. A. L. S.

Conidia and Paraphyses of Pezicula eucrita Karst.—J. S. Bayliss Elliott and H. C. Chance (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 353–4, 1 fig.). The spores of this fungus may often germinate in the ascus, and conidia can be seen arising on the germ-tube; they are linear and are produced on any part of the spore or germ-tube in chains, in bunches or singly. The paraphyses are long and slender, and branched or unbranched. The excipulum is parenchymatous and covered with hairs. A. L. S.

Volutin, or the Metachromatic Bodies in the Yeast Cell.—W. Henneberg (*Wochenschr. Brauerei*, 1915, 301–54, 1 fig.; see also *Hedwigia*, 1918, **60**, Beiblatt, 25–6). Metachromatic bodies are recognized as those that take stains in the yeast cells, and they are practically identical with "volutin" or "volutin-drops." The record is given of much experimental work and of the conclusions reached. Henneberg is convinced that volutin is the fermentation enzyme itself or the mother substance of the enzyme, and cites in support of his view the rapid multiplication of the "volutin-drops" during activity of fermentation. Volutin varies in the different fungus cells, and it is hoped that a ready means of identification will be found in the differences of staining. A. L. S.

Fungi Imperfecti.—Franz von Höhnel (*Hedwigia*, 1917, **59**, 236–84; 1918–19, **60**, 129–209; 1920, **62**, 56–80). The author has prepared a complete account of *Fungi Imperfecti* to be published shortly. He gives here descriptions of new species and critical notes on a large number of forms. As new genera, based on species already described, he publishes: *Sclerochæta* (based on *Phoma*); *Sclerochætella* (near to *Pyrenochæta*); *Sclerostagonospora* (on *Hendersoriæ Heraclei*); *Rhizosphærella* (on *Perisporium Lentisci*); *Pleuronæma* (on *Sphæronæma procumbens*); *Sphæronæmina* (on *Sphæronæma cylindricum*); *Ceratophoma* (on *Sphæronæma rostratum*); *Chondropodiella* (on *Sphæronæma cathrincolum*); *Mycorhynchella* (on *Spæronema Betæ*); *Cyanophomella* (on *Phoma acervalis*); *Bactrexcipula* (somewhat similar to *Stagonospora Pini*); *Stictopatella* (on *Phyllosticta destructiva*); *Didymochora* (*Leptostromaceæ*), the pycnidial form of *Euryachora* spp.; *Sclerothyrium* (*Coniothyrium*, etc.); and *Pseudodichomera*, the pycnidial stage of *Cucurbitaria* spp. Full notes of these and many other members of the group are contributed by the author.

In a further contribution many more genera are passed under review and one new genus diagnosed, *Amphiciella*, which forms small stromata on dead leaves; the spores are colourless, and one to three septate. A. L. S.

New Species of Melanotænium, with a General Account of the Genus.—Rudolph Beer (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 331–43, 1 pl.). The author found the new species *Melanotænium Lamii* on *Lamium album*, numerous tumour-like swellings formed on the underground organs being due to the presence of the fungus. There may be dark blister-like swellings on the side of the stem or tuberous bodies surrounding the stem in the form of Kataplasmic galls. The author considers the genus to be a member of the Ustilagineæ. He reviews the various species of *Melanotænium* already published, and describes more particularly the morphology and cytology of *M. Lamii*. The mature spore is uni-nucleate; the hyphal cells and young spores are binucleate. A. L. S.

Biology of Panus stypticus.—MARIE E. M. JOHNSON (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 348–52, 1 pl.). The author thus summarizes new results:—(1) The sporophores can withstand frost, and so can be cultivated in the open during winter. A sporophore takes about three months in developing. (2) Spores germinate readily in suitable media; wood-block cultures in favourable conditions produce sporophores in six or seven weeks. (3) Wood attacked by the fungus becomes light, very soft, and paler in colour; the less lignified elements disappear first. (4) Sporophores, after a time of desiccation, when moistened, shed spores which are viable; the mycelium also can be dried for many months and still retain its vitality. A. L. S.

New Record for Polyporus montanus Quélet.—S. KILLERMAN (*Hedwigia*, 1919, **61**, 1–3, 1 pl.). The fungus was found in the Bavarian forests in large quantities and growing to an immense size. It is distinguished by the ochraceous echinulate spores. It has a wide distribution in Central Europe. A. L. S.

Mycological Transactions.—(*Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 299–396). The present part opens with an account of the Spring Foray at Painswick. Larger fungi were scarce, but other kinds of great interest were collected; *Eichleriella spinulosa* was collected for the first time so far south. The English records of *Stereum rufum* were based on this plant, and other synonyms are *Radulum deglubens* and *R. spinulosum*. A list of the fungi collected is appended. A. L. S.

Note on Marasmius cauticinalis.—D. PAUL (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 344–5). The name *cauticinalis* has been confused with *caulicinalis*, and the confusion may have been due to a printer's error. Paul has traced the changes of the spelling through the different authors; *caulicinalis*, he holds, is well-chosen and descriptive, as it means growing on stalks, stems, etc., which exactly expresses the habit of the *Marasmius* in question. A. L. S.

Records of Surrey Resupinate Hymenomycetes.—E. M. WAKEFIELD and A. A. PEARSON (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 317–21, 6 figs.). A descriptive list is given of a varied series of "resupinates," most of them new to Britain. They were collected mostly near Weybridge. *Sistotrema variecolor* was collected at Farnborough, Hampshire, and was determined by M. l'Abbé Bourdot. It has the habit of a *Radulum*, but is sufficiently distinguished by the larger, longer spores. A. L. S.

New or Rare British Fungi.—CARLETON REA (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 322–30, 1 col. pl.). The descriptive list of novelties contains two new species of *Mycena*, one *Nolanea*, and a new variety of *Pluteus phlebophorus*. *Astrosporina* Schroet. is a genus new to Britain; one species is newly recorded for this country, another is new to science. *Astrosporina* includes species with irregular or rough spores formerly classified under *Inocybe*. Rea also describes a new Ascomycete, *Urceolella Iridis*, from Perthshire. A. L. S.

Comparative Research on the Biology of Wood-destroying Fungi.—BRUNO RADAU (*Beitr. Biol. Pfl.* (*Cohn*), 1917, **13**, 375–458, 6 pls.). The author comments on the economic necessity of understanding the biology of fungi that attack forest trees. For the present elaborate study he selected *Polyporus igniarius* as one of the most widespread and most dangerous parasites of deciduous trees. He examined the tissues of a number of trees, *Alnus incana*, *Betula alba*, *Carpinus Betulus*, etc., and records his results in detail. In Section III. he summarizes the results as affecting different parts of the tree. The mycelium of the *Polyporus* cannot penetrate cork; the fungus is therefore a wound parasite. A. L. S.

Boletus conglobatus sp. n.—K. BLAGAIC-ZAGREB (*Hedwigia*, 1918, **60**, 10–11). The new *Boletus* grew close to oak-trees in somewhat light soil from July to September in Maksimir. It is characterized by the yellow flesh of the pileus and the brown fusiform spores. A. L. S.

Red Squirrel of North America as a Mycophagist.—A. H. R. BULLER (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 355–62). Field observations on the eating of mushrooms by squirrels, rabbits, etc., have already been made in this country. Buller describes the mushroom-eating habit of squirrels in North America. He sums up thus:—The red squirrel of North America not only feeds on the seeds of fir-cones, hazel-nuts, etc., but is also an habitual mycophagist. In the late autumn it often collects fleshy fungi in large numbers for its winter supply of food, and it stores these fungi sometimes *en masse* in holes in tree-trunks, old bird's nests, etc., and sometimes separately on the branches of certain trees. A. L. S.

New British Coprini.—A. H. R. BULLER (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 363–5). The first to be described is new to science, *Coprinus echinosporus*, with finely echinulate or warted spores. It was found on sticks taken from a pool at Kew in October, 1911. The other two were also found at Kew. Full descriptions are given. A. L. S.

Significance of Sex and Nuclear Fusion in the Fungi.—HAROLD WAGER (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 305–17). The author gives an outline of the occurrence and manner of sexual fusion in the different fungus families. Sexuality, he states, is characterized by the association of two cells, each with its nucleus, and their fusion to form a zygote, at a definite period in the life-history of any plant or animal in which it occurs. But though fusion is necessary for the blending of hereditary characters, it is not essential for growth and development, since the developmental stimulus under certain conditions can be effected by other agencies. Wager gives special attention to sexuality in Ascomycetes, where there may be well-differentiated sexual organs with nuclear fusion, and again a nuclear fusion in the ascus. The latter fusion is always present. He discusses the significance of nuclear fusion and its importance in the life-history of the organism. A. L. S.

Experimental Research on Red Mildew Fungi.—F. W. Neger (*Flora*, 1917, **110**, 67–139, 31 figs.; see also *Hedwigia*, 1918, **60**, Beiblatt, 29–30). It is a mistake, according to the author, to conclude that only one species enters into the dark brown felt on leaves that constitutes the above fungus. Only culture experiments will enable the mycologist to differentiate the various forms. By sowing spores of *Bulgaria polymorpha*, *Herpotrichia nigra*, *Xylaria Hypoxylon*, etc., in concentrated sugar solutions he was able to produce growths identical with the red mildew forms. A. L. S.

Fungus Flora of Hevea braziliensis.—T. F. Chipp (*Gardens' Bulletin, Straits Settlements*, 1920, **2**, 186–92). The paper was prepared in answer to enquiries as to the fungus diseases of *Hevea*. The long list is grouped according to the respective habitats of the fungi—on root and collar, stem and branches, etc.—and contains the names, with notes, of all fungi that have been found on the tree in Malaya. A. L. S.

Mycological Contributions: I. Ascomyceten.—C. van Overeen (*Hedwigia*, 1920, **61**, 383–9, 2 figs.). The author adds notes to the previously published descriptions of several fungi, as, for instance, in *Gorgoniceps aridula*, in which he found the spores formed in a fascicle: they varied from single to 16-septate, and were all equally capable of germination. *Helotium pallescens* is also described, and the conidial stage, *Rutsbræmia firma*, is described and figured. Other Discomycetes are reviewed. In another paper on *Fungi Imperfecti* (pp. 375–79, 1 fig., 1 pl.) Overeen gives an account of two little-known parasites of Discomycetes, *Stephanoma strigosum* and *Sepedonium simplex*, both of which grow on *Lachnea hemisphærica* and other *Pezizæ*. A. L. S.

Hypomyces on Lactarius.—A. Lingelsheim (*Hedwigia*, 1920, **61**, 380–2). The author describes a new species, *Verticillium silesiacum*, which grew on *Lactarius thejogola*. He discusses the relation of this fungus with *Hypomyces lateritius*. A. L. S.

New or Rare Microfungi.—A. Lorrain Smith and J. Ramsbottom (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 365–76). A long list of species new to Britain have been determined and published; a few are new species; two genera have been added to the British Flora. Many of the fungi listed are minute parasites on the higher plants. A. L. S.

Host Index of Fungi of the Malay Peninsula.—T. F. Chipp (*Gardens' Bulletin, Straits Settlements*, 1920, **2**, 231–8, 276–82). The host plants are listed alphabetically, and the fungi include not only the known parasites which cause disease, but all those that have been recorded on any of the higher plants. Biological notes are given in many instances—short descriptions of the effect produced by the parasite, etc. A. L. S.

Mycological Notes. V.—W. B. Grove (*Journ. Bot.*, 1921, **59**, 13–17). Notes are given on various species, *Boydia insculpta Puccinia Peucedani-parisiensis* and *Phomopsis abietina*, the latter a parasite on *Pinus silvestris* and *Pseudotsuga Douglasii*, reported as causing great harm on the Continent, and a source of possible danger to home conifers. A. L. S.

Macrosporium Foot-rot of Tomato.—J. Rosenbaum (*Phytopathology*, 1920, **10**, 415–22, 4 figs.). The author has suggested Foot-rot as a suitable name for this disease, seeing that the trouble is mainly visible at the base of the plant: the stalks turn brown where they emerge from the soil, and the fungus causing the disease spreads both up and down. Plants are attacked at all ages both in the seed bed and in the field, and the disease has caused considerable loss in Delaware. Many cultures and inoculations were made, and the fungus was finally identified as *Macrosporium Solani* E. & M. A. L. S.

Pythium Disease of Ginger, Tobacco and Papaya.—L. S. Subramaniam (*Mem. Dept. Agric. India*, 1919, **10**, 181–94, 6 pls., 3 col.) The disease, which attacks not only seedlings but the base of trees, is caused by a new species of *Pythium*, *P. Butleri*. The author gives an account of experimental cultures and inoculations and suggests methods of treatment. A. L. S.

Mycological Notes.—C. G. Lloyd (*Cincinnati, Ohio*, 1920, No. 62, 904–44, 16 pls.). A portrait and chronological arrangement of the principal events of J. C. Arthur's career opens the present series of notes. Several genera of fungi are described, the species of which are criticized and figured. Among these are *Cordyceps*, *Thamnomyces*, *Aleurodiscus*, *Echinodothis*, etc. There are also historical and structural notes of many other somewhat obscure species. A. L. S.

Mycological Notes.—C. G. Lloyd (*Cincinnati, Ohio*, 1920, No. 63, 945–84). The author begins these notes by calling attention to an article on Fungi in the "National Geographic Magazine" by L. C. C. Krieger. It is illustrated by sixteen coloured plates and thirty-six photographs. Both styles of illustration are of very high quality. Lloyd also remarks on the death of P. A. Saccardo and bears testimony to his great work on Fungi. The bulk of the notes deals with letters from correspondents and the fungi sent by them from all over the world. A. L. S.

Fungi from the Polish Trenches.—S. Killerman (*Hedwigia*, 1917, **59**, 220–33, 1 fig.). The collection was made by a theological student who served in the war. The fungi were chiefly collected during the summer of 1916 in the virginal forest near Lida. Drawings made by the collector enabled Killerman to determine many of the species, mostly Basidiomycetes, and some of the larger Ascomycetes. There is one Myxomycete determined, *Ceratiomyxa mucida*. A. L. S.

Fungi of North Caledonia and the Loyalty Islands.—E. M. WAKEFIELD (F. Sarasin and J. Roux, Berlin and Wiesbaden, *Nova Caledonia*, 1920, **89**, 108). The author comments on the character of the fungus flora: it is on the whole of tropical type with an intermingling of temperate forms, and "the affinities are with Malaya, Australia and other Pacific islands." There are also relations with Central and South America, as well as with tropical Africa. There is a numerous list of genera and species. The fleshy Agarics were named by the late W. Massee. A number of new species in the various groups are diagnosed. Habitats are not given. A. L. S.

Botrytis cinerea as Parasite of Æsculus parviflora Walt.—ALFRED MARKOWSKI (*Beitr. Biol. Pfl.* (*Cohn*), 1917, **13**, 347–74, 5 figs., 2 pls.). The fungus attacked and destroyed the twigs and branchlets of the trees. The author has proved that the trouble was due to *Botrytis cinerea*. He made careful inoculations on *Æsculus parviflora*, where the results were immediate, and also on *Æ. Hippocastanum*, where they were less visible, as the fungus in that tree seemed to go deeper. The action of the fungus on the host tissues is described. Markowski discusses the question of sclerotia formation by *Botrytis cinerea*. He does not look on the fungal balls formed by the fungus as true sclerotia, but as pseudo-sclerotia, and concludes that there is no connexion between this fungus and *Sclerotinia*. A. L. S.

Diagnoses of Fungi from "Spotted" Apples.—ARTHUR S. HORNE (*Journ. Bot.*, 1920, **58**, 238–42). The author isolated from "spotted" apples a considerable number of familiar fungi, Pyrenomycetes or Basidiomycetes. In addition he determined a new species, *Pleospora pomorum*, and a new genus of Sphæropsideæ near to *Phoma*, but distinguished by the number of ostioles formed in one pycnidium. He has named it *Polyopeus*, and has described four species of the genus with a number of varieties. A. L. S.

Lichens.

Lichen Systematic Studies: 1. The Lichen-Genus Rhabdopsora Müll.-Arg.—A. ZAHLBRUCKNER (*Hedwigia*, 1917, **59**, 301–4; 1918, 305–6, 1 fig.). The genus *Rhabdopsora* was doubtfully placed by Zahlbruckner among Gyalectaceæ. He has now examined the lichen on which it was based, and he concludes that it is a member of the Pyrenidiaceæ. A. LORRAIN SMITH.

Verrucariaceæ of Central Europe.—H. ZSCHACKE (*Hedwigia*, 1918, **60**, 1–9). The study of this family was made while the author was interned in Switzerland. He collected round Davos, and was granted permission to work at the Zürich Technical School. He gives lists, with notes, etc., of the genera *Staurothele* and *Polyblastia*, both well represented in Switzerland. A. L. S.

Swiss Lichens.—I. G. Lettau (*Hedwigia*, 1918, **60**, 84–138; II., 1919, 267–312). The lichens listed in this work were mainly collected in 1912. They are arranged according to locality: from Via Mala, Martigny, Sion, etc. Any new species found are to be published later. Most of the lichens collected are saxicolous. A. L. S.

Contributions to the Lichen-flora of Lower Austria.—A. Zahlbruckner (*Verk. K. K. Zool.-Bot. Ges. Wien*, 1917, **68**, 1–35). The list is fairly extensive and includes a number of new species. Diagnoses are also given of species not previously described with sufficient care. A. L. S.

Llanberis Lichens and District.—J. A. Wheldon (*Journ. Bot.*, 1920, **58**, 11–15). The lichens recorded are mostly saxicolous, as the author of the paper spent most of his time collecting on the mountains above the tree zone. The species found are listed, and biological notes with the localities of each species are appended. Wheldon discovered a new species, *Bilimbia cambrica*, the diagnosis of which is given. The author states that the list is by no means exhaustive.

W. Watson (*Journ. Bot.*, 1920, **58**, 108–10) evidently collected over a wider area. He has recorded a considerable number of lichens additional to Wheldon's list. These comprise many corticolous species, and a proportion of rare and unusual plants. A. L. S.

New Buelliæ.—J. Steiner (*Oesterr. Bot. Zeitschr.*, 1919, No. 57, 141–8). The Lichens here described are from many different countries—from Central Africa, South America, North Europe, etc.—showing the wide distribution of the genus. A. L. S.

Lichenographic Notes.—J. Steiner (*Oesterr. Bot. Zeitschr.*, 1918, Nos. 8–9, 276–84). The author here deals with a fascicle of lichens collected in Portugal by L. Menyhart in 1890. They are almost exclusively corticolous species on *Arbutus Unedo*, *Pistacia Lentiscus*, *Phillyrea*, *Quercus Ilex*, *Pyrus Malus*, *Viburnum Tinus*, etc. With the exception of a few new species or forms, and a few that are peculiarly Mediterranean species, the collection belongs to the widespread European flora. A. L. S.

Contribution to the Knowledge of the Greek Flora: C. Lichenes.—J. Steiner (*Verk. K. K. Zool.-Bot. Ges. Wien*, 1919, **70**, 52–101). The lichens were collected by members of the Vienna University Expedition in 1911. There are a large number from various regions and on various substrata. A number of new species are described, and as the most outstanding of these Steiner indicates *Stereocaulon Santorinense*, which, though allied to *S. denudatum*, differs in the persistence and form of the primary thallus on which are borne the apothecia; the podetia are constantly sterile. A. L. S.

Preparation for a Lichen-flora of Dalmatia.—A. Zahlbruckner (*Oesterr. Bot. Zeitschr.*, 1919, **70**, 1–18, 148–65, 237–53, 297–326). The present series of papers deals with collections by Baumgartner and others made in Dalmatia and on many of the islands. The series includes the numbers 441–552, with notes on numbers previously recorded. The most noteworthy discovery recorded is *Phylloporina Höhneliana* (previously published as *Calonectria Höhneliana* Jaap), a genus of tropical lichens that grows on leaves, but in this case on the stems and phylloclades of *Ruscus aculeatus*. Zahlbruckner also reinstates the genus *Amphidium* in Heppiaceæ: he had relegated it to *Leptogium* sect. *Homodium*. A. L. S.

Relation between the Alga and Fungus of a Lichen.—R. PAULSON and SOMERVILLE HASTINGS (*Journ. Linn. Soc.*, 1920, **44**, 497–506, 2 pls.). The authors comment on the mistaken theory that the lichen plant is merely a fungus parasitic on an alga. They cite various authors who in recent times have revived and upheld this view of the relationship between the two organisms of the composite plant. Research was undertaken to find out if possible the connexion between the fungus and the alga, and the condition of the algal host. The method of preparing and staining the sections is described. The material was collected in February and March and also in autumn, and incidentally it was found that spring was the season of most active growth. The green cells are then increasing very rapidly, and the authors determined that their reproduction was by the formation of daughter gonidia within the parent algal cell (autospores—reduced zoogonidia). They claim that this abundant increase testified to the healthy condition of the alga. No instance of parasitism or penetration of the alga by fungus hyphæ was seen. The form and contents of the algal cell are described and discussed. It is probably a species of *Chlorella*. A. L. S.

Lichens found near Painswick.—R. PAULSON (*Trans. Brit. Mycol. Soc.*, 1920, **6**, pt. 4, 303). Paulson found at Painswick a rich harvest of saxicolous lichens: they grew in great profusion on the sunny side of oolitic stone walls, and on rocks projecting from the soil. Corticolous species were rare in the woods, and Paulson is unable to account for their absence, unless some unknown edaphic factors have been inimical to their growth. The fungus parasite *Tichothecium pygmæum* was abundant on the thallus of *Placodium rupestre*. A. L. S.

Fruticose and Foliose Lichens of North Bohemia, II.—JOSEF ANDERS (*Hedwigia*, 1920, **61**, 351–74). Owing to war conditions the writer had to work under great disabilities. The list is restricted to the larger lichens. Among the most numerous of these are the *Cladoniæ*; not only species but a large series of varieties and forms are listed. *Parmelia* and *Cetraria* are fairly well represented: Usneaceæ by only one lichen, *Letharia vulpina*, a rather poor greenish-coloured specimen. There were found two species of *Gyrophora* and one *Physcia*. A. L. S.

Lichens of New Caledonia.—A. D. COTTON (F. Sarasin and J. Roux, Berlin and Wiesbaden: *Nova Caledonia*, 1920, 108). A short supplement to a previously recorded list. Two of the species are from New Caledonia, the others from Loyalty Islands. A. L. S.

Lichens from Litau.—E. BACHMANN and FR. BACHMANN (*Hedwigia* 1919, **61**, 308–20; 1920, **61**, 321–42). The lichens enumerated were collected on the German East Front during the war. The writers give the general topography, the climate, etc. The lichen-flora showed most affinity with that of East Prussia. The special earth lichens are noted as growing on soil poor or rich in lime. As to the rocks of the district there was an absence of lime and a corresponding scarcity of calcicolous lichens. Epiphytic lichens are carefully delimited according to the trees on which they were mostly found. The complete list of lichens found is given, and then follows a comparison with other districts. The great similarity as to the lichen-flora between Litau and Prussia is again commented on. A. L. S.

Lichen Symbiosis.—A. H. Church (*Journ. Bot.*, 1920, **58**, 213–9, 262–7). The author's views on the origin of lichens may be best summed up by the closing paragraphs of his paper:—"Lichens thus present an interesting case of an algal race, deteriorating along the lines of a heterotrophic existence, yet arrested, as it were, on the somatic down-grade by the adoption of intrusive algal units of lower degree to subserve photosynthesis (much in the manner of the marine worm *Convoluta*). Thus arrested, they have been enabled to retain more definite expression of more deeply inheritant factors of sea-weed habit and construction than any other race of fungi; though closely paralleled by such types as *Xylaria* (Ascomycete) and *Clavaria* (Basidiomycete) which have followed the full fungus-progression as holosaprophytic on decaying plant-residues."

"There can be little doubt that such a view will enlarge one's conception, not only of the remarkable history of these often despised fungus-races, as compared on one hand with the surviving Florideæ of the sea, and on the other with the great range of Ascomycetous phyla: but also it must throw light on the general problems of the changes of biological environment which may have been effective in such a striking response as included within what has been termed the period of the subaerial transmigration." A. L. S.

New Portuguese Lichens.—Gonçalo Sampaio (*Porto*, 1920, 8 pp.). Diagnoses are published with biological notes of a number of new species of crustaceous lichens, Lecideaceæ and Lecanoraceæ, with one foliose species, *Lobaria mollissima* Gonç., intermediate in appearance between *Lobaria scrobiculata* and *Peltigera limbata*. The lichens were collected in Lusitania. A. L. S.

Spanish Lichens from the Wilkomm Herbarium.—Gonçalo Sampaio (*Ass. Esp. Para. el Prog. Ciencias Madrid*, 1917, 135–44). The plants have been preserved in the University of Coimbra, and lichens form only a small part of the general collection. Gonçalo, who has overhauled these, found among them two new species, *Physma hispanicum* and *Acarospora granatensis*. A. L. S.

Portuguese Lichens.—Gonçalo Sampaio (*Ann. Acad. Polytechnica do Porto*, 1918, **12**, 1–15). The author has listed, with full descriptions, 56 species of lichens belonging to many different families and genera; several species are new to science. A. L. S.

MICROSCOPY.

A. Instruments, Accessories, etc.

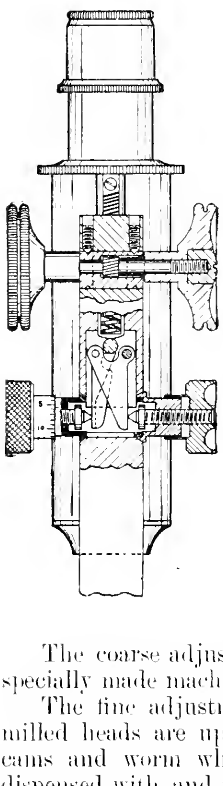
National Physical Laboratory Report, 1919. Published by His Majesty's Stationery Office. The following abstracts are of interest to microscopists :—

Optical Glass.—During the latter part of the war the Laboratory was called upon to test large numbers of specimens of glass for refractive index and dispersion. In connexion with this work a number of investigations were made which proved to have important bearings on other optical problems. The reliability of such measurements is of great importance, as an error may easily lead to the waste of much material, as well as of skilled labour, in making systems which are only found to be unusable when they are completed. Since the war the demand for such tests has ceased, but it is very desirable that further investigations contemplated in connexion with these measurements should be continued. The tests are of fundamental importance to the optical industry, and it is only the extensive experience acquired in making them which has enabled the existing degree of accuracy to be reached. One of the questions proposed for examination in this connexion is the constancy of quartz and other natural transparent minerals as regards their optical properties. Existing determinations show variations which may either be instrumental errors or may be due to variations with different specimens. The source of these variations can be traced quite definitely with the accuracy in measurement which is now attainable, and it can thus be determined whether such materials can be used with safety as standards of reference in the calibration or checking of instruments intended for testing other materials. For this purpose it is necessary to obtain a number of specimens of quartz whose history is known. In particular it is desired to examine prisms of quartz derived from all the chief sources at present known. These specimens should preferably be examined independently by a number of investigators who have made accurate determinations of refractive indices, with a view both to increased accuracy on the finally accepted results and to the application of corrections for instrumental errors, if such exist, to other measurements made previously. It is hoped that specimens owned by other investigators will be lent for examination at this Laboratory.

Optical Calculations.—For some years before the war extensive researches had been made into the methods employed in calculating optical systems. It is hoped before long to prepare for publication a systematic account of a number of the results already reached, which indicate that methods of calculation differing from those in general use can be very widely adopted with a great saving of time. Approximate methods of calculation have been tried in the past and abandoned, but the failure of any one system need not mean the failure of all systems resting on a similar basis. The question of success or failure appears to be largely determined by what may at first sight seem to be quite minor details in the application of approximate methods. It will be necessary to justify the new methods suggested for use by including a large number of fully worked examples illustrating applications to a considerable variety of optical problems.

Microscopes.—A number of requests have been made from time to time for certificates for microscope objectives, eye-pieces, and other apparatus. It is evident that the institution of regular tests of this kind, as distinct from the unsystematized tests hitherto made, would meet a generally felt want. As in the examination of many other optical instruments, such as high-class photographic lenses, the tests will only carry the necessary authority if they are made by admittedly expert workers.

Before the tests can be standardized it will be necessary to acquire typical specimens of the various objectives produced by different manufacturers at home and abroad. In some cases the qualities of objectives are largely a function of the price at which they are sold, and it is not altogether justifiable to demand the same standard from expensive and cheap objectives having approximately the same fundamental properties. Additions are also required to the microscope equipment of the department for general laboratory work.



Standard London Microscope (manufactured by R. & J. Beck, Ltd., 1920).—The base of this microscope is on the so-called horse-shoe pattern, standing on three feet.

The pillar has a joint for inclination.

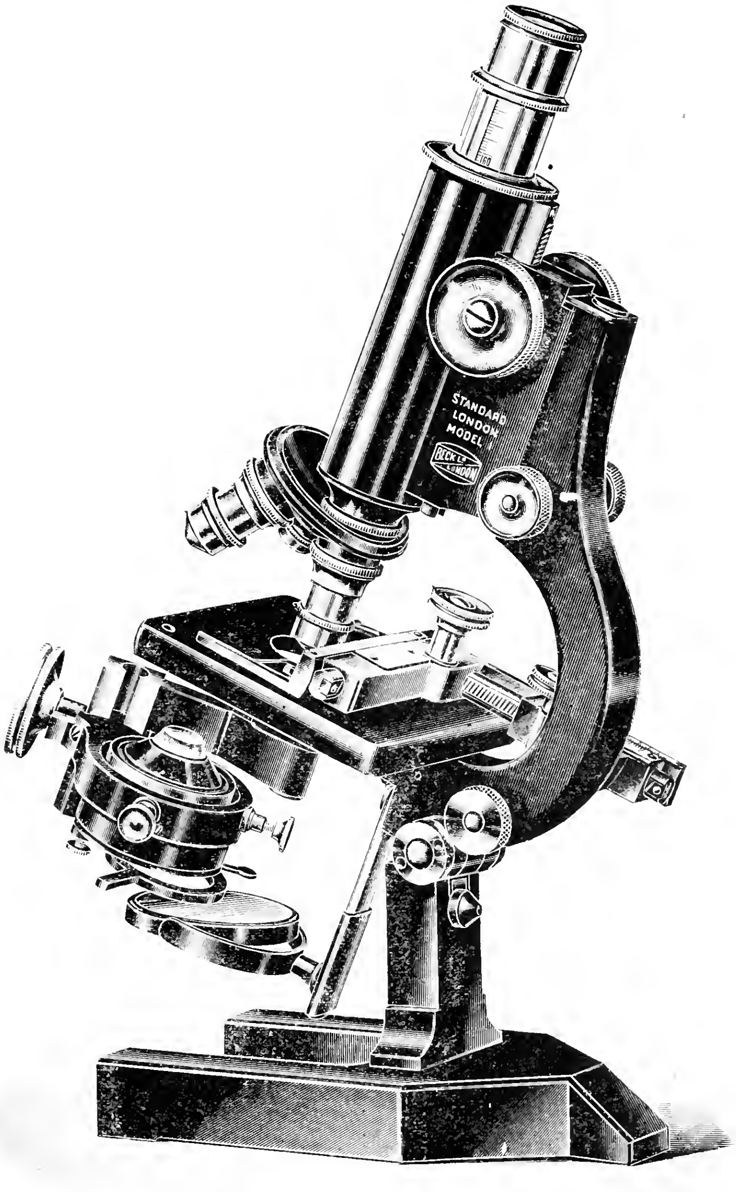
The stage is completely covered with ebonite and is 4 in. wide. The free distance from the optical centre to the limb is 3 in.

The mechanical stage is attached to the microscope by means of a bolt which passes through a hole provided for the purpose in the limb of the instrument. It has slightly over 1 in. vertical and 2 in. horizontal travel, each provided with divided scales.

The draw tube is nickel-plated, and is divided in millimetres, enabling any tube length between 140 and 200 mm. to be used.

The coarse adjustment is by means of spiral rack and pinion, cut on specially made machines to secure accurate and smooth running teeth.

The fine adjustment is on a new patented design in which both milled heads are upon the same axis, but the whole of the complicated cams and worm wheels generally adopted for side slow motions are dispensed with, and the movement is imparted by the point contact of a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screw upon a lever. The milled head on one side moves the body at twice the speed of that on the other, so that either a moderately fine or a superlatively fine adjustment can be used. The friction is so slight that the delicacy obtained only by a lever and point contact motion is secured. One of the milled heads is divided in $\frac{1}{100}$ of a millimetre for measuring thickness.

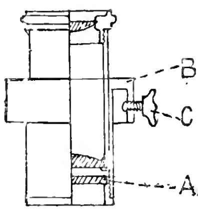
The mirror is 2 in. in diameter, and is plane on one side and concave on the other, mounted on a swinging arm on which it slides up and down for focusing.

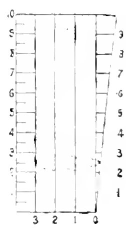
The substage is made to the standard 1·52 in. diameter.

A possessor of a Standard London Microscope in its simplest form with only a tubular substage can, at any time, obtain one of the different substages together with full instructions for fitting, and can attach it himself with the aid of a screw-driver.

Beck Micrometer Eye-piece.—This consists of a complete eye-piece with a magnifying power X8, and a special vernier millimetre scale A (see diagram) placed in its focus, which is outside the lenses.

It is provided with a collar B, which fits over the draw tube and can





be clamped in position by a milled head C. The eye-piece itself can be focused up and down by revolving it in its fitting till the scale A is in exact focus for the observer's eye.

The scale (see diagram) is in millimetres with a vernier reading to $\frac{1}{10}$ of a millimetre.

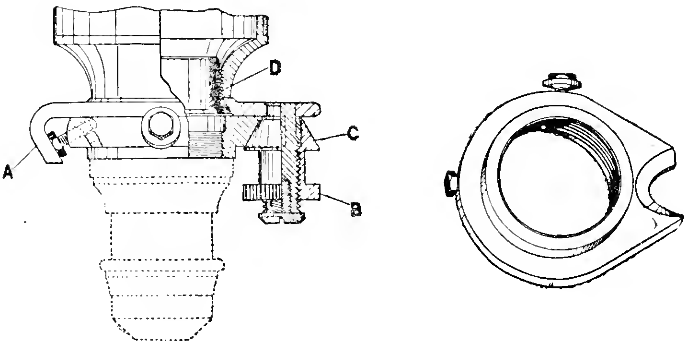
On the left is a vertical series of divisions divided in half-millimetres for rough measurement. For fine measurement the object to be measured is placed in a horizontal position, or the eye-piece scale turned round, and the length is measured in $\frac{1}{10}$ millimetre by use of the slanting line on the right. The image of an object as shown in the diagram measures 3·25 millimetres, because it covers three large divisions and extends to the oblique line at a point halfway between the 0·2 and 0·3 of tenth millimetre vernier divisions.

To obtain the actual size of the object itself this result has merely to be divided by the initial magnifying power of the object glass, which is engraved on each object-glass.

In cases where great accuracy is required each object glass can be verified as to its initial magnifying power by the use of a stage micrometer. For this purpose focus the scale of a stage micrometer carefully;

if $\frac{1}{10}$ of a millimetre now measures 2·5 millimetres in the scale with the correct tube length of 160 millimetres, and a particular object glass, the magnifying power of that object glass is 25.

Sloan Objective Changer.—This apparatus, which is patented, takes the place of the double or triple nose-piece, and has many advantages. It consists of an adapter which has on one side a sloping projection A with a bevelled nut C. The adapter is clamped to the nose-piece of the microscope by a screwed ring D, which is provided with stop, into which



a halfpenny will fit, for tightening it up, and a series of loose fittings, one of which is screwed on to each object glass.

These can be readjusted by means of a spanner supplied for that purpose, so that each lens can be centred with an accuracy that is never possible with a revolving nose-piece. The object glasses can be interchanged almost as rapidly as turning a revolving nose-piece.

(3) Illuminating and other Apparatus.

A New Microscope Illuminator.—The device, patented by Alexander Silverman, which is here described has already come into extensive use in the United States.

The lamp consists of a $\frac{1}{4}$-in. glass tube containing a single tungsten filament. The tube is bent into a circle of 1-in. inside diameter and $1\frac{1}{2}$-in. outside diameter. It is made of colourless or blue (daylight) glass, and silvered so that light is reflected downward from the circular source to the object being examined.

The lamp is operated at 0·9 ampere and 13·5 volts for visual work, and 1·06 ampere and 18 volts for photographic work. Current from an ordinary lighting circuit is utilized and controlled through a special rheostat (fig. 1) which contains a push-button switch for the lower current and a spring contact for the higher one.

An automatically adjustable support (fig. 2), provided with three iris-like fingers, controlled by springs, is attached concentrically about the objective. The lamp is held to the underside of the support by two curved prongs and a perforated spring clip which slips over the exhaust-protuberance of the lamp. The terminal wires from the lamp are attached to binding posts which are so constructed that they will also receive the brass pegs attached to the cord coming from the rheostat. These pegs may be inserted vertically or horizontally.

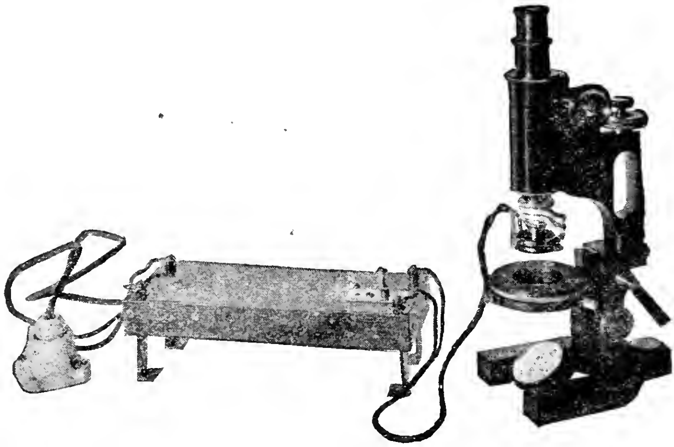


Fig. 1.

For general observation the lower portion of the lamp is in a plane with the flat face of the objective-lens, but it may be raised or lowered to meet the needs of the operator.

While the lamp-holder is clamped directly to the objective on

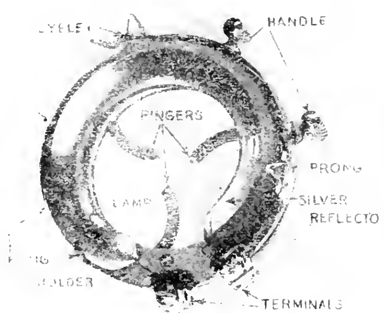


Fig. 2.

monocular (fig. 1) and single-objective binocular microscopes when 16 mm. or higher power objectives are employed, a stage support (fig. 3) is provided for use with low power objectives and double objective binocular microscopes. Lateral adjustment of the stage adapter centres the light, and vertical adjustment enables the operator to keep the lamp at a constant distance from the object under examination.

A shutter (fig. 4), which slips inside the lamp circle, may be placed under the lamp to cut off the light from one half of the circle so as to produce shadows where these prove desirable. Where depth without shadows is desired the shutter is unnecessary.

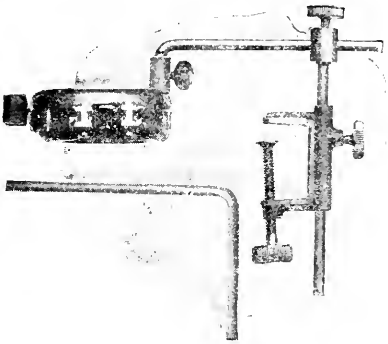


FIG. 3.

The absorption disk is a dull black disk (fig. 5) for covering highly polished surfaces, so that only the small portion under examination is exposed to the light.

For photomicrographic work the illuminator is attached as already described and the camera employed without lenses except those contained in the objective and ocular.

Excellent results have been obtained with low-power objectives from

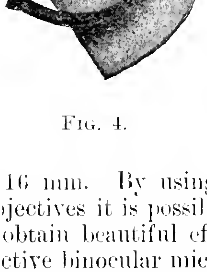


FIG. 4.

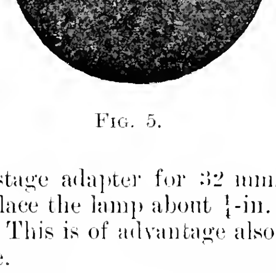


FIG. 5.

60 mm. to 16 mm. By using the stage adapter for 32 mm. and less powerful objectives it is possible to place the lamp about ¼-in. from the object and obtain beautiful effects. This is of advantage also with the double objective binocular microscope.

The illuminator has proven satisfactory for oil-immersion work with a 1·8 mm. objective and 15x ocular (1425 diameters). The markings on diatoms and structure of fine-grained alloys show clearly.

To allay any fear concerning the heat radiated or conducted from the lamp, it may be stated that the lamp was attached to various objectives and run continuously at 100 p.c. over-voltage for more than half an hour without doing any harm to the objectives. Dr. E. M. Chamot, of Cornell University, conducted an independent series of experiments in which he drilled a hole in the side of the objective, inserting a small pyrometer tube between the lenses. He burned the lamp continuously over long periods and pronounced it harmless.

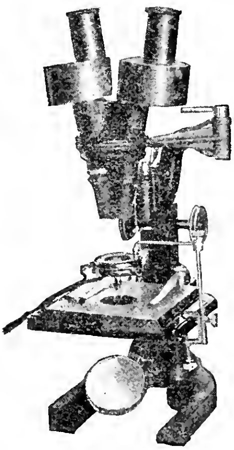


FIG. 6.

The Contrast Sensibility of the Eye as a Factor in the Resolving Power of the Microscope.—F. E. WRIGHT. The following summary is reprinted from the *Journal of the Optical Society of America*, 1919, **2–3**, Nos. 3–6, May–November. Attention is directed to three factors which are of importance in high-power microscope work, namely—(*a*) the use of a polarizing prism to eliminate that part of the field light which does not contribute to the diffraction pattern in the image, and hence tends to reduce the contrast and to decrease the sharpness and crispness of the image. This phenomenon arises because diffracted beams which emerge from gratings whose interval is of the order of magnitude of half-a-wave length of light are sensibly polarized in a plane normal to the lines of the grating. (*b*) A diaphragm of the rectangular type is recommended for use in the image plane of the eye-piece in order to cut out all light except that from the particular object under examination. This device allows the eye to work at best efficiency because it is not disturbed by extraneous light. For the same reason the writer uses a soft rubber eye-shield fitted to the microscope to cut out extraneous light from the sides. Rubber eye-shields of this kind have been employed by the Army and Navy for many years on fire-control and other observing instruments. A dark screen or curtain of velvet is also suspended between the observer and the strong source of light and shields his eye from the intense rays which fatigue them quickly. (*c*) The importance of a field intensity of illumination approaching that of daylight and best adapted for the eye at any particular time is emphasized: the simplest method for securing this is by means of a substage polarizer which can be rotated, and with it the intensity of illumination of the field varied.

These factors are not important for ordinary observations, because the resolving power there required is not great: but in high-power, critical work they are significant and enable the observer to accomplish with comparative ease that which under other conditions is a matter of difficulty.

J. E. B.

METALLOGRAPHY.

Defects arising in Steel during Fabrication.—AUSTIN R. WILSON (*Chemical and Metallurgical Engineering*, Dec. 22, 1920, **23**, No. 25). Microscopic appearances caused by surface defects, cold-working, overheating, and burning. Nuclei of fatigue fractures are associated with phosphorus bands. Photographs of changes in structure during annealing of steel castings are also given.

Effect of Iron on Brass.—O. SMALLEY (*Metal Industry*, Nov. 26, 1920, **17**, No. 22). The author concludes that small quantities of iron improve the hardness and strength and shock-resisting properties of brasses, and discusses its effects upon the working of both cast and wrought brass.

Polarized Light in the Study of Ores and Metals.—F. E. WRIGHT (*Proc. Amer. Phil. Soc.*, 1919, **58**).

Examination of Ores and Metals in Polarized Light.—F. E. WRIGHT (*Mining and Metallurgy*, 1920, No. 158).

Metallography of Arc-fused Steel.—HENRY S. RAWDON, EDWARD C. GROESBECK, and LOUIS JORDAN (*Chemical and Metallurgical Engineering*, Oct. 20, 1920, **23**, No. 16). Various lines of investigation are utilized to support the idea that microscopic "plates" existing in fusion welds are due to nitrogen; that the plates are very persistent, and are not responsible for the low ductility of the metallic piece.

Diffusion of Solid Copper in Liquid Aluminium.—ROBERT J. ANDERSON (*Chemical and Metallurgical Engineering*, Sept. 22, 1920, **23**, No. 12). Details of experiments where copper rods were dipped in molten aluminium under definite conditions, and the resulting alloy analysed. Filiation experiments also were made in various ways, all giving nearly the same results.

Manufacture of Rich Copper : Aluminium Alloys or Hardeners.—ROBT. J. ANDERSON (*Chemical and Metallurgical Engineering*, Sept. 29, 1920, **23**, No. 13). Describing the methods in use in aluminium foundries of the United States for manufacturing rich alloys of copper and aluminium, and details of experiments carried out for the purpose of comparing different methods.

Quenching of Carbon Steels.—PORTEVIN and GARVIN (*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, May–June, 1920). This study deals mainly with the conditions under which troostite and martensite are formed. F. I. G. R.

Relationship between Dendritic Structure and Ferrite Mesh.—F. GIOLITTI (*Chemical and Metallurgical Engineering*, May 19, 1920, **22**, 921–9). These investigations were made upon a 2 p.c. open-hearth nickel steel. Both the position and the form of the ferrite elements appear to be wholly independent of the position, and also the state, of the system of dendrites. Microphotographs accompany the paper. F. I. G. R.

Microstructure of Malleable Cast-iron in relation to its Behaviour under Stress.—R. STOTZ (*Stahl und Eisen*, July 29, 1920, **40**, 997–1002). The appearance of the fracture when subjected to microscopical examination is described, in the case of both correctly and incorrectly manufactured specimens. F. I. G. R.

Oblique Fracture in Steel, and Segregation.—P. OBERHOFFER (*Stahl und Eisen*, June 20, 1920, **40**, 705–13, 872–8). The author considers the form of fracture to be due to local accumulations of phosphorus. Segregation and means of revealing it by different etching re-agents are discussed, and some particularly interesting microphotographs are appended. F. I. G. R.

Effect of the Addition of other Metals on the Plasticity of Nickel Steel.—C. E. GUILLAUME (*Comptes Rendus*, June 28, 1920, **170**, 1433). The effect is described of varying proportions of manganese, chromium, and carbon in nickel steel of known nickel content. F. I. G. R.

NOTICES OF NEW BOOKS.

Report of the Inquiry Committee on the Standardisation of the Elements of Optical Instruments. London: Published for the Department of Scientific and Industrial Research by His Majesty's Office. 1920. Price 1s. net.

The question of standardisation of the elements of optical instruments, the need for which was made evident by experience during the war, was first brought to the attention of the Sub-Committee on Standardisation of the Elements of Optical Design of the Standing Committee on Glass and Optical Instruments by members representing the Ministry of Munitions, the War Office and the Admiralty. Previous to the appointment of the Committee on Standardisation, a *questionnaire* was addressed to the principal manufacturers of optical instruments, twenty-three in number, in order to ascertain their opinions on the subject generally, and on the following subjects in particular:—Units of measurement; diameters, focal lengths and radii of curvature of lenses; small screws; screw threads for cells and tubing; diameters of tubes, rods and wire; thicknesses of sheet metal; shafts and holes; racks and pinions.

The replies of the manufacturers indicated great diversity of practice, and showed generally that standardisation would be welcomed by them. The chief objects of the Committee have been to reduce to a reasonable minimum the existing great variety of sizes of some of the components of optical instruments, and to appoint limiting dimensions so as to secure, among components of the same nominal size, real interchangeability and reasonable closeness of fit. The present Report is confined to certain subjects selected by the representatives of the Admiralty, War Office and Air Ministry as being most urgent in connexion with the redesigning of Service instruments in the light of experience during the war, but it is applicable to other optical instruments. J. E. B.

The Microscope: An Introduction to Microscopic Methods and to Histology. By Simon Henry Gage. 1920. x + 474 pp. 13th edition. Published by the Comstock Publishing Co., Ithaca, New York.

The Growth and Shedding of the Antler of the Deer. By William Macewen, F.R.S. 1920. xviii + 110 pp. Published by Maclehose, Jackson and Co., Glasgow. Price 10s. 6*d*. net.

The Microscope in the Mill. The Formation, Chemistry, and Pests of Corn, Meal and Flour. By James Scott. 1920. x + 246 pp. Published by the Northern Publishing Co., Ltd., 17 Goree Piazzas, Liverpool.

An Introduction to the Chemistry of Plant Products. Vol. I., On the Nature and Significance of the Commoner Organic Compounds of Plants. By Paul Haas and T. G. Hill. 1921. 3rd edition. xiv + 414 pp. Published by Longmans, Green and Co., 39 Paternoster Row, E.C.4. Price 16s. net.

The British Fresh-water Rhizopoda and Heliozoa. Vol. V., Heliozoa. By G. H. Wailes. 1921. xii + 72 pp. and 10 pls. Published by the Ray Society.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W., ON WEDNESDAY, OCTOBER 20TH, 1920, PROFESSOR JOHN EYRE, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of twelve candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows of the Society :—

Mr. Richard Siddoway Bagnall, F.R.S.E., F.L.S.
Mr. James Bronté Gatenby, B.A., B.Sc., Ph.D.

A Donation was reported from Mr. W. M. Bale (Australia) of a Collection of Slides (Hydroids, etc.), and a hearty vote of thanks was accorded to the Donor.

The Deaths were announced of :—

Mr. Frank W. Lacy—Elected 1917.
Mr. Francis E. Robotham—Elected 1916.
Mr. Wynne E. Baxter—Elected 1890.

The President referred to the services rendered to the Society by Mr. Wynne Baxter, who was elected a Member of the Council in 1903, and served as Honorary Treasurer from 1903 to 1913.

A paper by **Professor G. H. Bryan, F.R.S.**, entitled "A Polariscope for Dissecting and Pocket Microscopes," was read, and will be published in the Society's Journal.

An Exhibition was then given, illustrating the use of polarized light in microscopical work.

Mr. Scourfield said that in suggesting this exhibition he had hoped that they would not only have examples of the use of polarized light in the study of rocks, minerals and other inorganic substances, but also a very full demonstration of its value in connexion with organic structures. Although the exhibition in this respect was by no means complete, he thought that it did show very clearly that polarized light was a most useful aid to research in the organic world. It might not always be possible to find out absolutely new structures by its means, but it often put one on the track of things that would otherwise be overlooked, or gave a new significance to well-known details. He thought that work with high powers and a very strong light in conjunction with the polariscope would probably open up a very fruitful line of research. For instance, in examining *Volvox* in this way he had noticed that the red eye-spots of the individual green cells show out like so many little glow-lamps, probably indicating a very definite specialized structure in addition to the pigment. The eye-spots in other forms of the Volvocaceæ, such as *Chlamydomonas*, he found to behave in the same way. In many Desmids strong polarized light with high magnification revealed myriads of bright granules often arranged in characteristic ways. In a species of *Pleurotænium* he had seen the cell sap charged with minute scintillating particles, not uniformly distributed, but massed at different spots, in one case ending abruptly about half way along a semi-cell as if retained by a septum. It was just possible that this was a very early indication of approaching cell division not recognizable at that stage in any other way.

Mr. Scourfield also read extracts from letters he had received from Mr. Ashe and Mr. Wycherley, who were unfortunately unable to be present, giving many examples of the way in which they had found the use of polarized light helpful in their work, especially in the examination of foodstuffs, drugs, fibres used in paper manufacture, etc.

Exhibits were made by

F. Addey . . .	Transverse section of leaf of *Hakea*, showing columnar sclerides.
M. A. Ainslie . .	Resolution of fine Diatom structure, *Nitzschia singalensis*, 117,000 transverse striæ per inch; practically unresolvable in styrax without polarized light.
S. C. Akehurst . .	Wing case of Beetle, *Dichirotrichus pubescens*, showing rows of tiny medallions with characteristic black cross.
W. E. Watson Baker .	Various rock and mineral sections, chemical substances, etc.
F. E. Cocks . .	*Melicerta ringens.*
E. Cuzner . . .	Coumarin, Platino-cyanide of Yttrium.

B. K. Johnson	. .	Section of Granite. Polarizer made of a 3 in. by 1 in. slip, with black varnish on one side stuck on to mirror.
C. H. Oakden	. .	Crystals of Quinol.
F. A. Parsons	. .	Crystals of Oxalurate of Ammonia.
J. H. Pledge	. .	Leg of Cockroach showing muscles.
F. I. G. Rawlins	.	Various rock sections.
F. Rowley .	. .	Section of Norite showing good Felspars.
W. Russell	. .	Raphides of Daffodil leaf.
D. J. Scourfield	. .	*Volvox aureus*, showing eye-spots glowing like little lamps.
W. R. Traviss	. .	Platino-cyanide of Barium.
J. Wilson .	. .	*Leptodora hyalina*, showing muscles.
G. W. Young	. .	Section of Labradorite in Basalt, also Radula of Whelk.

Various objects were also shown with polarized light by means of the projection lantern, and a hearty vote of thanks, proposed from the Chair, was accorded to those gentlemen who had assisted in the exhibition.

The President announced that the next meeting of the Biological Section would be held on Wednesday, November 3, when Dr. A. H. Drew would give a practical demonstration of microscopic technique.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT No. 20 HANOVER SQUARE, W., ON WEDNESDAY, NOVEMBER 17TH, 1920, PROFESSOR JOHN EYRE, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of twelve Candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows of the Society :—

Mr. Frederick Adams, M.Inst.C.E.
Mr. James J. G. Bates.
Mr. Philip G. Bradford, A.M.I.Mech.E.
Mr. H. M. Carleton, B.A.
Mr. Eryk Hayman Cathcart.
Mr. William G. Collins.
Mr. W. J. S. Herbert.
Mr. W. Basil Hill, F.C.S.
Mr. Alfred Hutchinson, M.A., B.Sc.
Mr. John William Ware.
Mr. Tidde Westerdyk.
Mr. Karl George Zwick, Ph.C., Ph.D., M.D.

Professor J. R. Partington read a paper on "The Reduction of Osmic Acids by Lipoids," contributed by himself and **Mr. D. B. Huntingford.** The paper will be published in the Society's Journal.

Mr. E. J. Sheppard read a paper on "A New Method of Treating and Mounting Celloidin Sections."

Very hearty votes of thanks to the authors of the foregoing papers were proposed from the Chair and carried by acclamation.

The President announced that the next Meeting would be on December 15, when a Conversazione would be held at the Mortimer Halls; that the Biological Section would meet on December 1, when Commander Ainslie would make a communication on "The Correct Microscopical Image," and that the Section would pay a visit to the Cancer Research Laboratory on December 8, by the kind invitation of the Director, Dr. J. A. Murray.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT THE MORTIMER HALLS, W., ON WEDNESDAY, DECEMBER 15TH, 1920, MR. RADLEY, VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

The nomination papers were read of ten Candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows of the Society :—

Mr. Ernest W. Bowell, M.A., M.R.C.S., L.R.C.P.
Mr. John Marsh Burns.
Mr. J. Thornton Carter, F.Z.S.
Mr. D. C. L. Derry.
Mr. Fini G. A. Enna.
Mr. John Hepworth, M.R.C.S., L.R.C.P.
Mr. Alfred Edward a'Court Hudson.
Mr. James Gordon Parker, Ph.D., F.I.C.
Mr. Herbert Charles Whitfield.
Mr. Clarence Wright.

Mr. Hiscott and **Mr. Mortimer** were elected Auditors for the ensuing year.

The names of Fellows nominated for election to the new Council were read.

The business proceedings then terminated.

The Meeting was held during the Society's

CONVERSAZIONE

at the Mortimer Halls, Mortimer Street, W.1

A Reception was held by the **President**, Professor Eyre, from 7.45 to 8.15.

General Exhibits were shown by—

F. Addey.—Longitudinal Section of first year ovule of *Pinus sylvestris.*
S. C. Akehurst, F.R.M.S.—Mayfly (Ephemeridæ).
G. P. Bate, M.D., F.R.M.S.—Eyes of Insects and Spiders (Opaque).
Charles Baker.—Latest Pattern Microscopes and Accessories.
R. & J. Beck, Ltd.—Standard London Microscopes, showing Test Podura Scales, and other Microscopical Apparatus.
C. H. Bestow, F.R.M.S.—Spicules of *Synapta.*
A. J. Bowtell.—Larvæ of *Trichina spiralis*, encysted in human muscle.
British Drug Houses Ltd.—Microscopical Stains.
Miss Brooks.—Drawings of Microscopical Objects.
W. G. Collins, F.R.M.S.—Ebonite—Transparent Sections—and Photomicrographs of Slides.
J. Bronté Gatenby, B.Sc., D.Phil.(Oxon), F.R.M.S.—Insect Parasites.
C. E. Heath, F.R.M.S.—Arachnoidiscus on Weed (Dark-ground Illumination).
E. Heron-Allen, F.R.S., F.R.M.S., and A. Earland, F.R.M.S.—Foraminifera.
W. J. Ireland, F.R.M.S.—Muscle Structure in Insects (Polarized Light).
A. Morley Jones.—Diatomaceæ.
H. C. Lancaster, F.R.M.S.—Metallurgical Specimens—Non-ferrous Alloys.
J. R. Leeson, M.D., F.R.M.S.—*Spironema pallidum* (Organism of Syphilis).
W. J. Marshall, F.R.M.S.—Auditory Organs of Cricket.
E. R. Newmarch.—Chemical Crystals, etc. (Polarized Light).
C. H. Oakden.—Living Cheese Mites.
J. Rheinberg, F.R.M.S.—Graticules, Eye-piece and Stage Micrometers, etc.
Frank Rowley, F.R.M.S.—Insects Eggs (Opaque; Binocular); Diatoms (High-power Binocular).
H. A. St. George.—Opal-eyed Spider: also Disintegrated Roman Glass.
E. J. Sheppard, F.R.M.S.—Mitosis.
H. Taverner, F.R.M.S.—Stereo Colour Photographs of Water-Mites.
C. Tierney, M.S., D.Sc., F.R.M.S.—*Spironema pallidum* in tissue.
G. Tilling, F.R.M.S.—The Ruby-tailed Fly, *Chrysis ignita* (Chrysididæ).
W. R. Traviss.—Eyes of Jumping Spider.
W. Watson & Sons, Ltd.—Microscopes and Accessories, and Various Forms of Illumination.
C. L. Withycombe.—Early Stages of some Marine Animals: Pluteus Larvæ, Zoëæ, etc.
S. R. Wycherley, F.R.M.S.—Marine Algæ.

Demonstrations were given by—

Professor John Eyre on "Blood Grouping."
Dr. T. Skene Keith on "Bacteriological Staining Methods."
Mr. F. Welch with the Microscopical Projection Apparatus.

Pond Life Exhibits were shown by the following FELLOWS OF THE SOCIETY and Members of the QUEKETT MICROSCOPICAL CLUB—

M. BLOOD, F.R.M.S.
H. G. CANNON, F.R.M.S.
F. E. COCKS.
T. N. COX.
A. J. CURWEN.
B. S. CURWEN.
MISS A. DIXON, F.R.M.S.
A. J. FRENCH.
G. FRYER.
H. GOULLEE.
H. F. GREEN.
J. T. HOLDER.
J. J. JACKSON.
H. J. LAWRENCE.
A. E. McCLURE.
E. R. MARTIN.
E. K. MAXWELL.
H. H. MORTIMER, F.R.M.S.
J. C. MYLES.
E. R. NEWMARCH.
J. M. OFFORD, F.R.M.S.
R. PAULSON, F.R.M.S.
F. J. W. PLASKITT, F.R.M.S.
J. RICHARDSON, F.R.M.S.
W. RUSSELL.
D. J. SCOURFIELD, F.R.M.S.
R. S. W. SEARS, F.R.M.S.
C. D. SOAR, F.R.M.S.
B. J. THOMAS.
G. TILLING, F.R.M.S.
C. TURNER.
J. WILSON, F.R.M.S.
C. L. WITHYCOMBE.

Photomicrographic Exhibits were shown by the following Members of the PHOTOMICROGRAPHIC SOCIETY—

A. W. ALDIS.—Photomicrographs.
W. H. BADDELEY.—Microscope and Objects, Photomicrographs and Transparencies.
W. R. BISS.—Photomicrographic Camera.
J. G. BRADBURY.—Photomicrographic Camera, Microscope, Prints and Transparencies.
E. M. BULL.—Microscope, and Geological Specimens and Prints.
C H. CAFFYN.—Ditto, ditto.
E. CUZNER, F.R.M.S.—Microscopic Marine Studies and Stereoscopic Transparencies of the Same
F. MARTIN DUNCAN, F.R.M.S.—Photomicrographs.
D. J. REID, M.B., F.R.M.S.—Microscope and Objects, and Photomicrographs.
J. M. SIERRA.—Ditto, ditto.
H. C. WHITFIELD.—Photomicrographic Projection Apparatus.

An Exhibit of Early Microscopes was shown, comprising types of Simple and Compound Microscopes up to the year 1750 from the collection of the Royal Microscopical Society, with objects as then mounted with the original objectives; illustrated by contemporary books and pamphlets.

The Nickolds Quartette, under the direction of Mr. A. H. Nickolds, gave Selections during the evening.

THE ANNUAL MEETING

OF THE SOCIETY WAS HELD AT NO. 20 HANOVER SQUARE, W., ON WEDNESDAY, JANUARY 19TH, 1921, PROFESSOR JOHN EYRE, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of seven Candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows of the Society :—

Captain Arthur Angers, A.M.I.E.E.
Mr. P. Y. Bharadwaja, M.Sc., M.R.A.S.
Mr. John H. V. Charles.
Mr. Walter C. Crawley, B.A., F.E.S.
Mr. E. M. Cutting.
Mr. J. T. Holder.
Mr. Henry G. de Lazlo.
Mr. W. A. Poyser.
Mr. Frank L. Seymour-Jones.
Mr. John T. R. Wildman.

A Donation of a Collection of Metallurgical Specimens was reported from Dr. Stead.

On the motion of the **President**, a very hearty vote of thanks was accorded to Dr. Stead for his valuable gift to the Society.

THE ANNUAL REPORT of the Council for 1920 was read as follows :—

FELLOWS.

During the year 58 Ordinary Fellows have been elected and 1 reinstated. Six deaths have been reported, 7 Fellows have resigned and 1 has been removed from the Roll.

The number of Fellows at the end of the year 1920 was as follows :—

Ordinary	461
Honorary	17
Ex-officio	69
Corresponding	1
	549

Of the Ordinary Fellows—

380 have paid the annual subscription.
36 have compounded.
6 have had subscriptions remitted.

The deaths reported above were those of—

Mr. Wynne E. Baxter. Elected 1890.
Mr. John Davis. Elected 1875.
Mr. William Gadd, C.E. Elected 1889.
The Hon. Thomas Kirkman. Elected 1898.
Mr. Frank Lacy. Elected 1917.
Mr. Francis E. Robotham. Elected 1916.

Mr. Wynne E. Baxter, who was elected in 1890, became a Member of the Council in 1903, and was elected Treasurer in 1906, serving in that capacity until 1913. The Society owes much to his energy and continued active interest in its affairs.

FINANCE.

The Revenue Account shows the excess of the expenditure over income as £280. Since the valuation of the Society's securities last year, these have suffered a further depreciation of £177, and this amount has therefore been written off the Investment and Capital Account. The Investment Account, therefore, now stands at £1,636.

During the year two life membership fees have been received, and these have been placed to the credit of the Life Membership Account, which now stands at £181 2*s.* 6*d.*

Compared with last year the income of the Society shows a net increase of £68, but the net expenditure has advanced by £349, the cost of the publication of the Journal alone being increased by £200.

Fellows of the Society will realize that it is impossible to meet post-war expenses with pre-war subscriptions—unless the membership is greatly increased. The reputation and success of the Society largely depend on the maintenance of the quality of the Transactions, and for this reason the Council is anxious to avoid the necessity of further reducing the volume of Transactions.

The extra commitments for the year 1921 are likely to be heavy, as, in addition to other necessary items, the Council wish to commence printing a catalogue of the instruments and accessories.

The Council has had under serious consideration the advisability of increasing the subscriptions, but have deferred taking action at the present time in the hope that during the coming year the steady increase of subscription and admission fee income will enable the Society to balance its expenditure account.

It has, therefore, been decided to open a voluntary fund to meet this year's deficit, and all Fellows are invited to subscribe at least 20*s.* to this fund. A copy of this report and a special letter will be sent to all Fellows.

Dr. INCOME AND EXPENDITURE ACCOUNT

Dec. 31, 1919. £ s. d.		£ s. d.	£ s. d.	£ s. d.
155 5 0	To Rent and Insurance . .			164 18 6
254 7 6	,, Salaries and Reporting . .			292 16 11
	,, Sundry Expenses—			
29 0 2	Library, Books and Binding		72 19 3	
85 19 7	Stationery, Printing, etc. .		100 16 2	
	Cleaning Library and Repairs		13 1 6	
32 2 0	Petty Expenses and Postages		41 8 1	
				228 5 0
	,, Journal—			
	Expenditure—			
	Printing	875 7 9		
	Editing and Abstracting .	73 4 0		
	Illustrating . . .	23 0 0		
	Postages, etc. . .	34 7 6		
			1005 19 3	
	Less Receipts—			
	Sales	390 5 11		
	Advertisements . .	116 1 10		
			506 7 9	
310 12 8				499 11 6
	,, Expenses of Conversazione .		32 17 6	
	,, Symposium . . .		41 3 9	
35 6 9				74 1 3
10 10 0	,, Donation to Board of Scientific Societies			5 5 0
2 16 7	,, Balance, being excess of Income over Expenditure			
916 0 3				£1264 18 2

Dr. BALANCE

Dec. 31, 1919. £ s. d.	Liabilities.	£ s. d.	£ s. d.	£ s. d.
	To Sundry Creditors—			
	Subscriptions paid in Advance		37 5 6	
	On A/c Journal Printing, etc.		365 2 6	
	,, Sundry A/cs outstanding		18 15 0	
364 2 7				421 3 0
	,, Life Membership (1917 A/c) .		118 2 6	
	Add Life Membership Fees received in 1920 . .		63 0 0	
118 2 6				181 2 6
	,, Capital Funds—			
2023 2 3	Balance as per last A/c .	2023 2 3		
	Less Depreciation of Society's Investments . . .	177 0 0		
			1846 2 3	
	Less Excess of Expenditure over Income for year .		280 18 4	
				1565 3 11
2505 7 4				£2167 9 5

(Signed) C. F. Hill, *Hon. Treasurer.*
17*th Jan.*, 1921.

Dec. 31, 1919. £ s. d.		£ s. d.	£ s. d.
	By Subscriptions (excluding Life Members' Fees)	699 4 3	
	,, for year 1920, unpaid . .	37 16 0	
682 15 5			737 0 3
77 14 0	,, Admission Fees		115 10 0
35 15 8	,, Sundry Sales		6 2 2
119 15 2	,, Interest on Investments and Deposit A/c .		125 7 5
	,, Balance being Excess of Expenditure over Income		280 18 4
916 0 3			£1264 18 2

SHEET. Cr.

Dec. 31, 1919. £ s. d.	Assets.	£ s. d.	£ s. d.
	By Cash—		
150 0 0	On Deposit A/c	—	
86 2 11	On Current A/c	55 12 7	
3 2 5	On Petty Cash A/c	5 18 9	
			61 11 4
	,, Sundry Debtors—		
	Subscriptions unpaid	37 16 0	
	On A/c Journal Sales	192 8 7	
	,, ,, Advertisements . .	43 5 0	
259 16 6			273 9 7
	,, Investments at Valuations, Dec. 31, 1919—		
	£400 North British Railway 3 % Deb.		
	£500 Nottingham Corporation 3 % Deb.		
	£915 India 3 % Deb.		
	£150 Metropolitan Water Board 3 %		
	£421 War Loan 5 %		
	£612 Caledonian Railway No. 1 Pref. .	1813 0 0	
	Less Depreciation	177 0 0	
1813 0 0			1636 0 0
18 16 0	,, Stock of Screw Gauges, Valued at . .		7 5 0
	,, Property Account, as per last Balance Sheet	174 9 6	
	Add Purchased during year	14 14 0	
174 9 6			189 3 6
2505 7 4			£2167 9 5

We have examined the accounts as above set forth, and have verified the same with the books, vouchers and securities belonging to the Society, and, in our opinion, the Balance Sheet is properly drawn up so as to exhibit a true and correct view of the Society's affairs, but no account has been taken of the value of the Society's Library, Instruments and Stocks of Journals (valued for Insurance at £3500).

(Signed) T. H. HISCOTT,
H. H. MORTIMER, } *Hon. Auditors.*

JOURNAL.

For some years past, owing to the adverse conditions prevailing, it was found impossible to produce the Parts of the Journal during the months for which they were dated. Your Council is pleased to report that the current Part was issued in good time, and it is hoped that no delay will occur in the publication of future Parts.

The Council wishes to thank most cordially the Editors, Abstractors and Contributors for their valuable and much appreciated work during the past year.

LIBRARY.

During the year 117 volumes have been borrowed from the Library by Fellows of the Society, in addition to 19 volumes that have been obtained from Lewis's Library for their use.

Donations to the Library have been received from—The British Museum, The Cambridge University Press, Mr. E. Heron-Allen, Messrs. Methuen & Co., Ltd., Mr. P. E. Radley, Dr. E. J. Spitta, and Messrs. W. Wesley & Son.

INSTRUMENTS AND APPARATUS.

The Instruments and Apparatus belonging to the Society are in excellent condition.

During the year the Society has received the following donations:—

Mr. C. D. Soar:—A Microscope.
Major T. C. Squance:—Three Microscopes.

A large amount of work has been done during the year by Mr. W. E. Watson Baker and Mr. C. F. Hill in the preparation of a Catalogue of the Society's Collection. The thanks of the Society are due to those gentlemen for their valuable services.

GAUGES.

Early in the year the Committee of Gauges, in conjunction with the Committee of Standardization of Limits of Optical Instruments of the Department of the S. and I. Research, fixed the limits for eye-piece and eye-piece fittings of Microscopes. A full report will be found on p. 127 of the R.M.S. Journal, 1920.

CABINET.

During the year valuable additions to the Society's Cabinet have been received from:—

Mr. W. Bale:—A Collection of Slides (Hydroids, etc.).
Mr. C. T. Harris:—A Collection of Slides (Bryophyta).
Dr. E. Penard:—A Collection of Slides (Rhizopoda, etc.).

MEETINGS.

The Meetings of the Society have been well attended.

The papers have been of a varied and interesting character, and have been followed by useful discussion.

The **Biological Section,** which meets on the first Wednesday of each month, has had a most successful year. During the session a special visit was paid to the Cancer Research Laboratory by the kind invitation of the Director, Dr. J. A. Murray.

The thanks of the Society are due to Mr. J. Wilson for his continued energy and activity as Honorary Secretary of the Section.

LEATHER INDUSTRIES SECTION.

Owing to the active interest of Mr. Alfred Seymour-Jones, a new Section of the Society has been formed which will deal with Physiology, Mycology and Bacteriology in relation to the Leather Industries. The inaugural meeting was held in November, when Dr. S. H. Browning kindly undertook the duties of Honorary Secretary to the Section. It is hoped that during 1921 a great amount of useful and practical research work will be accomplished. It is anticipated that similar developments may be arranged in connexion with other important industries.

THE SYMPOSIUM.

In addition to the Ordinary Meeting in January a Symposium was held on the 14th of the month of which an account was included in last year's report. This Symposium was followed by special sectional discussions in Sheffield in February and in the Lecture Hall of the R.M.S. on April 21. A full report of the Symposium and the subsequent discussions has been issued as the concluding Part of the Society's Journal for 1920, and forms a very valuable work of reference to those epoch-making conferences.

A CONVERSAZIONE

was held on the 15th December at the Mortimer Halls. The exhibits were numerous and of a most interesting character, and the thanks of the Society are due to those Fellows of the Society and Members of the Quekett Microscopical Club and Photomicrographic Society whose assistance contributed to the success of the evening.

INSTITUTE OF PHYSICS.

During the year the Society has become a Participating Society in the newly formed Institute of Physics. Fellows are urged to enrol themselves as Members of the Institute. Arrangements are being made whereby Members of the Institute who are also subscribing Fellows or Members of other Participating Societies will be allowed a substantial reduction in the fees payable to such Societies. Other benefits of a far-reaching character are anticipated in the future.

MARINE BIOLOGICAL ASSOCIATION.

During August the R.M.S. table at the Plymouth Laboratory was placed at the disposal of Mr. A. Clavering Hardy, and some useful work was accomplished by that gentleman.

Mr. Marshall moved, and **Mr. Pledge** seconded, that the Annual Report and Balance Sheet be received and adopted. Carried.

Mr. Cuzner moved, and **Mr. A. W. Sheppard** seconded, that a very hearty vote of thanks be tendered to the Honorary Officers and Members of the Council for their services to the Society during the past year. Carried.

The President appointed Mr. Cuzner and Mr. Whitfield to act as Scrutineers, and afterwards announced the result of the ballot for the election of Officers and Council for the ensuing year as follows :—

President.—J. W. H. Eyre, M.D., M.S., F.R.S.Edin.

Vice-Presidents.—Sir George Sims Woodhead, K.B.E., M.A., M.D., LL.D., etc. ; Frederic J. Cheshire, C.B.E., F.Inst.P. ; Percy E. Radley ; David J. Scourfield, F.Z.S.

Treasurer.—Cyril F. Hill

Secretaries.—Joseph E. Barnard, F.Inst.P. ; James A. Murray, M.D.

Council.—Maurice A. Ainslie, R.N. ; S. C. Akehurst ; W. E. Watson Baker ; Aubrey H. Drew, D.Sc. ; F. Martin Duncan, F.R.P.S., F.Z.S. ; Arthur Earland ; E. Heron-Allen, F.R.S. ; T. H. Hiscott ; Julius Rheinberg ; E. J. Sheppard ; Clarence Tierney, M.S., D.Sc. ; Joseph Wilson.

Librarian.—F. Martin Duncan, F.R.P.S., F.Z.S.

Editor.—Charles Singer, M.A., M.D.

Curator of Instruments.—W. E. Watson Baker.

Curator of Slides.—E. J. Sheppard.

Curator of Metallurgical Specimens.—F. Ian G. Rawlins.

A vote of thanks to the Scrutineers was moved from the Chair and carried.

Mr. Scourfield exhibited a further selection from Dr. Penard's preparations of Rhizopoda and Heliozoa presented to the Society last year, and called attention to the great value of the Collection to those working on those groups.

The President then delivered his Presidential Address, "Twenty-five Years' Bacteriological Work : a Personal Retrospect."

Mr. Mortimer moved : "That the best thanks of this meeting be accorded to Professor Eyre for his Presidential Address, and that he be asked to allow it to be printed in the Journal of the Society."

Mr. E. J. Sheppard seconded the proposal, which was carried by acclamation.

The President announced that he had a very sad and at the same time a very pleasant duty to perform. For many years Mr. Scourfield had acted as Honorary Secretary to the Society. The Fellows knew Mr. Scourfield, and they loved him—(applause)—and he did not think there was a Member of the Council who had not tried to induce Mr. Scourfield to retain his position. But nothing would move him from his decision to retire. He had spent many years in doing what he could for the Society, and no man had its interests more at heart, or had done his work better. He had certainly earned his retirement. He was now going to devote his time to a special research work, and he (the President) was sure it was the desire of the Fellows to express their appreciation of all that Mr. Scourfield had done, and to wish him every success in any work he might undertake in the future—(applause).

Mr. Scourfield, in reply, said he hardly knew how to thank the Fellows for the kindly way in which they had received the remarks of the President. He had tried to do what he could for the Society, and it gave him great pleasure to know that his efforts had met with their appreciation. He was sorry to relinquish the duties, but he felt that he must have more spare time in which to do some original work.

The President announced that the next meeting of the Society would be held on February 16, and of the Biological Section on February 2, when Mr. E. Cuzner would make a communication on "Hydrozoa."

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W., ON WEDNESDAY, FEBRUARY 16TH, 1921, PROFESSOR JOHN EYRE, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of three Candidates for Fellowship.

New Fellows :—The following were elected Ordinary Fellows of the Society :—

Rev. W. Monaghan Coombes.
Mr. James Stretton Frith, A.I.C.
Mr. Reginald J. Ludford, B.Sc., F.R.H.S.
Mr. Edgar Ribton Newmarch.
Mr. C. L. Sahni, M.B., B.S.
Mr. J. M. E. Sierra.
Captain Henry Francis Stobart.

Donations were reported as follows :—

Mr. J. Rheinberg—
A Pointolite Lamp.
Mr. C. D. Soar—
"Woolwich Surveys."
Mr. S. H. Gage—
"The Microscope."
Messrs. Longmans, Green & Co.—
"Chemistry of Plant Products."
Messrs. Maclehose, Jackson & Co.—
"Growth and Shedding of the Antler of the Deer."

Thanks were accorded to the donors.

The Deaths were announced of :—

Mr. C. E. Hanaman—Elected 1882.
Professor Henry Hanks—Elected 1874.
Mr. F. A. Parsons—Elected 1912.
Dr. E. J. Spitta—Elected 1903.

Mr. Reginald J. Ludford, B.Sc., read a paper, "Contributions to the Study of the Oögenesis of *Patella*." It was illustrated by means of exhibits and lantern slides, and will be published in the Society's Journal.

The President said that it was extremely fascinating to trace the processes stage by stage, and it was to be hoped that at some future time Mr. Ludford would be able to describe the later stages.

A discussion followed, in which **Dr. Murray**, **Dr. Gatenby** and **Dr. Bowell** took part, after which a very hearty vote of thanks to Mr. Ludford for his interesting paper was proposed from the Chair, and carried unanimously.

Mr. Rawlins presented a Report on the Collection of Metallurgical Specimens recently presented to the Society by Dr. J. E. Stead, F.R.H.S.

The thanks of the Meeting were accorded to Mr. Rawlins, and also to Messrs. Hawksley & Sons for the loan of Microscopes.

The President announced that the next Meeting would be held on March 16, and that the Biological Section would meet on March 2.

The business proceedings then terminated.

REPORT ON THE WORK OF THE BIOLOGICAL SECTION DURING THE SESSION 1919–20.

It is my pleasing duty to submit to the Council the 12th Annual Report of the Biological Section, for it will show that increased interest is taken in the sectional work, that the evenings have been fully occupied, and that the average attendance at the meetings is steadily increasing. In the Session 1918–19 the average attendance was 25·6, that being a record. The average attendance last session was 30·1, the lowest number at any meeting, November, was 26, and the highest at the May meeting, 36, a record number.

During the session eight meetings were held on the first Wednesdays in the months November to June, at which seven interesting communications were read and discussed. At the November meeting Mr. Paulson gave some notes on "The Nucleus and Pyrenoid in certain Spherical Algæ." The December meeting was occupied by Mr. Akehurst with "Notes on the Larva of *Corethia Plumicornis*." On January 7, 1920, Dr. J. A. Murray gave a practical demonstration on "The Manipulation of Frozen Sections of Animal Tissues." At the February meeting Sir Nicholas Zermoloff gave an interesting communication on "Beggiatoa and Allied Forms." The March meeting was mainly occupied by Dr. Tierney on the "Bacterial Flora of Water," and this proved of such interest that the discussion upon it was adjourned until the April meeting, when the specimens of cultures exhibited could be further examined. The meeting on May 5 was occupied by Mr. J. E. Barnard, who described "The Correct Image" in the unavoidable absence of Commander Ainslie, R.N., who was on the programme for that evening. The last meeting of the Session was on June 2, when Mr. Scourfield gave some "Notes on Zoochorellæ."

In addition to these communications, many interesting specimens were shown under the microscope and described by the exhibitor, thus adding to the attraction and usefulness of the meetings.

J. WILSON, *Hon. Secretary.*

REPORT ON THE COLLECTION OF METALLURGICAL SPECIMENS RECENTLY PRESENTED TO THE SOCIETY BY DR. J. E. STEAD, F.R.S.

By F. Ian G. Rawlins.

At the Meeting of this Society held in November 1919, Dr. J. E. Stead, F.R.S., who was present, asked me to announce that he would be willing to contribute a number of metallurgical microscope specimens to our collection, of which the first instalment was given by Sir Robert Hadfield, Bart.

Dr. Stead's valuable gift has now come into the Society's possession, and, in accordance with the wish of the Council, it is proposed to exhibit it at this meeting and to describe its outstanding features.

A catalogue on the lines of that already issued will shortly be available for the use of Fellows who wish to examine the collection. Meanwhile, it is pleasant to say that the specimens are of unique interest, as being the actual material upon which Dr. Stead conducted his classical researches on Blast Furnace Bears and the iron-carbon-phosphorus system of alloys.

The collection consists of eighteen micro-sections. A number of these require polishing and etching, so that some delay may ensue before they are ready, but those that do not require such treatment are on view to-night. The method of differentiating the structure is that known as heat-tinting. The piece of material is immersed in a small bath of molten-lead, with the polished face upwards, just lying in the liquid surface. The different constituents present oxidize at different rates, forming, for a given temperature, characteristically coloured films. The process can be stopped at any desired moment by removing the specimen from the lead, and plunging it into mercury. As a method of showing up the structure it is very perfect and beautiful, no depressions or alteration of level of the surface being produced, such as necessarily occur with etching re-agents. It may be pointed out that the examination of such sections microscopically is attended with some difficulty, as the light incident upon such a surface must be truly normal, otherwise there is loss of illumination and also flare due to the complete absence of minute shadows such as occur with etched slides.

Before proceeding to a brief résumé of the structures it might be well to mention that the behaviour of phosphorus in iron and its alloys is complicated, but in general it is as follows: In carbonless iron, a binary eutectic Fe_3P (61 p.c.) and a saturated solution of Fe_3P in iron (39 p.c.) occurs, but when carbon is present a ternary eutectic containing Fe_3P, Fe_3C, and ferrite with small amounts of phosphorus in solution manifests itself. This ternary eutectic is characteristic of white and mottled cast-iron, but the binary eutectic ("Steadite") is found in grey cast-irons, even if the metal contains less than 1·7 p.c. C.

The outstanding features of some of the structures may now be very briefly stated (the numbers referring to the annotated list). In No. 21, in both sections, the interesting matter is the appearance of the minute white rod-like crystals of iron phosphide. No. 22 is mostly remarkable for the exceptionally perfect triangular inclusion of binary eutectic at the junction of three ferrite grains. Its area is no less than 2 sq. mm. (approximately). The dove-grey manganese sulphide in No. 25 is very clearly defined, and is particularly welcome from the microscopist's point of view, because usually this constituent needs a magnification of the order of 1000 to recognize it, and even then it is very elusive. All the other specimens are interesting for one reason or another, but these remarks must only be taken as giving a few hints towards examining the more unusual of them. In conclusion, it is a matter of great satisfaction to us to have been favoured with such a gift from one of the greatest masters of Metallurgical Research, in which the microscope has played so great a part.

ANNOTATED LIST OF THE METALLURGICAL SPECIMENS PRESENTED TO THE ROYAL MICROSCOPICAL SOCIETY BY DR. J. E. STEAD, F.R.S.

21. Coahula Meteorite and Columnar Crystals.—Heat-tinted. *Mag.*: × 300.

The blue and red background is a section through the columnar crystals of ferrite. Minute white spots, crystals of Fe_3P.

Ref.: "Micro-analysis" (Stead), fig. 191. "Journal of the Iron and Steel Inst." (Stead), No. I. for 1915, p. 140.

22. Toluca Meteorite.—Heat-tinted. *Mag.*: × 25.

Background, saturated solution of Fe_3P in iron (1·7 p.c. P). Bright yellow areas, binary eutectic containing 61 p.c. Fe_3P, 39 p.c. saturated solution of Fe_3P in iron.

Ref.: "Metallography" (Sauveur), p. 388 *et seq.*

23. White Iron from Blast Furnace Bear.—Heat-tinted. *Mag.*: × 50 for general view. × 300 for the ternary eutectic. Red = Fe_3C. : blue = Fe_3P ; white = iron (ferrite) containing some phosphorus in solid solution. Composition of ternary eutectic as follows:—Fe = 91·19 p.c. ; P = 6·89 p.c. ; C = 1·92 p.c.

Ref.: "Journal of the Iron and Steel Inst." (Stead), No. I. for 1915, p. 140, and coloured plates.

24. Grey Iron from Blast Furnace Bear.—*Mag.*: × 100. *Constituents*: Graphite (dark plates), pearlite (laminated), ferrite (plain), steadite (mottled). The last-mentioned is a eutectic containing 10 p.c. P, 90 p.c. Fe, approximately.

Ref.: "Metallography" (Sauveur), pp. 390 and 391, fig. 374.

25. SEGREGATION OF MANGANESE SULPHIDE (MnS) FROM BLAST FURNACE BEAR.—Heat-tinted. *Mag.*: × 50. *Constituents*: White = iron. Grey = MnS. Dark = graphite.

Ref.: "Proceedings of the Cleveland Inst. of Engineers" (Stead), 1913–1914, p. 169.

26, 27, 28, 29. ELECTRICALLY TREATED STEELS.—*Mag.*: × 100.

C = 0·25 p.c., 0·68 p.c., 0·82 p.c., 1·32 p.c., respectively, showing strong line of demarcation of structure.

Ref.: "Value of Science in the Smithy and Forge" (Cathcart), chap. vii.

30. INGOT STEEL.—C = 0·3 p.c., P = 0·3 p.c. *Mag.*: × 100.

After forging from 6 in. ingot to 2 in. bar. The effect of mechanical work on the structure is illustrated consecutively by this specimen, which consists of four pieces.

Ref.: "Metallography" (Sauveur), chap. xiv.

JOURNAL

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ROYAL MICROSCOPICAL SOCIETY.

JUNE, 1921.

TRANSACTIONS OF THE SOCIETY.

IV.—THE BEHAVIOUR OF THE NUCLEOLUS DURING OÖGENESIS, WITH SPECIAL REFERENCE TO THE MOLLUSC PATELLA.*

By Reginald James Ludford, B.Sc. (Lond.), F.R.M.S., Department of Zoology, University College, London.

(*Read February* 16, 1921.)

Two Plates.

Introduction.

In a previous paper on the Oögenesis of *Patella* (*11*)† the relation of the Golgi Apparatus and Mitochondria to the formation of yolk was described, and it was mentioned that during that process there was an extrusion of "solid" nucleolar material from the nucleus into the cytoplasm. The present paper is devoted to an account of the behaviour of the nucleolus and the changes in the chromophility of the cytoplasm during oögenesis.

This research, as the former, was carried out in the Zoological Laboratories of University College, London, and my thanks are due to Dr. J. Bronté Gatenby, Lecturer in Cytology, for his kindly interest and helpful suggestions during the course of this investigation.

I have also to thank Mr. H. Graham Cannon, of the Imperial College, for some help with the literature of the subject, and Mr.

* The cost of the materials used in this research was defrayed by a Government Grant of the Royal Society, for which I express thanks.

† The figures in brackets refer to the bibliography at the end of the paper.

J. H. Woodger, of University College, for kindly fixing some of the material used in this research, during my absence.

Previous Work on the Nucleolus.

It is customary to recognize three types of nucleoli within the nuclei of various cells—namely, plasmosomes, karyosomes and amphinucleoli (*1*). The plasmosomes, or "true nucleoli" are usually spherical bodies, composed of "plastin" whose staining reaction is oxyphil--that is, they take up acid stains such as eosin. The term karyosome is usually applied to nuclear granules whose histo-chemical reactions are similar to those of chromatin; such bodies stain with dyes like hæmatoxylin and methyl green, and are therefore spoken of as basophil. Amphinucleoli are believed to be composed of a mixture of "chromatin" and "plastin"; they occur in many Protozoa. Their staining reactions are intermediate between those of plasmosomes and karyosomes.

Our knowledge of the relationship of the nucleolus to the metabolism of the cell is very fragmentary. Nucleoli at different times have been regarded as storehouses of either albuminous compounds, or chromatin, or both combined, as accumulations of waste products within the nucleus, or as special nutritive organs concerned either with the metabolism of the cell, or else with the elaboration of chromatin from the karyolymph.

Recently, emphasis has been laid upon the importance of the nucleolus by Carleton (*4*), who has shown that within the nucleolus of epithelial cells of the gut of the cat and frog there is an argentophil core consisting of several granules. During cell division, while the greater part of the nucleolus disintegrates, these granules persist and pass in about equal numbers to each of the newly forming cells, where a new nucleolus is formed around them. Such intranucleolar bodies have been found associated with both plasmosomes and karyosomes.

Actual fission of the nucleolus can be observed during amitosis of follicle cells in the ovaries of insects. In those of *Dytiscus*, which have been prepared by fixation in Bouin's fluid and stained with Mann's methyl blue eosin, I find a distinct oxyphil nucleolus. This elongates, becomes dumb-bell shaped and eventually separates into two distinct spherical bodies. Meanwhile the nucleus as a whole has elongated, and eventually becomes separated into two parts in typical amitotic fashion.

That nucleoli of somatic cells may stand in nutritional relationship to the cytoplasm has been shown by the work of Schreiner on Myxine (*15*). He found that the oxyphil nucleolus or plasmosome of many of the somatic cells increased in size, became lobulated, and portions broke away and passed in the form of granules from the nucleus into the cytoplasm; there they formed rodlets which broke up into smaller granules which were converted into fat. Nucleolar extrusion in Myxine has been observed in pigment cells, connective tissue cells, blood cells, many gland cells, and in the male germ cells.

Schreiner regards the rodlets formed by the extruded nucleolar fragments as mitochondria, and considers this to be a case of conversion of mitochondria into fat. The transformation of mitochondria into fat globules has been described by Murray in the cells of a transplantable sarcoma of Cavia (*13*), where the mitochondria at first, either moniliform or filamentous, break up to form granules which become swollen and eventually are converted into fat globules. No mention is made as to the nucleolus being concerned in this process, but nucleolar extrusions are described and figured in cells of the same tumour, their ultimate fate being uncertain.

Nucleolar extrusions in somatic cells seem to be specially related to active metabolism of the protoplasm. Instances of this are the considerable nucleolar extrusions which occur in the epithelial cells of the silk glands of insects during the formation of silk, and in the cells of squamous epithelium of Mammals during the formation of keratin.

It is doubtful to what extent the nucleoli of oöcytes are comparable with those of somatic cells. Usually there is a single nucleolus present in the young oöcyte. This is the case in most Echinoderms, many Cœlenterates, worms, molluscs and rodents (*2*). After the oöcyte has undergone the prophases of the heterotypic division, the chromosomes as such generally seem to disappear (*5*). This seems to be due to their spreading out in order to exert their maximum influence in the growing cell. Confirmation of this is afforded by the work of Maréchal on the oöcytes of Elasmobranchs (*12*), where after the diplotene stage the chromosomes spread out irregularly to form a structure which has been compared to a cylindrical chimney brush.

During the growth stages when the chromosomes are becoming less distinct in the nucleus of the young oöcyte, the nucleolus makes it appearance, and grows considerably in size. Usually there is one large plasmosome at the beginning. During the early stages of oögenesis in *Periplaneta* and *Libellula* (*8*), Hogben has recently shown that there is an extrusion of oxyphil material from such a nucleolus, and he concludes that this is connected with yolk formation and that "the chromatic organization of the nucleus retains its integral continuity throughout this phase." This is contrary to the opinion of Schaxel (*14*), who working on the oöcytes of Echinoderms and Tunicates came to the conclusion that chromatin *was* emitted from the nucleus and played an important part in yolk formation, a conclusion which is open to considerable doubt in the light of recent work.

In the oöcyte of Saccocirrus, Gatenby (*6*) has found a complicated case of nucleolar extrusion. "The nucleolus buds off fragments which, passing into the cytoplasm, give rise by fission to numberless granules of a dense proteid nature; these granules form the main bulk of the reserve material of the Saccocirrus egg and constitute the yolk."

The behaviour of that part of the nucleolus which remains within the nucleus until the end of oögenesis varies in different animals. In many cases it seems to persist as a definite body until the chromosomes reappear, and then it disintegrates with the breaking down of the nuclear membrane preparatory to the maturation divisions. Kuhn (*10*), however, describes in *Daphnia* a large central nucleolus which breaks up to form a number of smaller granules which become spread over the linin network. At the late diakinetic stage when the nuclear membrane breaks down, the remaining nuclear mass disintegrates. Jörgensen (*9*) working on a species of *Patella* describes, in the youngest oöcytes, a nucleolus

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EXPLANATION OF PLATES SHOWING THE BEHAVIOUR OF THE NUCLEOLUS IN PATELLA.

Lettering.—BB., basophil body or basophil staining nucleolus; BP., part of nucleolus which will form the basophil body; DB., disintegrating basophil nucleolus; FB., fragment of basophil substance derived from the basophil nucleolus; FO., fragment of oxyphil substance derived from the oxyphil nucleolus: GA., Golgi apparatus; LN., linin network of nucleus; NC., nurse cell; NE., oxyphil substance extruded from nucleolus; NL., nucleolus; OB., oxyphil body or oxyphil nucleolus; OC., oöcyte; OP., part of nucleolus which will form the oxyphil body; OS., oxyphil substance remaining attached to basophil nucleolus; T., trabecula wall; YS., yolk spherule.

The oxyphil nucleolus and the substance extruded from it into the cytoplasm are shown in red; the basophil nucleolus in black. The chromophility of the cytoplasm is not represented in colour owing to the difficulty of reproducing the gradations in colour between primary oxyphilia and basophilia, and basophilia and secondary oxyphilia.

All the figures are drawn from portions of the ovary fixed in either Bouin with acetic or corrosive acetic and stained with Mann's methyl blue eosin.

Plate III.

Fig. 1.—Connective tissue cells, showing the oxyphil nucleolus (NL).

Fig. 2.—Portion of trabecula, showing young oöcyte (OC) with oxyphil nucleolus (NL), surrounded by yolk cells.

Fig. 3.—Older oöcyte with a large pear-shaped oxyphil nucleolus (NL) and extruded oxyphil substance in the cytoplasm.

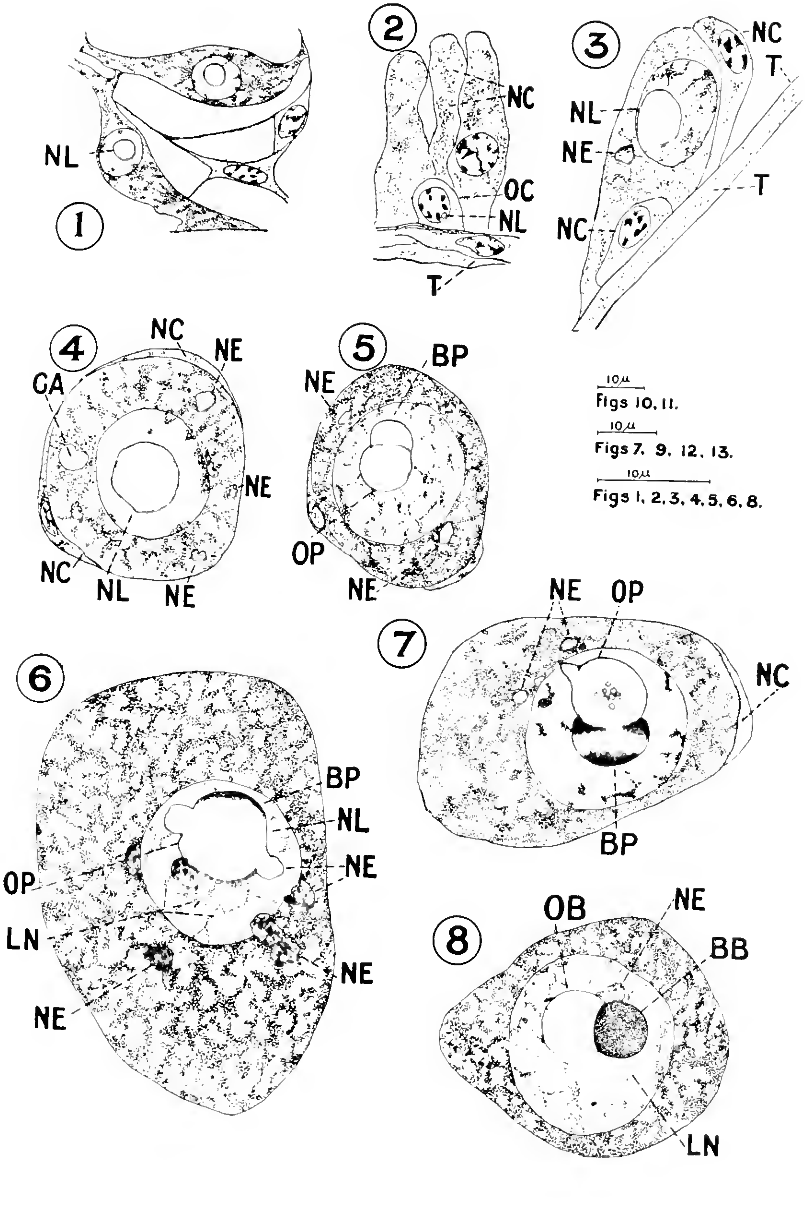
Fig. 4.—Oöcyte at a later stage with nucleolus (NL) rounded off and extruded nucleolar material (NE) in the cytoplasm.

Fig. 5.—An early stage in the differentiation of the nucleolus into two parts. BP will become the basophil body, OP the oxyphil one.

Fig. 6.—Oöcyte during the process of differentiation, showing the extrusion of oxyphil material from the nucleus (NE) and the beginning of basophilia at BP.

Fig. 7.—A slightly later stage than Fig. 6. The basophilia of BP is more pronounced, and the nucleolar extrusion is still proceeding.

Fig. 8.—Oöcyte with distinct oxyphil (OB) and basophil (BB) nucleolar bodies joined together.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apparently amphophil, from which are budded off into the karyolymph two kinds of bodies—namely, amphophile bodies which develop a basophil cap, and oxyphil granules. During growth these become scattered throughout the nucleus and eventually arrange themselves peripherally as "Randnukleolen." The behaviour of the nucleolus in this species is very different from what is described below in another member of the same genus, a difference which emphasizes the striking cytological dis-similarities which occur in closely related organisms.

Technique.

The material used in the present investigation was fixed either in corrosive acetic or Bouin's modified solution, picro-formol acetic acid. The best staining results were obtained by using Mann's methyl blue eosin, which stained the nucleoli red, blue or purple according to the stages of development of the oöcyte. The same histo-chemical reactions, however, resulted from the use of Unna's methylene blue and eosin, lichtgrün and safranin, or hæmatoxylin and eosin used according to Scott's method. Nucleoli at similar developmental stages which stained blue with methyl blue took up the green stain when lichtgrün and safranin were used, or coloured purple when hæmatoxylin and eosin were employed. Such nucleoli are therefore referred to in this paper as the basophil nucleoli, while those nucleoli which colour with eosin or safranin are referred to as the oxyphil nucleoli.

In preparations made by the Mann-Kopsch method (*11*), stained with acid fuchsin and differentiated in picric acid, similar pictures were obtained as with the fixatives previously mentioned. However, the difference in staining reaction of different parts of the nucleolar content of the nucleus, although noticeable, was not so striking as with the other techniques. Sections fixed by the method of Mann-Kopsch were treated with potassium permanganate solution to rectify the loss of staining properties due to the osmic acid, and then treated with Mann's methyl blue eosin, but although the same essential results were obtained the staining reaction was not satisfactory.

The acetic acid fixatives have the further advantage over chrome-osmic acid when dealing with the nucleolus and nucleolar extrusions, as the chrome-osmic preserves the mitochondria, and these stain with acid fuchsin similarly to the nucleolus and its extrusions, and so render it difficult to distinguish between the two.

Chromophility of the Cytoplasm of Patella.

In preparations made by fixation in corrosive acetic or Bouin with acetic, and stained by so-called acidic and basic stains, the cytoplasm colours differently according to the stage of development of the oöcytes. With Mann's methyl blue eosin the nuclei of typical somatic cells stain blue and their cytoplasm purple, while with hæmatoxylin and eosin used according to Scott's method the nuclei are purple and cytoplasm red. The undifferentiated cells of the germinal epithelium appear to stain in the same way. However, when such cells begin to develop into oöcytes, a change takes place both in their nuclei and cytoplasm. The latter begins to stain basophil (that is, with methyl blue eosin it stains blue, with hæmatoxylin and eosin purple). During growth of the oöcyte, by the time that yolk spheres are sparsely scattered throughout the cytoplasm its chromophility undergoes a further change. The blue or purple colour very gradually gives place to red again. This change in staining properties occurs at about the same time as the scattered mitochondrial granules (*11*) commence active division. In the full-grown oöcyte the cytoplasm stains similarly to that of the undifferentiated epithelial cells.

There is therefore, in the process of development of the egg from a cell of the germinal epithelium, a change from primary oxyphilia to basophilia, followed by a state of secondary oxyphilia in the mature oöcyte.

The Nucleolar Phenomena during the Oögenesis of Patella.

The nucleolar phenomena were studied in material fixed in Bouin (with acetic) or corrosive acetic, and stained with Mann's methyl blue eosin, or hæmatoxylin and eosin, or lichtgrün and safranin.

The nucleolus of a typical somatic cell stains oxyphil, as is shown in Fig. 1, Plate III, which represents connective tissue cells from the digestive gland. The nucleus of the youngest oöcyte has also a small oxyphil nucleolus. In Fig. 2 is shown a young oöcyte growing up from a trabecula of the ovary amongst three yolk cells. As such an oöcyte as this grows the nucleolus increases considerably in size until it comes to occupy a large area within the nucleus. During such early growth phases there is a considerable extrusion of the oxyphil substance into the cytoplasm.

In Figs. 2 and 3 are shown the large oxyphil nucleoli (NL), and in the cytoplasm the oxyphil substance (NE) derived from them. This extruded substance appears to dissolve slowly in the cytoplasm, as different fragments show various intensities of colouration; some are as red as the nucleolus itself, while others are purple in colour, due it would seem to intermingling with the ground cytoplasm, which stains blue.

It will be observed from the figures shown in Plate III. that the early extrusion of nucleolar material takes place when the nucleus is largest in proportion to the volume of the cytoplasm.

At the end of the preliminary growth stages the nucleolus becomes rounded off, and a distinct separation into two parts is noticeable. This is shown in the cell drawn in Fig. 5. From this stage onwards the two parts of the nucleolus react differently to stains. One part of the nucleolus (OP) still stains oxyphil, while the other gradually changes. At first, as shown at BP in Figs. 6 and 7, it stains a reddish purple, the colour change gradually spreads over the whole of this part of the nucleolus, and it becomes more and more bluish till eventually it appears as a definite basophil body, as is shown at BP in Fig. 8. The nucleolus then appears to be made up of two parts, one the oxyphil body, the other the basophil.

During the process of differentiation into two parts there seems always to be an extrusion of oxyphil substance into the cytoplasm. This is shown specially strikingly in Fig. 7, where the nucleolus is lobulated and oxyphil fragments are breaking away from it and passing out through the nuclear membrane into the cytoplasm. The nuclear membrane does not appear to be damaged by this process, which recalls the passage of leucocytes through the walls of blood capillaries. The oxyphil portion of the nucleolus during this process is usually vacuolated.

By comparing preparations fixed in corrosive acetic with those made by osmium tetroxide fixation (e.g. Mann-Kopsch-Altmann technique), it is seen that the early extrusion of nucleolar substance takes place before the dispersion of the Golgi elements, and the latter process commences about the time that the nucleolus becomes differentiated into oxyphil and basophil portions. Such comparisons lead one to assume that the oxyphil material dissolves in the cytoplasm and plays some part in preparing the cytoplasm for the activities of the Golgi elements, which, it was shown in a previous paper (*11*), are responsible for the formation of yolk spherules. Whether or not this be the case, the nucleolar extrusion ceases for a time, and is not so pronounced from this point onwards, until the end of the oögenetic process.

After the differentiation of the two parts of the nucleolus, the oxyphil and basophil portions may break up into several smaller bodies, or the two parts may remain joined, or they may separate and form distinct basophil and oxyphil nucleoli. The latter seems to be the commonest occurrence, and in such cases very often there is found a small portion of oxyphil substance remaining attached to the basophil body.

From the differentiation stage onwards, the oxyphil part of the nucleolus becomes gradually smaller in proportion to the basophil portion, and a certain amount of extrusion of oxyphil substance goes on. This is seen by comparing Figs. 9 and 10. The two nucleoli however remain distinct throughout the process of yolk formation, but by the time that the yolk bodies are fairly evenly scattered through the cytoplasm, both the oxyphil and basophil bodies have become vacuolated, and they commence to disintegrate. The oxyphil nucleolus breaks up into fragments which pass into the cytoplasm, as is seen taking place in Fig. 11, while the basophil nucleolus disintegrates and spreads out over the linin network of the nucleus. Fig. 12 shows this process taking place. When the basophil material is spread out in this manner there appears to be a small quantity of oxyphil substance left over, as is seen in Fig. 12 at FO. This seems eventually to pass out into the cytoplasm.

The basophil substance becomes spread out evenly over the linin network and forms little bodies at the nodes of the reticulum (FB in Fig. 13), resembling similar structures in the nuclei of somatic cells which are usually described as karyosomes.

It has been impossible to ascertain accurately whether a small quantity of oxyphil matter does or does not remain in the mature oöcyte, owing to the present difficulty of obtaining oöcytes at the maturation stages. This problem, together with the subsequent fate of the nucleolus, is still under investigation.

Discussion.

It will be noticed from the above description that the oxyphil nucleolus resembles in its general behaviour that of *Libellula* and *Periplaneta* (8) as described by Hogben, in that there is an early extrusion of oxyphil granules from the nucleolus into the cytoplasm. These granules however "pass to the periphery of the oöcyte, where they break up into smaller spheres which become the first vitellus." A somewhat similar process has been described by Gatenby in the

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Plate IV.

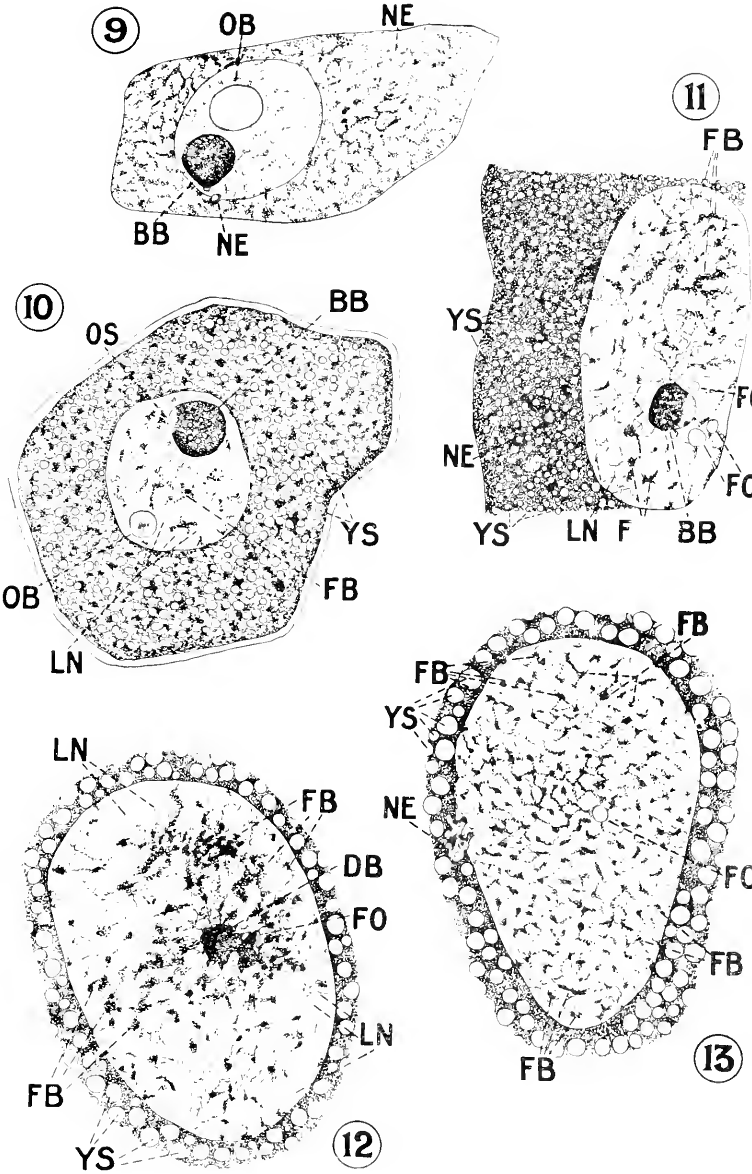
Fig. 9.—Older oöcyte with the two parts of the nucleolus separated. Extrusion is taking place of oxyphil substance which had been left attached to basophil nucleolus.

Fig. 10.—Oöcyte at a later stage with a large vacuolated basophil nucleolus (BB), and a small vacuolated oxyphil nucleolus (OB). Yolk spherules (YS) are fairly evenly scattered throughout the cytoplasm.

Fig. 11.—Older oöcyte showing the breaking up and extrusion (FO) of the oxyphil nucleolus and the beginning of the spreading out of the basophil substance (F and FB).

Fig. 12.—Nucleus showing the disintegration of the basophil nucleolus (DB), and the dispersal of its substance (FB) over the linin network (LN). Oxyphil substance produced as the result of this process is seen at FO.

Fig. 13.—Nucleus with basophil substance (FB) fairly regularly arranged upon the linin network. At NE is seen some of the remaining oxyphil substance being extruded into the cytoplasm.


9
OB
NE
BB
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11
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13
LN
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DB
FO
LN
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12

case of Saccocirrus (*6*), where there is an amphinucleolus with basophil preponderance in the youngest oöcytes. From this nucleolus portions break away and pass through the nuclear membrane, remaining attached for a time to its outer surface. A basophil cloud at this stage appears round the nuclear membrane and conceals somewhat the extrusions. This corresponds with a change in the chromophility of the cytoplasm from primary oxyphilia to basophilia. The basophil cloud disperses and the nucleolar granules become arranged spherically around the nucleus. Later they become scattered irregularly in the cytoplasm, and Gatenby shows that by fission they give rise to smaller granules which grow into yolk spherules. In the oöcyte of Saccocirrus there are also present small yolk bodies derived from the Golgi apparatus.

The chief difference between these cases and that of *Patella* is that in the latter the nucleolar extrusions appear to dissolve in the cytoplasm, and it seems most probable that this dissolved nucleolar substance either becomes converted into yolk under the influence of the Golgi elements, or else acts as an enzyme during yolk formation. This is borne out by the fact that there is always considerable nucleolar extrusion before the Golgi elements spread out in the cytoplasm to form the yolk granules.

In the oöcytes of Ascidians, according to Hirschler (*7*), there are present densely staining granules which give rise both to mitochondria and to a yolk nucleus. While the mitochondria are breaking away and spreading out in the oöcyte, the densely staining granule is temporarily connected with the nucleus by a stalk along which granules appear to flow out from the nucleus. The yolk granules of Ascidians are complex bodies formed as the result of the fusion of a Golgi element and a swollen mitochondrium, so that it may be that the mitochondria in these cases contain a small quantity of nucleolar substance, and this functions as an enzyme in the formation of yolk under the joint influence of mitochondria and Golgi elements.

The chromophility of the cytoplasm of the Ascidian oöcytes undergoes two changes. At first, during the primary diffused stage of the Golgi apparatus, the cytoplasm stains oxyphil. When the Golgi elements come together to form a compact body the cytoplasm becomes basophil, and the change to secondary oxyphilia is concurrent with the scattering of the Golgi elements, and the formation of yolk from them and the mitochondria. In *Patella* the Golgi apparatus is compact in the youngest oöcytes, and the change from primary oxyphilia to basophilia is unrelated to any observable change in the apparatus. The transition from basophilia to oxyphilia seems to take place at the same time as the fission and spread of the mitochondria, and this occurs after the early nucleolar extrusion has taken place and the nucleolus has been differentiated into oxyphil and basophil portions.

One of the most remarkable cases of nucleclar extrusion is that which has been described in Hymenoptera by Buchner (*3*), Hegner (see *6*), and Gatenby (*6*). In the oöcyte of certain Hymenoptera, the nucleolus buds off bodies which pass out of the nucleus into the cytoplasm, where they give rise to "secondary nucleoli" with a basophil reticulum and an oxyphil nucleolus. The function of such "secondary nucleoli" is not properly known.

The behaviour of the basophil nucleolus of the *Patella* oöcyte is paralleled by that of *Daphnia pulex* worked out by Kuhn (*10*), and I have observed exactly the same process occurring with the basophil nucleolus of *Limnæa*. The large central nucleolus in the oöcyte of these organisms towards the end of oögenesis becomes vacuolated and breaks up to form a mass of granules which spread over the linin network, as in *Patella*. Kuhn found that with the reappearance of the chromosomes, preparatory to the maturation divisions, the greater part of the nuclear matter disintegrated. Lack of suitable material has so far prevented the observation of the later stages in *Patella*, but the problem is still being investigated.

Maréchal found a process of disintegration of the nucleolus of a somewhat similar nature in the oöcytes of Selachians (*12*) towards the end of oögenesis. When the chromosomes were reforming, the nucleolus broke up into a mass of granules which became scattered in the nucleus, and in some cases formed rodlets resembling the chromosomes.

It is very difficult to find any explanation of the function of the nucleolus in such cases as these. In *Patella* and *Limnæa*, the basophil nucleolus is undoubtedly a specially elaborated substance, and it seems to me possible that it stands in some functional relationship to the subsequent condensation of the chromosomes as compact rodlets out of the diffused chromatinic reticulum. Possibly this is effected by producing a shrinkage or contraction of the framework upon which the chromatin is distributed, or may be by a kind of flocculation.

This is borne out by the fact that in preparations of the ovotestis of *Limnæa* which I have studied, there is a marked elaboration of basophil substance in the oöcytes, and towards the end of oögenesis, the basophil body disintegrates and spreads over the linin reticulum, as in *Patella*. In the spermatocytes, however, there is an amphinucleolus with definite oxyphil preponderance, which is present in the cells up to the late synaptic stages of the heterotypic prophase. There is no elaboration of definite basophil substance, nor is there any extrusion of nucleolar material during spermatogenesis.

Recent work on staining reactions has shown that we have no stain which can be relied upon as a criterion for chromatin. In preparations of the ovotestis of *Limnæa stagnalis* fixed in corrosive acetic or Bouin (with acetic), and stained with Mann's methyl blue eosin, I find that the chromosomes of the spermatocyte during reduction division appear amphophile with distinct basophil preponderance, and later the same chromatinic substance forming the head of the spermatozoon appears brilliantly red. Gatenby finds a similar thing in Saccocirrus (*6*), after fixation in Petrunkewitsch and staining in Ehrlich's or Delafield's hæmatoxylin and eosin or Biebrich scarlet. It is therefore absolutely unjustifiable on staining tests alone to call a basophil staining nucleolus a chromatin body, or to deny that an oxyphil nucleolus may contain chromatin.

It is also known that the fixative used may determine to a great extent the nature of the subsequent staining. Jörgensen, in his work on *Patella*, found the nucleolus amphophile with basophil preponderance in the youngest oöcytes, while in the species of *Patella* described in this paper the nucleolus was in most cases distinctly oxyphil, although there were exceptions where it could be described as amphophile with distinct oxyphil preponderance.

I attribute this difference in a large degree to the fixative used, for in making preparations with *Limnæa* material, I find that after fixation with Bouin's fixative the nucleolus stains oxyphil, while with prolonged fixation in corrosive acetic it stains basophil.

Observations such as these detract from the value of much work on nucleoli and chromatin based upon staining reactions alone. Also we know that differences in staining may be the result of differences in the surface membrane of the objects stained. In the case of *Patella* however, where there is a functional differentiation of the nucleolus into two parts, I consider it is justifiable to assume that the difference in staining reactions of oxyphil and basophil nucleoli corresponds to a difference in chemical constitution. That there is a difference in the chemical composition of the nucleoli of different animals has been shown by Jörgensen (*9*), who, as the result of digestion experiments with pepsin, divides nucleoli into three classes—namely, those immediately digested, those digestible after prolonged exposure to the ferment, and those indigestible to begin with, but soluble later.

Jörgensen concluded "that we can only say with certainty that the nucleolar substance is a functional organ during egg growth, and is no worthless metabolic product"; and all that we are justified in adding at present is that it is in several species related to the formation of yolk, while in others it gives rise to "secondary nucleoli," and that it may stand in some functional relationship to the formation of the small condensed chromosomes from the much spread out structural forms the latter assume during the various formative processes in the oöcyte, but such a hypothesis does not imply any interference with the integral continuity of the chromosomes throughout the germ cell cycle.

Summary.

A.—Chromophility of the Cytoplasm of the Oöcyte of Patella.

1. Transition from an undifferentiated cell of the germinal epithelium to an oöcyte is marked by a change in the chromophility of the cytoplasm from oxyphilia to basophilia.

2. During the early stages of oögenesis, the cytoplasm remains basophil. A change towards secondary oxyphilia occurs about the time that the Golgi elements have become scattered and the mitochondria are commencing active division.

3. From this stage onwards, the cytoplasm becomes gradually more oxyphil till definite secondary oxyphilia is attained.

B.—Behaviour of the Nucleolus of the Oöcyte of Patella.

1. The nucleolus of the youngest oöcytes resembles that of certain of the somatic cells in being an oxyphil body.

2. During the early stages of growth before the commencement of yolk formation, the oxyphil body extrudes portions of itself into the cytoplasm. These fragments disintegrate or dissolve.

3. At an early stage the oxyphil nucleolus becomes differentiated into two parts, one of which remains oxyphil, while the other begins to stain basophil.

4. There is an extrusion of oxyphil substance during the differentiation of the nucleolus, especially marked in that part which is becoming basophil.

5. Definite basophil and oxyphil parts of the nucleolus are established, and in most oöcytes they separate into distinct spherical bodies. During the later stages of oögenesis, the oxyphil nucleolus dwindles in size, and ultimately fragments into granules which are extruded into the cytoplasm, while the basophil nucleolus disintegrates and becomes distributed upon the linin network, mostly in the form of little accumulations of basophil material around the nodes of the reticulum.

6. It is suggested that the oxyphil substance extruded from the nucleus is related to yolk formation. The basophil substance is tentatively assumed to stand in functional relationship to the condensation of the spread out chromosomes into discrete chromosomes from the chromatinic network. This does not imply any interference with the integral continuity of the chromosomes throughout the germ cell cycle.

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V.—SOME SUGGESTIONS REGARDING THE MECHANICAL DESIGN OF MICROSCOPES.

By Captain Frank Oppenheimer, I.M.S., M.B., Ch.B., F.R.M.S.

(*Read April* 20, 1921.)

The mechanical design of the modern microscope has of late been receiving increasing attention, and formed an important subject for discussion at the recent Symposium held by the allied scientific Societies.

On this occasion the need for improved design was emphasized, but very few definite suggestions as to the line such improvements should follow were brought forward, except that the optical-bench principle should be more fully applied to the higher types of instrument. As one who uses the highest type of microscope for critical work, and is at the same time a constant worker in medical laboratories, I venture to put forward a few concrete suggestions for alterations or improvements, some of which are intended for incorporation in the highest type of instrument, and others for the ordinary laboratory or standard microscope, and some of which might be applicable to both types. It is only right to state that I have not had the opportunity of having these ideas incorporated in an experimental instrument owing to the prohibitive cost.

First, with regard to concentric, rotating, and centreing motions to the stage.

As usually constructed, this is a most expensive item in microscope construction, owing to the fine machining and fitting required for the two concentric rings which form the bearing of the rotary mechanism. It is, moreover, usually impossible to compensate for wear, the consequence being that the stage drops slightly when the microscope is brought to the horizontal position, and a certain undesirable play is given to the upper stage as a whole.

In the design suggested the centreing and rotatory movements are combined in a single simple fitting which is more or less geometric, and which cannot possibly develop shake or play in any direction.

The bottom plate of the rotating stage A has attached to it underneath a turned bronze ring B, in which is turned a channel of triangular section. In this channel engage three steel balls about $\frac{3}{16}$ of an inch in diameter. These balls are held in conical cups attached to the centreing screws and the spring buffer. The stage is supported by and rotates on this ball-bearing while the balls communicate the centreing motion to the stage. The axes of the centreing screws, buffer and clamp screw are all on one plane at right angles to the optic axis. The pressure of the spring buffer should be considerable, to prevent the stage being dislocated from its three-point bearing. Rotation is by hand, and the movement is locked by the action of a screw located near to the spring buffer, the point of the former engaging in fine serrations cut in the bottom of the channel when the locking screw is screwed home. This provides a positive lock which does not tend to press the stage upwards and so throw the object out of focus, as is commonly the case. An index to record the angle of rotation of the stage is mounted on the buffer pin, which is provided with a rib to prevent its rotation.

The buffer pin and clamp screw should be mounted in the front edge of the stage, and the centreing screws at either side of the limb.

Improvememts in the Substage.

Now that nearly every microscopist, including laboratory workers since the introduction of the high-power dark ground illuminator, requires to change his substage condenser frequently and easily, and with the minimum of labour in re-centreing, it would appear that the standard ring fitting for condensers is obsolete. The changing of apparatus is laborious, and sometimes entails the inclining of an instrument for which the lighting has been arranged when in a vertical position, and invariably entails re-centreing of the apparatus to be used.

I therefore suggest that the "ring" should be done away with and replaced by a sliding changer of the same construction as the Zeiss objective changer, but more massive, to allow of the use of large-sized condensers.

Each upper slide with its own condenser system would have its own centreing gear, as in the Zeiss changer.

These slides might be made with two standard threads, the first to be R.M.S. objective size, taking most English condensers, and the second the same thread as the Watson Holoscopic Condenser (dry), which would also take the Zeiss, Abbe and many other large patterns.

This system would permit of all the condensers in use being set to work centrally with all the objectives, if the latter were provided with their own centreing changers. Where a revolving nose-piece was used, it would usually suffice in medical laboratories where the

$\frac{1}{12}$-in. objective is used for practically all the finer work, to centre all the condensers to the $\frac{1}{12}$-in. objective in use.

Under this changing device would be the iris diaphragm and stop carrier, which would be of the Abbe design, with the addition of an extra turn-out ring to carry screens. On many instruments it is impossible to use a stop and colour screen simultaneously in the substage. For those who use two condensers only and desire a less revolutionary change, I suggest that the substage be provided with two rings mounted on hinges some distance either side of the centre line, and each provided with its own centreing gear. Either of these could be in turn swung into position, and held by a catch against a strong lug on the substage rack slide. By this means the necessity of removing the condenser and re-centreing when changing from normal to dark ground illumination would be obviated. In designing centreing gear for the ordinary substage ring, I would point out that the pattern in which the moving ring is pressed against the flat upper surface of the outer ring by the centreing screws and buffer, which act on steel-faced inclined planes, is much to be preferred, on mechanical and practical grounds, to the system employed by most English houses. The addition of a locking nut to the spring buffer which opposes the centreing screws would be of value and increase the rigidity of the condenser fitting.

Substage Condenser Fittings.

Complaints are frequently made regarding the faulty placing of the iris diaphragm and stop carrier in modern English condensers

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EXPLANATION OF TEXT-FIGURE.

Showing structure of rotating centreing stage in three radial sections: I. Through centreing screw. II. Through buffer. III. Through clamp screw.

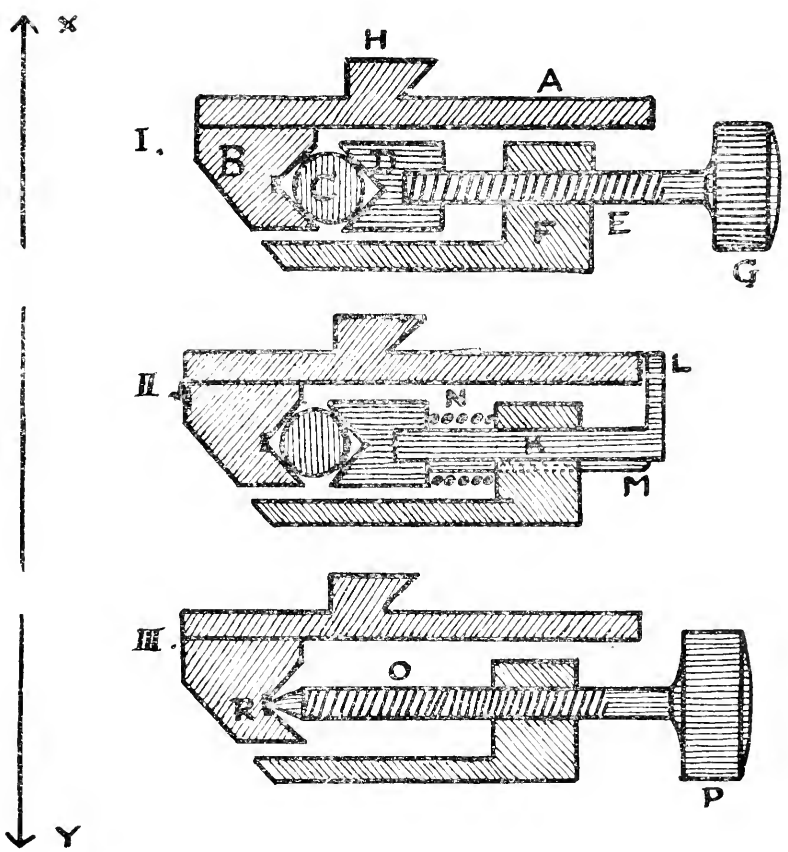
X–Y. Centre of stage and optic axis.

A. Bottom rotating plate of stage, bearing prismatic slide H for mechanical stage.
B. Bronze ring with channel of triangular section turned in its periphery.
C. Steel bearing-ball.
D. Bronze end to centreing screw with conical hollow in head.
E. Centreing screw.
F. Fixed base of stage, attached to limb.
G. Milled head to centreing screw.
H. Prismatic bearing for mechanical movements.
K. Pin of spring buffer.
L. Index to record degrees of rotation.
M. Rib on K to prevent rotation of L.
N. Spring of buffer.
O. Clamp screw engaging in R.
P. Milled head to clamp screw.
R. Serration in bottom of channel to give clamp screw a positive locking action.

Diagram drawn to a scale of × 2.

designed to slip into the substage ring from above, the diaphragm being nearly always too far from the back lens of the condenser. This is especially noticeable in a large instrument owned by myself, in which, owing to the thickness of the mechanical stage, an adaptor about ½ in. long has to be inserted between the optical portion of the condenser and its mount.

When one considers the care taken to overcome this difficulty



in the early condensers made by Powell, Ross and others (see Carpenter, 4th edition), it is surprising that this detail is now so neglected.

It is surely simple to mount the iris in its proper position close to the back lens of the condenser, and to actuate it by means of a rotating tube within the ring of the condenser mount. The lower end of this rotating tube should project about ¼ in. below the substage ring and be milled.

Stops would be inserted on the summit of a third tube, sliding easily within the iris tube, which should be lined with black cloth. This would permit of the stop being adjusted in a vertical direction.

In addition to these advantages, such a condenser mount would have no projecting levers to foul the substage slides when used in a rotating substage.

The coarse adjustment to the body has been actuated from the earliest days by rack and pinion, which has undergone various improvements, such as Nelson's "stepped" rack, and finally the oblique spiral form.

This has several disadvantages. First, in laboratories the exposed rack frequently gets dirty and damaged. Secondly, the motion is rather more rapid than is desirable, more especially when most of the work is done with high powers. This in turn leads to the abuse of the fine adjustment commented upon by every skilled microscopist when watching the average laboratory worker.

I propose that the rack and pinion be replaced by a multi-thread large diameter screw, such as is used in the substage of many student's microscopes, the body to travel on the usual bearings.

The milled head controlling the motion might be mounted on the top of the limb or at the bottom, in the position adopted for the fine adjustment in Baker's Nelson model. If lateral milled heads were considered essential they could be introduced by employing a similar system to that used by Zeiss in the Berger pattern fine adjustment, substituting bevel for worm gear perhaps.

The multi-thread screw would rotate in the microscope limb, no vertical movement taking place, and movement would be translated to the body tube by means of a split nut attached to the latter and travelling upon the screw.

The rapidity of the motion could be made as desired, but half the average present rate is suggested as suitable.

The advantages claimed for this system are :—

1. Slowing down of the movement.
2. No tendency to "run down" from the weight of the body or pressure on the draw tube. Hence an easier working adjustment can be made than where the pinion has to act the part of a brake.
3. Mechanism entirely enclosed.
4. No fine teeth to be damaged by over-winding.
5. Especial value in very simple microscopes where no fine adjustment is fitted.

There is much room for development along optical-bench lines, and the first essential is that the main body tube and substage bearings should be planed on one block of metal on one machine to ensure their being parallel and remaining so. This is only done on a few instruments at present. The petrological instrument might well be modified along these lines, the body tube with its many doors and slots being abolished altogether. Nose-piece, eye-piece, and all intermediate apparatus being attached to a bar carried by the adjustments, the eye-piece to be carried on a rack-work extension. To exclude light a simple bellows could be sprung on at top and bottom of this "tube." Many instruments, including some of the most complete, appear to be designed with a view to compactness when in their cases. This is no doubt a desirable feature, but nothing should be sacrificed to attain it. The commonest fault is the position of the focusing slides. With many instruments the body is one or two inches out of its slides when a short focus objective is in use with a nose-piece or changers (one or the other appliance is in universal use). There is no possible reason for this fault except the striving after compactness —and this particular fault is the commonest cause of lack of rigidity in the modern microscope.

The same tendency one must suppose is the explanation of the inadequate foot still commonly fitted, and the lack of room under the stage for substage and mirror manipulation.

All this is perhaps excusable in student's microscopes, which sometimes have to be carried about, but is quite inexplicable in instruments designed for the advanced worker or the laboratory, such being rarely moved from the room in which they are used from one year's end to another. The type of foot which combines the maximum of rigidity and convenience is one in which the limb is swung between two strong vertical pillars which are cast in one piece with a wide-spreading flat triangular base, *the apex of the triangle being towards the front*, as in a "flat-iron"; this triangle to rest on cork pads at the angles. Levelling screws may be added at the corners for use in micro-photography.

For laboratory work I would make this flat triangular base so large that a glass bell-jar placed over the instrument would rest on the base, its circumference in no place projecting over the sides. The trunnions should be placed at or above the level of the surface of the stage and a clamping lever provided. If it is essential that the instrument be more or less portable, it may be so made as to be readily detached from its working foot and transferred to a light folding tripod foot, a smaller travelling case being provided.

With regard to such details as milled heads, it is worth while remarking that those of the coarse adjustment are commonly placed too near together, and are frequently of too small a diameter. The latter remark also applies to many fine adjustment milled heads since the introduction of the lateral position.

Some firms appear to be taking up the position that one "standard" simple microscope should be supplied which can be gradually converted into a "research" model by various additions. Surely this is analogous to trying to convert a "Ford" into a "Rolls-Royce" by the addition of new radiator, self-starter, etc. If the highest type of microscope is to be satisfactory it must be designed as an instrument complete from the beginning. As England has held the palm for the production of the finest types of microscope from the very earliest days, one hopes that this class of instrument will not be overlooked in the anxiety to fill the world's demand for what one may call the "Ford" type of microscope.

By far the largest number of microscopes produced are used in the medical schools and laboratories. The work there is mainly of the nature of "spotting" known structures or organisms, and for such purposes neither very perfect appliances or manipulation are essential. Consequently interest in the development of the microscope has fallen very low in this quarter. The result is extreme conservatism in the design of instruments for this work. Where there is active interest there one finds new departures in design, as is well shown in the development of the microscope for metallurgy in recent years.

At the recent Symposium many speakers appeared to consider that the question of design should be left in the hands of the instrument makers. Surely the high state of development reached in England in the early days was mainly due to the stimulus of suggestions by the working microscopist, and not least by the Fellows of this Society. At this time, when makers are planning models which will be the basis of their productions for many years to come, every possible detail should be most carefully considered. This communication is written with a view to provoking such discussion.

VI.—MR. FRED ENOCK'S METHOD OF MOUNTING HEADS OF INSECTS WITHOUT PRESSURE.

By The Rev. J. S. Pratt.

(*Read April* 20, 1921.)

Some thirty years ago Mr. Enock explained to me his method of mounting insects' heads without pressure, asking me to keep the secret to myself, and, so far as I know, and I knew him very well, he never confided the secret to anyone else. He told me that the first idea was given him by seeing some of the Rev. Thornton's beautiful mounts which were evidently prepared without pressure.

For eight years he worked at his method before being satisfied, every slide not perfect being destroyed, for he would never have a second best. But now that he is gone, leaving no one to carry on his work, and, so far as I am able to learn, there being no one who has any pecuniary interest in his method of mounting, it seemed to me a pity that science should lose his beautiful discovery.

Therefore, after much thought and consultation with friends, I approached the Royal Microscopical Society and asked them to be the custodians of Mr. Enock's method.

The President has suggested that I should write a paper for publication in the Society's Journal, giving an outline of the process, and for that purpose Colonel Carrick Freeman, M.D., has most kindly drawn for me some illustrations. These are not to scale.

The problem is—how to get, and keep, the tongue of, say, a wasp or bee protruded, and the various mouth organs laid out, so as to be easily seen in their entirety, and above all, to be as far as possible in the same plane.

For this purpose we require a few special tools.

A small mounting block is prepared, built up with a small piece of sheet glass, a fairly thin slice of mounting cork, and a piece of white note paper, of equal size—1 inch by $\frac{3}{4}$ inch—and bound together at each end with white thread, the cork being in the middle, fig. 1. The head is set out on the paper in the space between the threads.

A couple of special pins must also be prepared as follows. Towards one side of a small block of cork, slightly less than $\frac{1}{4}$ inch square, a finest 1-inch entomological pin is thrust through right up to its head, and from top to bottom of the cork. Seizing the pin with a pair of pliers on the under side of and close up to the cork, the pin is first bent at right angles to its upper part, and then into a small loop, as in fig. 2. Behind this pin is thrust through the cork a stouter 1-inch pin.

By this means the thin pin may slide up and down through

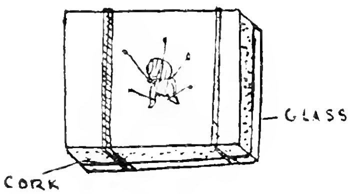


FIG. 1.

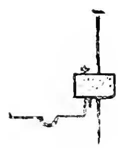


FIG. 2.

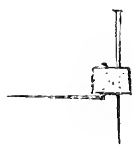


FIG. 3.

the cork, as required, while the stouter pin secures the little appliance to the small mounting block.

The second "cork pin" is prepared in like manner, except that the thin pin is simply bent at right angles close up to the cork, fig. 3.

When intending to use the pins during the operation of setting

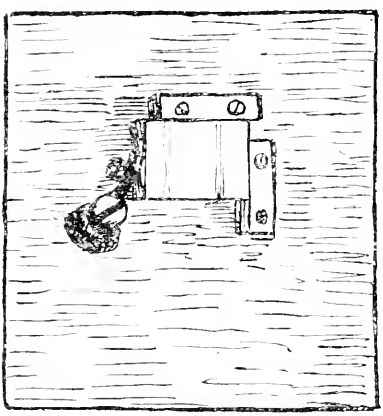


FIG. 4.

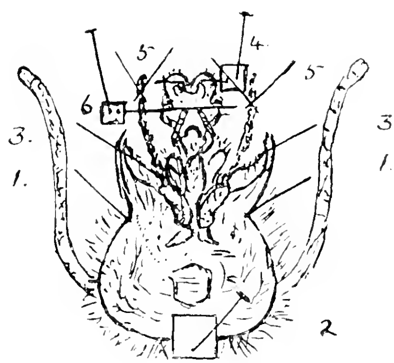


FIG. 5.

out, it is well to cut off the heads of the entomological pins, and a number of these may conveniently be reduced to $\frac{1}{2}$ inch in length and to be stuck lightly in at one end of the mounting block, ready to be taken up by the forceps as required.

I assume that an ordinary dissecting table is used, with rests for the hands, but in place of the usual glass slide a wooden one is fitted, about the centre of which two small lengths of wood should be secured, at right angles to each other, into the corner of which the small mounting block will fit and be kept in position by a short length of spring, fig. 4.

I propose to deal with the mounting of a wasp's head, which is in many ways more difficult to set out than a bee's, as the palpi are troublesome and will curl up if they can.

The small mounting block being in position on the dissecting table, the head is placed on it, antennæ-side down, and is kept in position by two of the headless pins placed one on either side close behind the mandibles, fig. 5–[1].

Mr. Enock took a rather larger pin, and pushing it through a small piece of thin card, placed it just behind the head, so that the card pressed flat upon the head.[2]

Personally I dispensed with this card as I found it unnecessary.

With a pin in the forceps open the left hand mandible and push the pin into the cork.[3]

Do the same with the other mandible, being careful, having regard to the beauty of the mount, not to straddle the mandibles too wide open.

With the loop of the bent "cork pin" gently draw out the tongue as far as it will go, and keep it protruded by pressing into the mounting block the second or stouter pin.[4]

Next lay out the palpi, preventing them from curling up by placing pins crossed where necessary.[5]

Finally place the straight "cork pin" across the tongue to prevent its rising up during the hardening process.[6]

The head is now finished.

For the hardening process I had a large round bottle made, about 5 in. in diameter, and 2 in. up to the shoulder, with an opening 2 in. or $2\frac{1}{2}$ in. in diameter, into which fitted a ground stopper. This bottle was filled with sufficient methylated spirit to completely cover the mount, say, for safety, to a depth of 1 in.

An ordinary common pin is stuck into one corner of the small mounting block, which is now removed from the dissecting table, and, by means of this pin, lowered into the spirit. Its glass bottom will cause the block to sink.

Colonel Freeman has suggested, and I think it well worth consideration, that in order to avoid the possible shrinkage and twisting of parts, it might be well to use two strengths of spirit solution, the first of half strength, in which the mount might stand for (say) three days, and the second of full strength, into which the mount might then be transferred, to stand for a week.

During the hardening, especially in the earlier stages, the mount should be frequently examined to see that there is no curling, or displacement of parts, and to remedy this if necessary.

When satisfied that the head is perfectly set lift the mounting block from the spirit and most carefully remove the pins with the forceps, sticking them into one side of the block ready for next use.

The head is then well washed in water, and transferred to the following solutions, in the order and proportions named, allowing it to remain at least three days in each:—

(*a*) Glycerin, 1 part; water, 3 parts.
(*b*) Glycerin, 1 part; water, 2 parts.
(*c*) Glycerin, 1 part; water, 1 part.
(*d*) Glycerin, 2 parts; water, 1 part.

This is the final stage, and the head is mounted in the last (*d*) solution to which should be added 3 minims of phenol to each 2 oz. of solution, which will cause the whole to smell strongly of carbolic. The solution should be filtered through filter-paper, and be kept in a capped bottle. The glass tube which takes out the solution should always be kept in the bottle, but should never touch the bottom. This may be prevented by fitting the tube tightly through a piece of card, which fits the neck of the bottle.

The mounting of a head is a matter of such vital importance that I give a detailed description of it. The glycerin solution will penetrate almost anything. It is necessary, therefore, to take what may seem almost exaggerated precautions.

Most of my slides are twenty-five years old, and so far, most are absolutely safe, though one or two do exude a very little at the top in very hot weather. I lay the greatest stress upon the cement.

It is composed of black sealing-wax dissolved in methylated spirit, and marine glue. Mr. Enock used only this cement for these mounts.

The wax must be of the very best and be crushed in a mortar until it becomes a fine powder. Methylated spirit is then added and the mixing and grinding in the mortar continued until it is sufficiently thin to filter through moderately fine muslin. When filtered, an equal part of liquid marine glue is added and thoroughly mixed in. If time is no object evaporation may be allowed until the required consistency (about that of thin cream) is reached, otherwise it must be reduced to that state by gentle heat.

In building up cells I used vulcanite or ebonite rings, $\frac{7}{8}$, $\frac{3}{4}$, and $\frac{5}{8}$ in. in diameter. Both sides of the rings should be rubbed on sand-paper to remove the gloss, and the rings should be carefully dusted before use, a cloth being passed through them.

Mr. Enock used to fix, or secure, his heads in the cells, but not so much latterly.

I prefer them not fixed, as you can then place them in any position.

In fixing, Mr. Enock made use of two short lengths of fine tubing, attached side by side, into which fitted two fine needles.

A strand of very fine silk was threaded through each needle, which were then thrust right through the head, and on being withdrawn left the two strands of silk with the ends at equal distance on either side of the head.

A ring of cement having been spun on the top of the cell a little glycerin solution is run, with a brush, all round and on the bottom of the cell; the ends of the silk, with the head suspended, are stretched out at equal distance across the cell, on to which they are lowered and embedded in the cement on each side. The cell is then filled with glycerin solution to well above the top in its convexity, on which a perfectly clean cover glass is carefully lowered and gently pressed down until it rests firmly on the cell, the pressure being kept up by a small weight placed on the cover glass until the cement dries.

For this purpose I used conical bullets.

The excess of glycerin fluid may be brushed off, but no attempt should be made to clean the slide until after the cover glass has become firmly attached to the cell by the drying of the cement.

The ends of the silk are then cut off, and the slip carefully washed and dried.

Mr. Enock made use of a trough of wood, 12 in. long and slightly over 3 in. wide, into which his mounts were placed, and left until dry.

If it be not desired to secure the head with silk, a little of the glycerin solution is run, with a brush, all round and on the bottom of the cell, as before; the head is placed in and arranged on the bottom of the cell, which is then filled, and closed, as before.

The slide is finished by spinning several coats of cement round the side of the cell and upon the edge of the cover glass, each coat being allowed to dry hard before the next is applied—and to perfectly seal the cell don't spare this part of the operation.

Such was Mr. Enock's beautiful method of mounting. One word—don't be dismayed at failures, for only practice can accomplish perfection; but the beauty of a successful mount is compensation indeed, for it is science and art in that small cell.

In conclusion I append a few notes.

1. The heads should be set before they are fixed in rigor mortis, as they cannot then be relaxed. Mr. Enock suggested that all insects be kept in crushed laurel leaves, which will keep them relaxed for a short time, but they should be set out as soon as possible.

2. It is impossible to clean a wasp's tongue. Put it under an inch power and you will see why it is so—those numberless hairs in each cell of the tongue hold all impurities, and you cannot get them away. If possible get queen wasps and hornets, for they have fasted all through the winter and their tongues are beautifully

clean. Beetles may be kept alive a day or two in clean surroundings to clean their mouths.

3. All the water spoken of above is aqua distil. Never use any other for solutions.

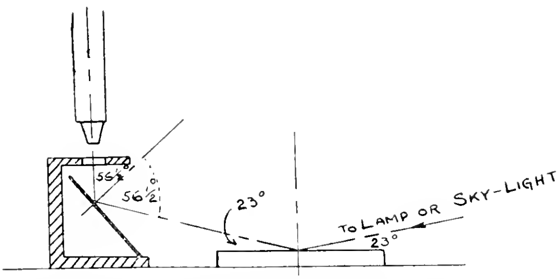
4. Always wash the brushes in spirit the moment you have finished with the cement; a small detail, but absolutely necessary, and not always remembered.

VII.—POLARIZERS FOR THE MICROSCOPE.

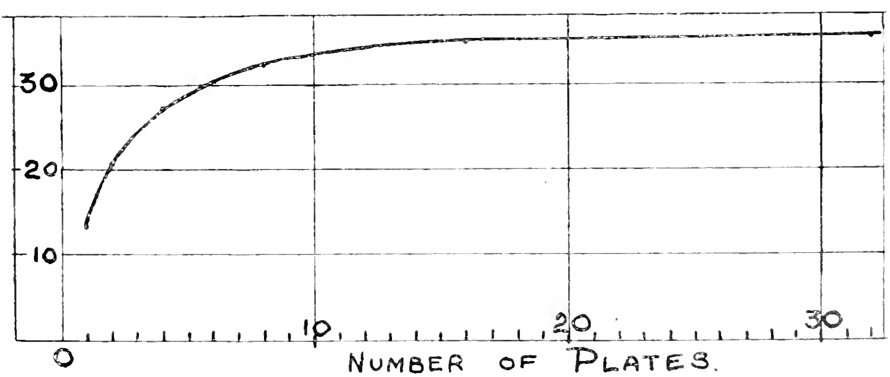
By B. K. JOHNSON, Department of Optical Engineering, Imperial College of Science and Technology.

(*Read March* 16, 1921.)

ICELAND SPAR is very scarce and is becoming more scarce. In the highest class of petrological microscopes, designed for advanced and research work, a form of Nicol polarizer made of Iceland Spar is desirable, but it is not necessary for the simpler students' microscopes. A very efficient polarizer can be made by taking an ordinary 3 × 1 slip and flowing a little black varnish over one surface and then allowing it to dry. Such a slip can then be stuck to the plane reflector with soft wax and tilted by trial to the polarizing angle. In the case of a tilting microscope either sky-



Light reflected from a bundle of plates varying in number from 1 to 32, the light being incident at the polarizing angle (56½°).



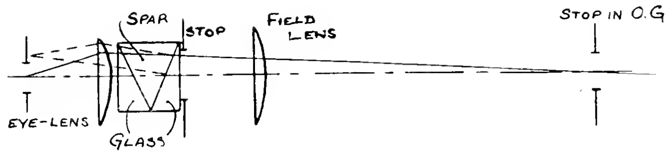
light or lamp-light may be directed directly upon the polarizer, but in the case of a vertical microscope a piece of plane mirror should be laid upon the table in front of the microscope to receive the light and direct it upward to the polarizer (see sketch).

If the light given by a single blackened plate is insufficient, it may be increased by superposing a second 3 × 1 slip upon the blackened plate.

The curve given by Stokes (see p. 147) will be of interest to microscopists.

From this curve it will be seen that practically the maximum amount of polarized light which can be obtained by reflection is obtained with eight plates. In practice one, or at most two, are sufficient for subjective work.

The simple vertical microscope can be adapted very simply for observation in polarized light by cementing a slip-polarizer to a small block of wood adapted to slide between the sides of the horseshoe foot.



Analyser.—This must be some form of Nicol, and it should be mounted to rotate. Perhaps the most generally useful form is a small and therefore square-ended Hartnack prism in a separate mounting, which can be placed when desired above the eye-piece. The Abbe polarizing eye-piece is convenient for many purposes, but it is not well known. It consists of a double-image prism mounted between the eye-lens and the stop of a Huygenian eye-piece. The prism and eye-piece combined project *two* images of the aperture of the object-glass into the plane of the Ramsden circle, one centrically and the other eccentrically. The eccentric image is stopped out, and the light passing through the centric image only is allowed to enter the eye. This analyser should be used with an ordinary eye-piece of about the same power, adjusted so that one eye-piece can be substituted for the other for refocusing.

VIII.—A POLARISCOPE FOR DISSECTING AND POCKET MICROSCOPES.

By Prof. G. H. Bryan, F.R.S.

(*Read October* 20, 1920.)

Hitherto the polariscope has been usually regarded as an accessory only of the compound microscope, for which purpose it generally takes the form of a pair of Nicol prisms. There are, however, many cases in which polarized light may be usefully employed in connexion with a dissecting microscope or even a hand magnifier, and in view of the scarcity of Iceland spar and the cost and small size of the prisms obtainable, interest attaches to the well-known alternative method of polarizing light by allowing it to fall on a bundle of plates of glass or similar material placed at a suitably oblique angle of incidence.

An application which should appeal to every microscopist lies in the fact that dust fibres, which in ordinary light are almost invisible in Canada balsam during the process of mounting a slide, are readily detected with a polariscope, and can be easily removed under a dissecting microscope fitted with this accessory. With the same apparatus I have been able to show the "black cross" effect and the colours produced by selenite on the shells of the embryo *Docis* while alive and moving in the water; and, on the other hand, the absence of polariscopic effect in the floats of *Velella* shows these to be non-calcareous in structure and formed of material which is not of a doubly refracting character.

In some early treatises on natural philosophy a bundle of glass plates is called a *polarizing frame* when the reflected light is used, and a *polarizing pile* when use is made of the light transmitted through the plates. As the light received in the former arrangement is made up of a number of portions produced by reflection at the several surfaces of the plates, a polarizing frame cannot be used as an analyser, though it would be possible to employ a single reflecting surface for the purpose. On the other hand, if the light is incident at the polarizing angle on a pile of plates, the polarized beam passes directly through the series of plates without any portion of it being reflected, so that on looking through the pile a single image only is seen, and it will be found that with an analyser of this description the loss of definition is far less than might be expected, even if ordinary cover-glasses are employed instead of more optically perfect scales worked to uniform thickness.

If such an analyser be attached to the pocket lens or hand microscope, which can be held in suitable inclined position, it is not necessary to have anything more elaborate than one or more glass slips laid on a dead black background as a reflecting polarizer. The proper angle of reflection can easily be found by trial, but it is rather convenient to make a set-square cut at this angle. This will be a triangle in which two sides are at right angles and their ratio is equal to the index of refraction, say 1·5 or 3 to 2 roughly. When I was young I should have been very glad to make a polariscope before I bought one, but I was deterred by the fact that the book I had gave the polarizing angle in degrees and minutes, whereas my protractor was only graduated in degrees!

For a dissecting microscope with a horizontal stage two reflecting beams are required in order to throw the light upwards. It will be found quite satisfactory to lay one frame horizontally and the other one may be at 60° instead of the more accurate polarizing angle of about 57°. Rays which are 3° on either side of the middle ray will be reflected at 57° and 63° or 63° and 57°, and will then be perfectly polarized at one or other of the frames, giving more uniform polarization of the illuminating cone.

By using several plates of glass in a polarizing frame the intensity of the reflected polarized beam is increased, but about four plates are sufficient, and not much is gained by using a greater number. On the other hand, the degree of polarization of the reflected beam depends largely on having the frame backed with a surface which is sufficiently absorbent of the transmitted light, since if any of this is reflected from the backing it will be completely transmitted back through the plates.

In using a pile of plates as an analyser the degree of polarization depends on the completeness with which the light polarizable by reflection is eliminated from the transmitted beam, and therefore a larger number of plates is needed. But the proportion of polarized to unpolarized transmitted light increases as the angle of incidence is increased. Very fair polariscopic effects can be obtained with as few as eight or ten cover-glasses if these be indeed at an angle somewhat in excess of the "polarizing angle." But it is better to use a large number, say from one to two dozen, and the older treatises on natural philosophy contain tables showing the number of plates sufficient to obtain *practically* complete polarization at different angles of incidence, as found in Brewster's experiments. If the angle of incidence falls short of the "polarizing angle" in any part of the field of view, that portion will hardly show any polariscopic effects unless a considerable number of plates are used. A more uniform field of view could, of course, be obtained by the use of two piles of plates turned in opposite directions so that those rays incident on one at the least angle would fall on the other at the greatest angle of incidence, but unfortunately an analyser so constructed would be of too great a length to be used except it be placed in the tube of a compound microscope between the object glass and the eye-piece. It would not be suitable for the simple microscope.

To fix the cover-glasses inside a blackened tube at the required obliquity is not such a simple operation as it might seem, especially as it is important to leave no gap through which light can escape between the cover-glasses and the sides of the tube. The plan I find best is to use a tube of black *paper* instead of cardboard, and to have the top and bottom covers hinged at their edges to slips of black paper which may be drawn through the tube until the pile is adjusted to the proper angle. The free ends of the slips may then be turned down outside, leaving however a very little free play, and the whole enclosed in an additional outer tube which may be of cardboard. This arrangement enables the cover-glasses to be taken out and cleaned from time to time, and it also allows of the angle of incidence being adjusted, being increased by slightly compressing the tube laterally and decreased by drawing the plates together by means of the slips of paper.

The attachment of the outside covers to the black slips does not really reduce the field of view, but has rather the effect of cutting off the light reflected from the edges of the cover-glasses, which would otherwise be troublesome. The fittings required to attach the tube to a pocket lens or dissecting microscope can be constructed without much difficulty.

For use with my compound microscope I have fitted an old eye-piece with a pile of cover-glasses between its two lenses. It gives a somewhat limited field of view, but it has the advantage of obviating the *seven* operations of screwing and unscrewing required to attach or remove the Nicol prism analyser, and substituting the simpler operation of changing the eye-piece. I have also arranged a polarizing frame to slip over the mirror, giving a better illumination than is obtainable with the Nicol. With careful adjustment this home-made polariscope shows the crosses on small starch grains much better than one would have expected under the circumstances.

An important point to be borne in view is that only a very small portion of the incident light reaches the eye through the polariscope, and it is therefore very essential, especially in working with a dissecting microscope, to screen off any light which would otherwise fall on the object from above. Otherwise the object will be visible as an ordinary opaque object on a dark background, and the polariscopic effects will be unnoticeable. In cases of doubt a selenite may be used with advantage, as doubly refracting objects will show colours when the analyser (not the polariscope) has been rotated into the position in which the colour of the selenite just disappears. A selenite slide showing various tints does very well for this purpose, and I am using home-made ones, split from some crystals which I found in some Kimmeridge clay dug from a well.

In claiming that these simple polarizing devices give much better results than one might expect it is not meant that they are free from defects. Apart, however, from their usefulness in the rough-and-ready examination of objects previous to final mounting there is a great interest to be derived by experimenting with the apparatus here described.

OBITUARY.

EDMUND JOHNSON SPITTA, L.R.C.P. (Lond.), M.R.C.S. (Eng.), F.R.A.S. 1853–1921.

EDMUND JOHNSON SPITTA, who died on January 21, 1921, was born at Clapham sixty-eight years ago. Entering St. George's Hospital in 1870, he followed up a successful career as a student by completing his studies at St. Thomas's and at Westminster. In 1874 he settled down to active work with his father, and for thirty years enjoyed a lucrative and extensive practice. He was an eminently successful general practitioner, and it was with some reluctance that he gave up practice in 1904 and retired to Brighton.

A man of tireless and almost restless energy, his mechanical and practical mind found early scope for research in Astronomy and Astrophysics, for he was elected a Fellow of the Royal Astronomical Society in 1880, sitting as a member of the Council for fourteen years, and later became Vice-President. In time his observatory at Clapham became well known, and from it originated several papers of great scientific interest, which were read before the Royal Astronomical and other learned Societies. One of his early contributions, on the "Satellites of Jupiter," put forth views of an original and controversial character, which at the time created much comment.

Even in those days the charm of the microscope and the fascination of its study held him in a firm grip, and when he found the calls on his time by professional work increasing, the observatory gradually gave place to the "Powell and Lealand." This gave Spitta the opportunity to apply his knowledge of photography to the microscope, and formed the foundation upon which his reputation as a photomicrographer was built. His investigations in this direction rapidly extended, and he devoted much time to the subject, with the same vitality, singleness of purpose, and thoroughness as he had shown in his earlier years when astronomical studies absorbed his attention.

His bent for photomicrography led to the publication of an "Atlas of Bacteriology," produced in 1898 with Dr. Slater, then Bacteriologist of St. George's Hospital, and marked the beginning of a close and life-long friendship. This book met with great success, and formed the nucleus from which developed his larger book upon photomicrography published in 1899, which has passed through several editions.

In 1904, jointly with his son, Dr. Harold Spitta, he was asked to form an exhibit of high-power photomicrography by the Government, to represent Great Britain at the St. Louis International

Exhibition, when they received the Grand Prix; two years before the Gold Medal had been awarded in the same way for their joint exhibit at the Paris International Exhibition.

On his retirement from practice, he took up the study of pure Microscopy with redoubled energy, and for many years it was his habit to spend two or three hours every night with his microscope, and he ultimately produced the first edition of "Microscopy," a comprehensive work dealing with the subject from a practical and theoretical point of view. This venture was equally successful, and three editions have passed the press.

As he became better known as a microscopist he was elected President of the Quekett Microscopical Club and a Vice-President of the Royal Microscopical Society, in which he took the greatest possible interest. In conjunction with Mr. Williamson, the well-known cinematographer, he became interested in photography as applied to the development of pond-life.

The accumulation of knowledge of Entomology gradually led Spitta into the public lecture hall, and for some ten years he devoted much time to travelling about the country giving lectures on various scientific subjects, with his own lantern, slides, etc., leaving nothing to chance which might detract from the value of his discourses. On these lectures he would spend weeks of preparation, thinking out the minutest details and practical means of bringing home to the audience the salient points.

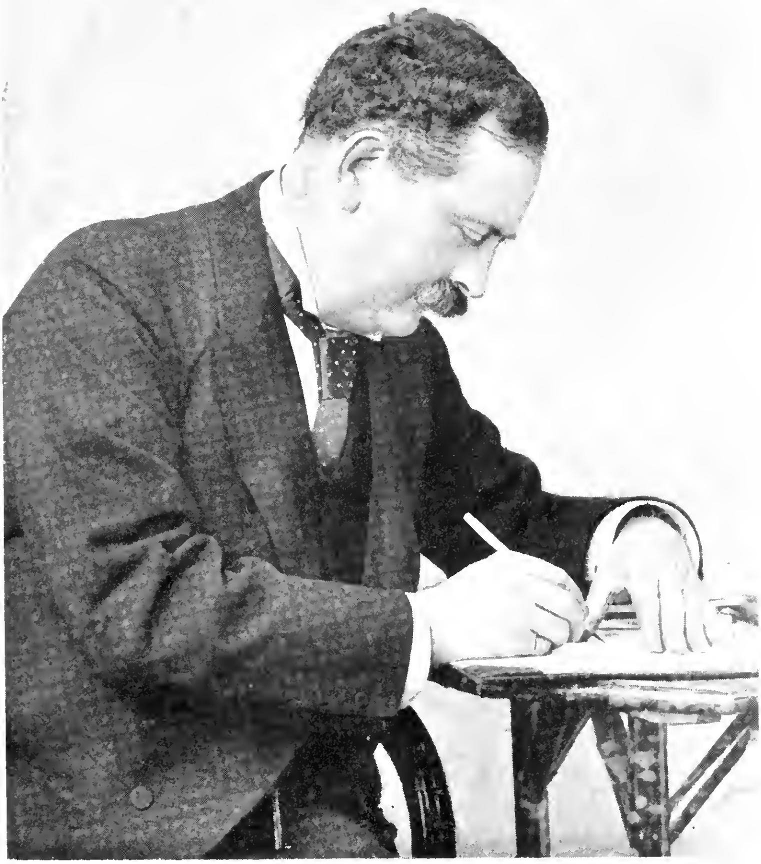
He found time also to experiment with wireless telegraphy, and the complete wireless equipment he fitted to his house was a source of pleasure to himself and to his friends, enabling him to take time signals and interpret messages sent by ships at sea from one to another.

These few reflections show the many-sided character of the man, and he would throw as much energy into discussions around these little side issues as into the details of his meteorological station, which he maintained for nearly thirty years.

At his funeral, which took place at Hove, members of the learned Societies to which he belonged were represented, and many of his personal friends attended the service In scientific circles his good fellowship and his readiness to hold out a helping hand to those interested in similar pursuits, will be much missed, for he was a striking example of an able man of many sides who never understood what it was to be unable to conquer a knotty scientific problem.

AN APPRECIATION OF DR. E. J. SPITTA.

I FIRST made the acquaintance of Dr. E. J. Spitta in 1903 as Secretary of the Quekett Microscopical Club, which was then passing through one of those periods of stagnation which occur in the life of all Societies. The enthusiasts who had been associated



Edmund Johnson Spitta, L.R.C.P.(Lond.), M.R.C.S.(Eng.), F.R.A.S.

Face p. 154.

with its early years were dead or retired from active work, and the Club appeared to be settling down into a listless middle age. A succession of weak Presidents possessing few qualifications for the office had been followed by the distinguished mycologist Massee, who held the Presidentship for four years. Ill health rendered him a frequent absentee, and although the Club was still apparently in a flourishing condition, the decreasing attendance gave warning that a President was required who would devote time and energy to his office. I was directed to get into touch with Spitta, who had joined the Club in 1899, but who owing to the demands of his large practice was unknown to the Committee at large. He had, however, obtained some celebrity as a photomicrographer and astronomer.

I called on Spitta at Clapham, where he then lived, and discussed the position with him. I was immediately struck with his outstanding appearance and personality, and with the care with which he went into the situation and its requirements. He told me that he was shortly retiring from practice, and he undertook, if elected, to spare neither time nor trouble to make himself a success. I reported accordingly to my Committee, and in February 1904 he was elected President.

Things soon began to move. Spitta had by this time gone to live at Hove, but he took himself and his office very seriously, travelling specially up for the meetings and doing all in his power to attract members and visitors to the Club. Long before the expiration of his four years' tenure of the office, the attendance had increased to such an extent that the room was often uncomfortably crowded. He was unquestionably a great success as President, and he was just as unquestionably fully aware of it. He often told me that he was proud to think that he left the Quekett Club to his successor, E. A. Minchin, in a far stronger position than when he assumed office.

I think the secret of his success was the seriousness with which he took himself and his position. Essentially a man of the world, he realized that an author who prepares a paper deserves to have some notice taken of his work, even if only to damn it. I never heard Spitta utter from the Chair those words which have damped the enthusiasm of so many authors: "Well, gentlemen, we have just listened to a very interesting paper. I know nothing of the subject myself, but no doubt somebody will make a few remarks on it." Nobody ever has the audacity to know more than the President, and the author goes away feeling that he has wasted his time.

This was not Spitta's method. I never heard him claim any special knowledge on a subject outside his own lines of work, but whatever the paper might be he made a point of devilling up the subject, and he invariably followed the author with a few well-chosen remarks, which usually led to a general discussion gratifying to the author and interesting to the audience.

A man of Spitta's sanguine temperament and somewhat dominating personality could not avoid making some enemies in his career. He was a strong and outspoken President in Committee, and his ways did not please all its members. But my relations with him as Secretary, during the first three years of his office, were of the most cordial description; I was always assured of his support, and I am glad to think that the friendship then formed remained unbroken to the end. That he was proud of his office and appreciative of the general support which he received, is shown by the dedication of his book on the Microscope to the Council and Members of the Quekett Microscopical Club. Less than a year ago he sent me a copy of the latest edition—"just as a reminder of all past and happy times." He was very human, and certainly one of the most engaging personalities I remember in the world of Microscopy.

A. E.

FREDERICK ANTHONY PARSONS.

It is with very great regret we have to record the death on February 7 of Frederick Anthony Parsons, in his eighty-fifth year.

Mr. Parsons had been engaged as an Engineer's Draughtsman, until he was appointed Assistant Secretary of the Royal Microscopical Society in 1896. He held this post until 1912, and during that period was a familiar figure at the meetings. On retiring he was nominated as a Fellow by the Council, in recognition of his long and valued service, and presented with a testimonial and an address at the meeting held June 19, 1912. He was a member of the Quekett Microscopical Club for a few months short of half a century, and during that time served for many years as Secretary to the Excursions' Committee. It was in April, 1885, on one of the Club's annual visits to the Royal Botanic Gardens, Regent's Park, that he was fortunate in first finding specimens of the fresh-water Hydroid Polyp, a biological discovery of much importance. It was taken from the *Victoria Regia* tank, where a few years previously had been found the Medusoid form which had been described by Prof. (now Sir) E. Ray Lankester, under the name *Limnocodium Sowerbyi*.

His kindliness, his enthusiasm in microscopical matters, the thoroughness and neatness which were marked features in everything he did, will be long remembered by all who knew him. Mr. E. M. Nelson writes, "No microscopist I have ever met was more ready than he to help not only in the department of pond-life, but also in that of the mechanical construction of the microscope, for he possessed a good knowledge of mechanical engineering."

A. W. Sheppard.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology, Evolution, Heredity, Reproduction. and Allied Subjects.

Pseudo-parthenogenesis in Human Ovum.—L. HOCHE and R. MORLOT (*Comptes Rendus Soc. Biol.* 1920, **83**, 1152–4). In a ripe Graafian follicle in a girl of twelve, operated on for ovarian hernia, there was found an ovum with distinct nuclear and cytoplasmic segmentation. as if indicating the beginning of parthenogenetic segmentation. But the cell-formation did not show the normal chromatin constitution and represented little more than a sort of struggle against death. The phenomenon was to be regarded as among the varieties of cellular degeneration and death. J. A. T.

Development of Uterine Glands in Man.—E. A. BAUMGARTNER, M. T. NELSON and WM. DOCK (*Amer. Journ. Anat.*, 1920, **27**, 203–19, 7 figs.). Glands are found in the corpus of the uterus in a six- to seven-month fœtus. The earliest are small irregular outpouchings from the semilunar mucosal folds, subsequently developing constricted necks and enlarged end-pieces similar to many other gland rudiments. The necks persist even to the adult stage; the enlarged ends become tubular and divide T-like, with sometimes a second longitudinal division of the end branches. The stalks follow an oblique course in the adult, sometimes almost a spiral one. Near the muscle layer the branches run parallel to the surface and all in one direction, sometimes forming a network by anastomoses of different branches. The greater part of the glandular tissue lies in the lower one-third or one-fourth of the endometrium. Adult uterine glands are compound, anastomosing, tubular glands. J. A. T.

* The Society does not hold itself responsible for the views of the authors of the papers abstracted. 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, etc., which are either new or have not been previously described in this country.

Spermatogenesis in the Orvet.—A. Dalcq (*Comptes Rendus Soc. Biol.* 1920, **83**, 995–7). The apparently similar spermatids have a hidden dimorphism, for some of them show a heterochromosome which the others lack. This corresponds to what has been observed in various insects and mammals. J. A. T.

Post-natal Development of Rat's Ovary.—Hayato Arai (*Amer. Journ. Anat.*, 1920, **27**, 405–62, 4 charts). The total number of ova in both ovaries was counted in thirty-nine albino rats, ranging in age from birth to 947 days. In relation to the body-weight the size of the ovaries increases to a maximum of 33 grm., thereafter it decreases up to puberty, after which it increases rapidly and reaches the second maximum. The ovary weight according to age shows continuous increase up to thirty-one months. The weight of the right ovary is less than that of the left—about 90 p.c.—while the total number of ova is slightly more in the right ovary. The total number of ova in both ovaries decreases rapidly from 35,100 at birth to about 11,000 at twenty-three days. From twenty-three to sixty-three days the number is nearly constant (11,000 to 10,000). It then decreases again rapidly to about 6,600 at seventy days. During the last period ovulation usually occurs. From seventy days up to thirty-one months there is a slow decrease to about 2,000 ova. In general, this decrease results mainly from the degeneration of the primitive ova, but in part from that of the definitive ova.

With the increasing weight of the ovary the total number of ova decreases. The increase in weight is associated before puberty principally with the formation of large degenerate follicles together with mature follicles and growth of connective tissue, but after puberty the increase depends mainly on the accumulation of small corpora lutea in addition to the mature and degenerate follicles and connective tissue. After puberty the number of large corpora lutea is about the same in all ovaries, and these, therefore, are not responsible for the regular age changes in the weight of ovaries. The new formation of the egg cells takes place after birth from the germinal epithelium. These ova grow in situ, and, as development proceeds, are covered by the adjacent epithelial cells and extend into the stroma, passing through the tunica albuginea. From these newly formed germ-cells the definitive ova appear to develop, beginning from about the second week after birth. The primitive ova, which are present during fœtal life, are found degenerating immediately after birth. After puberty the degenerate follicles are derived principally from the definitive ova. The mean number of all degenerated follicles is about 10 p.c. of the total number of ova. Ovulation can occur spontaneously, independent of sexual intercourse and without the influence of the male. The corpora lutea formed in rats in which the ova have been fertilized are a little larger than those in non-fertilized rats. Near maturity there may be as many as twenty-one follicles in both ovaries. J. A. T.

Development of Mammalian Spleen.—G. A. Thiel and H. Downey (*Amer. Journ. Anat.*, 1921, **28**, 279–339, 3 pls., 3 figs.). The spleen of white rat, pig and gopher is first seen as a dense mass of mesenchymatous tissue in the left dorso-lateral portion of the mesentery. In the first stages of its development it is impossible to make a sharp distinction between the cœlomic epithelium and the mesenchyme of the mesogastrium. Proliferating activity on the part of the epithelial cells may result in the crowding of some of the daughter cells into the underlying mesenchyme. After the splenic rudiment is established (15 mm. pig), the peritoneal cells are sharply separated from the mesenchyme by a distinct limiting membrane. The earliest splenic vessels are branches of the mesenteric artery, which form a network. Blood-forming activity in the spleen begins in pig embryos of 3 to 4 cm. in length ; cells of the mesenchyme become free lymphocytes. Erythropoietic activity is seen first in 4 to 6 cm. pig embryos. Erythroblasts are seen in small groups in lacunæ that were formed by the first free cells as they were cut off from the mesenchymal syncytium. The erythropoiesis is largely extra-vascular. Granulopoiesis is very limited in the pig's spleen at any stage. The authors discuss the differentiation of "white pulp," the lymphoid or follicular portion of the spleen, and the appearance of large lymphocytes. J. A. T.

Development of Opossum's Stomach and Intestine.— C. H. HEUSER (*Amer. Journ. Anat.*, 1921, **28**, 341–69, 6 pls.). As the intra-uterine period in the opossum is very brief, the intestinal nutrition commences in the new-born animals while they are relatively very immature. Ten days after the beginning of segmentation, or thirteen days after insemination, the young opossums appear in the pouch ; they become at once attached to the teats, and milk soon enters their stomachs. Five days before birth, however, the digestive tract of the opossum is no further advanced than this system in the three-day chick embryo ; the foregut extends forward from the broad connexion with the yolk-sac, and the first rudiments of the liver, hind-gut and allantois are just appearing. The transformation brought about during these last five days is remarkable in its rapidity. Certain of the changes, such as the enormous dilatation of the stomach, must be largely due to mechanical causes ; other alterations, as in the formation of villi and the differentiation of the epithelial cells in the upper parts of the small intestine, must be accounted for by the natural processes of development of the embryo, aided or hastened possibly by the early functional requirements of the organs. J. A. T.

Hypertrophy of Remaining Ovary after Semispaying.—HAYATO ARAI (*Amer. Journ. Anat.*, 1920, **27**, 59–79). Semispaying seems to have no influence on the growth of the body of the albino rat. There is compensatory hypertrophy of the remaining ovary, independent of coitus or pregnancy. The number of ova in the right ovary, excised at twenty days, and in the left surviving ovary in the same rat are about the same, despite the fact that the weight of the surviving ovary is two to ten times greater than that of the right ovary at the time of removal. On the other hand, the number of ova in the surviving ovary is 12 p.c. less than that in the ovary of the corresponding side of the controls in the same litter, and at the same ages ; nevertheless, the surviving ovary weighs one and a half to two times more than the control ovary. This indicates that changes in the total number of ova do not cause the hypertrophy of the surviving ovary. This is due to a greater abundance of well-developed normal and degenerate follicles, as well as by an excess of corpora lutea. This indicates an increased activity of the surviving ovary due to some unknown stimulus. Changes in the ovarian stroma influence but slightly, if at all, these results. Semispayed females produce litters with nearly as many young as the controls. The time of the first ovulation in the surviving ovary is normal. Young females separated from the males show a slightly slower growth and maturing of the ovary than do the females kept with the males. J. A. T.

Degenerative Changes of the Pancreas during Pregnancy.—M. Aron (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1122–5). Autolytic processes on the surface of the small pancreatic lobules are seen in pregnant bats and in some other cases, including man. Aron thinks the phenomena may be due to a toxic fluid in the peritoneal serosa. J. A. T.

Development of Supra-renal Body of Hedgehog.—A. Celestino da Costa (*Comptes Rendus Soc. Biol.*, 1920, **83**, 878–9). The primordia of the cortical portion are first seen in an embryo of 6 mm. Thickened zones of cœlomic epithelium grow into the mesenchyme, on the two sides of the origin of the mesentery, a little in front of the emergence of the cœliac artery. Besides this inter-renal primordium there is a distinct genital primordium, and the relations between the two are very clear in the hedgehog. Into the inter-renal primordium there is, in the 8 mm. stage, a penetration of sympathetic elements. J. A. T.

Hæmatopoietic Processes in Gonads of the Fowl.—José F. Nonidez (*Amer. Journ. Anat.*, 1920, **28**, 81–113, 3 pls.). In the gonads of the fowl, both in the embryo and mature bird, there is a widespread tendency towards the formation of blood-cells which usually appear as small lymphocytes grouped in lymphogranulopoietic foci. Similar groups occur in other organs and in the general mesenchyme. The granule-laden cells could be traced to hæmocytoblasts or large lymphocytes, which arise as a differentiation in the mesenchyme cells. The hæmocytoblasts become granulocytoblasts (= myeloblasts) after deposition of acidophile granules in their cytoplasm. The granulocytoblasts eventually become eosinophile leucocytes which degenerate. The small lymphocytes referred to above are endowed with several potentialities. Besides becoming granular leucocytes of smaller size, they give rise to large wandering cells which agree in their characteristics with cells hitherto regarded as interstitial. But they may be quite absent, and it does not seem probable that they have an endocrine function. The granule-laden interstitial cells in the ovary and testis described by Boring and Pearl are granulocytoblasts. The mature cock-feathered-male lacks a specific interstitial tissue influencing the secondary sex-characters. J. A. T.

Anterior End of Notochord in Embryos of Reptiles.—A. Weber (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1056–8). In the earliest stages the anterior end of the notochord is connected with the band uniting the pre-mandilubar head-cavities, and thereby with the posterior wall of the hypophysial diverticulum. But there is great diversity later on when the base of the cranium has become cartilaginous. In *Varanus* and *Cistudo* there are notochordal nodules just behind the hypophysial primordium, even in the sella turcica. In *Gongylus ocellatus* and *Cerastes cornutus* at the same stage the anterior end of the notochoid is much further back and not in the vicinity of the hypophysis. J. A. T.

Development of Auditory Apparatus in Sphenodon.—F. R. WYETH (*Proc. Royal Soc.*, Series B, 1920, **91**, 224–8). The cartilaginous auditory capsule and the anterior cornu of the hyoid are products of two connective-tissue proliferations, and there are two centres of chondrification—one hyoidean and one capsular—originally separated by an intervening tract of mesenchyme. It is concluded that the columella auris is derived from the hyoid arch, with which it is continuous throughout all stages of development, and that the extra-stapedial cartilage is primarily united with the anterior cornu of the hyoid. The supra-stapedial cartilage (including the recurrent process) is developed, and persists as an outgrowth from the extra-stapedial cartilage, and is therefore a hyoidean derivative. The auditory capsule contributes, at most, a portion of the foot-plate of the stapes, which is probably partly capsular and partly hyoidean in origin. The distal portion of the stapes is exclusively hyoidean. J. A. T.

Thyroid Gland of Anura in Relation to Metamorphosis.—C. O. JENSEN (*Comptes Rendus Soc. Biol.*, 1920, **83**, 948–9). In larvæ of *Rana esculenta*, *R. arvalis*, and *Bufo vulgaris* anomalies in the metamorphosis may be correlated with peculiar states in the thyroid gland. In abnormally precocious metamorphosis the follicles of the thyroid gland were filled with a colloid mass with a strong affinity for eosin, which points to an unusually intense secretory activity. In larvæ that had remained larvæ through the winter the thyroid was much enlarged, the follicles were swollen with a colloid with little affinity for eosin, and the epithelium of the follicles was much flattened. In giant tadpoles the thyroid was much enlarged, the numerous follicles in part in process of proliferation showed cubical or cylindrical epithelium: between the follicles there were in certain places cellular masses of considerable volume. J. A. T.

Pigmentation in Larvæ of Anura.—J. NAGEOTTE (*Comptes Rendus Soc. Biol.*, 1920, **83**, 319–20). What Prenant calls the reticulum of Asvadourova was described by Eberth in 1866. In tadpoles of the frog there are vacuoles with liquid contents between the chromatophores and the basal membrane, and forming a continuous layer. They are probably homologous with Eberth's reticulum seen in *Alytes*, *Discoglossus*, *Bombinator*, and other forms. They do not occur in the tadpoles of the common toad. J. A. T.

Grafted Embryos of Bombinator.—A. WEBER (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1058–60). Young embryos of *Bombinator igneus* at the end of gastrulation were placed in the dorsal lymphatic sac of adults of both sexes. They may develop till the appearance of the branchial arches, when the larva emerges from the egg-envelope and dies, being destroyed by the phagocytes of its host. In cases where they were left alone for a month without any opening of the host, it was found that development was very partial. There were traces of a medullary groove, but the mesoderm showed marked de-differentiation. The larvæ had developed up to a certain point, showing adhesive organs for instance, and had then gone back. J. A. T.

Grafting Eggs of Bombinator.—A. Weber (*Comptes Rendus Soc. Biol*, 1920, **83**, 891–2). Fertilized ova of *Bombinator igneus* surrounded by their viscous envelope were placed in the peritoneal cavity or in the dorsal lymph-sac of adults of both sexes and in the peritoneum of newts. The newly fertilized ovum underwent rapid destruction, especially in the newts. The development hardly got past gastrulation, but some showed an irregular medullary plate. An ovum that has undergone gastrulation will go on developing almost normally, but somewhat asymmetrically. The stage of branchial arches was reached, and then the larva hatches inside its host. J. A. T.

Grafting Eggs of Newt.—A. Weber (*Comptes Rendus Soc. Biol.*, 1920, **83**, 749–51). Experiments in grafting the ova of *Triton alpestris* in the peritoneal cavity of the adult. The ovum is covered externally with a transparent and elastic membrane; there is a delicate translucent vitelline membrane in direct contact with the ovum; between the two there is a fluid corresponding to white of egg, and in this some crystals appear shortly before the hatching of the larva. When the eggs are placed at various stages of development in the peritoneal cavity of the male they are soon killed; the same is true in the female, but the killing is rapid. The same is true of larvæ enclosed for a short time in the peritoneal cavity of the adult. The peritoneal reaction is slight when the introduced ova are in early stages of development; it is marked in the later stages. Segmentation of introduced ova may continue for a short time, but there is irregularity in the blastomeres, and the gastrula stage is never passed. Introduced larvæ show before they are killed some de-differentiation of the organs. J. A. T.

Pigmentation of Tadpoles.—A. Prenant (*Comptes Rendus Soc. Biol.*, 1920, **83**, 839–42). In tadpoles of *Discoglossus pictus* a number of very pale, greyish cells, at first isolated, come together and anastomose to form a "reticulum of Asvadourova," with quadrangular meshes, the whole being visible to the naked eye. Independent of the reticulum there are other pigmented cells at a deeper level, and some melanophores appear from connective-tissue cells. The reticulum occurs in *Pelodytes*, but not in *Pelobates*, frog, or toad. It is well known that tadpole and adult Batrachians have two kinds of pigment cells, xanthophores with a yellowish pigment, and melanophores with melanin. The xanthophores occur singly or in a reticulum (the "réseau jaune" of Mlle. Asvadourova); they contain in many cases (frog and toad tadpoles) numerous globules coloured by vital stains, but these are almost always absent in tadpoles of *Alytes* and *Disco-*

glossus. The pigment is usually indistinctly granular, but it may be distinctly granular and grey. The melanophores arise chiefly from transformed xanthophores, which pass through the greyish phase; and there is a pigment intermediate between the yellow and the dark. It may be that the yellowish pigment is of an amino-acid nature, as Verne finds in Crustaceans, and is transformed into a melanin.

J. A. T.

Lens Formation and Cyclopia in Tadpoles.—G. Leplat (*Bull. Soc. Roy. Belgique, Classe de Sciences*, 1920, 252–61). In over 200 monstrosities, cyclopean and anophthalmous, only fifteen had differentiated lenses, which is not in agreement with the view that the head-ectoderm very readily develops lenses. J. A. T.

Uterus of Narcine indica.—B. Prashad (*Records Indian Museum*, 1920, **19**, 97–105, 2 pls.). In a paper on Torpedinidæ from the Orissa coast, a description is given of the gravid uterus of *N. indica*, which contained a yellowish milk-like secretion. The entire inner surface is densely covered with spathulate villi-like trophonemata (198 on a square inch), which closely resembled those of *Torpedo ocellata*. J. A. T.

Irritability of Selachian Embryo.—P. Wintrebert (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1029–31). The very young embryo of the dogfish (*Scylliorhinus canicula*), when only 5 mm. in length and aneural, shows great irritability in response to mechanical stimuli applied directly to the muscle. The stimulus may be passed along a myotomic chain, and always acts as an accelerator. Excitation of a tissue at a distance from the muscle has no effect. J. A. T.

Leptocephalus Stage of Conger.—E. Ford (*Journ. Marine Biol. Ass.*, 1920, **12**, 249–52). Note on a specimen of *Leptocephalus congri vulgaris* (*L. morrisii*) from a depth of 31 fathoms, captured (September 17, 1919) near Eddystone. It was between 115 and 120 mm. in length, and eighteen days after its transference to the aquarium the normal retrograde metamorphosis had resulted in a reduction to 80 to 90 mm., and its former "ribbon" shape was being superseded by the eel-like form, with a considerable loss of transparency. Its age at capture was certainly well over one year, with a possibility of eighteen months. A summary is given of previous captures of conger larvæ around the British Isles. J. A. T.

Pelagic and Early Bottom Stages of Teleosteans.—R. S. Clark (*Journ. Marine Biol. Ass.*, 1920, **12**, 159–240, 9 figs.). An elaborate report on 16,400 stages of well-known Teleostean fishes, referable to twenty-four families, thirty-nine genera, and seventy-one species. Attention is directed to the adaptive post-larval characters and the taxonomic value of the number of vertebræ and fin-rays. J. A. T.

Blood-formation in Bony Fishes.—J. Jolly (*Comptes Rendus Soc. Biol.*, 1920, **83**, 848–50). In Selachians, Sauropsia, and Mammals the blood appears first outside of the embryo on the surface of the yolk or in connexion with the yolk-sac. In Teleosteans the first blood-cells are formed within the embryo, and the appearance of the vitelline reticulum is delayed. Previous investigators have found the seat of blood-formation in a mesodermic mass between the notochord and the gut, and Jolly confirms this. Later on, when the mesodermic mass (the intermediate mass) is dissociated, blood-cells appear singly or in little groups at the expense of extra-embryonic mesoderm. This is a primitive mode of development, of secondary importance in Teleosteans. It is suggested that the peripheral extra-embryonic seat of formation has become incorporated in the body of the embryo to form the median primordium. J. A. T.

Life-history of the Angler.—ALEXANDER BOWMAN (*Scient. Investigations Fishery Board, Scotland*, 1920, 1–42, 6 pls., 2 charts). A study of the eggs and larvæ of *Lophius piscatorius*. The eggs, after expulsion from the ovary, are found floating in the sac enveloped in a ribbon-shaped mass of light violet-grey mucus, many feet long. They are arranged in a single irregular layer, each free in a polygonal compartment, oil-globules uppermost. The isolated egg is pelagic, large, and transparent, with a homogeneous yellowish yolk. It is typically oval in shape, with a variable number of oil-globules like burnished copper or amber. The newly-spawned egg is entirely free from pigment, but even before the embryo begins to assume definite form dark dendritic pigment appear on the surface of the embryo and on the yolk near the embryo, and this pigment spreads rapidly. The embryo does not extend round the whole egg before it is ready to hatch out; the tail remains quite free from pigment.

The newly-hatched larva, 4·5 mm. long, is a striking object. It floats with the yolk uppermost; the head, being heaviest, is lowest; thus the larva in still water assumes an oblique position, with the tip of the tail just touching the surface film. The yolk is still relatively large, its diameter being more than half the length of the larva. The body and the gut are richly pigmented. The pigment-free tail is short and fleshy. The mouth is closed.

Even the seven to eight days' old larva floats yolk uppermost, the body lying obliquely to the surface film. As the pelvic fins get shunted forwards till anterior to the fan-shaped pectorals, the larvæ gradually sink towards the bottom of the aquarium. In the summer months the absorption of the yolk is completed in about fifteen days. At this stage there was still no depression of the head or body, but a superficial tadpole-like appearance. The mouth is now open and well formed. The pelvic fins are long, simple, filamentous rays.

A post-larval form, about 10 mm. long, with three well-developed first dorsal rays and the beginning of the second dorsal and anal fins, shows the first signs of the change which leads to the adult shape. The pelvic fins develop subsidiary lobes, and their rays become very long. The changes on to the time when the young fish takes to the bottom are described—e.g. the changes in the form and in the relation of the paired and unpaired fins, the enormous lateral expansion of the head behind the eyes, the shifting of the eyes from their original lateral position to the top of the head, the multiplication of seaweed-like tags of skin.

The fact that *Lophius piscatorius* has a prolonged pelagic period is now made clear. Insufficient data led to the view that the pelagic period was very short. The specific gravity of the eggs and the loose binding together in a gelatinous matrix of extended surface ensure for the large eggs a prolonged period of flotation, first at the surface, and afterwards in the upper layers. Later on the power of flotation is increased by the extraordinary length and spread of the membranous pelvic fins of the larvæ; and there are other interesting adaptations.

The remarkable sheets of spawn are discussed at some length. The spawning period in the northern parts of the North Sea extends from February or March to July. It begins at least as early as January in the Mediterranean. A careful study of the records points to the conclusion that the main spawning area in the North is beyond the limits of the North Sea, and that the Atlantic itself may be the main spawning area. The sheets of spawn probably drift for great distances. J. A. T.

Secondary Sex Characters of Elasmobranchs.—W. HAROLD LEIGH-SHARPE (*Journ. Morphology*, 1920, **34**, 247–65, 12 figs.). In the male Elasmobranchs the basal element of the pelvic fin is prolonged to form a stout backwardly directed skeletal rod supporting a portion of the fin specially modified to form a copulatory organ, called the clasper. It is rolled up in a manner resembling a scroll, so as to form what is practically a tube along which the spermatozoa pass, injected in sharks and dogfish by a very muscular apparatus, the siphon. In the skates the place of the siphon is taken by the clasper gland contained in a sac which it completely fills. Other accessory structures may be present on the claspers, such as the spurs and the like in Acanthias and the fan-like terminal expansion (the rhipidion), most developed in skates, whose function is to spray the spermatozoa in all directions in a radiating manner. The author describes the clasping apparatus in *Scyllium catulus*, *S. canicula*, *Acanthias vulgaris*, and *Raia circularis*. In *S. catulus* there is a pair of accessory sacs (parasiphons), smaller than the siphons, and nearer the median line, dorsal to the skeletal rod. They are accessory to the siphons. In *S. canicula* the parasiphons are vestigial. The clasper groove or tube is filled with spermatozoa by a gradual flow through the apopyle (anterior proximal opening). Copulation ensues, and the claspers are bent forward so that the apopyle is closed. Muscular contraction of the siphon-wall follows, and the spermatozoa are ejected by the flush of sea-water into the oviduct of the female. The posterior end of the oviduct is naturally dilated to admit of the inclusion of the claspers. In young females it is closed by a hymen. The roughened rhipidion, with backward pointing denticles, passes anterior to this dilation and serves for close and secure attachment. In *S. canicula* the rhipidion is vestigial. The siphon of the living animal contains sea-water. The siphons arise in development apparently as invaginations of ectoderm. The siphon wall consists of an internal membrane of stratified epithelium, a broad layer of circular muscles, a ventral band of longitudinal muscle, and, dorso-lateral in position, a longitudinal muscle-band external to the whole. In *Acanthias vulgaris* the apopyle is considerably removed from the cloaca, the actually closed portion of the clasper tube is short, the rhipidion is pronounced, and there is a short straight thorn-like spur, a brief distance anterior to the hypopyle (the posterior distal exit). This spur is worked by a powerful muscle, so that while it normally is kept in a relaxed condition against the side of the clasper, once the latter has entered the oviduct of the female it can be erected, forming an important organ of attachment. The extreme tip of the clasper, posterior to the hypopyle, is also provided with a very small much-curved claw, likewise movable, perhaps serving to rupture the hymen. In the ocellated ray (*Raia circularis*) there are many differences. The claspers are almost smooth ; the apopyle exists rather in name than in reality, and is removed a considerable distance posterior to the cloaca ; the clasper has a groove, not a tube ; the rhipidion is a fan ; the siphon sac is filled with a remarkable gland somewhat like a date stone. Each of the two lobes of the gland is compound and the components open by papillæ in a longitudinal groove of the gland. The siphon tube, which forms the ultimate duct of the gland, does not debouch at the apopyle, but is continued as a completely closed passage to a separate aperture posterior to the hypopyle. In this case the muscular walls of the siphon sac do not serve to propel spermatozoa ; they serve to inject the secretion of the clasper gland into the female. The claspers have a minimum of skeletal support, but they are very erectile, it may be to four times their natural size. Such an erection is not needed in *Scyllium* and *Acanthias*, which are provided with dermal denticles and spurs, respectively ; *Raia* relies on erection and on a relatively larger rhipidion for fixing purposes during insemination. J. A. T.

Developmental Rate and Structural Expression.—CHARLES R. STOCKARD (*Amer. Journ. Anat.*, 1921, 115–277, 6 pl. 32 figs.). A given animal species passes through its embryonic stages at a specific rate of development, probably dependent upon the rate of oxidation in the protoplasm of the species. This developmental rate varies within certain normal limits ; should variations in rate extend beyond these limits, the developmental result frequently becomes modified and distorted. The rate is not uniform throughout, but periods of rapid progress alternate with moments of slow rate or almost quiescence. But development in most forms is continuous, though stopping completely is universal among birds and is known in several mammals. Discontinuity may be induced by temporarily lowering the surrounding temperature and thereby reducing the rate of oxidation, and by directly cutting off the supply of oxygen. The effect varies with the moment, for some moments are critical, especially when marked inequalities in rate of cellular proliferation are taking place in different portions of the blastoderm or embryo. Slowing does not have the same abnormal results as stoppage, for the normal inequalities of rate are reduced in the same proportion. Practically any deformity recorded in the literature, other than those due to germinal mutations, can be induced by lowering the temperature. Duplicities are easily induced in the sea-minnow, *Fundulus heteroclitus*, and in the trout, by arrest or stoppage before the process of blastopore formation has begun. Double chick embryos are probably due to the eggs being laid (in a minority of cases) before the gastrulation has begun. The fall in temperature following laying gives rise to two points of gastrulation instead of one. Polyembryony in the armadillo is probably due to delayed implantation of the blastocyst in the wall of the uterus. The stop here is not due to a temperature change, since none has occurred, but is very probably due to an exhaustion of the original oxygen supply derived from the ovarian blood. The degree of duplicity in double individuals depends on the original distance apart of the embryonic buds on the blastoderm. The degree of deformity in the small component of two varies directly with the extent of difference in size between the two components. As the large component reaches adult size the lesser component may be represented by a nodular mass or by a twin inclusion. The primary action of all factors inducing deformity is to inhibit the rate of development. Both monstra in defectu and monstra in excessu may exist in the same specimen, being due to a common cause. Species may be lost by failure to find environments in which harmonious development is possible, but birds and mammals have partially succeeded in controlling their own developmental environment. But in no sense is the regulation constantly perfect, and this fact is the underlying cause of frequent malformations and monstrous productions. J. A. T.

Influence of Parental Alcoholism.—E. C. MacDowell (*Proc. Soc. Exper. Biol. and Med.*, 1919, **16**, 125–6). Training records of the offspring and grand-offspring of a pair of rats heavily alcoholized daily for two months before the birth of the young. Habit formation was tested on a Watson maze and a Yerkes multiple choice apparatus. The criteria were the average time per trial, the number of "perfect" trials, the number of wrong turns or errors. The rats that received alcohol and their unalcoholized descendants were less successful than the controls in meeting the situations presented. J. A. T.

b. Histology.

Fibrillar Reticulum of the Human Spleen.— G. Dubreuil (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1098–1100). There is a fibrillar reticulum throughout the spleen, except in certain Malpighian corpuscles. It is seen in the white pulp in the form of collagenous, precollagenous and elastic fibres. It is seen in the red pulp in the form of precollagenous fibres in the strands of Billroth and of ill-differentiated elastic fibres round the special endothelium of the venous sinuses. This fine supporting reticulum is attached to the capsule and to the fibrous framework of the spleen. It is useful to distinguish this fibrillar reticulum from the cellular reticulum which forms narrow meshes enclosing free elements. J. A. T.

Islets of Langerhans and Blood-formation.—M. Aron (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1119–22). The hæmatopoietic islets of the pancreas seen in a few mammals result from the transformation of some of their elements into red blood corpuscles. This transformation is cytologically identical with what occurs in the case of the "cellules troubles" of the pancreas in the embryo pig. J. A. T.

Minute Structure of Langerhans's Islets. — S. Saguchi (*Amer. Journ. Anat.*, 1920, **28**, 1–57, 6 pls., 4 figs.). An account of the different types of islet cells, their nuclei, granules, mitochondria, lipoid corpuscles, the urano-argentophile apparatus, pigment granules, division, development, and distribution in the pancreas. There is a transformation of the acinus cell into the islet cell, whereby not only the cell-body and the nucleus change shape and position, but the intra-cytoplasmic structures also undergo a series of definite alterations. There is also a transformation of islet cells into acinus cells. The theory that the islet is an organ for internal secretion, giving certain substances to the blood-stream, is the most probable theory as to function. Most of the islet cells are, at one or both ends, in contact with distended capillaries, and the islets have no lumina that are continuous with the pancreatic duct. The lipoid corpuscles and urano-argentophile apparatus must be looked upon as specific secreted matter of the islet, and it is probable that, after having undergone a certain chemical alteration, these constituents pass into the blood-capillary. J. A. T.

Smooth Muscle Fibres of Central Suprarenal Vein. — Jean Peindarie (*Comptes Rendus Soc. Biol.*, 1920, **83**, 958–60). From the enveloping capsule of the suprarenal body, as Stilling has shown, delicate bundles of muscular fibres spread into the connective partitions of the glandular stroma, and act on the capillaries and parenchyme cells. The secretion is thus passed into the central collecting vein. This has a remarkably developed system of smooth muscle fibres, sometimes regarded as indicative of endophlebitis. A careful description is given of what Peindarie regards as quite normal. The experiments of Stewart and Rogoff show that animals without a suprarenal body react like the others to psychical stimuli, the phenomena being vaso-motor. Glandular hyper-secretion may not be the primary cause of the immediate change following emotion ; what happens may be due to the compression and emptying of the collecting vein by the powerful musculature in the walls. J. A. T.

Musculature of Central Veins of the Suprarenal Body in Man.— G. Dubreuil (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1096–8, 1 fig.). The striking development of smooth muscle around these veins as described by Peindarie is confirmed. It is not found in sheep, rat, or rabbit. In man the musculature is unequally developed on different sides of the vessel. The fibres are seen only on the large branches. Most are longitudinally disposed, but some are oblique, so that a plexiform distribution results. J. A. T.

Minute Structure of Human Lung.—Ch. Ogawa (*Amer. Journ. Anat.*, 1920, **27**, 315–32, 8 figs.). The alveolar ducts divide two to nine times to reach the air-sacs, at various angles from wide to acute, showing both monopodial and dichotomous ramification. Diverging planes of alveolar ducts frequently cross each other. The alveolar ducts branch in frequent succession ; the decrease in diameter is not marked. The mouths of the alveolar ducts consist of alveolar septa, but usually the mouths are enclosed partially by the wall of the alveolar duct itself. The number of alveoli contained in one air-sac is estimated to be from one to twenty, eleven in average. The alveolar walls, other than the base, are formed usually by both the protruding wall of the alveolar ducts and the alveolar septa. J. A. T.

Histology of Vertebrate Lung.—CH. OGAWA (*Amer. Journ. Anat.*, 1920, **27**, 333–93, 28 figs.). A comparative study in Amphibians, Reptiles, Birds and Mammals of the respiratory epithelium, the muscle fibres, the elastic fibres, and the reticular fibres. The respiratory epithelium of reptiles is intermediate between that of amphibians and that of mammals. It seems to be absent in birds, mole and bat. The muscle fibres are entirely absent in all parts of the alveolar ducts in the bat lung, and they are usually absent from the alveolar walls. The distribution of the elastic and the reticular fibres is described in detail, but we cannot do more than indicate the general nature of the investigation. J. A. T.

Paranucleus of Pancreatic Cells.—P. R. CHAVES (*Comptes Rendus Soc. Biol.*, 1920, **83**, 881–4). Methods of technique may cause sudden coagulations and the like in the cytoplasm, and some of the resulting lamellar or fibrillar products have been called Nebenkerne or paranuclei. Others are due to nucleoli which migrate into the cytoplasm. These usually show a central and a peripheral substance, differing in their reactions. The precise mode of expulsion and migration of the nucleoli is obscure. They begin to exfoliate into a number of lamellæ, and probably dissolve in the cytoplasm. Thus, besides the lamellar paranuclei arising as artefacts from the condensation of ergastoplasmic filaments, there are true paranuclei of nucleolar nature and origin. J. A. T.

Transformations of Hepatic Cell in Hedgehog.—P. R. CHAVES (*Comptes Rendus Soc. Biol.*, 1920, **83**, 879–81). During embryonic life the hepatic cell becomes vacuolated, increases in size, and accumulates fat which subsequently disappears. The chondriosomes, at first very small, are transformed into large rodlets and granulations. The vacuoles become confluent and increase in size, forming a secretion which disappears in the sucking young. After birth the transformations continue, those of the chromosomes being remarkable. During the lactation the fat reappears. J. A. T.

Giant-Cells of Bone-Marrow.—H. E. JORDAN (*Amer. Journ. Anat.*, 1920, **27**, 287–313, 27 figs.). The red bone-marrow of the rabbit and the guinea-pig contains three chief varieties of giant-cells: (*a*) Megakaryocytes, the mononucleated forms derived by excessive growth from the hæmoblast; (*b*) polymorphokaryocytes, the forms with polymorphous or lobulated nucleus derived from the megakaryocyte by incomplete direct division of the nucleus; and (*c*) polykaryocytes, the multinucleated forms derived from forms with lobulated nuclei by completion of the constrictions in the complex nucleus to produce separate smaller and spheroidal nuclei. Certain giant-cells of the multinucleated variety, chiefly bi- or quadri-nucleated, retain to the small degree the power of producing ultra-cellular erythrocytes. The giant-cells in normal marrow and in the yolk-sac are devoid of phagocytic function; and they do not undergo mitosis, either complete cytoplasmic or incomplete nuclear. Once the hæmogenic giant-cells of the red bone-marrow have passed beyond the stage with features characteristic of the hæmoblast, their further history only leads through progressive steps toward disintegration, involving terminally in some cases nuclear appearances simulating multipolar mitotic figures. J. A. T.

Dental Star in Horses and Cattle.—E. Retterer (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1069–72). The teeth of horses and cattle continue to form ivory, even after the layer of odontoblasts has disappeared. The ordinary, rounded or stellate, cells of the papilla preside at this formation of ivory. The dentine thus formed exhibits some of the characters which pathologists have described under the name of secondary dentine. It is traversed by calcified globular masses, interrupting the course of the canaliculi. No cells were visible. In man's teeth the secondary dentine is formed by large osteoblasts: in horse and ox the ordinary tissue of the papilla forms the secondary dentine. Mechanical factors influence its development: where there is strong pressure it turns into enamel; where it is sheltered it turns yellow or black and begins to show disintegration. The dental star is ivory at the beginning of caries. J. A. T.

Retina of Alligator.—H. Laurens and S. R. Detwiller (*Journ. Exper. Zool.*, 1921, **32**, 207–34, 13 figs.). The eye of *Alligator mississippiensis* shows a well-developed retinal tapetum in the dorsal and posterior portions of the retina to within 1·5 mm. of the entrance of the optic nerve. It is due to the inclusion of guanin in the cells of the epithelial layer. The pecten is a slightly raised pigmented cap covering the entrance of the optic nerve. Typical rods and cones occur, the ratio differing in different regions. The rods are all of one type. There are thick and thin cones, none with oil drops. The authors discuss the change in the length of the rods and cones, and the change in the position of the pigment between light and darkness. A theoretical consideration of photomechanical changes and of the duplicity theory from the comparative point of view is appended. J. A. T.

Oviducal Glands of Chelonia.—R. Argaud (*Comptes Rendus Soc. Biol.*, 1920, **83**, 828–9). There is a double equipment: (*a*) mucus-making unicellular glands due to a temporary transformation of ciliated cells, and (*b*) definitive glands in the form of ramified tubes. The very granular cells of the tubular glands are differentiated at sexual maturity, and probably serve to secrete protective membranes for the ovum. J. A. T.

Grünhagen's Spaces.—M. A. Herzog (*Revue Suisse Zool.*, 1920, **82**, 99–113). The spaces below the villous epithelium of the intestine have been studied experimentally and histologically, with the result that the investigator is quite convinced as to the artefact nature of Grünhagen's spaces. J. A. T.

Minute Structure of Choroid Plexus in Frog.—R. Collin and J. Baudot (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1143–5). The epithelial covering of the thalamencephalon consists of a club-shaped nodule (the paraphysis or superior choroid plexus) and two bunches of digitiform villosities (the median and inferior choroid plexuses). The epithelial cells of the villosities are prismatic ciliated cells, in contact basally with a collagenous zone resting on the endothelial wall of capillaries. Their minute structure is described. The paraphysis proper is formed of endothelial capillary tubes covered with cubical cells, which have no cilia. J. A. T.

Hiwatari, Kazuo.—" Uber das Wesen des Trachoms nebst einem Beitrag zur normalen Histologie der Conjunctiva " (Actæ Scholæ Medicinalis, Kioto, 1919, **3**, 31–48). The substantia propria of the conjunctiva consists of a layer of connective-tissue containing fairly numerous histiocytes of Kiyona, and smaller numbers of Marschalkos' plasma cells and lymphocytes—contrary, therefore, to the wide-spread assumption that the Tunica propria shows no adenoid condition.

Lymph-nodes are absent from the normal conjunctiva ; they are produced when the tissues react against external irritation of different duration and vigour. Only two other points come under consideration in the formation of follicles in the conjunctiva. These are general bodily health and a local disturbance of the tissue. These two points depend firstly on age, and secondly on the anatomical structure of the conjunctival parts. Now and then variation in the cell-abundance of the sub-epithelial tissue and the form of the epithelial cells (cylindrical or flat) are specially emphasized.

In trachoma early luxuriance of fibroblast occurs, without the formation of lymph-nodes or any increase of histiocytes, lymphocytes, or plasma cells, so that a peculiar granulated tissue is formed in the sub-epithelial layer, making the trachoma a kind of chronic granular inflammation. Excessive granulation and the formation of lymph-nodes are important in the pathology of trachoma, as they represent the reaction product of the tissues against the trachoma virus. Granulation always occurs in the scars caused by trachoma, whereas the follicle may be missing if the local tissue-arrangement be imperfect—e.g. in conjunctiva bulba and in pannus—hence the latter formation is less important than the former. The question of the occurrence of follicles in pannus has previously been answered in the affirmative. This is incorrect, however, as is also the assertion that the trachoma process alone produces follicles. Their scarcity is another point against it. Only an occasional congenital anatomical variation in the limbus is favourable to the formation of follicles, a variation sometimes marked by an excess of cylindrical cells in the epithelial layer. J. E.

Nishikawa, Y.—" Zur vergleichenden pathologischen Morphologie der chronischen Miltztumoren " (Mitteilungen aus der Medizinischen Fakultät der Kaiserlichen Universität zu Tokyo, 1919, **21**, 1–215, with bibliography). The author records anatomical, micrometrical, and comparative histological experiments on seventy-seven different kinds of chronic splenic tumours, directing his attention chiefly to the enlarged spleen which must be regarded as the primary locus morbi in Banti's disease.

Banti's fibro-adenoma, in the opinion of Chiaris, is due chiefly to the growth and thickening of the fibres—i.e. hyperplasia of the reticulo-endothelial cells—though the connective-tissue of the capsule-trabecular system and the separation of its vessels may also have effect. The question of the resulting severe reticulum enlargement is still undecided. The author agrees with Kozumis that the reticulo-endothelial cells, in the production of the reticulum fibres, show large, blistered nuclei, poor in chromatin, with phagocytic power, but shrunken pyknotic nuclei. Banti's fibro-adenoma is, briefly, characterized by marked out-standing of the elastic fibres from the thickened capsule-trabecular system in the pulp; excessive increase and intrapulpal growth of the periarterial, elastic, collagenic, and interlaced fibres, with partial collagenic metaplasia and hyalin degeneration; regular enlargement and thickening of the intersinal reticular cords and the reticulum formation of the ring fibres, with partial collagenization and sometimes even hyalinization; partial strong decrease in the sinus lumina and marked reduction of the free-cell elements; diminution, atrophy, and fibrous alteration of the Malpighian corpuscles by increase and intrafollicular growth of the periarterial, elastic, and collagenic fibres, as well as of the real follicular fibres, with partial collagenic metaplasia and sometimes even hyalin degeneration of the Kosten cell elements.

The so-called collagenic metaplasia of the interlacing fibres frequently occurs in the spleen in liver cirrhosis, schistosomiasis, and Morbus banti, and has been specially noted in chronic myelocytic leukæmia. It is nearly always associated with increase and thickening of the fibres. Elastic necrosis of the capsular system with its hemosiderin-lime impregnation is very marked in liver cirrhosis, schistosomiasis, and Morbus banti, and it is interesting to note that elastic fibre increase occurs in both the capsular and arterial systems together. Its origin appears to be due chiefly to the chemical action of some toxic product; it is very doubtful whether it can arise from healthy enlargement alone—at any rate, this is of much rarer occurrence.

The plasma cells in the spleen are so important that it is doubtful if they may be regarded as a pathological appearance as in other organs, for it is quite clear that the spleen as a filter for free and corpuscular degeneration products already contains a relatively stronger physiological stimulus for plasma-cell production. They are scanty in the healthy enlarged spleen and in simple anæmia, but are plentiful in syphilis, malaria, abdominal cancer, as well as in chronic and sub-acute infective disease; are fairly numerous in liver cirrhosis and schistosomiasis; and are not rare in Morbus banti. J. E.

Hiwatari, Kazuo.—"Zur Histologie der Gegend der Corneasspleralgrenze" (Actæ Scholæ Medicinalis, Kioto, 1919, **3**, 277–86). Coloration of the epithelial cells of the conjunctiva cornealis is of common occurrence in Japanese, though showing many variations, whereas only one-third of the European cases examined were pigmented.

Children of all nationalities are less strongly pigmented than adults. In some cases it is stronger in the part covered by the eyelids than in the exposed part.

The author raises two points as quite new. 1. Coloration of the epithelial cells sometimes spreads as far as the junction of the limbus and the cornea. 2. Chromatophores are constantly present in the propria. Several variations of epithelial cells are found in the limbus, e.g. a mucus membrane cell with modified columnar epithelium and epithelium with goblet cells. The former was found in 2·5 p.c. of 120 cases investigated, the latter only in one case out of another series of fourteen.

Swelling of the tunica propria of the limbus does not occur as papillæ but as ridges, which are most defined in the upper sites, while they are missing from the temporal and nasal sites. The ridges are arranged regularly, but differ in size with the case; in forty-day-old babies they are missing altogether. In the cell elements of the tunica propria four kinds of cells must be distinguished:—Lymphocytes, plasma cells, histiocytes and chromatophores. J. E.

c. **General.**

Avoidance of Objects by Bats in Flight.—H. HARTRIDGE (*Journ. Physiol.*, 1920, **54**, 54–7). Bats flying at night, or in experimentally produced darkness, avoid obstacles. It has been suggested that they have very keen sight, but the capacity remains when eyes are covered. It has been suggested that they have exquisite tactility, but they can perceive objects at some distance away. "Bats in full flight and in what appeared to be absolute darkness can not only steer round a room and avoid one another, but they can also avoid obstacles such as threads. Further they can tell whether a door is shut or open wide, or just sufficiently wide open to allow them to pass." Bats have acute hearing, and they emit short wave-length sounds near the audible limit of man, and above that of some people. The hypothesis is advanced that their flight is diverted by a specialized sense of hearing, since the sound waves of short wave-length which they are known to emit are capable of casting shadows and of forming "sound pictures." One may ask if this would apply to the avoidance of *threads*. J. A. T.

Susceptibility to Growth of Transplanted Tumour.—C. C. LITTLE (*Journ. Exper. Zool.*, 1920, **31**, 307–26, 1 fig., 2 diagrams). Analysis of certain factors underlying susceptibility and non-susceptibility of mice to implants of a sarcoma of the Japanese waltzing mouse. The factors underlying susceptibility are definite inherited units, and certain of them find their active expression as favourable agents in supporting growth of the tumour implants in female animals, at the onset of sexual maturity. J. A. T.

Pulmonary Evolution in Mammals.—GEORGE S. HUNTINGTON (*Amer. Journ. Anat.*, 1920, **27**, 99–201, 15 figs.). The search for the elusive hypothetical pro-mammalian ground-plan of bronchial architecture has terminated somewhat like the hunt for the philosopher's stone. The mechanistic concept of a definite and crystallized archeal bronchial

tree, from which all the extant mammalian types are derived by modification of the pattern through migration, does not exist in the commonly predicated form of a concrete and fixed morphological entity. It had no reality in any definite ancestral structure, save in the sense that the primitive reptilian lung and its phyletic derivative, the mammalian endodermic primordium, both retain the potency of development by selection into the type demanded by the environment. In place of the mythical common ancestral bronchial tree appears a living plastic organization, responsive to the changing demands of biological evolution and replete with answers to the modern problems of morphogenetic enquiry.
J. A. T.

Transitory Polydactylism. — J. A. PIRES DE LIMA (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1190–2). Attention is called under this title to the occurrence in new-born children or infants of digitiform nodules which do not last, being attached only by a filiform stalk. The author thinks that they are often overlooked, and that their occurrence increases the number of cases of hyperdactylism. In some cases they bear a distinct nail, but little is said in regard to their internal structure.
J. A. T.

Temperature of New-born Camels.—E. SERGENT and A. DONATIEN (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1062–3). For some weeks after birth the average rectal temperature of healthy young camels is 38° C., not varying more than a fifth of a degree up and down. But, as in adult camels, if there is illness, e.g. due to injection of trypanosomes, there may be fluctuations of 5° in a few hours. The temperature may rise to 40° and sink to 34° when the animal is in a pathological state.
J. A. T.

Reactions of Amphibian Cells to Croton Oil.—ELIOT R. CLARK and ELEANOR L. CLARK (*Amer. Journ. Anat.*, 1920, **27**, 221–53, 15 figs.). A study of the reactions and changes of cells of the tail in Amphibian larvæ in response to injections of minute globules of croton oil. It is a study of aseptic inflammation. Connective-tissue cells manifest all grades of injury, depending upon their nearness to the oil. Non-pigmented leucocytes move toward the globule and at a certain distance become stationary, sending out many fine processes, which are withdrawn and renewed continuously. Pigmented leucocytes are more resistant and may touch the globules without losing motility. Blood capillaries near the globule show thickening and vacuolization of the endothelium, and, subsequently, narrowing of the lumen, with, in many cases, retraction of the endothelium. Lymphatic capillaries also show vacuolization of the endothelium, and their lumen may become much distended, particularly if an œdema develops. Throughout the inflammatory reaction each type of cell maintains its specificity, and there is no evidence of transformation from one kind to another.
J. A. T.

Lipoid Content of Kidney Tubule.—CHRISTIANNA SMITH (*Amer. Journ. Anat.*, 1920, **27**, 69–97, 2 pls.). Lipoids are characteristically present in normal kidney cells either masked or free, and are shown after a dichromatic fixation with the application of heat. In certain species, e.g. cat, different portions of the tubule have characteristic lipoid formations which may indicate a difference in function. The mitochondrial rods of the ascending limb of the medullary loop are by nature strongly lipoid and are resolved into lipoid granules under certain conditions. The presence, distribution, and, in some cases, characteristic distribution of lipoids in kidney cells suggest that they may be intimately connected with metabolic processes, besides perhaps having the function of influencing the physical state of the protoplasm. J. A. T.

Pyloric Cæca of Herring.—E. Ford (*Journ. Marine Biol. Assoc.*, 1920, **12**, 325–31). An examination of 475 females and 600 males showed that the general variation in the number of cæca is from 14 to 28, the most frequent number being 21, that there is no appreciable difference between the sexes, and that although the mean of the number is greater in the longer fish, the successive increases are not sufficiently great to be of much significance. In another sample of 197 the commonest occurring number was 22, in a general variation from 16 to 34 (two specimens over 30). J. A. T.

Degeneration of Pancreas during Pregnancy.—M. Aron (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1122–5). Description of curious degenerative changes in the pancreas of bats, goats and various other mammals during pregnancy. There is more or less intense autolysis of the pancreatic acini. It may be that some toxin from the peritoneal serosa passes into the wall of the pancreas where it is in contact with the peritoneum. J. A. T.

Function of Lymphoid Tissue.—J. Jolly (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1209–12). It has been usual to regard lymphoid tissue as the seat of the formation of blood cells. In the lymphoid tissue of the spleen and the marrow red blood cells and leucocytes suffer disintegration and are replaced. The cells in lymphoid tissue have well-developed nucleoplasm and little cytoplasm: there is a reserve of nucleo-proteins as well as of blood-corpuscles. J. A. T.

Function of Embryonic Kidney.—J. Firket (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1230–1). In the embryo cat it has been possible to show that as soon as the glomeruli are developed the embryonic kidney is able to eliminate crystalloid salts (ammoniacal citrate of iron and ferro-cyanide of sodium). J. A. T.

Adsorption of Hydrogen Ions by Living Cells.—J. Gray (*Journ. Physiol.*, 1920, **54**, 68–78). Under normal conditions the egg of the trout lives in water containing a very low concentration of electrolytes. The egg itself, on the other hand, has a much higher electrolytic content. It is shown that when the living eggs are exposed to dilute concentrations of hydrochloric acid, the hydrogen ion is taken up, but the concentration of chlorine ions in the external solution remains practically unchanged. To replace the hydrogen ions removed from the solution, a kation (possibly potassium) is given up by the eggs. The uptake of the hydrogen ion by the cell follows the laws of adsorption. The equilibrium between the external solution and the cell is apparently established by means of the outer membrane of the cell. This process constitutes Loeb's "membrane effect." J. A. T.

INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Pulsating Organ in Hyalin lucida.—G. Mermod (*Revue Suisse Zool.*, 1920, **28**, 119–24, 1 fig.). In this carnivorous snail there is a small pulsating organ, visible with the naked eye, situated in the sub-terminal region of the ureter, close to the opening of the shell. In a snail with a shell a centimetre in diameter the pulsating organ is about a millimetre in length by half a millimetre in height. There is no regularity in the pulsations; while the heart had 56 pulsations in a minute, the organ had 76, 80 or 100. The body of the organ consists of a loose network of connective cells and darkly pigmented cells; its root is in the circular vein of the pulmonary cavity. It may be a sort of secondary heart, facilitating the return of the blood from the circular vein. Or it may be an organ that drives excreted particles into the ureter. J. A. T.

δ. Lamellibranchiata.

Nutrition in Lamellibranchs.—D. Carazzi (*Rassegna Sci. Biol.*, 1920, 33–56, 2 figs.). A discussion of the mode of nutrition in oysters, with an account of experiments. In 1896 the author came to the conclusion, afterwards re-affirmed by Pütter (1908), that oysters absorb nutritive material in absorption in the water. To this he firmly adheres. The main mode of nutrition in Lamellibranchs is by absorption of substances in solution in the water. The absorption is by means of the epithelium of the intestinal mucosa, the labial palps, the branchial lamellæ, and the edge of the mantle. According to Carazzi, is is only in a secondary way that Lamellibranchs feed on plankton organisms. J. A. T.

Animals Associated with Spondylus.—Charles Pérez (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1027–9). On the pearl banks of the Persian Gulf there is a frequent occurrence of *Spondylus gaederopus*. This bivalve always contains either the Pontomid crustacean *Anchistus miersi* (a pair) or the Pinnotherid *Ostracotheres spondyli* (invariably a female). The Pinnotherid harbours two parasitic crustaceans, usually one or the other—namely, a new Bopyrid, *Rhopalione uromyzon* (both sexes), fixed under the abdomen, and *Sacculina ostracotheris*. But the Sacculina harbours a group of Cryptoniscids—several adult females, numerous males, and some transitional forms between male and female. The Cryptoniscid seems to be new; it is named *Enthylacus trivinctus*. It appears that *Spondylus gaederopus* is an immigrant from the Mediterranean, but the Indian Ocean commensals above noted have found it quite suitable for their purpose. J. A. T.

Arthropoda.

a. Insecta.

Oogenesis in Hymenoptera.—LANCELOT T. HOGBEN (*Proc. Roy. Soc.*, Series B, 1920, **91**, 268–93, 6 pls.). Studies of the oogenesis in *Cynips kollari*, *Rhodites rosæ*, *Synergus rheinhardii*, *Orthopelma luteolator*, *Lasius flava* and *Formica rufa*. All three types of cells (oocytes, follicle, and nurse cells) in the ovary originate from germ cells. The divisions of the oogonia are apparently equipotential, and no distinction exists between nurse cells and oocytes until after synapsis. After synizesis the haploid number of pachytene threads appear, and in *Rhodites* split lengthwise. During the growth period there is a diffuse or confused stage. At the termination of the growth period the diploid number of chromosomes reappears, and they pair end to end, so that a temporary separation of the diplotene threads is intercalated between synapsis and the first polar mitosis. This confirms Agar's account of a double syndesis. The restoration of the diploid number by the lengthwise splitting of the haploid pachytene threads permits the inference that the first conjugation is of the type described as parasyndesis. Immediately after this an abortive maturation spindle appears—an interrupted mitotic process. In *Rhodites* and *Cynips* there is a reduction of the number of chromosomes in the young oocytes. Secondary nuclei are transitory structures arising from ejected nuclear particles, as Hegner concluded. The oosoma or so-called germ-cell determinant is not of nuclear origin, as believed formerly by Hegner and Silvestri, but arises, as Gatenby affirms, from cytoplasmic granules which are not mitochondrial. J. A. T.

Striped Muscle of Wasp.—H. E. JORDAN (*Amer. Journ. Anat.*, 1920, **27**, 1–67, 48 figs.). The comparative histology of the leg and wing muscle of the wasp, with special reference to the phenomenon of stripe reversal during contraction, and to the genetic relation between contraction bands and intercalated discs. The contraction is associated with a genuine reversal of striations as regards a deeply staining substance of the dark disc of the sarcostyle. This reversal of striations results in the formation of contraction bands in the contracted fibre. A contraction band is composed essentially of the fused opposite halves of two adjacent dark discs. The striping of the striated muscle fibre results from the segregation of darker and lighter (chromatic and achromatic) substances in alternating dark and light discs. The segregation of anisotropic materials (conditions) in strata alternating with isotropic levels, and corresponding more or less sharply, under certain conditions, with the dark disc, would seem to find its explanation in the relatively more fluid consistency of these dark discs. Anisotropy and the deep-staining character of the dark disc are two essentially distinct phenomena.

Reversal of striation concerns only the deeply staining substance of the dark disc, not at all the phenomenon of anisotropy. The contraction band is a genuine new structure, consisting essentially of the dark staining (chromatic) substances originally segregated within the dark disc of the relaxed fibre. The intercalated discs of striated muscle (cardiac and skeletal) are essentially modified irreversible contraction bands. J. A. T.

Shape of Hive-bees' Cell.—G. Cesaro (*Bull. Acad. Roy. Belgique.* 1920, 109–15, 2 figs.). The cell is a rhombododecahedron of which three surfaces form the apex, and six surfaces, parallel to a diagonal of the cube (a diagonal which is the axis of the cell), form the hexagonal body; the rhombododecahedron is cut by an octahedral surface normal to the axis and forming the hexagonal base. The cell corresponds not only to minimum of surface but to a minimum of perimeter. J. A. T.

Action of Centrifugal Force on Silkworms.—Hugues Clément (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1045–6). It is found that centrifuging considerably retards (for about a month) the onset of the pupal metamorphosis, which normally sets in five or six days after the commencement of the cocoon. J. A. T.

Circulation in Sphinx convolvuli.—F. Brocher (*Arch. Zool. Expér.*, 1920, **60**. 1–45, 20 figs.). The blood circulates in the body of this moth as the result of two aspiratory forces. The activity of the dorsal vessel draws the blood into the abdomen. The activity of the thoracic pulsatile organs pumps the blood into the currents produced by the dorsal vessels and makes it circulate in the wings, the legs, and the muscles of the thorax. The pulsatile thoracic organs have been found by Brocher in all orders of insects except Hemiptera. But in the Hemiptera there are special pulsatile organs in the legs. In *Sphinx convolvuli* the pulsatile organ of the mesothorax is very large and it is easy to see it working in the living insect. In the somnolent insect it beats 10 to 12 times in a minute; in the disturbed insect 75 times; in the active insect the pulsations are too rapid to be counted. The metatergal pulsatile organ, on the other hand, is very minute, and it does not communicate directly either with the dorsal vessel or with the aorta. In some other insects (ants?) it is probable that both the mesothoracic and the metatergal pulsatile organs are independent of the dorsal vessel and the aorta. J. A. T.

Immunity in Caterpillars of Wax-moth.—S. Metalnikow (*Comptes Rendus Soc. Biol.*, 1920. **83**, 817–20). The caterpillars of *Galleria mellonella* show a remarkable immunity to virulent microbes, such as those of tuberculosis, diphtheria, tetanus and plague, but they are very susceptible to others which are only slightly pathogenic. There is very active phagocytosis, and the phagocytes agglomerate into co-operative capsules. The toxic substances produced by certain microbes set the phagocytic activity agoing, while in other cases, as in the case of saprophytic bacteria and species like *Bacillus coli*, there is little or no activation. Paillot has made caterpillars of *Agrotis* immune to *Bacillus* *melolonthiæ*, and Metalnikow has done the same with the caterpillars of *Galleria* into which were injected *Bacillus perfringens*, *B. subtilis*, *B. proteus*, and *Pneumococcus*. In these cases of acquired immunity a change is produced in the activity and sensitiveness of the phagocytes.

J. A. T.

Two Parasites of Blow-flies.—A. M. ALTSON (*Proc. Zool. Soc. London*, 1920, 195–243, 20 figs.). A Braconid Hymenopteron, *Alysia manducator* Panz., oviposits in the larvæ of several carrion-feeding Diptera. Only one parasite emerges from one host puparium. Over-parasitism kills the larva. The mean-average of the life-cycle is 52 days, the shortest is 25. Both sexes are capable of sustained flight, and they lived over a month in captivity. Another Hymenopteron, a Chalcid, *Nasonia brevicornis*, oviposits in the puparia of several species of stercoral and carrion-feeding Dipterous larvæ. From 1 to 62 have been found in one puparium. The length of the life-cycle varies from 11 to 22½ days in different countries. Only the females can fly, and then only for short distances. They can live, whilst ovipositing, for 4 to 6 weeks, but for a considerably less period without host puparia. The males remain near the place of emergence, fighting and mating. If and when puparia containing *A. manducator* are within reach of *Nasonia*, the latter may act as an accidental secondary parasite on the former. Both parasites when hibernating as full-grown larvæ can withstand over 6 weeks at 2° C. Both check flies—*Alysia* more effective against the Blow-fly, *Nasonia* more effective against the House-fly. J. A. T.

Egg-laying Reactions in Pomace-fly.—EDWARD F. ADOLPH (*Journ. Exper. Zool.*, 1920, **31**, 327–41). Single stimuli do not call forth any considerable amount of egg-laying in Drosophila. When odours and textures are properly combined, the fly may lay nearly as many eggs as in natural conditions. The presence of moisture characterizes all conducive complexes. The most stimulating substances are known to occur in the natural food material of the fly, e.g. odorous substances. A slight amount of egg-laying takes place under the simplest conditions, but a large amount requires a complex. The only internal condition of importance is sexual maturity, but mating, nutritive condition, and internal periodicities seem to have some influence upon the production of eggs. J. A. T.

Bristle Inheritance in Drosophila.—EDWIN CARLETON MACDOWELL (*Journ. Exper. Zool.*, 1920, **30**, 419–60, 8 figs.). The early generations of a race of Drosophila that was continuously selected for increased bristle numbers during forty-nine generations show higher correlation coefficients than any others. With the greatest uniformity of the environment, the last thirteen generations show no correlation at all. A final test of the germ-plasm of the selected race was made by raising four more generations without selection. In generations 52 and 53, 31,000 bristle counts indicated that the higher-grade parents did not produce higher-grade offspring. No evidence of sex linkage was found. The difference between the sexes is interpreted as due to general developmental conditions initiated by the sex chromosomes, rather than to the linkage of a specific gene. The correlation method supports previous conclusions: there were genetic differences present among the original flies with extra bristles; these were entirely independent of the main factor that occasioned the monohybrid ratios in crosses; selection propagated the more homozygous flies, so that a race with uniform germ plasm was soon secured. There is no indication that any genetic change occurred during the course of the experiments. J. A. T.

Crossing-over in Drosophila.—J. A. DETLEFSEN and E. ROBERTS (*Journ. Exper. Zool.*, 1921, **32**, 333–54, 2 figs.). The question studied was whether the percentage of crossing-over in *Drosophila melanogaster* can be modified by selection. It was found that cross-over values are very variable, and that part of this variability is due to genetic causes. Low selection has been effective in two entirely independent series. The low cross-over stock bred true to about 0·6 p.c. (almost zero) for nine generations in one of the series. The low cross-over stock bred true to about 6 p.c. for twenty-two generations in the other series. High selection probably induces double crossing-over. Crossing-over in the various regions of the sex chromosome (and other chromosomes?) is probably controlled by multiple incompletely dominant factors.
J. A. T.

Effect of Temperature on Crossing-over in Drosophila.—HAROLD H. PLOUGH (*Journ. Exper. Zool.*, 1921, **32**, 187–201, 3 figs.). In *Drosophila melanogaster* a temperature of 31·5° C. has little or no effect on crossing-over in any part of the sex chromosomes, nor is there any significant variation with the age of the female. Crossing-over in the "sepia-spineless" region of chromosome III. is increased by a temperature of 31·5° C., the effect being most marked between "dichæte" and "spineless." The same region shows a variation in crossing-over according to the age of the female parent. Crossing-over in the remainder of chromosome III. is influenced neither by temperature nor age. The chromosomal regions which are "sensitive" to temperature and to age all give a very high ratio of double to single crossing-over. This is interpreted as indicating that the effects of environment cause observable differences in crossing-over only where crossing-over occurs least freely. It is shown that the view that temperature and age act on crossing-over in different ways is not established. J. A. T.

Rectal Papillæ of Panorpa.—L. MERCIER (*Comptes Rendus Soc. Biol.*, 1920, **83**, 758–60). The rectal "gills" of some aquatic larvæ are represented in some adults by rectal papillæ, which may be functional or vestigial. In *Panorpa communis* and *P. germanica* the rectal papillæ of the adult are hemispherical caps 250 to 300μ in diameter, covered by polygonal epithelial cells, fibrillated externally (probably for support) and enclosing the ends of tracheæ. These papillæ appear during the pupal state as six cellular proliferations, much in the same way as the rectal papillæ in *Calliphora erythrocephala* and other Muscidæ. J. A. T.

β. Onychophora.

West Australian Onychophora.—W. J. Dakin (*Proc. Zool. Soc. London*, 1920, 367–89, 5 pls.). There are two West Australian varieties of Peripatus, sub-genus Peripatoides. The northern form, *Peripatoides occidentalis*, has always sixteen pairs of legs: the southern form, *P. occidentalis* var. *gilesii*, has only fifteen pairs. It appears that *P. occidentalis* approaches most closely to *P. leuckartii*, but it stands apart from other species, e.g. in the presence of extraordinarily long crural glands opening on the first pair of legs. Among the most important general results of the paper are the following, probably applicable to most Onychophora. The cells of a certain part of the so-called nephridium, that which opens into the cœlomic vesicle, bear long and well-developed cilia. So these are not confined to the reproductive organs. Crural glands sometimes occur in the female, but do not seem to have any ducts. The tracheæ of Peripatus possess a characteristic spiral supporting fibre (disputed for many years). The tracheæ, although running a separate course for some distance from the tracheal pit, eventually branch. As Gaffron discovered, the spermatogenesis does not occur in the testis but in the seminal vesicles. J. A. T.

γ. Arachnida.

Malformations in Ticks.—L. E. Robinson (*Parasitology*, 1920, **12**, 175–9, 5 figs.). Description of a number of malformations in *Dermacentor atrosignatus* (deformity of hypostome), *Amblyomma hebræum* (absence of left eye and deformity of scutum and spiracle), *A. cajennense* (fusion of coxæ (I. and II.) and suppression of normal coxal armature), *Hyalomma ægyptium* (oblique curvature of body axis, and in another case suppression of spiracle and adanal shields on the right side of the body). Such malformations are probably the result of some mutilation of the tick during the course of the preceding nymphal phase. In the course of engorgement, particularly as the state of repletion is approached, the chances of injury to which a tick is exposed are numerous, owing to the intentional or accidental scratching and rubbing of the infested parts of its body by the host, and the remarkable power of regeneration of damaged or lost appendages, which the ticks, in common with other Arthropods, have developed, must ensure the survival of many individuals which otherwise would perish. J. A. T.

Regeneration of Mouth Parts and Legs in Ticks.—George H. F. Nuttall (*Parasitology*, 1920, **12**, 7–26, 6 figs.). The mouth parts of larvæ of *Argas persicus* were mutilated shortly after the larva abandoned the host fully gorged. The various structures were differently affected in the first-stage nymph. The palps are not regenerated, but appear as stumps, occasionally with an article or two regenerated. The hypostome is perfectly regenerated when amputated at any point short of its base. If cut at its base the regenerated hypostome may be slightly deformed. The digits of the chelicerae are usually deformed to a varying degree, but considerable regeneration occurs. As the tick develops towards maturity the power to regenerate palps and digits increases. In

Amblyomma hebræum and *Hyalomma ægyptium* regeneration takes place equally well after operations on larvæ and nymphs, and perfect regeneration of hypostome, palps and digits occurred after most amputations. When freshly gorged larvæ of *Argas persicus* had their legs amputated, the corresponding limbs were not regenerated in the first nymphal stage, but when these nymphs were fed and allowed to undergo a further moult without operative interference, they regenerated these mutilated limbs perfectly. When first-stage nymphs, under like conditions, were similarly mutilated, they gave rise to second-stage nymphs with well-formed legs of subnormal size. Leg amputations in *Amblyomma* and *Hyalomma* were followed in all cases by regeneration. The regeneration of mouth parts is important in immature ticks, because in nature they are frequently injured through their forcible removal from the host, the hooked hypostome and digits of the chelicerae being particularly liable to breakage, especially in Ixodid ticks. J. A. T.

Habits of Argas reflexus.—R. Lienhart and P. Remy (*Comptes Rendus Soc. Biol.* 1920, **83**, 1155–6). Living adults were found at the University of Nancy in a dove-cot vacated since 1914. They must have been fasting all that time, for the dove-cot was quite closed.

J. A. T.

δ. Crustacea.

Heart of Euphausid.—G. Colosi (*Atti R. Accad. Sci. Torino*, 1920, **55**, 51–62, 4 figs.). A histological study of the heart of *Nematoscelis megalops* G. O. Sars. The cardiac wall shows an external, connective-tissue, continuous layer, and an internal, muscular, and discontinuous layer. There is no endothelium. The movements of the heart are due to the parietal muscles, and especially to the muscular trabeculæ which cross the cavity in various directions. The contractions are mostly dorso-ventral. The ostial lips are purely muscular. The ostia open and shut by the action of the special muscles which traverse the cardiac cavity. The cardio-arterial valves are purely muscular; they open and shut according to the pressure of the blood, mainly or perhaps wholly. The walls of the arteries consist of a homogeneous internal intima and an external connective adventitia. There are no muscle fibres and the arteries are not contractile. The walls of the venous sinuses consist of a homogeneous internal intima and an external connective adventitia. There are no muscle fibres and the sinuses are not contractile. The arterial valves and the ostial lips represent a continuation of the internal muscular envelope of the heart. The walls of the arteries and veins are continuous with the external connective-tissue tunic of the heart.

J. A. T.

Development of Calcareous Skeleton in Cirripeds.—Hjalmar Broch (*Vidensk. Medd. Dansk. Nat. Foren*, 1920, **72**, 83–5). A preliminary account of a study of the development of the plates in *Mitella* (*Pollicipes*) *polymerus*. As in *Scalpellum* the first plates to appear are the five primordial valves (carina, terga and scuta). They appear in the pupa-stage as five chitinous plates of porous structure soon after the pupa fixes. Very soon the calcification begins, and almost at the same time the rostrum is seen, immediately followed by the Latus superius. Then the upper row of Latera appear, and then the small scales of the stalk begin to form. The growth of the animal, especially that of the stalk, is almost entirely restricted to the narrow transition-zone from capitulum to stalk. In all probability the ancestral form of the stalked Cirripeds had only five thickened parts of the mantle, Darwin's "primordial valves"—first chitinous and subsequently calcareous. From this primitive type the pedunculated Cirripeds seem to have developed along two lines. One leads to the extinct *Archæolepas* and *Loricula*, and to the recent genera *Mitella* (possibly the starting-point of the sessile acorn-shells) and *Scalpellum*. The other line has given rise to the other genera of stalked Cirripeds, which have retained the five primordial valves or even reduced the number. J. A. T.

Melanin in Crustacea.—J. Verne (*Comptes Rendus Soc. Biol.*, 1920, **83**, 760–2). In the epidermis of Brachyura there is a yellowish pigment from which a melanin can be obtained experimentally. The pigment is formed on a mitochondrial substratum by mesenchyme cells, disposed in a perithelium around blood-vessels. These chromatophores move to the surface, and in parts exposed to light their contents are changed into insoluble melanin. The original yellowish pigment is of the nature of amino-acid, and the transformation into melanin depends on the presence of tyrosin. The chromatophores are amino-acidophores physiologically. J. A. T.

Carotin of Crustacea.—J. Verne (*Comptes Rendus Soc. Biol.*, 1920, **83**, 988–9). The carotins of Crustaceans oxidize very rapidly. But Merejkowski's idea that this facile absorption of oxygen pointed to a function like that of hæmoglobin is negatived by Krukenberg's observation that carotin once oxidized does not readily part with its oxygen as oxy-hæmoglobin does. The result of oxidation is a complex, which includes a product like cholesterin. This may account for the presence of cholesterin in Crustaceans. It is absent from the epidermis, abundant in the hepato-pancreas, and occurs in small quantity in the blood. The oxidation of carotin takes place very slowly in tissues protected by a thick integument. J. A. T.

Red Pigment of Crustaceans.—J. Verne (*Comptes Rendus Soc. Biol.*, 1920, **83**, 963–4). This pigment has received many names—zooerythrin (Merejkowski), vitellorubin (Maly), lutein or lipochrome (Krukenberg, Heim, Newbigin). It is chemically and spectroscopically like carotin. It is a hydrocarbon, with the carbon and hydrogen in the proportion 5 : 7. The formula $C_{40}H_{56}$ is suggested. Like vegetable carotin it forms along with iodine a characteristic violet-brown pigment. J. A. T.

Annulata.

Australian Polychæta.—W. A. Haswell (*Proc. Linn. Soc. N.S.W.*, 1920, **45**, 90–112, 4 pls.). A systematic account of members of the families Syllidæ, Eusyllidæ, and Autolytidæ, including the following new species:—*Syllis* (*Typosyllis*) *pectinans*, *S.* (*T.*) *truncata*, *S.* (*T.*) *punctulata*, *S.* (*T.*) *parturiens* (viviparous, like *S. vivipara*), *S.* (*T.*) *augeneri*, and *Pionsyllis melænonephra*. The memoir is very well illustrated.

J. A. T.

Nematohelminthes.

New Genus of Nematodes from Elephants.—H. A. Bayliss (*Parasitology*, 1921, **13**, 57–66, 7 figs.). What Baird took to be the female of *Sclerostoma clathratum* appears to be a worm of Spirurid affinities. To include both and *Filaria smithii*, the genus Habronema is established. The diagnosis includes the following features:—Polymyarian, paired lateral lips with papillæ, six horseshoe-shaped cuticular auricular appendages on the head, slender body, the tail of the male coiled ventrally into a spiral and provided near the extremity with lateral alar expansions, the spicules markedly unequal, the posterior papillæ complicated, the female considerably larger than the male, the tail of the female short, conically pointed or blunt and characteristically curved towards the dorsal side, the vulva near the posterior end of the œsophagus, the uterus with immense numbers of embryos not enclosed in a hard egg-shell.

J. A. T.

Gnathostomid Nematodes.—H. A. Bayliss and Clayton Lane (*Proc. Zool. Soc. London*, 1920, 245–310, 8 pls., 40 figs.). The chief family characteristic is the possession of a pair of large, fleshy, trilobed, lateral lips. Each lip is provided externally with three papillæ, while internally its cuticle is thickened and frequently raised into tooth-like prominences in the form of longitudinal ridges, which either meet or interlock with those of the other lip. The œsophagus is a muscular club with the usual valves where it opens into the intestine. A pair of cervical papillæ, usually not prominent, is always present in both sexes, and the tail of the female is always provided with a small pair of lateral papillæ. The male has more or less well-developed caudal alæ and two spicules, usually with characteristic ornamentation. The parasites are in the alimentary canal (of mammals, birds, reptiles and fishes), usually anteriorly, often burrowing in the tissues, sometimes causing tumours, sometimes merely holding firm. One genus (*Gnathostoma*) is a rare, probably abnormal parasite in man, in the subcutaneous connective tissue, not in the alimentary canal. The sub-family Gnathostominæ (with head-bulb, ballonets and cervical sacs) includes the genera *Tanqua*, *Echinocephalus* and *Gnathostoma*; the sub-family Spiroxyinæ (without head-bulb, ballonets or cervical sacs) includes the single genus Spiroxys.

J. A. T.

Platyhelminthes.

New Tapeworms from the Ostrich.—F. J. Meggitt (*Parasitology*, 1921, **13**, 1–24, 1 pl., 2 figs.). A description of *Davainea beddardi* sp. n. from *Struthio camelus*, and *D. linstowi* sp. n. from *Struthio molybdophanes*. A revision of the genus *Davainea*, with a list of species and their hosts. The genus may be defined:—Tæniodea, scolex with simple rostellum armed with a double row of very numerous and generally very small hammer-shaped hooks. Suckers armed or unarmed. A single set of reproductive organs in each segment. Genital pores unilateral or alternating. Uterus persistent or transient: in the latter case the eggs either enclosed in egg-capsules or scattered throughout the parenchyma. Eggs with thin transparent shells. Adults in mammals or birds. Larval stage a cysticercoid in molluscs or insects. J. A. T.

Extract of Tapeworm.—J. PARISOT and P. SIMONIN (*Comptes Rendus Sci. Biol.*, 1920, **83**, 937–9, 939–41). Aqueous extracts of the whole of *Tænia saginata* injected into the rabbit show relatively marked toxicity, and bring about fatal circulatory and respiratory disorders. A very specific effect is seen in the wall of the intestine, and the histological changes are described. There is also abundant diarrhœa. J. A. T.

Incertæ Sedis.

Minute Structure of Tardigrada.—H. BAUMANN (*Zool. Anzeig.*, 1920, **52**, 56–66, 5 figs.). Studies of *Macrobiotus*, *Hypsibius*, *Echiniscus* and *Milnesium*, with reference to the spermatozoa (remarkable in showing in immature stages a locomotor process from each end of a bent spindle-shaped cell), the buccal apparatus with its musculature and stilets, the pharynx with a characteristic disposition of the nuclei in the component cells (there is a purely convergent resemblance to the Nematode pharynx). It is interesting to find that the number of cells in the pharynx seems to be constant in *Macrobiotus hufelandi*, *Hypsibius* and *Echiniscus*; but in *Milnesium* the number is much greater. J. A. T.

Remarkable New Species of Porocephalus.—W. N. F. WOODLAND (*Parasitology*, 1920, **12**, 337–40, 1 fig.). From the intestine of a Nigerian cobra two specimens were obtained of a remarkable form, *Porocephalus pomeroyi* sp. n., approaching *P. annulatus*, but with a very long narrow "neck," and with the prosoma roughly three times longer than it is broad, and the first annulus at least twice the size of the third or any succeeding annulus. The specimens represented the two sexes. The white cylindrical body is divided into a large prosoma, a long narrow neck, and a long annulated opisthosoma. The female was 64 mm. long, the male 12 mm. The prosoma of the female was 8 mm. long and sac-shaped; the neck was 7 mm. long and only 0·8 mm. in breadth. Thus the total appearance of the animal is very curious. The two specimens were found in sexual union. J. A. T.

Cœlentera.

Hydra oxycnida.—ED. BOECKER (*Zool. Anzeig.*, 1921, **52**, 97–100, 2 figs.). This species, apparently very rare, was established by P. Schulze for a form of notable length and with a polar pointing of the large pear-shaped cnidoblasts (penetrants). Boecker obtained a number of specimens at Wittenberg on the Elbe. They were 18–20 mm. in length apart from the tentacles, and very slender. The 6–11 tentacles were about half the length of an elongated specimen. Budding was observed in one case. The penetrant cnidoblasts are as Schulze described. There are also volvents which Schulze was unable to find.

J. A. T.

Association of Tubularian and Sponge.—Ch. Pérez (*Comptes Rendus Soc. Biol.*, 1920, **83**, 835–7). A new species, *Tubularia ceratogyne*, from the Pas-de-Calais, where it lives under big tubular rocks, was found to be always associated with the Crumb-of-Bread sponge (*Halichondria panicea*) which grew up between and united the hydranths up to the distal ends. Modified hydrorhizæ from the Tubularian grow into the sponge. The association does not seem to be more than topographical, or epizoic, but it was constant at two stations.

J. A. T.

Genus Corallimorphus.—T. A. Stephenson (*Proc. R. Irish Acad.*, 1920, **35**, 178–86, 2 pls., 2 figs.). A description of *Corallimorphus rigidus* Moseley from off Ireland. It lives in deep water, and apparently, in correlation with that, it has a very thick body-wall and seems immobile. Moseley described it from living material, which appears to have been rigid. What we cannot tell is how changed it was by leaving the deep sea, and, if it was as rigid down there as it is now, how it fed. Hertwig held it as primitive, because of its very weak generalized musculature, but Stephenson emphasizes some characters which he regards as the reverse of primitive. These are the thick body-wall, the preponderance of diameter over height, and the large size: the numerous perfect mesenteries, the specialization of tentacles into two sorts, and of each of them into a head and a stem, and the large size of the nematocysts. The generalized musculature is perhaps a survival of primitiveness, or a degeneration connected with the mode of life in deep water.

J. A. T.

Circulation of Water in Renilla.—G. H. Parker (*Journ. Exper. Zool.*, 1920, **31**, 343–65, 1 pl., 1 fig.). In its natural habitat *Renilla amethystina* contracts and buries itself in the sand as the tide recedes, and expands above the sand when the tide returns. In contraction its volume may be diminished 83 p.c. by the discharge of sea-water. The water enters through the lateral siphonozooids, and possibly in very small amounts through the autozooids, which certainly serve for the entrance of food. It does not enter through the axial siphonozooid or the terminal pore of the peduncle. The water leaves the body by the axial siphonozooid, which normally discharges from time to time. Under high pressure water may also escape through the lateral siphonozooids, the autozooids, or even the terminal pore of the peduncle. Within the body the water that enters by the lateral siphonozooids collects in the inferior canal of the rachis, and passes thence by very fine openings of the peduncular septum from the inferior canal to the superior canal, and thus less directly but more freely out at the axial siphonozooid, or the water is drawn into the colony by the action, probably ciliary, of the lateral siphonozooids and is expelled by general muscular contraction.

J. A. T.

Protozoa.

Reactions of Amœbæ.—Asa A. Schaeffer (*Biol. Bulletin*, 1917, 45–72, 6 pls.). Amœbæ sense beams of light of 20 microns diameter that pass no nearer to them than 100 or 150 microns. In nearly all cases under these conditions the amœba moves directly towards the beam. When the amœba reaches the beam it either flows over it indifferently, or it reacts negatively to the beam by changing its direction of movement. Beams of spectral light and of white light have approximately the same general effect. It appears, however, that spectral light at the blue end is somewhat less attractive than that at the red end. Beams of darkness are also sensed at a distance like beams of light, but the amœba usually avoids them before coming very near them. No explanation is suggested for the sensing of beams of light and of darkness at a distance. It is the change of light intensity that determines changes in reactions. Grains of globulin illuminated by perpendicular beams of light seem, on the whole, to be at least as attractive as when not more brightly illuminated than the field. But when globulin grains are laid in dark beams, the amœba frequently shows unmistakable signs of a tendency to react negatively. An amœba is positive, negative, or indifferent to beams of light according to circumstances. J. A. T.

Supplementary Chromatic Body in the Ciliate Maupasella nova.—D. Keilin (*Parasitology*, 1920, **12**, 92–4, 1 pl.) In this Ciliate parasite of the earth-worm's intestine there is often a ribbon-shaped supplementary chromatic body, of variable position in the endoplasm, and of variable shape. It is different in structure from the macronucleus; there is no continuity between the two bodies; it does not divide when the macronucleus does. It does not originate from the micronucleus, nor from abnormal conjugation. In short, it is a very puzzling structure. It may be the result of a condensation of extranuclear chromatin, produced by some environmental change. J. A. T.

Peculiarities of Nicollelidæ. — E. Chatton and Ch. Perard (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1116–8). In the interesting parasitic Ciliata of this family, found in the food canal of some rodents and Hyraxes, there is a peculiar backward shunting of the mouth, and this is associated with a perturbation of the transverse cleavage. Thus in *Colinella ctenodactyli* one of the two individuals formed by division is as long as the intact individual; the other is a minute posterior fragment. The state of affairs in *Nicollela* and *Pycnothrix* is discussed.

J. A. T.

Dinoflagellates and other Organisms causing Discoloration of the Sand.—E. Catherine Herdman (*Trans. Liverpool Biol. Soc.*, 1921, **35**, 1–5, 2 figs.). A study of variable greenish-brown patches on the sandy beach at Port Erin. These were due to various Dinoflagellates and Diatoms. The former were represented by at least three species of *Amphidinium*, and one or more species of *Gymnodinium* and *Polykrikos*. There were also a few unidentified colourless naked Dinoflagellates present. The diatoms were several species of *Navicula*, *Pleurosigma*, and other genera, forming brown patches. Small dark green patches were found to be due to species of *Oscillatoria*. J. A. T.

Movements of Flagellates.—JEAN MASSART (*Bull. Acad. Roy. Belgique, Classe des Sciences*, 1920, 116–41, 32 figs.). A new littoral form, *Podomastix fabacea* g. et sp. n., is somewhat intermediate between Thecamœbæ and Flagellata. It has long and delicate, sometimes branched, pseudopodia, and these beat the water like oars. Yet they are quite transient structures. This interesting form may attach itself to a foreign body, retract all the pseudopodia save in one front, and glide along. In *Cercobodo primitiva* sp. n. there are permanent pseudopodic filaments, one in front and one behind. There are in this form three modes of movement—free swimming, pushing along on a foreign body, and an amœboid gliding. Numerous illustrations are given among Flagellata (1) of free swimming, usually accompanied by rotation of the body; (2) of swimming on a foreign body; and (3) of amœboid gliding. Active change of shape, especially in relation to the medium, is also discussed. The paper is generously illustrated. J. A. T.

Sporozoon of Grass Snake.—E. GUYÉNOT and A. NAVILLE (*Comptes Rendus Soc. Biol.*, 1920, **83**, 965–6). A sporozoon, with some microsporidian and some sarcosporidian features, occurs abundantly in *Tropidonotus natrix*, in the dorsal musculature and in the connective tissue. But the same parasite occurs abundantly in a species of *Distomum* found attached to the mucous membrane of the snake's stomach. It seems likely that the sporozoon can pass through its entire life-history in this fluke, and that the fluke is the agent in infecting the snake. J. A. T.

New Coccidia from Cyprinid Fishes.—S. STANKOVITCH (*Comptes Rendus Soc. Biol.*, 1920, **83**, 833–5, 5 figs.). Descriptions of *Goussia legeri* sp. n. in the intestine of young larvæ of *Alburnus lucidus* and *Scardinius erythrophthalmus*. All the stages of sporulation were observed, also macrogametes and microgametocytes. Another species, *G. alburni* sp. n., from the same fishes and also from *Leuciscus rutilus*, in the intestine and in the adjacent fatty tissue. J. A. T.

New Species of Monocystis.—HERMANN VON VOSS (*Arch. Protistenkunde*, 1921, **42**, 176–8). Description of *Monocystis naidis* sp. n. found in abundance in the cœlom of a species of *Nais*. It was of an elongated spindle shape, narrowed anteriorly, more rounded behind, usually solitary, sometimes in syzygia of two or three. The size usually varied from 27 to 37 μ in length, 6 to 7 μ in breadth; but some of 45 × 11 μ were found. A distinct pellicula epicyte shows longitudinal ridges; there is a well-developed sarcocyte; no gelatinous layer was seen; muscle-filaments, though probably present, were not demonstrable. The entocyte showed a finely granular or finely alveolar plasma. The nucleus, with a distinct membrane, is spherical or ellipsoid, up to 10 μ in diameter—a large karyosome with 2 to 4 chromatin fragments on a linin framework. Attachment to the cœlom wall suggests viscid attachment, but there are also pseudopodic processes of the endoplasm issuing through a gap in the anterior pellicula. The pellicula may also disappear all over, and a coalescence of two or three somewhat amœboid plasmogametes is described. In such combinations a central aggregation of the nuclei occurred. J. A. T.

BOTANY.

(Under the direction of A. B. RENDLE, M.A., D.Sc., F.R.S., F.L.S.)

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Cytology,

Including Cell-Contents.

Morphological Constitution of Cytoplasm of Plant-cells.—A. GUILLIERMOND (*Rev. Génér. Sci.*, 1921, **32**, 133–40, figs.). Contrary to the opinion expressed by many writers, the author maintains that there is no essential difference between the structure of the animal- and plant-cell; both in morphological and chemical structure the chondriome of the plant-cell is the equivalent of that of the animal-cell, but in chlorophyll-bearing plants the chondriome is affected by photosynthesis.

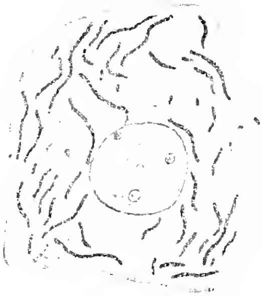
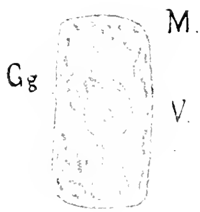
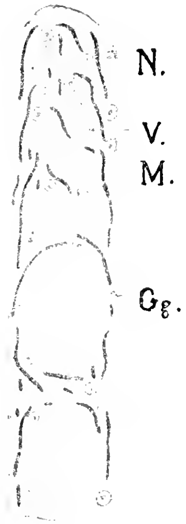


FIG. I.—Animal-cell (living). M, mitochondrias; V, vacuoles.

Those authors who differ from this view have apparently based their opinions upon either a too exclusive study of Phanerogams—in which only one variety of mitochondrias can be distinguished in the embryonic stage, and have therefore concluded that the plastids arise from the undifferentiated mitochondrias of the meristem—or, having confined their attention to the Muscineæ, have assigned to the plastids a significance and nature apart from that of the mitochondrias.

The present work shows that there are two varieties of mitochondrias. In Phanerogams they are of the same form and dimensions in the embryonic cells, and the difference does not become visible until the adult stages, where photosynthesis is in active progress. In the Algæ and Muscineæ, where photosynthesis is continued through the entire life-history of the plant, the two forms of mitochondrias are easily distinguishable from the earliest stages of the embryo. In ferns they can be distinguished in early embryonic stages by slight differences in dimensions, and in certain Cryptogams mitochondrias of intermediate forms between those of Algæ and Muscineæ have been seen. Work on





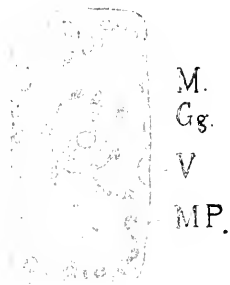


Fig. III. Fig. II. Fig. IV.

II. Filament of *Endomyces Magnusii.* Gg, fatty globules; M, mitochondrias; V, vacuoles in various stages of development: N, nuclei.
III. Very young cell.
IV. More advanced cell. MP, chondriosomes.

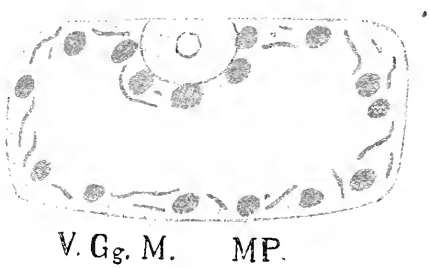


Fig. V.—Cell in last stage. The chloroplastids (MP) in their final form; the mitochondrias which have not assisted in their formation take the form of typical chondriosomes (M). V, vacuole.

certain fungi likewise confirms these results. In conclusion, it is shown that the mitochondrias of plant-cells have elaborate functions in that certain of them can produce starch, while the remainder of them develop into the colour-bearing plastids; this is in complete agreement with what is known of animal-cells where the mitochondrias also have elaborate functions and form the basis of colouring matter.

The quality of the mitochondrias in plant-cells appears to be connected with the process of photosynthesis. S. GREVES.

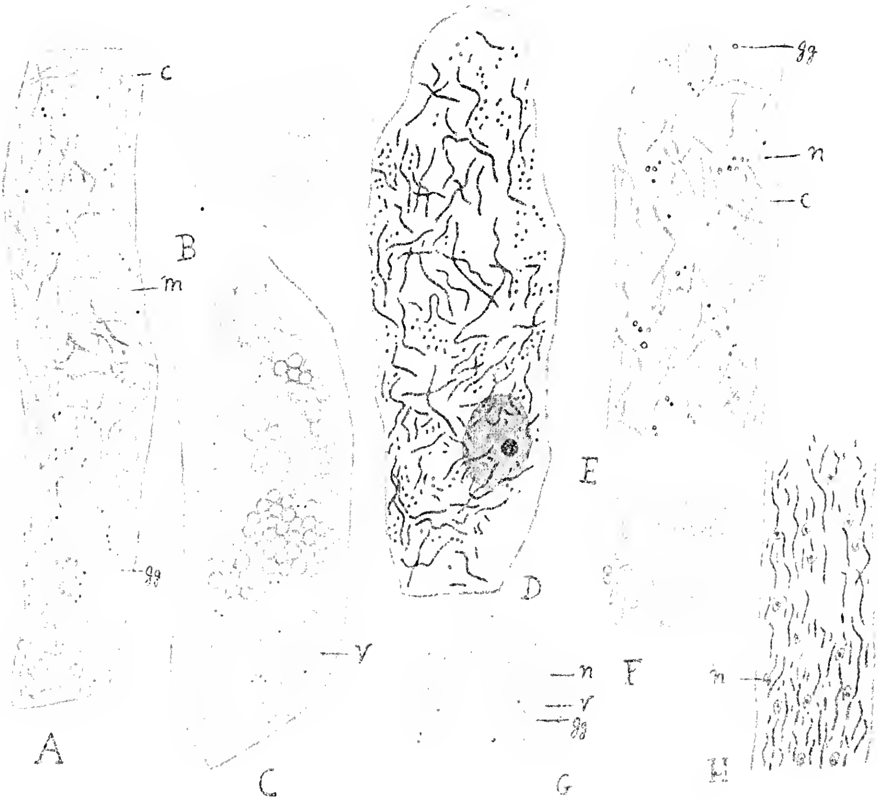


FIG. VI.

A. Epidermal cells of the white Tulip (living).
B. Chondriosomes of the same cell in process of alteration.
C. Similar cell, in which all the chondriosomes are transformed into vesicles (v).
D. Cell, fixed and stained by Regaud's method.
E. Filaments of *Saprolegnia* (living).
F. Chrondriosomes of same in process of development.
G. Filament in which all the chondriosomes have been transformed into large vesicles (v).
H. Filament, fixed and stained by Regaud's method.
c, chondriosomes; m, mitochondrias; gg, fatty globules; n, nucleus.

Cell-division in the Pollen-grain of Cobæa.—W. K. FARR (*Bull. Torr. Bot. Cl.*, 1920, **47**, 325–38). A study of the pollen-mother-cells o

Cobæa scandens var. *alba* indicates that in the formation of the microspore no cell-plate is apparent during the division of the cytoplasm. There is a general similarity to the process observed in *Nicotiana*, and the "hyaline areas" which accompany the cleavage of the cytoplasm strongly resemble those seen during spore-formation in the fungi *Pilobolus* and *Fuligo*. It is significant that similar cytoplasmic differentiation occurs under similar conditions in such widely separated forms. In all cases observed these "hyaline areas" are formed during cytoplasmic division of a multinucleate cell in which cell-plates are not formed, and they bound off a single nucleus and never a group of nuclei; they may also indicate a future cleavage in a uninucleate mass. It is probable that the nuclei may control the orientation of the "hyaline area" or furrows, and that the latter constitute visible expressions of the activity of the nuclei. It has been suggested that soluble ions are diffused along the paths of the fibres, and if this is so, the compounds formed by the ions would be most concentrated around the fibres in the equatorial planes, so that it is possible "that in these regions of highest concentration the substances may be in the necessary condition for the development of the plasma-membrane, and that in this manner they determine the position and direction of the penetrating furrows." S. G.

Structure and Development.

Vegetative.

Anatomy and Biology of Lathræa.—E. Chemin (*Ann. Sc. Nat.*, 1920, **10**, No. 2, 125–271, 88 figs.). The writer has studied the germination of the seed, and the development of the root, suckers, scales and glands, of *L. clandestina*, and has compared his observations with those of other writers upon *L. squamaria*. In both species the root-system is mainly adventitious, but while in *L. clandestina* the roots are orange-yellow with a thick lacunar cortex, which serves as storage-tissue, in *L. squamaria* the roots are whitish in colour, and have a thin cortex containing very little food-material, exfoliation being frequent. In the former species the endodermis has lignified thickenings and functions as an internal layer of the cortical tissues; in the latter the cell-walls of the endodermis are suberised, and the numerous cells retain their individuality. The suckers are lateral swellings of the root—relatively large and yellowish in colour in *L. clandestina*, smaller and whiter in *L. squamaria*. They usually penetrate as far as the wood of the host; in *L. clandestina* they attach themselves to the conducting vessels, but in *L. squamaria* they attain their greatest development in the phloem-parenchyma. Hydrocarbons and nitrogenous compounds are obtained by breaking down and digesting the adjacent tissues of the host; starch and allied carbohydrates by the solution and absorption of these substances. Usually the host forms a layer of growth which serves the double purpose of isolation and renewal of the affected area; no permanent injury is caused to the main root-system, except when a weakly plant is attacked. The scales of *Lathræa* are not atrophied organs, neither do they play any part in the nutrition of the plant; they are modified leaves which act as excretory organs, giving off excess of water together with sulphates and phosphates of ammonia obtained from the host-plant. When ripe the seeds are scattered to a considerable distance, but little is known as to the conditions necessary for

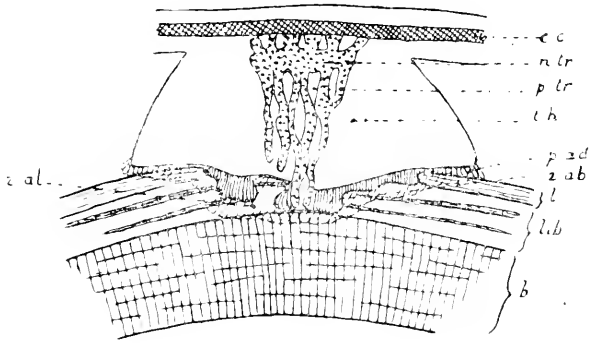


FIG. 1.—Longitudinal section of a sucker of *L. clandestina*, and of the root of Honeysuckle upon which it is fixed.

cc, central cylinder; *ntr*, *ptr*, tracheal cells showing nucleus; *th*, hyalin tissue; *pad*, adhesive papillæ; *zab*, absorbent zone; *zal*, zone of the root-host altered by the parasite; *l*, bark; *lib*, cortical parenchyma; *b*, wood.

germination. The food-reserve is sufficiently abundant to enable the root and suckers to grow until they become attached to the host. The present work proves that *Lathræa* is a genus adapted to subterranean

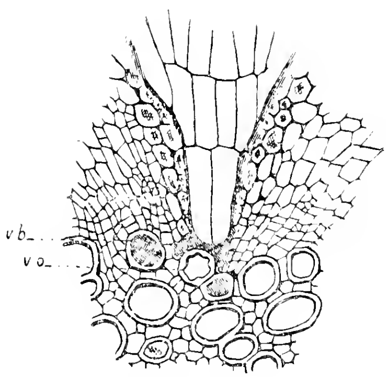


FIG. 2.—Sucker of *L. clandestina* upon the rootlet of *Heracleum Sphondylium*.

vo, extremity of penetrating cone in contact with a vessel with undulating walls; *vb*, vessel filled with a brown substance.

life, but which has preserved without reduction or degradation all the complex organization of a flowering plant. Water, mineral salts, hydrocarbons and nitrogenous compounds are derived from the host, but with the exception of the water and salts they are afterwards elaborated by the parasite. The parasitic habit is accidental and partial, and has been determined by necessary adaptation to the medium in which the plant lives. S. G.

Reproductive.

Inheritance of Sugar and Starch Characters in Corn.—R. A. Harper (*Bull. Torr. Bot. Cl.*, 1920, **47**, 137–86, 3 pls.). Four generations of plants, obtained by crossing a sweet with dent corn. were studied in order to establish the facts as to the occurrence of intermediates between starch and sugar corns and the behaviour of these when grown and self-fertilized. The observations show that the parental germ-plasms are separated in the reduction-division, and that the recombination of the gametes so produced is in accordance with the laws of chance assumed in Mendelian conceptions, but intermediates occur the characters of which are heritable to a considerable degree. Selected intermediates give a higher percentage of intermediates than pure parents.

The general occurrence of intermediates appears to be due not only to the bringing together of divergent or contrasting pairs of characteristics, but to the exigencies of sexual reproduction itself; variability, however, is more characteristic of the offspring of impure races than of pure races. The very nature of the gametes and of the chromosomes makes it improbable that the germ-plasms remain unaltered during the reproductive processes. Constitutional differences in the gametes are likely to be responsible for wider and so-called sudden variations known as mutations, sports, monstrosities, etc., while the complex nature of the reduction, fusing and pairing processes may be regarded as responsible for those fluctuating normal variations which are often confused with the not directly heritable variations due to external environment. External conditions may, however, influence the complex of reproductive processes.

The characters, sweet and starchy, are typically metidentical characters. The presence of sugars and dextrin gums leads to shrinkage of the cell, and the whole kernel becomes wrinkled, while the presence of more solid starch-grains prevents this shrivelling and the kernels remain plump and round. The fixity of type resulting from asexual reproduction is sufficient to furnish a fairly stable product for the market, but is not absolutely stable. Sugar and starch characters are not due, as is often supposed, to a pair of fixed Mendelian characters.

S. G.

CRYPTOGAMS.

Pteridophyta.

Old Red Sandstone Plants from the Rhynie Chert. Part II.: Additional Notes on Rhynia Gwynne-Vaughani, with Descriptions of Rhynia major and Hornea Lignieri.—R. Kidston and W. H. Lang (*Trans. Roy. Soc. Edinburgh*, 1920, **52**, 603–27, 10 plates). A further account of the remarkably preserved structure of early

Pteridophytes obtained from the silicified peat-bed at Rhynie in Aberdeenshire. *Rhynia major* represents a new species, and *Hornea Lignieri* a new genus and species. *Rhynia* was a gregarious, rootless and leafless plant growing erect from a subterranean rhizome and branched dichotomously. It bore stomata; and its stele consisted of a zone of phloem surrounding a strand of tracheides. The sporangia were cylindrical, without columella, and were terminal on aerial stems. The spores were of one sort only, were developed in tetrads, and had a cuticularized wall. *Hornea* was also rootless and leafless, its dichotomous aerial stems growing up from protocorm-like rhizomes. The sporangia were terminal on ultimate branches, having a basal columella projecting up into the sporangial cavity, and the cuticularized spores were developed in tetrads. The family Rhyniaceæ is placed in a special class, Psilophytales. The Rhyniaceæ were land plants, and may afford some clue to the origin of the land-growing sporophyte, as suggesting derivation from an algal ancestry comparable in habit with *Furcellaria fastigiata*. A. GEPP.

Old Red Sandstone Plants from the Rhynie Chert. Part III.: Asteroxylon Mackiei.—R. KIDSTON and W. H. LANG (*Trans. Roy. Soc. Edinburgh*, 1920, **52**, 643–80, 17 plates). An account of the structure of *Asteroxylon*, well-preserved fragments of which were found with the remarkable plants *Rhynia* and *Hornea* in the silicified peat-bed at Rhynie, which belongs to the geological horizon of the Old Red Sandstone. All these genera are referred to the Psilophytales, a class of the Pteridophyta; and while *Rhynia* and *Hornea* constitute the family Rhyniaceæ, *Asteroxylon* (characterized by the stellate outline of its cauline xylem in transverse section) represents a separate family. *Asteroxylon* had a leafless rhizome, from which arose branched aerial stems bearing numerous small leaves. The stele (xylem) of the rhizome was cylindric, but in the stem was stellate and gave off leaf-traces. The fertile region appears to have consisted of slender branched leafless axes bearing pyriform sporangia of moderate size, with definite dehiscence at the wider free end. The tracheides of the metaxylem and protoxylem have a peculiar type of spiral thickening. A. G.

Morphology of the Stele of Platyzoma microphyllum.—JOHN McLEAN THOMPSON (*Trans. Roy. Soc. Edinburgh*, 1920, **52**, 571–95, 3 pls. and figs.). A discussion of the stelar problem of *Platyzoma*, with a résumé of the facts of stelar structure previously recorded for the plant and of the theories founded upon them by Poirault, Jeffrey, Boodle and Tansley. The author is unsatisfied as to the nature and origin of the medullated stele, and describes the structure of a number of recently acquired specimens, which revealed neither a solenostelic condition nor evidence of degenerate stelar gaps or of inner phloem. One small specimen showed interesting features which are illustrated in detail. In this (examined from the broken base upwards) the pith and inner endodermis became narrowed to a vanishing point, and a medullated protostele was locally established; the pith then again expanded and within it there arose *de novo* an inner endodermis at first irregular, then definitely tubular to the apex of the stem. Upon the evidence so far obtained the author inclines to the view that the tubular medullated stele of *Platyzoma* is the result of upgrade development from within of an original protostele; but the problem cannot be solved until the "sporeling" stages have been investigated, and solenostely and reduction are proved or disproved. A. G.

New Facts as to the Stelar Theory of Ferns.—J. McLean Thompson (*Trans. Roy. Soc. Edinburgh*, 1920, **52**, 715–735, 4 pls., 9 figs.). The writer has studied the anatomy of various species of the Schizæaceæ and Gleicheniaceæ with special reference to the stelar theory. In the Schizæaceæ the author finds that (1) the stelar endodermis is an unbroken cylinder without lateral connexions between the cortex and the pith; (2) the pith is of intrastelar origin, arising by gradual increase of wood-parenchyma and accompanying decrease of central tracheides; (3) there is no marked increase in diameter of the xylem cylinder or stelar area during transition from solid protostely to the medullated state. In *Schizæa dichotoma* the endodermal pockets are intrastelar structures which arise by change of procambial destination within the stele. In the Gleicheniaceæ ontogenetic progression from protostely to solenostely is seen in *Gleichenia pectinata*, *Loxsoma Cunninghamii* and *Acrostichum aureum*, and the evolution of the *Lindsaya* type can be traced in *Lindsaya adiantifolia*. Development shows that both the inner phloem and the medulla are of purely intrastelar origin, and there is no evidence of the intrusion of cortical tissues into stele during medullation. Ontogenetic evidence for the ferns appears to show that medullation and the solenostelic and dictyostelic states arise by intrastelar readjustment, in which change of destination is mainly operative. S. Greves.

Contributions to a Knowledge of the Anatomy and Cell-contents of Ferns.—H. Martin (Dissertation (Göttingen: W. F. Kastner) 1916, 137 pp.; see also *Bot. Centralbl.*, 1918, **138**, 154). During microchemical investigation for tannic acid and other substances in seventy-seven representative Filicales, the author paid particular attention to the anatomical structure of the lesser known species, with the following results:—According to the development and the amount of the thickening of the epidermis of the *leaf-stalk*, three groups may be distinguished. Some ferns have a hypodermis. A sclerenchyma-ring is always present, but not a "stützscheide." The cells of the main parenchyma are thickened and brown. Idioblasts occur in certain Cyatheaceæ; mucilage-canals in the Marattiaceæ; capitate glandular hairs, which become less abundant towards the apex of the leaf-stalk (*Aspidium Filix-mas*). The endodermis entirely surrounds the fibro-vascular bundle of the Osmundaceæ, despite Thomae's statements, as is clearly revealed by Berthold's method of preserving the material. The stele of ferns does not always contain parenchyma in the xylem. Collateral vascular bundles occur in *Ceratopteris*. The protoplasm cells are always collenchymatous. Conducting cells are never present in the phloem, as is easily shown by the method of preservation employed. In *Aspidium falcatum* the sieve-tubes adjoin the tracheides. The protoxylem cells mostly disappear with age. Sclerenchymatous elements seldom occur in the stele. Rhizome and root were not examined in anatomical detail. *Angiopteris erecta* is remarkable for its polyarch bundle. According to the development of the *frond*, ferns fall into three groups:—1. The epidermis and mesophyll are almost similarly developed. 2. The mesophyll is a typical spongy- and palisade-parenchyma, quite different from the epidermis. 3. The mesophyll is very thin-walled and large-celled, and quite different from the epidermis. In some ferns there is a hypodermis in the frond. Only those forms of frond that are more than eight layers thick are mechanically stiffened along the margin.

As regards *cell-contents*, chlorophyll rarely occurs in the epidermis of the *leaf-stalk*, not as a rule in the sclerenchymatous ring, never in the endodermis, but it does occur in the stele, and still more in the main parenchyma. The amount of chlorophyll increases from the base upwards. Tannin occurs everywhere, and mostly diffused: in the "stützscheide" it is more abundant than in the main parenchyma: it is nearly always present in the stele, but in the endodermis it is as often absent as present. Tannin is never found in the sieve-tubes, and the tannin-ideoblasts are not very frequent in the outer layers, nor in the stele. Tannin, like chlorophyll, increases from below upwards. Accumulations of tannin occur in certain parts of undeveloped or dying leaf-stalks. Starch is rare in the epidermis and in the sclerenchyma-ring; is always present in the main parenchyma, sometimes in great quantity; but never occurs in the endodermis and protophloem. The amount of starch either diminishes or increases from the base upwards. Oxalate has been found in four cases only. In the *frond* the distribution and occurrence of chlorophyll, tannin, starch, and oxalate is similar to that in the leaf-stalk, and the same applies to the rhizome and root. A. G.

Further Note on the Ecology of Phyllitis hybrida.—V. Vouk (*Oesterr. Bot. Zeitschr.*, 1916, **66**, 397–99; see also *Bot. Centralbl.*, 1918, **138**, 138). This species is regarded by the author as a mesophyte with well-developed xerophytic adaptability; in contrast to Morton, who regards it as a typical hygrophyte with great capability of adaptation. *Phyllitis hybrida* and *Ceterach* are considered euryphotic plants, while *P. hemionitis* is stenophotic. *P. hybrida* and *Ceterach* could also be called euryxerophil, and *P. hemionitis* stenohygrophil.
E. S. Gepp.

Bryophyta.

Critical Revision of Carl Müller's Moss Genera. II.—Max Fleischer (*Hedwigia*, 1917, **59**, 212–19; see also *Bot. Centralbl.*, 1918, **138**, 153). A continuation of the critical examination of C. Müller's herbarium. A new genus, *Pterogoniadelphus*, is founded, between *Forstroemia* and *Pterogonium*, with the species *P. montevidensis* (= *Cladomnium montevidense* C.M.). *Leucodon levifolius* Broth. ined. is placed in *Hypnum* sect. *Pterogoniophyllum* Flsch. (a new section). A new species, *Cryptoleptodon acuminatus*, is formed, for *Leptodon Pluvini* C.M. var. *foliis acuminatis* C.M. Müller's *Leptodon* species in his herbarium belong to four different genera, according to Fleischer. He gives similar treatment to the genera *Dusenia*, *Cladomnium*, *Lepyrodon*, *Leucodon*, *Erythrodontium* and *Pterigynandrum*. The drastic treatment of the author threatens to leave very little of C. Müller's nomenclature intact. E. S. G.

Mosses of Papuasia.—MAX FLEISCHER (*Engler's Bot. Jahrb.*, 1917, **55**, 19–37, 1 pl.; see also *Bot. Centralbl.*, 1918, **138**, 152–3). An account of several noteworthy mosses from the islands of the New Guinea group, including two new species. The principal interest of the paper lies in the geographical notes, which fill in many gaps in our knowledge of the distribution and mode of life of the Sphagnaceæ, Fissidentaceæ, Dicranaceæ, Leucophanaceæ, Syrrhopodontaceæ, Splachnaceæ, Rhizogoniaceæ, Hypnodendraceæ and Othotrichaceæ. The information is derived from personal observations of Papuan plants by the author himself. A. G.

Remarks on the Contributions of J. Györffy to the Histology of Ephemeropsis tjibodensis in Ann. Jard. Bot. Buitenzorg and elsewhere.—MAX FLEISCHER (*Hedwigia*, 1917, **59**, 209–11; see also *Bot. Centralbl.*, 1918, **138**, 152). By means of very detailed anatomical studies of the sporophyte of *Ephemeropsis tjibodensis*, Györffy has extended the description of the species beyond the limits laid down by Max Fleischer in his "Mosses of Buitenzorg." In certain points he considered his view a correction and improvement on that of Fleischer. In the present paper Fleischer answers Györffy, and maintains his own point of view. E. S. G.

Third Contribution to the Moss Flora of the Erzgebirge.—J. RÖLL (*Hedwigia*, 1917, **59**, 285–300; see also *Bot. Centralbl.*, 1918, **138**, 153). A bryofloristic treatment of the central portion of the Erzgebirge, principally of the places Reitzenhain and Sebastiansberg, on the ridge of the mountains. Both are surrounded by great moorlands, about 740 to 880 metres above sea level. The special features of the district are described, followed by a synopsis of the mosses observed. Among these are *Dicranella squarrosa*, *Bryum Duvalii*, and *Drepanocladus hercynicus*. Sphagnaceæ are the most abundant, and their treatment occupies the larger part of the paper. Thirty-four species are recorded as well as numerous forms. E. S. G.

New Hepatic for the Iberian Peninsula.—F. BELTRAN (*Bol. R. Soc. Españ. Hist. Nat.*, 1920, **20**, 310–12). The species in question is *Ricciocarpus natans* Corda, f. *natans*, which was found in the village of El Saler, near Albufera in Valencia. It was growing in a short and narrow canal intermixed with *Lemna*, which it closely resembles. Its discovery was made by chance during a search among the *Lemna* for larvæ. The material was taken to the botanical laboratory of the University of Barcelona, where it was successfully cultivated in spite of the ravages of a larva. Antheridia were found on mature plants, but no archegonia. The author suggests that the rarity of this widely-distributed species is due to its having been overlooked, owing to its great resemblance to *Lemna*, with which it grows. E. S. G.

Mean Annual Thermal Life-Conditions of Webera nutans and of Leptoscyphus Taylori in the Elbe-sandstone Mountains.—A. Schade (*Ber. Deutsch. Bot. Ges.*, 1917, **35**, 490–505; see also *Bot. Centralbl.*, 1918, **138**, 153). An account of the temperatures recorded by means of thermometers plunged in living tufts of the Bryophytes under observation, controlled by synchronous observations of the temperatures of the air and of the substrata upon which the plants grew. In a sunny place the *Webera* tufts attained a temperature 20° C. and more above that of the air, whereas the *Leptoscyphus* growing in the shade had a temperature 8·5° C. below that of the air. The highest temperature recorded for a moss was 56·8° C., and that was in a *Webera* tuft which had previously reached a minimum of − 9·7° C. This species can therefore tolerate such a range of temperature as 66·5° C.; whereas the range recorded for the hepatic did not exceed 23° C. The mean temperature for the year was, for the *Webera* 23·3° C., and for the *Leptoscyphus* 6·2° C. The two plants grew but 50 metres apart, and indicate two climates of marked contrast within a very narrow area. A. G.

Thallophyta.

Algæ.

New Species of Peridinieæ, with Remarks on the Structure of the Outer Membrane in Gymnodinium and Glenodinium.—J. Woloszynska (*Bull. Acad. Sci. Cracovie*, 1917, **57**, Ser. B., 114–122, 3 pls.). All genera of Peridinieæ, including *Gymnodinium*, possess a more or less delicate outer membrane, which in the simplest forms is composed of small hexagonal plates. In more highly developed forms the arrangement of the plates is more complicated, reaching its highest point of development in *Peridinium*, *Ceratium* and *Gonyaulax*. The following points are characteristic of the simple structure of the outer membrane: the minute size, the large and inconstant number of the plates, and their regular hexagonal form. The alteration in the arrangement of the plates generally begins first in the longitudinal furrow, then spreads to the hypovalve, later to the epivalve, and finally to the transverse furrow. The number of the plates decreases markedly in the higher genera, and remains constant. The structure of the outer membrane must always be taken into account in systematic keys. The author gives a short diagnosis of the characters of the outer membrane of all species of *Gymnodinium* and *Glenodinium* which she has examined. Several new species and varieties are described, found near Lemberg. *Sphærodinium limneticum* Wol. 1917 is identical with *Glenodinium cinctum* Ehrenb. E. S. G.

Asterocystis de Wildeman and Asterocystis Gobi.—A. Pascher (*Beih. Bot. Centralbl.*, 1917, **35**, 578–79). *Asterocystis* Gobi 1879 is an alga; while *Asterocystis* de Wildeman 1893 is an oomycete, for which the author suggests the name *Olpidiaster*. *Asterocystis radicis* de Wildeman therefore = *O. radicis* Pascher. E. S. G.

New Plankton Species of Raphidium, R. spirochroma.—L. Reverdin (*Bull. Soc. Bot. Genève*, 1917, **9**, 48–51, fig.; see also *Bot. Centralbl.*, 1918, **138**, 262). The precision of the spiral chromatophore, the visibility of the nucleus, and the form of the cell make a very well-marked species, even among those species of *Raphidium* which have pyrenoids. It may be necessary later to transfer it to the author's new genus, *Closteriospira*, and to form a new group of *Raphidium* comprising species which possess pyrenoids and a well-defined spiral chromatophore. In such a group several species of *Spirotænia* would naturally find their place. The name of Spiroraphideæ is proposed for this new series in the genus *Raphidium*. *R. spirochroma* was collected in the Lake of Geneva, almost on the surface, between Ariana and Port Noir.

E. S. G.

Phytoplankton of the Inland Lakes of Wisconsin. Part I.—G. M. Smith (*Wisconsin Geolog. and Nat. Hist. Survey, Madison*, 1920, Bulletin No. 57, Scientific Series No. 12, 243 pp., 51 pls.). This volume deals with the Myxophyceæ, Phæophyceæ, Heterokontæ, and Chlorophyceæ, exclusive of the Desmidiaceæ. Investigation was begun in the autumn of 1913 and continued during the summers of 1914–15–16–17. In the introduction the author discusses the geography and geology of Wisconsin, chemical composition of the lake waters, methods of collection and study, and lakes studied. Available data on location and size of the lakes visited during the course of the investigation are given in tabular form. The systematic treatment is preceded by a key to the genera based upon the vegetating characters. Diagnoses are given for the Class, Order, Family, Genus and Species, together with keys to the genera and species recorded. Critical notes are appended to some of the diagnoses, which, together with the references to literature and the numerous figures made from living material, should eliminate errors in determination. E. S. G.

Note on certain Species of Fresh-water Algæ new to the Spanish Florà.—C. C. Latorre (*Bol. R. Soc. Españ. Hist. Nat.*, 1920, **20**, 333–6, figs. in text). The species in question were collected in Portillo, Toledo, and include one new species, *Characium setiferum*, which much resembles *C. apiculatum*, but differs in having a very long seta at the apex of the mature plant, exceeding in length one-third of the cell. The other species are *Anabæna oscillarioides* Bory (which has been mentioned as occurring in Northern Spain), *Nostoc rivulare* Kütz., *Closterium lanceolatum* Kütz., *Pediastrum Boryanum* Turp., *Characium strictum* A. Br., and *Vaucheria De-Baryana* Woron. Figures are given of the two last and of the new species. The extremes in size of *Characium strictum* are shown. Intermediate sizes have been observed, which prohibit separation into distinct species. E. S. G.

Cytology and Systematic Position of Porphyridium cruentum (Naegeli).—M. Staehelin (*Ber. Deutsch. Bot. Gesell.*, 1917, **34**, 893–901, fig.; see also *Bot. Centralbl.*, 1918, **138**, 262). The chromatophore of *Porphyridium* is figured as a closed capsule lying along the periphery, such as has only been recorded hitherto for Cyanophyceæ.

The refractive grains embedded in the chromatophore correspond to the cyanophycin grains. A true germ is lacking, but a plasmatic central body is present, which contains grains of anabænin arranged in rosettes. Hydrolysis transforms the anabænin into glycogen, as in Cyanophyceæ; by autolysis it is entirely dissolved, leaving only the chromatophore and the plasmic central body. *P. cruentum* must therefore be placed in Cyanophyceæ, near to *Aphanocapsa*. E. S. G.

Contribution to the Study of Polymorphism and of Monstrosities in Desmidiaceæ.—F. Ducellier (*Bull. Soc. Bot. Genève*, 1916, ser. 2, **7**, 75–118, figs.; see also *Bot. Centralbl.*, 1918, **138**, 117). A fair number of anomalies in connexion with the form and the method of division are described, and many are figured. Nine new varieties and forms of *Euastrum didelta* Ralfs are also described. E. S. G.

New Desmidiaceæ for Switzerland.—F. Ducellier (*Bull. Soc. Bot. Genève*, 1916, ser. 2, **8**, 282; see also *Bot. Centralbl.*, 1918, **138**, 119). Fourteen species are stated to be new records. *Cosmarium perforatum* Ld. var. *Ranchii* and *C. alpestre* Roy & Biss. var. *ellipticum* (Delp.) are described as new varieties. E. S. G.

New Genus of Algæ (? Desmidiaceæ) Closteriospira.—L. Reverdin (*Bull. Soc. Bot. Genève*, 1917, **9**, 52–4, fig.; see also *Bot. Centralbl.*, 1918, **138**, 262). A new genus between *Spirotænium* and *Closterium*. Distinguished from the former "apicibus hyalinis corpusculis interjectis," and from *Closterium* "chromatophoro spiraliter torto." The species is *C. lemanensis*, and was collected between Ariana and Port Noir, on the Lake of Geneva. E. S. G.

Occurrence of Diatoms on the Skin of Whales.—A. G. Bennett, with Appendix by E. W. Nelson (*Proc. Roy. Soc.*, B, 1920, **91**, 352–7). A short account of the film of diatoms which frequently covers the blue whale and the fin whale in Antarctic waters. The film is of a buff colour, and occurs most commonly on very fat individuals which have been feeding for some time on the abundant plankton of icy waters. The author suggests that the buff-coloured bands on icebergs may be formed also of diatoms. In an appendix Mr. Nelson gives the result of his microscopical examination of Mr. Bennett's three samples of the film, mounted in slides, dried, and in a tube. The two former consisted entirely of a new species, *Cocconeis ceticola*, here described and figured. The third sample consisted of *C. ceticola* and *Navicula viridis* Nitzsch. usually a fresh-water species, and here recorded for the first time as *living* in salt water. A few specimens of *Pinnularia interrupta* W. Sm. were also found in the tube, but it is not quite certain that any species except *C. ceticola* was really derived from the whale's skin. It is suggested that the association of *C. ceticola* with the skin of the whale is more than an accidental one, both on account of its enormous quantity in a state of absolute purity and of the colour. The question of saprophytism arises. Slides of the diatom are preserved in the British Museum, where are also notes of the first observation of the phenomenon made by the late Major Barrett-Hamilton. E. S. G.

Diatomiferous Deposits in the Valley of Toxi, Ixtlahuaca, Mexico.—E. D. Lozano (*Anal. Inst. Geol. Mexico*, 1920, No. 9, 19 pp., 5 pls.). The diatomiferous deposits occur in great abundance among the lacustrine sediments of the Toxi valley. The first half of this paper is devoted to a geological account of the valley and the sedimentary deposits. The second half deals with the diatoms, which are fully discussed from the point of view of their systematic position and structural details. The paper is in Spanish. E. S. G.

Cambrian Geology and Palæontology. IV..No. 5: Middle Cambrian Algæ.—C. D. Walcott (*Smithsonian Misc. Coll.*, 1919, **67**, 217–60, 17 pls.). A study of the algæ preserved in the Middle Cambrian Burgess shale of British Columbia. The habitat is described as a deposit from relatively quiet muddy water in a small bay or lagoon in close connexion with the shallow sea. The water was swarming with life. The algæ were probably washed into the lagoon by currents and did not grow *in situ*. Their remains usually occur as shiny black films on the surface of the hard dark siliceous shale. The species described belong to Cyanophyceæ, Chlorophyceæ (doubtful), and Rhodophyceæ. The genus attaining the greatest development in species, and abundance of specimens, is *Morania*, which is referred to Hormogoneæ, and with some uncertainty to the family Nostocaceæ. Both macroscopic and microscopic characters are described for this genus. Seven new genera and nineteen new species are described, as well as two new species of the calcareous genus *Sphærocodium* Rothpletz. They are figured in good photographic plates. E. S. G.

On the Occurrence of Structures like Walcott's Algonkian Algæ in the Permian of England.—O. Holtedahl (*Amer. Journ. Sci.*, 1921, series 5, **1**, 195–206). A comparison of the peculiar structures in the Permian magnesian Limestone of the Durham district with those of the Algonkian Newland Limestone described by Walcott (*Smithsonian Misc. Coll.*, 1914, **64**, No. 2). The structures of both types are described, and the author points out that they are identical. He agrees with the opinions of English investigators as to the inorganic nature of these structures, which are regarded as being secondary formations through alterations in the rock. Every transition between the various types is present, and there is no end to the modifications. Some of the characters suggest those developed by crystallization processes. The author does not, however, exclude the possible presence of algæ and bacteria in pre-Cambrian strata, as reported by Walcott, since very delicate structures are often preserved in concretions of lime or of silica. E. S. G.

Appendix to Notes on Oceanic Algology.—A. Mazza (*Nuova Notarisia*, 1921, **32**, 1–48). A continuation, which includes notes on species of *Rhodophyllis*, *Erythroclonium*, *Gelidiopsis*, *Curdiea*, *Gracilaria*, *Hypnea*, etc. *Gracilaria lichenoides* is treated in considerable detail.
E. S. G.

Remarks on Splachnidium rugosum Grev.—C. Skottsberg (*Svensk. Bot. Tidskrift.*, 1920, **14**, 277–87). A study of the structure and development of this alga found in fresh material collected by the author in the Juan Fernandez Islands, off the coast of Chile. The plants were comparatively small, rarely exceeding 8 or 10 cm. in length. The structure of the growing plant is described in detail. It is filamentous, with a pseudoparenchymatous cortex, the filaments being repeatedly branched, and sometimes ending in a hair of the Phæosporean type. Thus the structure is ectocarpoid, and essentially the same as Chordariaceæ, although at maturity it resembles that of *Fucus*. The "apical cell," so-called, is described and discussed fully, as the result of an examination of numerous examples. No connexion with the other cells was ever found; its shape is quite peculiar; its wall much thicker than in all other cells. Though it generally occurs in the conceptacles and is very persistent, the author has series of sections in which it is lacking. He believes it to be a small epiphytic alga, possibly a *Codiolum*, which is unable to penetrate the mature cortex, and thus starts by infesting the meristematic region. It has been observed in almost mature cortex tissue, and is generally found in old conceptacles as well. The development of the conceptacle is described. *Splachnidium* is acknowledged as a unique type, and is regarded as representing a branch of the Chordariaceæ, and not as allied with either Laminariaceæ or Fucaceæ.

E. S. G.

Effect of Unilateral Monochromatic Light and Group Orientation on the Polarity of Germinating Fucus Spores.—A. M. HURD (*Bot. Gaz.*, 1920, **70**, 25–50, 2 figs.). The primary purpose of this investigation was to determine whether all wave lengths of light, the intensity factor being eliminated, are able to bring about this orientation and establish the polarity of the germinating spores of *Fucus inflatus*. Subsidiary studies are (1) on the phenomenon here called "group orientation," consisting in the orientation of the cleavage plane and the establishment of the apical and basal ends of the dividing spore by the direction of some other spore or group of spores in close proximity; and (2) on the phototropisms of the young rhizoids in monochromatic lights of equal intensities. The author reviews briefly the literature on biological experiments with monochromatic light, describes her apparatus and methods, and deals with polarity, phototropism, and group orientation. After a short discussion she summarizes her results as follows: (1) A convenient method for obtaining monochromatic lights of equal intensity is the use of the thermopile and galvanometer to obtain the relative intensity of the light transmitted by accurate colour screens, and the adjustment of the distances of these screens from the light source such that the deflections of the indicator on the galvanometer scale are equal for each exposure of the thermopile screened by the light filters in turn. (2) The effective wave lengths in the establishment of the polarity of *Fucus* spores, the result of whose use for unilateral illumination is the same as that produced by white light (the orientation of the first cleavage plane perpendicular to the direction of the incident light with the cell on the darker side of the spore becoming the rhizoidal cell), are, with the intensity of strong diffused daylight, the shorter rays of the blue end of the spectrum of approximately 4000–5600 Angstrom units. There is some evidence that ultra-violet light can produce the same effect. (3) The negative phototropism of the rhizoids in monochromatic light is also primarily a function of the quality of the light, since, with equal intensity of illumination, the wave lengths of the red end of the spectrum are without effect, while those of 4000–5200 Ångstrom units produce the same phototropism produced by white light. (4) The term "group orientation" is suggested for the phenomenon of the orientation of the first cleavage plane of a dividing spore with reference to the position of adjacent spores, such that it is perpendicular to the direction of the centre of a group or of a single spore within the effective radius, with the subsequent development of the cell on the side towards the source of stimulus as the rhizoidal cell. (5) This group orientation reported in other species is a conspicuous phenomenon in every culture of *Fucus inflatus*, the stimulus acting in such orientations being so strong that when spores are separated by as much as 0·2 mm., and often more, light stimuli as a rule fail to overcome it. (6) The chemical stimulus, which orients the direction of the first cleavage plane and determines which cell shall become the rhizoidal cell in group orientations, has no power to cause a chemotropism of the rhizoids. E. S. G.

Carbon Monoxide a Respiration Product of Nereocystis Luetkeana.—S. C. Langdon and W. R. Gailey (*Bot. Gazette*, 1920, **70**, 230–9, figs. in text). The investigation was carried on during the summer of 1918 at the Puget Sound Marine Station, Friday Harbour, Washington. The authors give the following summary: (1) The existence of a percentage of carbon monoxide in the gas contained in the pneumatocyst of *N. Luetkeana* is confirmed. (2) The substance of the kelp when ground and allowed to undergo autolysis and decay does not form carbon monoxide by enzyme action or fermentation process. (3) Kelp plants, in which the gas normally present within the float (pneumatocyst) is replaced by air, form several per cent. of carbon monoxide within a few days. (4) The formation of carbon monoxide takes place only when oxygen is present as one of the gases within the float. No carbon monoxide is formed when the float is filled with nitrogen or hydrogen. (5) Light does not affect the rate of formation of carbon monoxide. (6) The gas obtained from the cavities of various other plants failed to show a similar occurrence of free carbon monoxide. (7) The percentage of free carbon monoxide which occurs in the float of *N. Luetkeana* is considered to be a respiration product for the following reasons: It forms only when oxygen is present within the float; it forms as readily in the dark as in the light; it is not formed by enzyme or fermentation process when the substance of the plant undergoes autolysis and decay; and it is not formed in killed plants.

E. S. G.

Fungi.

Note on certain Variations of the Sporocyst in a Species of Saprolegnia.—Marjorie I. Collins (*Proc. Linn. Soc. N. S. Wales*, 1920, **45**, 2, 277–84, 11 figs.). Considerable variation in the development has been observed in artificial cultures of *Saprolegnia*, as first described by Lechmere in the New Phytologist, 1910. M. Collins has repeated these observations on a *Saprolegnia* that grew on a beetle in a laboratory tank. Lechmere had followed the development of five different types of spore discharge which are characteristic of genera other than *Saprolegnia*. Collins noted the same type of spore discharge in her culture; she has also evidence that one condition is a further stage of a previous condition. Thus in *Dictyuchus* and in the *Dictyuchus* condition the spores encyst within the sporocyst, then they enter on a second motile stage, and pass out to the open. In *Aplanes*, which seems to develop from that condition, mobility is suppressed and the spores germinate within the sporocyst. Instances were noted in the culture of both these conditions, and also of the two occurring in the same sporocyst.

A. LORRAIN SMITH.

Distribution of Swiss Peronospora Species.—ERNST GAÜMANN (*Mitt. Naturf. Ges. Bern.*, 1920 [1919], 176–87). The author has sought to determine if possible the causes affecting the distribution of *Peronosporeæ*. Most of the hosts are culture plants or weeds, the presence of few of them being independent of human agency. The dispersion of the fungus is but little understood, whether it is by oospores or by vegetative growth, but occasionally for no known reason there occur severe epidemics of certain species. Some species spread widely and quickly; others, such as *Peronospora lapponica*, are confined to narrow limits. Tables are given of the *Peronospora* species, with their hosts and their geographical distribution.

A. L. S.

Soft Rot of Pepper Fruits.—S. G. LEHMAN (*Phytopathology*, 1921 **11**, 85–7). The fungus causing the rotting was isolated and cultured, and then again inoculated into healthy fruits. Antheridia, oogonia and oospores were found, and it is believed that the fungus is *Pythium de Baryanum*. It is probable that zoospores are splashed from the ground by rain on to the fruits.

A. L. S.

Massospora cicadina Peck.—A. T. SPEARE (*Mycologia*, 1921, **13**, 72–82, 2 pls.). This fungus, one of the Entomophthoales, is parasitic on the periodical Cicada *Tibicina cicada*, and is confined to America. It is chiefly male insects that are parasitized; conidial and resting spores never occur simultaneously in the same individual. The writer does not consider that the fungus will prove to be of economic importance, as it does not kill the larvæ.

A. L. S.

Methods of Direct Inoculation with Damping-off Fungi.—ANNIE E. RATHBUN (*Phytopathologist*, 1921, **11**, 80–4, 3 figs.). As inoculation experiments by placing fungi in the soil were unsatisfactory for various reasons, the author explains in detail new improved methods of inoculation. She placed the fungi on small pieces of cardboard (platforms), and fixed them by means of toothpicks pushed through the cardboard at any distance required above the soil and in close proximity to the plant. The results were found to be very successful.

A. L. S.

Crown-gall of Alfalfa.—O. T. WILSON (*Bot. Gaz.*, 1920, **70**, 51–68, 4 pls.). The galls arise as branching tuberculate structures on the larger secondary roots of *Medicago sativa*. The organism causing the galls has been referred to *Urophlyctis*, and the author of this paper retains the name, though his researches have caused him to doubt the classification and relationship of the fungus. Sporangia developed from resting spores form zoospores—one large and many small are frequently to be seen, and there is some evidence of fusion—presumably sexual fusion—between the two forms. An amœboid stage follows, and plasmodia are found in the galls of young seedlings of Alfalfa. Resting spores are formed in cavities within the tissues of the galls. The cytoplasmic and nuclear contents of the resting spores in the dormant condition correspond to those of the plasmodium in the stage immediately preceding the formation of resting spores. The disease has only recently appeared in the United States. It has been known for some time in Europe, and may cause serious loss. A. L. S.

Sexuality in Mucors.—A. F. Blakeslee (*Science*, 1920, **51**, 375–82 and 403–9). The author makes a survey of the differentiation of sex based on the results of his researches on Mucors. He discusses imperfect hybridization, zygospore germination, environmental factors, mutations, etc. He hopes that the study of Mucors may be of some service in helping to solve the fundamental problems of sex. A. L. S.

Sexual Differentiation in the Bread Moulds.—A. F. Blakeslee (*Proc. Soc. Exp. Biol. and Medicine*, 1919, **16**, 131). Blakeslee describes shortly the sexual organs of the Mucorales: certain sexually primitive forms are hermaphroditic with equal gametes; from these forms differentiation has proceeded towards inequality in the gametes and a difference in the plants themselves. The male and female races remain constant, though variations may occur in their sexual vigour. A. L. S.

Occurrence in Britain of the Ascigerous Stage of a "Brown Rot" Fungus.—H. Wormald (*Ann. Bot.*, 1921, **35**, 125–35, 2 pls.). The fungus described by the author occurred on mummied plums, on one such mummy as many as twelve sporophores were formed of the usual *Sclerotinia* type; these formed the apothecial stage of the grey mould *Monilia cinerea* so frequently found on plums and cherries. Culture experiments and inoculation experiments were carried out successfully. A. L. S.

Occurrence in Britain of the Conidial Stage of Sclerotinia Mespili Schell.—H. Wormald (*Ann. Applied Biology*, 1920, **7**, 173–7, 1 pl., 2 figs.). Trees of *Mespilus germanica* were observed for years to be suffering from a form of brown rot. The cause was determined as the *Monilia* form of *Sclerotinia Mespili*; the *Sclerotinia* stage has now been found in this country. Leaves, flowers and fruit are attacked by the fungus. A. L. S.

Pectin Relations of Sclerotinia cinerea.—J. J. Willaman (*Bot. Gaz.*, 1920, **70**, 221–9). In this paper the writer records his observations on the behaviour of the fungus towards various pectic substances; in fruit-juice cultures it coagulates soluble pectin to calcium pectate by means of the enzyme pectase. When the fungus invades a fruit tissue it follows the line of the middle lamella, dissolving it out by means of the enzyme pectosinase, and probably precipitating the pectin of the lamella as calcium pectate. This latter is strongly hydrophyllic, and maintains the firmness of the fruit even after rotting, and, as it is an imbibing "gel," it aids the fungus in providing water supply. A. L. S.

North American Species of Discina.—F. J. SEAVER (*Mycologia*, 1921, **13**, 67–71, 1 pl.). The genus is distinguished from other *Pezizæ* by the wide-spread apothecia and the apiculate spores. The writer describes four species that have been found in the United States, all of them also European; they grow on the ground, mostly in woods.
A. L. S.

New Dimorphomyceteæ.—ROLAND THAXTER (*Proc. Amer. Acad. Arts and Sci.*, 1920, **55**, 211–82). This section of Laboulbeniales includes those unisexual forms in which the male individual possesses one or more compound antheridia; there are four genera, *Dimorphomyces*, *Dimeromyces*, *Streblomyces*, and *Polyandromyces*, the last a new genus, with one species and one variety. The author describes the peculiar sexual organs of this group. A great many new species are also described.
A. L. S.

Relation of the Health of the Host and other Factors to Infection of Apium graveoleus by Septoria Apii.—H. E. THOMAS (*Bull. Torrey Bot. Club*, 1921, **48**, 1–29). The writer discusses the relation between the condition of the host and parasite, gives a historical account of the fungus in question, and describes his methods of tackling the problem—by culture experiments, effect of fertilizers, etc. He has shown by his experiments that *Septoria Apii*, though it readily assumes the saprophytic habit, has become so adapted to its host that it increases as the host becomes stronger and better nourished, and he found also that infestation of the host-roots by Nematodes inhibits the growth of the fungus. Citations are made from workers on other fungi who came to similar conclusions. A. L. S.

New Species of Phomopsis Parasitic on the Douglas Fir.—MALCOLM WILSON (*Trans. and Proc. Bot. Soc. Edin.*, 1920, **28**, 47–9). Wilson gives here a diagnosis of the new species *Phomopsis Pseudotsugæ*. It attacks the Douglas fir in two ways—either the leading shoot is killed back for some distance, or the young tree is attacked a short distance above the ground level. The pycnidia grow on bark or on the leaves. They produce three types of spore, or rather spores in three different stages of development occur in different pycnidia. A. L. S.

New Species of Uredineæ. XIII.—J. C. ARTHUR (*Bull. Torrey Bot. Club*, 1921, **48**, 31–42). The writer publishes a number of new species; he adds also a number of name combinations. He revises the names of three of his previous genera: *Lysospora* (a synonym of *Tranzschelia*, and now replaced by *Lipospora*), *Telospora* (which becomes *Teleutospora*), and *Dasyspora* (which becomes a synonym of *Micropuccinia* Rostr.). Arthur gives the history of these genera, and the reasons for alteration. A. L. S.

New Uredine of the Iberian Flora.—R. G. Fragoso (*Bol. R. Soc. Españ. Hist. Nat.*, 1920, **20**, 309–10). The new species was found by Professor Caballero on leaves of *Lamarckia aurea* near to Barcelona. A diagnosis is given, and a figure showing the numerous swollen paraphyses, a characteristic feature of *Uredo Lamarckiæ*; they surround the sorus, curving inwards towards the centre. No alternate stage has been discovered. A. L. S.

Observations on the Infection of Cratægus by Gymnosporangium.—J. F. Adams (*Mycologia*, 1921, **13**, 45–9, 4 figs.). The observations were made on a shrubbery growth of hawthorns in Pennsylvania; with these were also growing *Juniperus virginiana*, the alternate host of two species of *Gymnosporangium*. The infection by *G. germinale* results in modified branches and abnormal hypertrophied buds; partial defoliation is caused by *G. globosum*. A list of the hawthorns affected by one or the other of these rusts is given. A. L. S.

Gametophytic Development of Blister Rusts.—J. F. Adams (*Bot. Gaz.*, 1921, **71**, 131–7, 4 figs.). The author considers the season and the manner of growth of pycnidia and æcidia in these rusts. He finds that there are three types of growth in *Peridermium cerebrum*. 1. The pycnidia appear in spring: the following spring the æcidia are developed; in the third season pycnidia again appear. 2. The maturity of the pycnidia precedes the æcidia in adjacent as well as overlying tissue within a period of about six months. 3. The period of development is completed within one growing season, the pycnidia preceding the æcidia by a varying short period. A. L. S.

Infection Experiments of Pinus Strobus with Cronartium ribicola.—G. P. Clinton (*Report Conn. Agric. Exp. Stat., New Haven, Conn.* (1917–18), 1919, 428–59, 8 pls.). The disease, blister rust, due to this fungus was first noted in Connecticut in a plantation of three-year-old seedlings imported from Germany. The alternative host, a *Ribes* species, was found to be rusted in 1912, also in Connecticut; since that date it has been reported from various localities. In the present paper Clinton gives results of various culture experiments. He finds that infection of the pines takes place in the autumn: pycnidia and pycnidiospores are first developed in the spring; æcidia are formed later. The æcidiospores are conveyed to *Ribes* species, and uredo- and teleutosori are formed during the summer. Clinton has also followed the results of infections in the injury caused to the leaves, which become yellow and stunted, and to the stems by producing swelling and discoloration of the tissues. A. L. S.

Rusts on Ribes.—G. P. Clinton (*Report Conn. Agric. Exp. Station, New Haven, Conn.* (1917–1918), 1919, 423–7). The writer examined plants of *Ribes* in a number of Herbaria to decide the prevalence of *Ribes* rusts. He failed to find evidence of the presence of *Cronartium ribicola*, but other rusts were detected as not infrequent—*Æcidium Grossulariæ* was very common, being found on eleven different hosts; *Coleosporium ribicola*, a western rust, has been recorded on five species of

Ribes from eight different States. Clinton determined it on eight different hosts. *Puccinia Ribis* is uncommon with a northern distribution; in the Herbaria it occurred only once. A. L. S.

Behaviour of Telia of Puccinia graminis in the South.—H. R. Rosen (*Mycologia*, 1921, **13**, 111–3). The writer made observations on the teleutospores of this fungus on *Elymus australis* with a view to studying the overwintering of the rust. In the North the alternate host, the barberry, carries on the infection, but it is of rare occurrence in the South. Rosen proved from cultures and observations that if the teleutospores were fully developed they were capable of infecting the following spring. A. L. S.

Preliminary List of the Uredinales of California.—Walter C. Blasdale (*Univ. Calif. Publications in Botany*, 1919, **7**, 101–57). In the present paper the writer sketches previous work done on the group in California, and gives a short account of the development of the Uredinales. In the list, which includes 237 species, the genera are arranged in alphabetical order. Most of the species have been already described; a few are new to science. A. L. S.

Rust of Onion followed by a Secondary Parasite.—J. C. Walker (*Phytopathologist*, 1921, **11**, 87–90, 2 figs.). The rust, an æcidial stage, was diagnosed as probably *Puccinia Asparagi*. The secondary organism was *Botrytis* sp.; it formed lesions round the rust pustules, and finally girdled the plants. Experiments showed that the fungus grew only as a secondary organism; no results followed direct inoculation of the onion on areas unaffected by the rust. A. L. S.

Early Development of Inocybe.—Gertrude E. Douglas (*Bot. Gaz.*, 1920, **70**, 211–20, 5 pls.). The writer found that the basidiocarps developed from young buttons of fundamental tissue, the stem being formed by progressive growth of the other tissues later. The gills developed as in other Agaricaceæ (not of the *Amanita* type). A. L. S.

Polyporous dryadeus on Conifers in North-West America.—J. R. Weir (*Phytopathologist*, 1921, **11**, 99). This fungus is the cause of a well-known heart-rot in various trees, especially oaks and poplars, and has also been found at the base and on the roots of conifers. Collections of the fungus have been made in a number of States. A. L. S.

Clitocybe sudorifica as a Poisonous Mushroom.—J. W. Roberts (*Mycologia*, 1921, **13**, 42–4). The above fungus has been determined as *Clitocybe dealbata*; morphologically it is exactly similar. Specimens were collected at Washington and were cooked and eaten, with very alarming results. It has been collected in various localities, and all the American authorities are agreed in pronouncing it decidedly sudorific and unwholesome. A. L. S.

New Species of Exobasidium.—J. W. Hotson (*Phytopathologist*, 1921, **11**, 106). The fungus attacks the young branches of *Vaccinium parvifolium*, gaining access by some wound. The stem is slightly hypertrophied, and from the swelling spine-like processes grow out. Other processes grow out later, and are white with the mycelium of the fungus. Large basidiospores are formed and are very abundant. A. L. S.

Common Mushrooms of the United States.—LOUIS C. C. KRIEGER (*National Geographic Magazine*, 1920, **37**, 387–439, 16 pls. and figs.). The author gives a popular account of the more common edible and poisonous species, illustrated by a beautiful series of photographs and coloured drawings. The species described are mostly abundant in Europe as well as in America. A. L. S.

Light-coloured Resupinate Polypores. III.—W. A. MURRILL (*Mycologia*, 1921, **13**, 83–100). The white species of *Poria* have already been described by the author: the present list deals with those coloured lilac, red, purple, etc.—twenty-six species. A number of them are new to science. A. L. S.

Genus Tinctoporia.—W. A. MURRILL (*Mycologia*, 1921, **13**, 122–3). The author describes three species belonging to this genus of Polypores. Two of these, American species, *Tinctoporia albocincta* and *T. graphica*, stain the substratum; the third, *T. fuligo*, does not leave any stain; it was originally described from Ceylon. A. L. S.

Mycological Notes.—C. G. LLOYD (*Cincinnati, Ohio*, 1920, N. 64, 985–1029, 16 pls.). Lloyd gives portraits and short accounts of some eminent mycologists—George. W. Clinton, Paul Hariot, Rev. L. J. Grelet and Worthington G. Smith. The fungological notes range over a wide field, being based on material sent to him from all countries. Gasteromycetes, Hymenomycetes and Ascomycetes all come under review, and the rarer specimens are figured and described. Among those described are many *Polyporeæ* which were sent to him from Cuba, Africa, Singapore, Australia, etc. Among other unusual forms he notes two species of *Ptychogaster*, one from West Africa, the other from Japan. A. L. S.

Two Species of Fuscoporia.—W. A. MURRILL (*Mycologia*, 1921, **13**, 119). Both of the Polypores described are American species, and were originally placed in *Polyporus*. A. L. S.

Fermentation Organisms of California Grapes.—W. V. CRUESS (*Univ. Calif. Publications Agric. Sci.*, 1918, **4**, 1–66, 2 pls., 15 figs.). The author classifies the organisms found on grapes as—(1) budding fungi, including moulds, true yeasts which form spores, and pseudo-yeasts which do not form spores; (2) fission fungi, including bacteria (non-motile rods), bacilli (motile rods), the various forms of Coccaceæ, and the fission yeasts. All of these, except bacilli, Coccaceæ and fission yeasts, were found in California grapes. The various moulds, yeasts, bacteria, etc., are described, the types are figured, and the species enumerated with notes. Nineteen organisms in all have been studied, the majority of them harmful in wine-making. The yeasts found on the grapes should not be relied on for fermentation; some of the grapes contained no true wine-yeasts. Moulds occur mostly on the surface, and they increase in storage. These, with the wild yeasts and bacteria, can be eliminated by crushing the grapes and adding moderate amounts of sulphurous acids. Good fermentation should be assured by the use of pure selected yeast. A. L. S.

Endophytic Fungus of Lolium. Part I.—ETHEL MCLENNAN (*Proc. Roy. Soc. Victoria*, 1920, **32**, 252–301, 9 pls., 8 figs.). The presence of a fungus in the grains of *Lolium* has long been known; the present writer considers that it is probably a case of symbiosis, somewhat similar to that of *Calluna*. In the latter plant the fungus—distinctly symbiotic—is intra-cellular; that it is also intra-cellular in *Lolium* has now been demonstrated. The growth of the fungus keeps pace with that of the plant; the hyphæ, however, are mainly restricted to the growing apex. When the inflorescence is formed, they are abundant at the base of the carpels, and are present in the embryo-sac at or immediately after fertilization. . . . . On the formation of endosperm the fungus is absorbed as a source of food-supply to the developing embryo. "The fungus of *Lolium perenne* was unable to fix nitrogen in the total absence of external supplies of combined nitrogen." A. L. S.

New or Noteworthy Porto Rican Fungi.—F. L. STEVENS (*Bot. Gaz.*, 1920, **70**, 399–482, 4 figs.). The first species, *Anthostomella Rhizomorphæ* B. & V., had been recorded on "coriaceous" leaves. Stevens has now determined the host plant and gives a full description. It grows on leaves and excites the tissues to gall-like outgrowths. One new genus, *Trabutiella*, was discovered; it is similar to *Trabutia*, but with sixteen spores in the ascus. Several new species or forms are also described. A. L. S.

Sequence of Fungi and Mycetozoa.—W. T. ELLIOTT and J. B. ELLIOTT (*Journ. Bot.*, 1920, **58**, 273–4). The writers have kept under observation an oak branch blown down in 1912. In the autumn of 1913, after lying on the ground in a conifer plantation for twelve months, it was profusely covered with the black gelatinous ascocarps of *Bulgaria polymorpha*. *Coryne sarcoides* appeared later, then *Stereum hirsutum* and other forms. In the autumn of 1919 the first mycetozoon appeared, a dense growth of *Physarum nutans* spreading over an area of about four square feet. Other fungi continued to develop, and in July 1920 the second mycetozoon, *Stemonitis fusca*. The luxuriant growth of *Physarum nutans*, with the disappearance of *Bulgaria polymorpha* and *Coryne sarcoides*, lead the authors to the conclusion that *Physarum* must have lived on and exhausted the hyphæ of the fungi. A. L. S.

Some New Hampshire Fungi.—L. O. OVERHOLTS (*Mycologia*, 1921, **13**, 24–37). Collections in the above district had been made in 1884 by Dr. Farlow, who listed 107 species distributed through 63 genera. Overholt's collection furnished 195 species with about 77 genera, but only about a dozen species are duplicates of those collected by Dr. Farlow. This is explained by the statement that while the latter collected the smaller fungi, Overholts gave his attention more particularly to Basidiomycetes. He notes as of special interest a fungus that attacked and destroyed the heart-wood of *Picea rubens*; the sporophores of the fungus were not found. A list of the fungi, with locality, habitat and biological notes, is appended. A. L. S.

Fungi of the Wilkes Expedition.—William W. Diehl (*Mycologia*, 1912, **13**, 38–41). The fungi of the Expedition were named by Berkeley and Curtis and published—31 species, 8 of them new to science. Since that publication they have fallen aside, but search has been made and a number of specimens, including the types of the new species, have been found in the U.S. Department of Agriculture (Bureau of Plant Industry). Diehl publishes a list of the species, marking by an asterisk those that are preserved in the herbarium. A. L. S.

Deterioration of Cotton in Wet Storage.—Nancy Fleming and Aage Christian Thaysen (*Biochemical Journal*, 1920, **14**, 21–8, 1 pl.). It was found that cotton kept in store in damp conditions became brittle and short-fibred, the damage done being often very considerable. It was found that micro-organisms were responsible for the deterioration of the fibres, mainly bacteria and a Schizomycete, some form of *Streptothrix*. These attack and decompose the cellulose, causing a general weakening or a breaking up of the fibres to the condition known as "fly." A. L. S.

New or Unusual Plant Injuries and Diseases found in Connecticut, 1916–19.—G. P. Clinton (*Conn. Agric. Exp. Stat. Bull.*, 1920, **222**, 397–482, 24 pls.). The author discusses all diseases and injuries of economic plants in the State of Connecticut, more especially those caused by fungi. He gives first an account of two cases of fungus trouble, not on living plants; the first of these is dry-rot, which was gradually destroying the woodwork of a house in the county. The attack is described and the means used to eradicate the fungus and prevent its recurrence; the diseased wood was burnt, the new wood creosoted where possible, and ventilation provided. The second instance of trouble was the injury caused to butter by moulds—probably infected from mouldy cheese. Five different moulds were isolated and cultured.

The diseases of plants are described under the different hosts arranged in alphabetical order from Apple to Willow. All forms of trouble are included in the survey: fungi, soil troubles, smoke, etc. Thus under Potato some fourteen different forms of injury are described. The illustrations are mostly photographic. A. L. S.

Development of Cyathus fascicularis, C. striatus, and Crucibulum vulgare.—Leva B. Walker (*Bot. Gaz.*, 1920, **70**, 1–24, 6 pls., 3 figs.). Pure cultures of the species were obtained by planting the peridioles on agar media. Mycelium was transferred to sterile loam, old leaves, etc., in flask cultures. Light was necessary for the formation of the fruits which begin as minute white mycelial knots. Development was followed of the basidiocarps, the peridioles with their funiculi, and of the peridium, etc.

All three species were easily grown, but specimens matured only in *Cyathus fascicularis*. The mycelia of all are very similar except for slight colour changes; clamp connexions are abundant, and mycelial stands are formed. The basidiocarps of *Cyathus* originate from strands, while those of *Crucibulum* may arise from mycelial strands, dense mats of hyphæ, or from the interior of old peridioles. A. L. S.

Lichens.

Thallus der Kalkflechten.—E. BACHMANN (*Nova Acta Abh. Leop.-Carol. Deutsch. Akad. Naturf.*, 1919, **105**, 1–80, 4 pls.). In this paper the author records results of his examination of a series of lichens living on or in limestone. One of these, *Verrucaria parmigera*, is associated with *Pleurococcus* algæ, the other five species with *Chroolepus*. Among the lichens of the latter group the algal threads penetrate along with the lichen hyphæ deep down into the limestone in *Gyalecta cupularis*, *G. cucapsis*, and *Sagedia byssophila*. In *Arthopyrenia saxicola* and *Acrocordia conoidea* the thallus is more superficial and the penetration is not so great. Bachmann describes both algæ and hyphæ, their form, etc., and their relation to each other. The occurrence of fat-cells is noted. In other endolithic species (*Petractis clausa* and *Xanthopyrenia* (*Arthopyrenia*) *tichothecioides*) he demonstrates the presence of *Glœocapsa* (*Xanthocapsa*) gonidia. A. L. S.

Microscopical Structure of Lichens.—ROBERT PAULSON (*Journ. Quek. Micro. Club*, 1920, **14**, 8 pp., 1 pl.). R. Paulson gives a short account of the general structure of lichens. He dwells more particularly on the theories of parasitism and symbiosis. He himself brings forward new proof of the symbiotic nature of the thallus in the condition of the gonidia or green cells. These are entirely healthy and normal, and at certain seasons they multiply very actively by sporulation within the mother-cell. This condition of sporulation is found in many of our familiar lichens, the gonidium being a species of *Chlorella*. In other lichens are to be found other gonidia, but apparently all are healthy and capable of increase. A. L. S.

The Lichen as Transmigrant.—A. H. CHURCH (*Journ. Bot.*, 1921, **59**, 7–13, 40–6). Church presents a further contribution on the origin of the lichen plant. He gives his views on the development of the thallus from deteriorating green algæ, saved from ultimate decay by the intrusion into their tissues of minute green algæ. He traces the development of the ascocarp, the ascus having been elaborated in the first place from a unilocular sporangium. He contrasts the perithecia of lichens with the cystocarps of the Florideæ. He considers that the small ascocarps scattered over the thallus, as in lichens, is more primitive than the large fruiting body of the *Pezizæ*, and he notes in lichens the suggestion of vestigial sexual organs, such as the trichogyne, etc., though he considers that there is no direct connexion between lichens and Florideæ. He discusses the whole question of symbiosis in the lichen and in other organisms. The lichen habit, he considers, could not have been evolved in the open sea, but must be the product of subaerial and transmigrant conditions. The stages of association are sketched as a sequence of biological factors—(1) Failure of oxygen supply in standing pools of sea-water; (2) competition for substratum of green intrusive algæ; (3) the greater success of the associated organisms in subaerial conditions; (4) the nitrogen problem keeping the plants impoverished; and (5) the water problem restricting their growth to shorter seasonal periods. A. L. S.

New Portuguese Lichens.—GONÇALO SAMPAIO (*Ann. Acad. Polytechnica do Porto*, 1917, **12**, 1–4). Diagnoses of seven new species of crustaceous lichens. A. L. S.

The Sulphur Lichens of Saxon Switzerland.—A. SCHADE (*Abh. Naturw. Ges.* "*Isis*" *Dresden*, 1916, 28–44; see also *Ann. Mycol.*, 1917, **15**, 511). The yellow colour of the Sandstone rocks, due to the colour of the vegetation, has been determined by the author as caused by the growth chiefly of *Lepraria chlorina*, to a lesser extent by *Biatora lucida* and others. A. L. S.

Lichens of Sardinia.—GIUSEPPE COLOSI (*Malpighia*, 1919, **28**, 458–71). The lichens here listed were collected by the author during a stay at Cagliari. He gives a list of the places visited. He has added two new varieties to science—*Ramalina capitata* var. *sardoa* and *Parmelia tiliaceæ* var. *alba*, so designated from the white under-surface. A. L. S.

NOTICES OF NEW BOOKS.

Critical Microscopy: How to get the Best out of the Microscope. By Alfred C. Coles, M.D., D.Sc., M.R.C.P., F.R.S.E. 1921. viii + 100 pp. and 3 pls. Published by J. and A. Churchill, 7 Great Marlborough Street, W.1. Price 7*s*. 6*d*. net.

Faune de France: I. Echinodermes. By Professor E. Koehler. 1921. 210 pp. and 153 figs. Published by Paul Lechevalier, 12 Rue de Tournon, Paris. Price 25 francs.

Faune de France: II. Oiseaux. By P. Paris. 1921. 474 pp. and 490 figs. Published by Paul Lechevalier, 12 Rue de Tournon, Paris. Price 40 francs.

Supplement (1918–1920) to the Catalogue of Lewis's Medical and Scientific Circulating Library, with List of Additions to March 1921. 68 pp. Price 1*s*. net.

Dictionary of British Scientific Instruments. Issued by the British Optical Instrument Manufacturers' Association. 1921. xii + 334 pp. Published by Constable and Co., Ltd., London. Price 21*s*.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W., ON WEDNESDAY, MARCH 16TH, 1921, PROFESSOR JOHN EYRE, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of five Candidates for Fellowship.

New Fellows:—The following were elected Ordinary Fellows of the Society:—

Miss Mabel J. McFarlane, B.Sc.
Mr. Harold J. C. Mathews, F.C.S.
Mr. Harold Moore, O.B.E., B.Sc., F.I.C., F.Inst.P.

Mr. Barnard reported that, at a Special Meeting of the Council held on March 2, it was unanimously resolved:—

1. That the President of the Board of Trade be asked to receive a Deputation from the Royal Microscopical Society in reference to the proposed Key Industries Bill about to be introduced.
2. That the Deputation consist of the President, the Treasurer, the Secretaries, and two other Fellows, or such number of these as may be expedient.
3. That the Deputation be instructed that the Royal Microscopical Society represents a large number of British scientists who require for their work the most efficient optical instruments and accessories that can be obtained.
4. That in cases where British Manufacturers are not yet in a position to supply apparatus, similar to or of the same efficiency as that manufactured elsewhere, it would be a serious handicap to scientific workers if any prohibitive legislation were passed which would prevent the free use of the most efficient types of instrument, irrespective of its country of origin.
5. That the Royal Microscopical Society is fully conscious of the necessity of rendering every possible assistance to British Manufacturers in the production of an adequate supply of optical glass and of microscopical appliances of which such glass forms an essential part, both for purposes of war and of peace. The Society ventures to suggest that Government support with this object in view may be best achieved by means of subsidies spread over a term of years.

He further reported that as a member of a deputation from the Optical Society which waited upon the Board of Trade on March 8, he had fully explained the views of the Council of the Royal Microscopical Society to the Board of Trade officials. The Board of Trade had therefore asked that the proposed deputation from this Society should not wait upon them unless it was desired to raise any new points.

The President moved the confirmation of the foregoing resolutions. This was carried with one dissentient.

Exhibits were shown by Dr. Murray, Mr. E. J. Sheppard and Mr. Whitfield, who were accorded the thanks of the meeting.

Donations were reported from :—

The City of Birmingham—

Metallurgical Specimens.

Mr. C. D. Soar—

A Wilson Pocket Microscope (1702) and Case of Ivory Mounts.

This instrument is unengraved, but typical of those produced by Culpeper. It is the pocket form without attachment for handle or stand; apparently it is an early model, as the later forms usually had the under surface of the lens polished, so as to act as a Lieberkuhn. The accessories accompanying the instrument are three object-glasses, one box for talcs, one brass slide with glass concavities, and one brass slider, with ten ivory sliders in separate sharkskin case.

Mr. J. T. N. Thomas—

Slide of *Astromma Aristotelis.*

Mr. G. T. Harris—

A Collection of Slides of Algæ.

On the motion of the **President**, hearty votes of thanks were accorded to the donors.

Mr. B. K. Johnson (Imperial College of Science and Technology) read a paper on "Polarizers for the Microscope."

Mr. John H. Pledge, F.R.M.S., read a paper on "The Use of Light Filters in Microscopy."

On the motion of the **President**, hearty votes of thanks were accorded to the authors of the papers.

The President announced that the next meeting would be held on April 20, and that the Biological Section would meet on April 6, when Mr. E. J. Sheppard would give a Demonstration on the Microtome.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT NO. 20 HANOVER SQUARE, W., ON WEDNESDAY, APRIL 20TH, 1921, MR. D. J. SCOURFIELD IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

The nomination papers were read of four Candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows of the Society :—

Mr. William R. Chapple.
Mr. Archibald A. Davis.
Mr. E. B. Miller-Williams, F.C.V A., etc.
Mr. Albert Norman.
Professor Gobind Singh Thapar, M.Sc.

A paper by the Rev. J. S. Pratt on "Mr. Fred Enock's Method of Mounting Heads of Insects without Pressure," was read by Mr. Scourfield.

Mr. F. Martin Duncan, F.R.P.S., F.Z.S., F.R.M.S., read a paper "On the Presence of two Spermathecæ in the rare Mole Flea (*Hystrichopsylla talpæ*), and the Flea as a Distributor of a Tyroglyphid."

Mr. Henry Crowther, F.R.M.S., read a paper on "A Coal-dust Explosion as seen through the Microscope."

A paper by Captain Frank Oppenheimer, I.M.S., S.R., M.B., Ch.B., F.R.M.S., on "Some Suggestions regarding the Mechanical Design of Microscopes," was read.

The best thanks of the meeting were accorded to the authors of the foregoing papers.

The Chairman announced that the Annual Pond-Life Exhibition would be held on May 18; that the Biological Section would meet on May 4, when Mr. H. G. Cannon would make a communication on "Some Experiments on Inheritance in *Simocephalus vetulus*"; and that the Metallurgical Section would meet on May 11, when Mr. George Patchin would make a communication on "The Application of Microscopy to the Metal Industry."

The business proceedings then terminated.

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AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W., ON WEDNESDAY, MAY 18TH, 1921, PROFESSOR JOHN EYRE, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of four candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows:—

Mr. Charles H. Caffyn.
Professor Ekendranath Ghosh, M.Sc., M.D.
Mr. Alfred Holt, F.C.S.
Professor Sakae Saguchi.

Donations were reported from:—

Messrs. J. and A. Churchill—
"Critical Microscopy." (A. C. Coles.)
M. Paul Lechevalier—
"Faune de France: I. Echinodermes." (R. Kœhler.)

On the motion of the **President**, hearty votes of thanks were accorded to the donors.

Pond-Life Exhibition.—The **President** then called upon Mr. Scourfield to make some observations on the Annual Exhibition of Microscopic Pond-Life which had been arranged by Fellows of the Society and Members of the Quekett Microscopical Club.

Mr. Scourfield said that those who had been present at recent Pond-Life Exhibitions would remember that he insisted again and again upon the idea that such exhibitions might, and indeed should, have at least one good effect—namely, that of encouraging the study of pond-life organisms as living things and not merely as subjects for systematic and morphological research.

Even limited in this way, however, there were so many problems arising that it was quite impossible to deal adequately with them all on any one occasion. Some had been briefly referred to at previous Pond-Life Exhibitions, as, for example, the characteristic movements of different fresh-water microscopic organisms, the correlation of their structure to their mode of life, their colours and patterns, and so on.

The problems so far touched upon, however, had all been such as could, in the main, be solved by simple direct observational methods. But there also existed quite a number of biological problems which demanded more or less experimental methods for their investigation; and what he wanted to emphasize that evening was the fact that many pond-life organisms lent themselves excellently to this experimental treatment. He proposed therefore to call attention to two or three lines of experimental work in which pond-life organisms had been used with considerable success.

There was first of all the cultivation of the organisms under somewhat abnormal, but, so far as possible, controlled conditions. The main idea underlying this line of work was of course to discover the influence of different elements in the environment, and if possible to throw light on that very fundamental biological problem, the causes of variation. Much work had been done in this way, e.g., the cultivation of diatoms and other algæ in or on various media. In connexion with the cultivation of diatoms the work of Dr. Allen, although dealing with marine forms, was particularly referred to. Dr. Allen found that in artificial sea-water the diatoms would not thrive, whereas if an extremely small amount of actual sea-water was added they developed quite readily. The explanation seemed to be that there was some unknown substance, probably organic in origin and possibly comparable to the so-called vitamines, present in ordinary sea-water which was essential to the proper growth of the diatoms. The same might very well be done for fresh-water organisms, and it would be very important if this matter could be further investigated. Another case specially referred to as showing the effect of particular kinds of food on structure was that of Prof. Agar's curiously modified forms of *Simocephalus*, due apparently to their being reared on a particular species of *Chlamydomas.*

Another line of experimental work was in connexion with problems of heredity, and Prof. Agar's results with *Daphnia* and *Simocephalus*, and Prof. Punnett's with *Hydatina*, were mentioned in illustration of this kind of work.

Yet another way in which living pond-life organisms lent themselves to the experimental method was as subjects for intra-vitam staining. Prof. Fischel's results with *Daphnia* were quoted as a good illustration of what might be undertaken in this direction.

Altogether it was evident that pond-life organisms offered a wide field for experimental biological work, and it was to be hoped that many already familiar with particular groups from the systematic and morphological standpoints would be induced to give some attention to the possibilities for experimental biological work which such organisms afforded.

Mr. Scourfield then called attention in detail to many of the exhibits, which he thought were more varied and certainly more numerous than had been the case for several years past.

On the motion of the **President**, a hearty vote of thanks was accorded to the Members of the Quekett Microscopical Club, and to the Fellows of the Royal Microscopical Society who had kindly exhibited specimens, and to Mr. Scourfield for his remarks.

The President announced that the next meeting would be held on June 15; that the Biological Section would meet on June 1, when Mr. F. Martin Duncan would make a communication on "Studies in Insect Biology"; that the members of the Biological Section, by the invitation of the President, would pay a visit to the Bacteriological Laboratories at Guy's Hospital on June 8; and that the Leather Industries Section would meet on May 25, when Mr. Percy Hampshire would make a communication on "'Run' Pelts in Sweating Process of De-wooling."

The following **Objects** were exhibited :—

Mr. S. C. Akehurst . .	Larva of *Corethra plumicornis*, showing air sacs with polarized light.
Mr. A. J. Bowtell . .	Larva of Gnat.
Miss M. H. Brooks. .	*Stephanoceros eichhornii.*
Canon G. R. Bullock-Webster	*Nitella mucronata*, showing cyclosis.
Mr. C. H. Caffyn . .	Newly hatched larvæ of *Tanypus.*
Mr. W. R. Chapple. .	Young larva of *Corethra plumicornis.*

Mr. F. W. Chipps . .	*Lophopus crystallinus*, also *Plumatella* sp. and *Fredericella sultana*.
Mr. F. E. Cocks . .	*Stephanoceros eichhornii.*
Mr. T. N. Cox . .	*Nitella* sp., showing cyclosis.
Mr. B. S. Curwen . .	*Polyphemus pediculus.*
Mr. E. Cuzner . .	Larva of May-Fly ; also *Hydra fusca* and *Chara delicatula* in fruit.
Mr. F. Martin Duncan .	*Hydra vulgaris.*
Mr. Gordon Fryer . .	*Macrotrachela quadricornifera.*
Dr. J. B. Gatenby . .	Culture of *Amœba proteus* by Miss M. [Taylor's method.
Mr. C. E. Heath . .	*Closterium* sp.
Mr. H. J. Lawrence .	*Pleurosigma attenuatum.*
Mr. R. Ludford . .	Ciliated Trochosphere of *Limnæa auricu-*
Mr. A. E. McClure . .	Diatoms—various spp. [*laris.*
Mr. R. H. Marchment .	*Daphnia pulex.*
Mr. E. R. Martin . .	*Melicerta ringens.*
Mr. E. Maurice . .	*Hydra viridis.*
Mr. H. H. Mortimer .	*Euglena viridis.*
Dr. J. A. Murray . .	*Cyphoderia ampulla.*
Mr. J. C. Myles . .	*Hydra viridis.*
Mr. E. R. Newmarch .	*Hydra vulgaris* ; also *Cristatella mucedo.*
Mr. C. H. Oakden . .	*Scaridium longicaudum.*
Mr. J. M. Offord . .	*Encyonema* sp., a diatom secreting and inhabiting a tube.
Mr. R. Paulson . .	*Protococcus rufescens* var. *sanguineus.*
Mr. J. Richardson . .	*Vaginicola crystallina* and *Anabæna* sp. on ivy-leaved duckweed.
Mr. W. Russell . .	*Chromatium okeni.*
Mr. D. J. Scourfield .	*Leydigia quadrangularis* (male).
Mr. R. S. W. Sears . .	*Vorticella* sp.
Mr. C. J. H. Sidwell .	*Leydigia quadrangularis* ♀ ; also *Simocephalus vetulus*, showing circulation of amœboid corpuscles.
Mr. T. G. Smith . .	Larval Newt, showing circulation of blood.
Mr. B. J. Thomas . .	Ditto ditto
Mr. C. Todd . . .	Parasitic stage of a Water-Mite on *Nepa*
Mr. W. R. Traviss . .	*Carchesium* sp. [*cinerea.*
Mr. E. E. Warr . .	*Volvox globator* ; also *Diaptomus castor.*
Mr. H. C. Whitfield .	*Epistylis* sp.
Mr. J. Wilson . .	*Clathrulina elegans* ; also *Floscularia triloba* and *Nitella* sp. in fruit.
Mr. C. L. Withycombe .	Young larva of *Anopheles plumbeus*, one of the mosquitoes capable of conveying malaria. From tree-holes in Epping Forest.
Mr. S. R. Wycherley .	Larva of May-Fly.

The following **preparation** was also exhibited :—

Mr. E. J. Sheppard. .	Testis of Newt, showing characteristic chromosomes of the meiotic phase, first division. Double stained by E. J. Sheppard's process described in Journal R.M.S.

JOURNAL
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SEPTEMBER, 1921.

TRANSACTIONS OF THE SOCIETY.

IX.—SOME ABBE LETTERS.

Read by PROFESSOR CHESHIRE, C.B.E., F.Inst.P., F.R.M.S.

(*June* 15, 1921.)

FOUR TEXT-FIGURES.

INTRODUCTION.

SOME time ago, my friend, Mr. Harrison Glew, presented me with a number of letters (holograph) written by the late Professor Abbe, and addressed to the eminent English microscopist, John Ware Stephenson, who was as you know, an honoured Fellow, and at one time Treasurer, of this Society.

The three letters which I propose to read to you to-night, although written nearly half a century ago, deal with the Abbe diffraction theory of microscope vision in such a clear and delightful way, that I suggested to our late President—Mr. Barnard—that they should be read at one of the Meetings of our Society, and placed upon record in the Proceedings as a matter of historical interest. To this suggestion he gave a cordial assent.

Now these letters were written in December 1876, whilst Abbe's theory was still hot on the anvil, and in fairness to Abbe, this fact should be borne in mind. A man deals with his theories in letters, the publication of which he does not contemplate, with a freedom of thought and expression which he would scarcely commit himself to in a paper written for a Society. This consideration, however, I think it will be agreed, enhances the interest of the letters.

I have gone through the letters very carefully, but beyond correcting a few—singularly few—slips of the pen, and removing

R

underlines, the letters are to all intents and purposes presented to you as written. The various diagrams have been carefully copied in *facsimile* for me by my colleague, Mr. B. K. Johnson.

First Letter.

Jena,
December 2nd, 1876.

Dear Mr. Stephenson,

Answering your kind letter. I begin with your question about the diffraction-experiment. The grating in form of alternately long and short lines (fig. 1) gives two sets of diffraction-spectra, if it is put beneath the objective so that the line *a* . . . . is in the middle of the field. The upper part will give a set of spectra, the distance* of which is double the distance of the spectra from the lower part, because the lines in the former part have just half the distances. After adjusting the illuminating flame and the position of the grating on the stage, you take out the eye-piece and look down into the tube ; you see now the two sets of spectra, one after the other, if you bring the pupil of the eye alternately on the air-image of part A and of part B. The aspect is as follows (fig. 2). Now you bring in the stop with three holes, adjusted as in the figure, so that besides the more distant spectra of both sets, the spectra *m* and *n* from B are stopped off, the three central diffraction pencils of A remaining unaltered. Therefore the image of part A will appear just as before, because the external pencils are not necessary for forming an image. But as the effective pencils from part B now are made identical with those from part A the image of B will be equal to the image of A ; it has less brightness only because there is only half the light passing through the lines of part B.

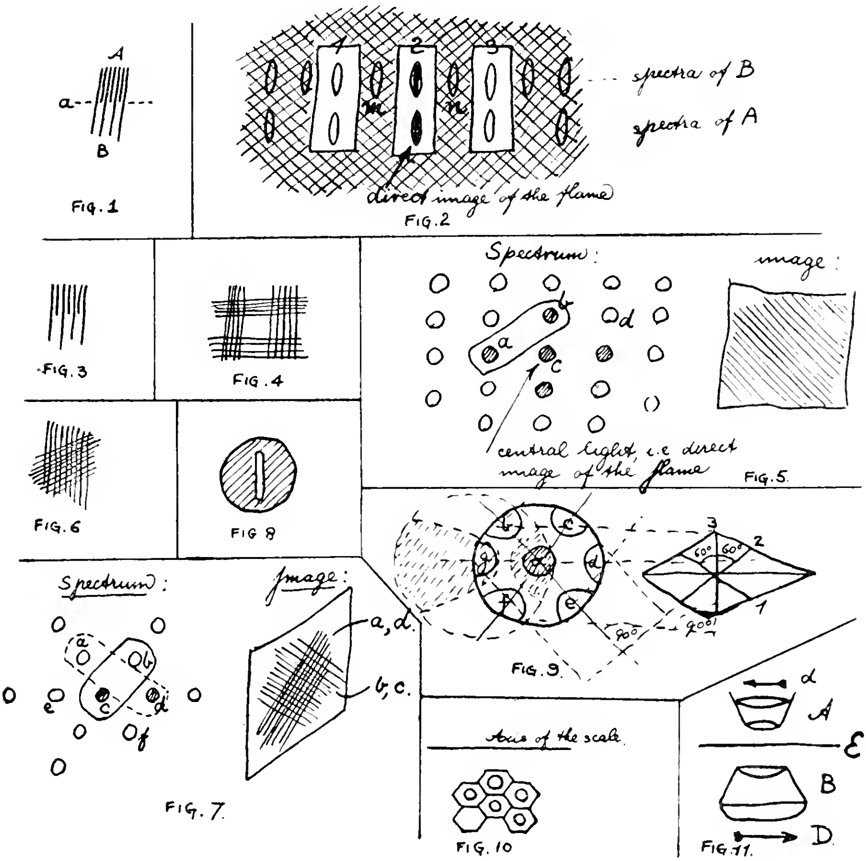
You will get just the same effect with two holes (1 and 2) in the diaphragm, because two different diffraction-pencils are quite sufficient for forming an image, and two consecutive pencils in every case give the normal image of the structure.

I found unexpected difficulties in getting the silvered glass in the right condition of the silver for ruling fine lines, and I was obliged to make many trials for that purpose, though formerly there never occurred any difficulty. From that reason I have got such preparations as I showed you only just now: and you will receive one in the next days, together with a contrivance for turning the diaphragms above the objective without altering the focus. You will find, on one slide, the grating (fig. 3) mentioned above, and on both sides of it gratings crossed at right angle and at the angle of 60° (figs. 4 and 6), just as I used when I had the pleasure to show you the diffraction-experiments. The distance of

* Abbe uses the word "distance" consistently for "distance apart."—F. C.

the lines on the simple grating is 0·0073 mm. (part A), and 0·0143 mm. (part B). The crossed gratings have two bands of lines each, one with the distance 0·0073 mm., the other band with 0·0110 mm. (2 : 3). Therefore each of those latter preparations shows three different figures—quadratical and rectangular on the one, rhombial and rhomboidivial on the other (figs. 4 and 6). (The

ABBE'S LETTER.— DEC. 2ND 1876.



silvered and ruled faces of the glasses are cemented together with balsam).

Those crossed gratings give a diffraction-spectrum in two dimensions, and you will get a great variety of markings by stoppng off various parts of it. You will easily command all these effects if you remember what, in my theory, is the general principle for explaining them: "any two pencils of light (i.e. two spectra, the direct image of the flame there included) entering the objective, give origin to a set of lines, the direction of which forms a right angle with the connecting line of the pencils, or spectra, and the distance of which is (exactly) inverse to the distance of the spectra (i.e. of corresponding points in them).

For instance, you will get diagonal lines on the quadratical gratings, the distance of which is in the ratio of $1 : \sqrt{2}$ narrower as the distance of the real lines, by excluding (fig. 5) all the spectra besides [except] *a* and *b*, *or* besides *c* and *d*, etc.

On the rhombical field (fig. 6) you will see a set of lines parallel to the short diagonal, in the same distance as the real lines, by the spectra (fig. 7) *c* and *b* (or *a* and *e*, or *d* and *f*)—and another set of lines, parallel to the long diagonal and narrower in the ratio $1 : \sqrt{3}$, by the spectra *a* and *d* or *e* and *f*—*a, s, o.*

You will remember, that I made the experiments with the open flame of a petroleum lamp. I took the light from the narrow side of the flame, with the concave mirror, in observing the simple grating, to show the duplication of the lines in part B, with the two- or three-hole diaphragm, and to show the disappearance of all the lines, by a single-hole diaphragm which only one pencil admits. For the experiments with the crossed grating I took the light from the broad face of the flame (in order to get a nearly circular image) with the plane mirror, adjusting the distance of the lamp in that way, that the different spectra appear separated. But I observe that in all these experiments the different aspects of the object will appear in the same way, if a broader beam of light is applied and the spectra are superposed—provided that the diaphragms, i.e. the holes in them, are exactly conform to the distances of corresponding points in the superposed spectra.

The preparation I am about to send you fits best to Zeiss' Objective *aa* (ca $1\frac{1}{2}$ in.) which you have got from Mr. Zeiss, or, if you want, will find at Mr. Baker's shop, 244 High Holborn. But any similar lens of 1 in. to $1\frac{1}{2}$ in. focus will do as well, if you adapt the diaphragms to the dimensions of the spectrum produced, and bring it as near as possible to the back-lens of the system. For settling the diaphragm, I send a ring with the society-screw, which is to be screwed between the objective and the nose-piece of your microscope. Within this ring there is another ring, turning from without by a prominent pin. On the under face of this ring, which is just above the back-lens, you fix the diaphragms (made in card-board) by some wax. Turning the diaphragm without altering the focus will allow to pass at once from the artificial image to the normal image (and vice versâ) which will appear as soon as the hole (or holes) get such a position as to admit consecutive pencils or spectra, proving in that way that the abnormal images are not caused by the diaphragms, but only depend on their position relating to the diffraction-phenomenon. In using, with the crossed gratings, a broad beam of light, which fills the whole aperture of the objective and thereby, by superposition of the spectra, makes them undiscernable, a diaphragm with a single hole (slit) (fig. 8) of *p p* 1 mm. in breadth, gives, by simply turning it, the several sets of lines one after the other.*

From my point of view the scientific interest of all these experiments is to prove experimentally, what is the summit of my theory of microscopical vision: that all microscopical images of fine structures are not direct dioptrical images, such as those of the outlines of an object, but are secondary images, produced by the interference of those pencils of light into which, by diffraction in the structure, the incident beam of light is resolved—the normal image of the structure as well as the artificial ones. My theoretical proof of this assertion is based on the fact, which is a direct consequence of the undulatory theory, that all corresponding points in the spectra which are formed by the objective (i.e. such points of those spectra which are derived from the same point in the illuminating face) make their oscillation with equal phase—therefore must produce interferences among the rays which from those points pass to the plane of the dioptrical image. The experimental proof, in my opinion, is given by the fact which the experiments mentioned illustrate: that there is no constant relation between the microscopical image and the structure itself, but only a constant relation between the image and the number and position of the diffraction pencils, which form the image, different structures producing identical images, if those diffraction-pencils are made equal, and one structure producing different images, if those diffraction-pencils are made different. My theorems about the functions of the aperture, the resolving power of an objective and the limits of visibility, are directly derived from the doctrine mentioned above.

You may repeat all the experiments with the rhombical grating on *Pleurosigma angulatum* and show the most striking aspect of longitudinal lines and new hexagonal markings on that diatom, which my theory anticipates. For that experiment your Zeiss' Immersion No. 1 in the short setting, you have got, is very convenient, if you apply the small tube of your binocular-apparatus for fixing small diaphragms (in tin-foil) above the back lens. If you bring to focus a good specimen of that diatom—flat and with distinct lines—using at first central light in a broad beam, you will see the diffraction spectrum in the following position within the margin of the back lens (fig. 9): *a* is the central incident beam of light, *b*–*f* [*g*?] the six diffracted beams which alone can be observed with any objective.

* Every position of the diaphragm showing that set of lines which—among the various possible sets—is at right angle to the direction of the slit.

The three sets of equidistant lines from which the hexagonal beadings of the scale result, correspond in direction and distance of lines, to the various pairs, which may be formed with consecutive pencils—as is indicated in the figure. Each set of lines can be produced alone by any pair in which the connecting line is at right angles to the direction of the lines, for instance the set (1) by the pairs *a* and *c* *a* and *f*, *b* and *g*, *d* and *e*—in bright field or in dark field. The seven pencils interfering together, give the common image with the hexagonal markings, which I have calculated in all its detail as a pure interference-phenomenon, which is quite independent of the real (quite unknown) structure of the scale, only depending on the distance and position of the spectra in relation to the axis. The calculated image is as follows (fig. 10): bright spots, representing the maxima of light, and hexagonal figures around those representing the lines, in which the interference produces minimum of light. A similar image, with a somewhat different distribution of light, is, theoretically, the result of the interference of say three pencils forming a triangle (as *a*, *b*, *c*—or *a*, *d*, *e*)—as are effective in observing *Pleurosigma* with a dry lens in oblique light—quite in accordance with the well-known aspect.

Now from the theory above follows that there must be visible in dark field three new sets of lines, bisecting the angles between the common lines—corresponding to the combinations of the spectra—

g, *c*	or	*f*, *d*
b, *f*	„	*c*, *e*
b, *d*	„	*g*, *e*

the distance of which must be narrower in the ratio of $1 : \sqrt{3}$: and three sets of lines coinciding with the common sets—but narrower in the ratio 1 : 2—corresponding to the combinations—

b, *e*
c, *f*
d, *g*

The interference of three pencils as

g, *c*, *e* or *b*, *d*, *f*

lastly produces a new image with hexagonal markings, the hexagons with their sides normal ($\perp$) to the axis of the scale (not parallel as in the common image) and smaller in the ratio $1 : \sqrt{3}$—both combinations the same (dark field, of course).

All those phenomena you may observe in accordance with the theoretical anticipation—by stopping off the pencils which are to be excluded. Most easily you will get the lines which bisect the angles of the common rows, one after the other, and among those one set parallel to the axis of the scale. For that purpose you bring the beam of light oblique in the direction of the axis of the scale, until the pencils *b*, *f* (or as well *c*, *e*) come nearly to the diameter of the aperture—in order to get as much light as possible—and stop off *a* and *g*. The red [dotted] lines in the figure indicate the arrangement of the diaphragm.

As to your other question relating to the best position of the diaphragm in your condenser, the principle for determining is very simple (fig. 11). Let A be the objective, focussed to the plane E: B the condenser beneath, D the diaphragm below the condenser. Now the two systems A and B form together one system which in every case will produce an image of the diaphragm. If D is outside the under focus of the combined system A and B, this image will be a real and inverse image *d*, as assumed in the figure. Now from the nature of optical images, all the rays passing from one point of the diaphragm D, will cross in one point of the image *d*. In your case, where it is necessary that the beams of light from the different parts of the diaphragm (the different apertures) should enter into different apertures above the objective, the image *d* therefore should coincide with the edge of your prisms. If those prisms with their lower edge, were exactly in the upper focus of the objective A, the diaphragm D ought to be in the lower focus of system B. Now in the higher powers the upper focus always will be within the lenses: your prisms therefore, will be outside the focus of A. The diaphragm therefore ought to be within, i.e. above the lower focus of the condenser B.

I presume that it will not be possible to bring the diaphragm near enough for getting the coincidence of *d* with your prisms, but in every case you will find the best position in the following way experimentally: you adjust the objective to the plane of the object and look down into the tube, without eye-piece. In moving the eye you will observe a parallax between the images of the apertures in D and the lower edge of your prisms seen by reflection. The best position of the diaphragm will be found if the parallax is brought to the minimum, which is possible with your apparatus.

I hope you will find intelligible my expositions and will succeed in making all the experiments after having got the preparation announced. I will be very glad to hear from your results in those experiments, and I shall take great pleasure in giving you any further information you should want.

* * * * *

Yours truly,
(Signed) E. Abbe.

SECOND LETTER.

JENA,
9th December, 1876.

DEAR SIR,

The preparation which I announced in my former letter has been sent to your address. I have added one of Mr. Zeiss' aa-objectives, because Mr. Z. was not sure if you would find such a lens at Mr. Baker's shop. I wished to save you the trouble of making the diaphragm, which must be exactly adjusted to the focal length of the system. If you have used the objective, please send it to Mr. Baker.

The diaphragms herein are marked with numbers:—No. 1 for the duplication of the lines; No. 2 for showing the disappearance of all the lines if no diffraction pencil is admitted. The broader slit makes disappear only the narrow part of the group, the smaller slit both parts.

The same diaphragms serve for showing the secondary lines on the crossed gratings—one set of lines after the other. The broader slit fits to the fine groups. No. 3 gives hexagonal markings, alike to those of *Pleuro angulatum* on the group [in which the lines are inclined at 60°], and quadratical markings on the group [lines crossing at right angles]—the wide aperture for the finer groups. This effect depends on the stopping-off of all the diffraction pencils except those which are next to the incident ray. With *P. angulatum* this condition is fulfilled without any artificial help in any lens, as great as the aperture may be—in consequence of the great dispersion of the diffraction pencils.

From this point of view the experiment named is of some interest. It proves that the markings on that diatom must not necessarily be the image of a real structure of the same kind: those markings have their sufficient reason in the admittance of three (or six) diffraction pencils with exclusion of any other.

No. 4 produces the same hexagonal markings on the finer group [of crossed lines]—but only in three distinct positions of the three holes, relating to the lines—only in those positions, in which the three holes coincide with three pencils of the diffraction-spectrum.

Making the experiments on the crossed lines with a narrow beam of light (from a distant flame) in order to see the spectra separated, is somewhat difficult from want of light, by which deep eye-pieces are excluded. All the experiments are much more striking, and make no trouble at all, if you resign to see the spectra and to compare their position with the position of the holes. You will use now a broad beam of light, filling the aperture of the objective. Though the spectra are superposed in this case and though direct rays will pass through all the apertures in every point, the effect must be the same—from the principle of my theory. For every single ray in the broad incident pencil is dispersed, by diffraction, into separated rays distant one from another in a definite angle. The image is formed, in every case, by the interference of those rays, belonging together, i.e. derived from one incident ray; as on those rays only the vibration is in equal phase. Now if, by the diaphragm, some ray is stopped off, or admitted, in one group, the same ray is stopped off, or admitted in every group —provided the apertures are exactly adjusted. You will do best to make the experiments at first in this manner, using a full and strong illumination. All the effects are got by simply turning the diaphragm.

Hoping you will find pleasure in these experiments,

I remain,

Yours sincerely,

(Signed) E. Abbe.

Third Letter.

Jena,
15*th December*, 1876.

Dear Sir,

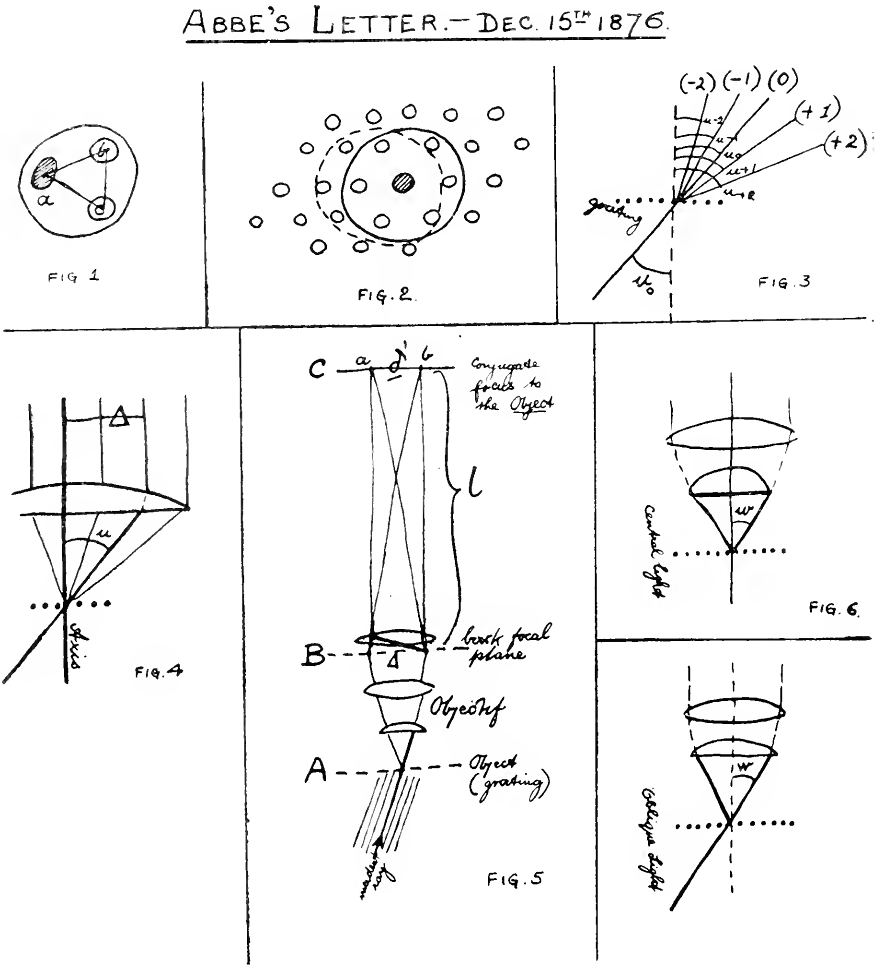
You are too obliging a correspondent, and I am rather ashamed of your praise. For I myself take pleasure in writing about my microscopical interests, to a gentleman whom I know to have a perfect understanding of those things by his mathematical training—since microscopists in general, have no, or little, understanding.

I add a few remarks which, I hope, will remove a difficulty you have found in my explanation, perhaps.

In some passages of my letter I distinguish: the pencil of direct rays and the diffraction-pencils. But this distinction does not mean any principal difference in the function, or action, of these rays. From a general point of view, the pencil of direct rays, transmitted by a lined, or marked object to the microscope, is one among the diffraction pencils: it is different from the others only by its greater intensity of light; but in its action, in the formation of the images of structured objects, it is quite on the same range with the others. (The outlines of any object, it is true, are delineated by the direct rays alone, in bright field; by diffracted rays only in dark field.)

Therefore in the production of the image of *Pleurosigma*, with oblique light, you have at least three active pencils, not two: the direct pencil *a* being the third (fig. 1). The three sets of lines arise from the three combinations: *a, b*; *a, c*; and *b c*—every pair producing one set, rectangular to the connecting line of corresponding points. The image of *P. angulatum*, with straight [direct] light, by an immersion lens, is formed by seven pencils.

As to *Pleurosigma*, whether there are three sets of lines or two, the following will state my opinion.



The diffraction-phenomena, produced by three sets, crossing at 60°, or by two sets, or by isolated apertures of any form, arranged [as in fig. 1*a*], are not different one from another in the first row of spectra around the direct pencil. Those diffraction-phenomena are different only in the more distant spectra, which differ in position and relative brightness.

Now, with *Pleurosigma*, those more distant spectra are not visible by any objective, from the great angular dispersion of the diffracted rays off the incident ray—owing to the smallness of the structure. (Those more distant pencils could be visible only in a medium of considerably higher refractive index than air, or water has.)

The microscopic image, depending on the distance and relative position of the diffraction pencils, which are effective in the microscope, must be the same for all the different structures, named above, as far as the first row of spectra is admitted only; what you see in that case, either on *Pleurosigma* or on the gratings, is the typical image belonging to the inner part of a diffraction-phenomenon of this kind (fig. 2). Therefore nothing can be inferred from the microscopic image of *P. angulatum*, relating to the *detail* of the structure. There may be two sets of lines, or three sets, or isolated apertures in the scale, etc.—in every case the known images will result.

That rhomboidal apertures, as on the grating [with two sets of lines inclined at 60°], look as hexagonal fields, is not surprising, if you consider my theoretical explanation: that the microscopic images result from the interference of the different diffraction-pencils which enter the microscope (the direct pencil there included). From this point of view, the real forms of the structure have no direct relation to the image—only an indirect relation, by determining the diffraction-phenomenon partially.

The microscopic image, which any structure will show, is the more similar to the structure, the more all the diffracted light is admitted to the microscope. The interference of all the diffraction-pencils, which come from the object, produces a copy of the real structure, alike to a dioptrical image. This is the keystone of my theory. From this is to be inferred: the smaller a structure is (the more dispersed therefore the diffraction-pencils) the less similar the microscopic image will be, for any aperture of the objective applied; and those objects as the fine diatoms, give, with any lens, only typical images (not copies of the real forms), because any lens will admit only a few pencils of the diffraction-phenomenon.

I am sorry not to have in my possession one single copy, neither German nor English, of my paper, in which I have stated more precisely, though very briefly, the consequences of this theory touching the interpretation of microscopical images. Perhaps it will be possible to you to lend [borrow ?] the first volume of the Bristol Naturalists' Society's "Proceedings," Part 2, in which you will find Mr. Fripp's translation in extenso; but you should observe the table of "Errata" which Mr. Fripp has given some time afterwards, because many sentences in the translation are quite unintelligible by errata. The abstract which appeared in the M. M. Journal is useless.

I add a few remarks about the mathematical side of the theory, of which I have stated only the point of view in my paper. I think you will quite understand the principle of my mathematical deduction by considering the simplest case—one set of equidistant lines—and observing the following notices :—

(1) Be δ the distance of the lines in a microscopical object; λ the wave length for one definite colour (Fig. 3); be U_0 the angle of incidence, in which a ray meets the grating; U_{-2}, U_{-1}, U_0, U_{+1}, U_{+2}, the angles formed by the several diffracted rays -2, -1, 0, $+1$, $+2$, the direct ray (0) included. The perpendicular line taken as zero-direction ; there is

$$\sin 0_{+2} - \sin U_{+1} = \sin U_{+1} - \sin U_0 = \sin U_0 - \sin U_{-1} = \frac{\lambda}{\delta},$$

in which formula the case of normal incidence is included, of course. If now the diffracted rays enter a microscope, the sines of the angles of any two consecutive rays with the axis of the microscope have the same difference $= \frac{\lambda}{\delta}$.

(2) If an objective is focussed to the grating (Fig. 4), and if this objective is perfectly* aplanatic for its focal point, any ray forming an angle u with the axis below the objective is refracted in such a way, that it will pass the upper (the back) focal-plane of the lens in a linear distance from the axis

$$\Delta = f \sin u$$

if f is the focal-length of the objective (by a theorem enounced by me and by Mr. Helmholtz). From this theorem (2) in connection with (1) is to be inferred : the linear distance of the diffraction-spectra, which appear in the back-focal-plane of the objective, is always $= \frac{\lambda}{\delta} f$, if corresponding points in every two consecutive spectra are considered — independent of the inclination of the incident rays to the grating. If you go from central light to oblique light, all the spectra move within the back-plane of the system, without changing their relative position.

(3) All the rays, which result by diffraction, from one incident ray, have their oscillations in equal phase, if points are compared on these rays which are situated in the back-focal plane, where the spectra are formed as images of the illuminating object : all those rays therefore most interfere within the plane, where they meet—that is the plane, where an image of the grating is formed by the objective (the conjugate focus to the microscopic object).

(4) (Fig. 5). If Δ be the linear distance of the two interfering rays in the back-focal-plane, l the distance of the conjugate focus

* "Perfectly aplanatic" means: without spherical aberration not only for the one point on the axis, but for the points aside the axis too.

to the object (= length of tube of the microscope) the maxima and minima of light, resulting by interference in the plane C, have a distance $\delta^1 = \frac{l\lambda}{\Delta}$. Now if the two rays considered are consecutive rays from a grating with the distance δ, $\Delta = \frac{\lambda f}{\delta}$, therefore $\delta^1 = \delta \frac{l}{f}$—that is the same distance, in which the lines of the grating would appear in a purely dioptrical image, under the same circumstances. λ being eliminated from the expression of δ^1, the intervals in the interference-image must be equal for the different colours; this image must be achromatic, if the objective is achromatic (constant for different colours).

If the two rays considered were not consecutive (as in the experiment with the three-holes-stop), Δ would have double or triple the value taken above; δ^1 would be $\frac{1}{2}$, or $\frac{1}{3}$ . . . . of the distance, which corresponds to the real distance δ in a similar image.

This reasoning shows, that the interference of the diffracted rays can give a similar image of the structure, but not must.

The want of mathematical exactness in the deduction above (in 4) arising from the supposition, l infinitely great in relation to f and Δ, is perfectly removed by considering the dioptrical effect of the microscope in a different manner, which I have stated in No. VI. of my paper (page 213 in Mr. Fripp's translation).

The theses in (1) and (2) involve the determination of the limit of visibility, as deduced from the fact, that two pencils must enter the objective in order to get an image. If w (Fig. 6) be the semi-aperture of any objective, and δ the minimum-distance of visible lines in an object, there is for purely central illumination:

$$\sin w = \frac{\lambda}{\delta}\,;\ \delta = \frac{\lambda}{\sin w}$$

and for the extreme oblique illumination, when the incident ray touches the margin of the lens on the one side (Fig. 7), the next diffracted ray on the other side:

$$2 \sin w = \frac{\lambda}{\delta}\,;\ \delta = \tfrac{1}{2}\,\frac{\lambda}{\sin w}$$

as stated on p. 244 of Mr. Fripp's translation. I hope these remarks will be sufficient to you for getting a clear notion of the mathematical principles of the theory.

I shall be very glad, if you should like to show the experiments to the Microscopical Society—especially if you should think it convenient to produce them not as paradox phenomena but rather as phenomena illustrating a distinct idea of the functions of the microscope. For there is no want of optical curiosities among microscopists; and I take no interest in bringing forth more of such. Please make any use of my explanations you like.

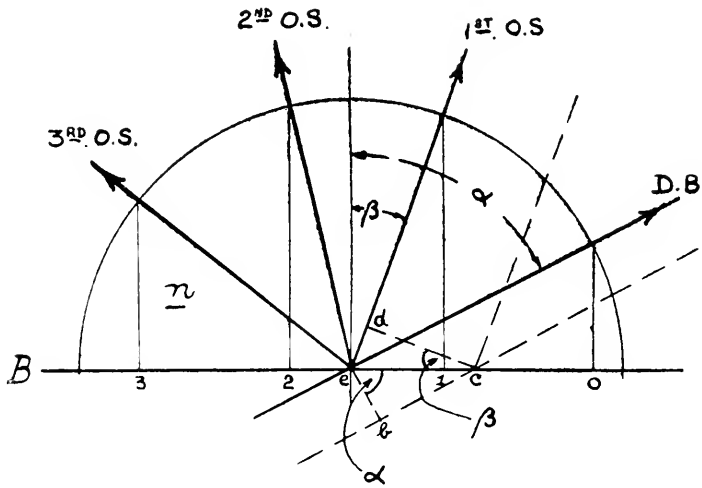
With my best regards, I remain,

Yours truly,

(Signed) E. ABBE.

NOTE BY PROFESSOR CHESHIRE.

By making use of a simple graphical method for determining the angular distribution of the diffracted beams produced by a grating, which I have used for many years, but which, so far as I am aware, has never been published, the proof of the equation for the resolving power of a microscope can be presented in a simple and convincing way. The method is as follows:—



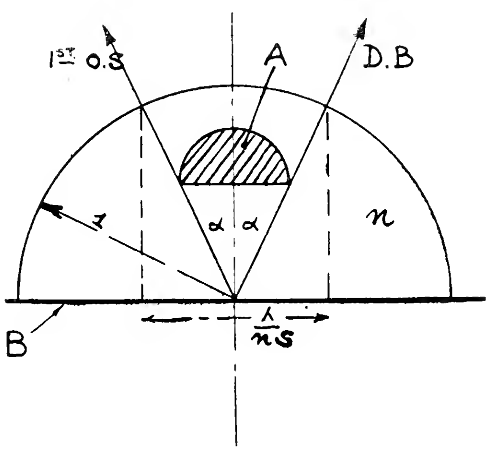
Graphic method of determining the angular dispersion of the diffracted beams produced by a grating.

Let B be a grating, immersed in a medium of refractive index n, upon which homogeneous light falls at an angle of incidence a. With the point of intersection e of the direct ray with the grating as centre, draw a semicircle with radius equal to unity, and from the point of intersection of the direct beam with this semicircle drop a perpendicular, and from the foot of this set off distances 0 1, 0 2, etc., in both directions, if possible, of the diameter equal successively to $\frac{\lambda_0}{n.s}$, $\frac{2\lambda_0}{n.s}$, etc., where λ_0 is equal to the wave-length of the light in air, and s the distance apart of the lines of the grating. Erect from the points thus determined perpendiculars intersecting the semicircle. Lines drawn through these intersections from the centre of the circle give the directions of the first, second, etc., diffracted beam.

Proof.—Draw dotted lines parallel to the incident and first diffracted rays, making the distance $e\,c = s$; then the lines $e\,b$ and $d\,c$, drawn at right angles to the incident and diffracted rays, represent respectively an incident and the corresponding diffracted wave-front, and the retardation (R), which is equal to the wave-length $\frac{\lambda_0}{n}$ for the first order spectrum (and $\frac{m\,\lambda_0}{n}$ for the mth order) is equal to $b\,e - d\,e$. But $b\,c = s\,.\sin a$, and $d\,c = s\,.\sin \beta$, so that $R = \frac{\lambda_0}{n.s} = (\sin a - \sin \beta)$, but $\sin a = 0\,1 + e\,1$, and $\sin \beta = e\,1$,

thus finally
$$0 = \frac{\lambda_0}{n.s}$$
and for the mth order
$$0\,m = \frac{m.\lambda_0}{n.s}. \qquad \text{Q.E.D.}$$

Assuming with Fraunhofer that fine structure cannot be seen unless the diffracted light produced by such structure is utilized for producing the image; and further, assuming with Abbe that



two consecutive beams only are necessary for this purpose—the direct beam and one of the two first diffracted beams, for example—the formula of Abbe connecting the resolving power, say in lines per inch, with the NA is very simply deduced with the aid of the preceding diagram as follows:—

Let us suppose that the objective A takes up a cone of light of semi-apical angle a from a grating B in a medium of refractive index n. Further suppose that the distance between adjacent lines—equal to s—and the direction of the incident light, are such that whilst the direct beam just enters the objective at one end of a diameter, the first diffracted beam similarly enters at the other end of the diameter. Then if a circle be drawn with radius equal to unity and perpendiculars be dropped from the points of intersection of the rays considered, with the circle, then the distance between these two perpendiculars is equal, as shown, to the wave-length of light in the medium divided by the interspace s. Thus if λ_0 is the wave-length in air, then the wave-length in the medium considered will be $\frac{\lambda_0}{n}$, so that the distance in question is equal to $\frac{\lambda_0}{n.s}$.

We have then $$\sin a = \frac{\lambda_0}{2\,n.s}$$

so that $$\frac{1}{s} = \frac{2\,n.\sin a}{\lambda_0}$$

$$= \frac{NA}{\lambda_0/2}$$

that is, the maximum number of lines per inch resolved with an objective of given NA, is equal to that NA divided by half the wave-length in air of the light employed. Thus in the limiting case, when

$$a = 90^\circ\ (\sin a = 1);\ n = 1\cdot5;\ \text{and}\ \lambda_0 = \tfrac{1}{45000}\ \text{inch}$$

$$\frac{1}{s} = 2 \times 1\cdot5 \times 45000 = 135000\ \text{(lines per inch)}$$

In air $n = 1$, so that $\frac{1}{s} = 90000$ (lines per inch).

F. J. C.

A Note by J. Rheinberg, F.R.M.S.

By Professor Cheshire's courtesy I have had an opportunity of perusing the interesting unpublished letters of Abbe to Stephenson —letters most interesting on account of the light they throw upon Abbe's views at the time, and on the many controversies which the Abbe diffraction theory led to.

To rightly appreciate things, we have to try and throw ourselves back to the time these letters were penned. Abbe was thirty-six years old; he had been eight years with Zeiss, and had been working on the bases of his famous theory for the last few years. The diffraction theory, or the theory of secondary imaging as they preferred to call it abroad, which he had evolved, largely as the result of a series of careful and in many ways startling experiments on Gratings, immediately led to the most important theoretical and practical results, and although that theory was frequently challenged, in its foundations and in its chief and main aspects, it has stood the test of time, and may, I think, rightly be termed unassailable.

That, however, is not quite the case with all the deductions that were made from the theory. Abbe himself drew certain incorrect inferences from his own theory, notably that the use ot wide-angled cones of light would not affect the image by yielding a truer rendering of structure than the use of narrow-angled cones would give, and Mr. E. M. Nelson did the greatest service to microscopy by combating this particular opinion, and showing that that was not so. Also in the early days, when Abbe brought out his theory, a number of his partisans, who imperfectly understood the theory, came out with positively fantastic statements—I will only name one, viz.: that since the images were rendered by the diffracted beams, in order to obtain the truest image it would really be best to stop out the central or dioptric beam altogether.

That an idea like this never entered Abbe's mind is clearly shown, for instance, in the passage of his letter read to-day, in which he says:—

> "In some passages of my letter I distinguish the pencil of direct rays and the diffraction pencils, but this distinction does *not* mean any principal difference in the function or action of these rays. From a general point of view, the pencil of direct rays is *one* among the diffraction pencils. It is different from the others only by its greater intensity of light, but in its action in the formation of images of structural objects it is quite on the same range with the others."

At all events, the main point which I think we want to bear in mind is that, owing to false deductions which were prevalent after Abbe brought out his diffraction theory, the theory itself was largely misunderstood, and led to an inordinate amount of opposition and controversy.

What does the theory, looked at in a broad way, amount to? Abbe has shown that the microscope system is equivalent to a telescope with an ordinary simple magnifying lens to parallelize the rays of the object placed in front of it. Abbe then treats the problems of microscope image formatian in two steps; he investigates firstly the nature of the light distribution in the back focal plane of the objective where the spectra produced by reason of the diffractive action of the object on the light source are formed, and secondly, he deduces the image of the object formed in the image plane from this. The diffraction phenomena which he is able to obtain by means of suitable objects, such as gratings in the back focal plane of the objective, are so simple and striking, and the results which follow from this particular mode of analysing image formation are so easily demonstrable and lend themselves to so many experiments, the interpretation of which would have been difficult by other means, that they led immediately, as is known, to far-reaching results. He can, for example, immediately deduce from this the important fact stated in the letter read this evening:—

> "The microscopic image which any structure will show is the *more* similar to the structure the more *all* the diffracted light is admitted to the microscope. *The interference of all the diffraction pencils which come from the object* produces a copy of the real structure alike to a dioptrical image. This is the keystone of my theory."

He goes on to infer from this that the smaller a structure is, the more dispersed therefore the diffracted pencils, the less similar the microscopic image will be, because the objective will admit fewer of these pencils.

There is nothing in this theory which necessarily clashes with any other well-grounded theory of the action of image formation by optical instruments. I refer to the methods of Airey and Rayleigh, for example. Long ago I tried to show that a common basis underlies all the theories of microscopic vision, and Professor Conrady, who has gone into the matter of the Abbe theory deeply, has sufficiently shown in his able papers how it suffices to cover all the results which we obtain by observation, no matter whether we use wide-angled cones of illumination, or narrow-angled cones, or indeed any method of illumination which we please.

It is interesting to note on the subject of wide cones of light that Abbe himself says in one of these letters:—

"But I observe that in all these experiments the different aspects of the object will appear in the same way, if a broader beam of light is applied and the spectra are superposed, provided that the diaphragms, i.e. the holes in them, are exactly conform to the distances of corresponding points in the superposed spectra."

I think we may account for at least some of the difficulties which people have had in following Abbe's theories by the fact that his English was not always of the best, and his critics were not always quite conversant with German. As a little illustration: What ought we to say to the amusing passage in the letter this evening:—

"Since microscopists in general have no, or little, understanding"?

That certainly seems a trifle hard on the poor community of microscopists, but if we turn it back into German* and read it in connexion with the context we find it only means that they have not in general a sufficient grasp of physical and mathematical optics—a complaint which I am afraid we must put up with.

I will only refer to two more passages of interest in the letters to Stephenson. One of them in which he says:—

"The outlines of any object are delineated by the direct rays alone in bright field, by diffracted rays only in dark field,"

is the sort of thing which is liable to give rise to a misconception, which I believe actually took place at the time, viz.: that the image formation of outline and structure of an object was produced by a different species of mechanism of the light-waves. What of course Abbe actually refers to is the fact that in ordinary or bright field illumination, as he calls it, the direct rays to the exclusion of the diffracted rays, *suffice* for the general, if somewhat hazy, outline of an object to be visible. In dark ground (or as he calls it dark field) illumination he points out that the outline of an object is seen by diffracted pencils only; that of course becomes self-evident when we bear in mind that dark ground illumination only arises when the direct or dioptric beam does not enter the objective.

The last point in the letters which I will call attention to is the interesting passage saying he will be glad if Mr. Stephenson showed some of his experiments, not "as paradox phenomena," but as phenomena illustrating a distinct idea of the functions of the microscope, and again where he emphasizes that the scientific

[* The three letters read were written by Abbe in English.—F.J.C.]

interest of all these experiments lies in the experimental proof of what he calls the summit of his theory of microscopical vision, viz.: that *all* microscopical images of fine structures are *not* direct dioptrical images, but secondary images produced by the interference of pencils into which, by diffraction in the structure, the incident beam of light is resolved.

X.—THE TECHNIQUE OF CULTURING AMŒBA PROTEUS.*

By MONICA TAYLOR, S.N.D., D.Sc., and CATHERINE HAYES, S.N.D.

(Communicated by PROFESSOR J. BRONTÉ GATENBY, F.R.M.S.)

(*Read June* 15, 1921.)

THE desirability of placing our experience of four years' successful work in some permanent and easily accessible form has been insistently emphasized by our reception of many letters asking for cultures, or for advice on the method of starting these, and maintaining them under varying conditions. Hence this Note, in which we have also endeavoured to give (in the subdivision, "Some Exigencies and How to Meet Them") a general answer to the questions most commonly asked of us in connexion with the Technique of Culturing *Amœba proteus.*

For convenience of reference we give at the outset, in a somewhat tabular form, the following list of what is required for the cultures:—

Glass vessels, rectangular (about 8 in. by 6 in. by 4 in.) or cylindrical (diameter 8 in., height 4 in.); glass covers for these.

A supply of boiled wheat grains (boiled to kill the embryo, which might otherwise germinate): 22 grains to a litre of liquid is a rough estimate of the amount of wheat required.

A Zeiss binocular microscope, or a dissecting microscope, or a mounted lens.

Boiled rain water, if the tap water is inimical. The cultures thrive best near a window at a temperature of 54° F. to 60° F.

ESTABLISHMENT OF A CULTURE.

With regard to the establishment of a new culture, the quickest method for us, where our cultures have been thriving steadily for years, is, obviously, to sub-divide an already existing one. When despatching such a sub-culture to another laboratory we find that the following instructions have proved of use to the recipient, who in most cases has been successful in establishing permanent supplies:—"Add three or four times its volume of water to the enclosed quantity of the original, and a supply of wheat, this latter to be regulated by the bulk of the culture.

* The species dealt with is *A. proteus* Pallas (Leidy). See Literature List.

"An addition of new wheat should be made every one or two months. There must be an abundance of flagellate, and ciliate life in a thriving amœba culture. This is supported by the decomposing wheat which feeds the countless bacterial and other lowly organisms requisite for its upkeep.

"Other substitutes for wheat can be used successfully, e.g. putrefying organic matter of any description provided it be sufficiently diluted, but the wheat is easy to obtain, and the quantities are easily gauged."

These instructions would be useful similarly to anyone desirous of making laboratory cultures, and who is in the position of having discovered a good yielding source of amœbæ, or who can obtain an initial supply from a dealer. Ordinarily it is a much more lengthy business to establish a luxuriant laboratory culture from natural sources. Indeed the process may occupy a whole year, unless particularly good habitats be discovered, and these are rare, for although *A. proteus* is of almost universal occurrence, it is seldom that the combination of circumstances necessary for the production of a good supply is found in nature. Moreover there are great fluctuations in the yield from well-favoured sources.

Amœbæ are most likely to be found in places where a continuous supply of decaying organic matter is being constantly brought by the currents of water to a more or less sheltered place, provided of course that this is not already over-run by animal rivals of the amœba. In addition to those enumerated below, fish and frog tadpoles are inimical.

A pond containing much organic debris, and not inhabited by amœba enemies, may sometimes yield a good supply—especially of the diatom-eating strain [i.e. *A. proteus* (Penard 1902), *A. dubia* (Schaeffer), *A. proteus* (X. Carter)].

In searching the gatherings the binocular microscope is useful. From the beginning the would-be culturer should accustom himself to surveying rapidly a large quantity of material under the low power, or under a mounted lens, over a dark background, when the amœbæ stand out as irregular whitish specks. Where they are scarce they are likely to be overlooked if sought by means of a higher magnification. The task of discovering the amœbæ is made easier if the material to be examined be placed under a gently dripping tap for a week or more. The device of adding wheat water to a prospective source and allowing the whole to stand for some time is also helpful.

Having then found some specimens the laboratory culture is made by picking out the amœbæ with a fine pipette, and putting them into a test-tube containing one or two wheat grains, and the necessary water. If the specimens are scarce they may be added as they turn up. Other organisms are necessarily carried over in this process; the minute plants and filamentous algæ oxygenate the water. When the test-tube culture is well established, the contents may be transferred to a larger vessel,* but more than one attempt may have to be made before success is obtained. It is unwise, however, to reject as useless any culture started in this way until it has been given a year's trial, as it frequently happens (especially if the inoculation be made in the summer or autumn, when they are most plentiful) that the amœbæ proceed to "encyst," and signs of success may not be evident for six or nine months.

The somewhat tedious method described above, especially if the amœbæ be derived from a variety of sources, results in the formation of a steady culture. *If, in addition, the culture has been reinoculated at different times of the year, the resulting laboratory culture will possess the advantage of yielding continuous supplies throughout the season*, an advantage not possessed by a successful culture derived from one gathering only. Such a culture will be dormant during regularly recurring periods.

Another method of culturing out the amœbæ from a natural source is to collect water-weeds and debris from a likely place, e.g. ditches, slow-running streams, ponds, etc., in autumn, and to store these in a quantity of water during the winter. As the weeds die down they give rise to an abundance of life. Eventually a mass of debris is formed which may yield amœbæ without further treatment, or which, when added to fresh water and wheat, eventually yields sufficient to start a laboratory culture. It is often necessary to sub-culture from this, by the methods already described, to get rid of oligochæte and other pests which are likely to be present also.

Some Exigencies and How to Meet Them.

1. The wheat may be largely used up to produce a too luxuriant algal growth. In this case it is well to start a new culture carrying off as many amœbæ as possible, discarding the algæ.

2. From time to time it is a good plan gently to pour off the top water from a culture and to add fresh aerated water. Where it is safe to use tap water the culture may from time to time be placed under a dripping tap. This revives the amœbæ. Theoretically the green weeds ought to oxygenate the water, but practically, on account no doubt of various metabolic products, the cultures, even when well stocked with green algæ, are wonderfully revived by a change of water.

3. Oscillaria of various species are troublesome. Where they cannot be removed the culture should be frequently well stirred.

4. Hydra, especially *Hydra vulgaris*, is useful in keeping down crustaceans, if they be present.

* See list of things required.

5. Ostracods quickly produce a "desert." When they appear it is time to sub-culture.

6. We have discovered no satisfactory method of keeping down oligochætes except to sub-culture. They are very troublesome.

7. Except under artificial control the amœbæ are scarce and very small during the spring months of the year.

The following Literature List may be of use for reference :—

For a full discussion on the nomenclature of *A. proteus* the reader is referred to—

1. *Note on the Specific and other Characters of A. proteus Pallas (Leidy), A. discoides spec. nov., A. dubis spec. nov.*, by A. A. Schaeffer, Arch. für Protistenkunde, Siebenunddreissigster, Band 1916.

2. *Some Observations on A. proteus*, by L. A Carter, S.N.D., Proc. Royal Phys. Soc., Edin., Vol. XX. Part 4.

Other references to culture methods—

1. *A Method of Obtaining a Supply of Protozoa*, by J. B. Parker, Science, N.S., Vol. XLII. No. 1090, p. 727 (1915).

2. Journ. Exp. Zool., Vol. XXIV, No. 1, by Libbie H. Hyman.

3. Journ. Exp. Zool., Vol. XX, No. 4, by Asa A. Schaeffer.

4. *Supplies of Amœba proteus for Laboratories*, by J. Graham Kerr, Nature, No. 2557, Vol. 102.

5. Proc. Royal Phys. Soc., Edin., Vol. XX, Part 4, by Monica Taylor.

6. *Aquarium Cultures for Biological Teaching*, by Monica Taylor, Nature, No. 2634, Vol. 105, p. 232.

XI.—ON THE PRESENCE OF TWO SPERMATHECÆ IN THE RARE MOLE FLEA (HYSTRICHOPSYLLA TALPÆ), AND THE FLEA AS DISTRIBUTOR OF A TYROGLYPHID.

By F. Martin Duncan, F.R.M.S., F.R.P.S., F.Z.S.

One Plate and Three Text-Figures.

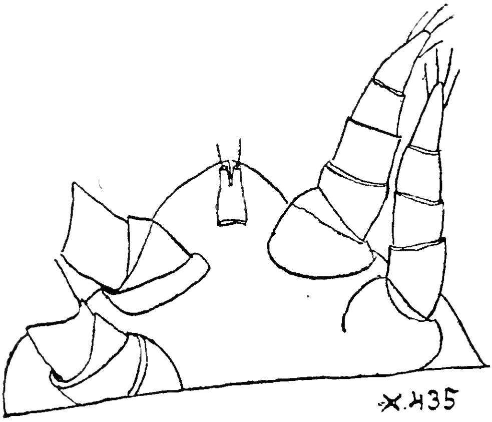
(*Read April* 20, 1921.)

Hystrichopsylla talpæ is one of the largest known fleas. It is found parasitic on the mole, occasionally on field voles, but is by no means a common insect on either host, and presents several points of interest. Externally this flea presents a remarkable appearance, for it has a denser covering of spines and bristles than is found on any other species. The colour of both sexes is a fine chestnut brown, and the males average 3–5 mm. in length, while females attain a length of 5 to nearly 6 mm.

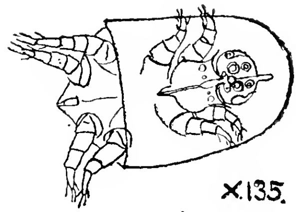
Curtis first described this flea (British Entomology, vii. p. 114) in 1826, from a specimen taken by Dr. Leach in Battersea Fields, and called it *Pulex talpæ*. This specimen, I believe, is still to be seen in the National Collection at the British Museum (Natural History), South Kensington. Ritsema found it in the nests of the bee *Bombus subterraneus*, and described it under the name *Pulex obtusiceps*. As field voles are known to rob the nests of this bee, it is probable that the fleas are carried there by these rodents. Species of *Hystrichopsylla* are recorded from various parts of the world; *H. dippiei* Rothschild having been obtained from British Columbia and Alberta, the hosts being *Putorius longicaudatus* and *Lutreola energumenos*. In Italy and Switzerland *H. narbili* has been recorded as being found on *Microtus nivalis*; while from Rome *H. tripectinata tiraboschi* is recorded as having been found on the common mouse (*Mus musculus*). Lastly, *H. talpæ*, the subject of the present note, is recorded from Great Britain, Sweden, Holland, Germany, Belgium, and France, on the common mole and field vole.

Although the general external characteristics of *Hystrichopsylla talpæ* have been described by several authors, its internal anatomy does not appear to have received the same attention, hence the reason for what must be considered a very remarkable and important feature having apparently been so long overlooked. Some little time ago, a fine female specimen of this flea came into my possession, and on examining it under the microscope with an

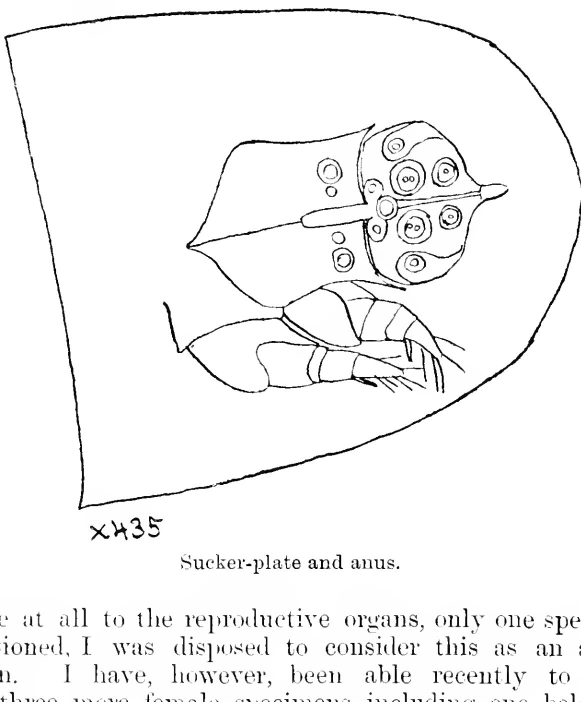
8 mm. objective I was greatly surprised and interested to find that instead of one *Receptaculum seminis*, two were present. As in all the published descriptions of this flea, where there is any



Head, 1st and 2nd legs, from below.

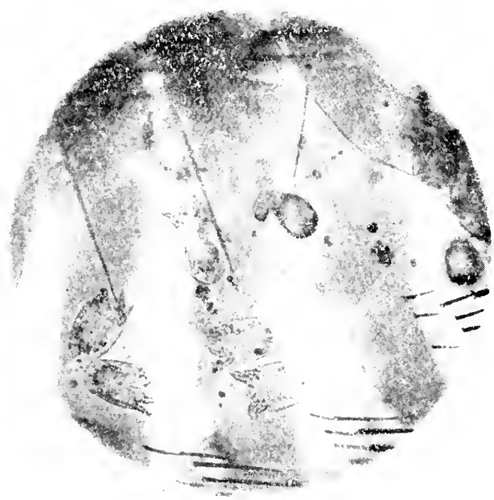


Ventral surface.



Sucker-plate and anus.

reference at all to the reproductive organs, only one spermatheca is mentioned, I was disposed to consider this as an abnormal specimen. I have, however, been able recently to examine two or three more female specimens, including one belonging to



LOWER PART OF ABDOMEN SHOWING THE HYPOPIAL NYMPHS AND SPERMATHECÆ.

HYSTRICHOPSYLLA TALPÆ ♀.

Face p 246

my friend Mr. Bacot, of the Lister Institute, and in all I have found that two spermathecæ were present. As the shape of the spermatheca varies in different species of the Siphonaptera, and has sometimes been used as a point of distinction, it seems curious that the presence of a pair should apparently have escaped notice.

A point of considerable biological interest in connexion with *H. talpæ*, which also seems hitherto unrecorded, is that this flea occasionally acts as host for the hypopial nymphs of one of the *Tyroglyphidæ*. One of my specimens has a number clinging to the abdomen. There are three or four genera of these minute mites which infest bees, and also at least three that are found on the mole. Michael has described the complete life-history of two out of the three found on the mole, but the hypopial nymphs do not resemble those seen on this flea. Indeed, I have been unable to find a figure or description in either Michael or Bank's works that quite resembles these specimens, though I think they are near some of the genera found in the nests of bees, perhaps near *Glycyphagus dispar*.

As the hypopial nymph is the stage in the life-history of the *Tyroglyphidæ* at which they are dispersed abroad, it is probable that *H. talpæ* acts as the natural distributor for this species, for not only has this flea been taken in the nests of bumble bees, as well as upon its regular hosts the mole and field vole, but the vole is a regular visitor to and robber of the bees' nests. The larvæ and ordinary nymphs of these Tyroglyphid mites generally resemble the adult in appearance, but hypopial or travelling nymphs often exist, and these are quite different, having well-developed abdominal suckers by means of which they cling to their temporary host. They cannot be termed true parasites at this stage of their life-history, for they are incapable of absorbing nourishment, the mouth-parts not being fully developed.

J. G. Tatem, in the Monthly Microscopical Journal for 1872, mentions having found a mite on a flea, but does not state if the flea was found on a mammal or a bird, nor does he give any description of the mite, though proposing the name *Acarellus pulicis* for it. His rough drawing is obviously that of the hypopial stage of a Tyroglyphid.

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XII.—NEW HYPOTRICHOUS INFUSORIA FROM CALCUTTA.

By Ekendranath Ghosh, M.D., M.Sc., F.R.M.S., Professor of Biology, Medical College, Calcutta.

(*Read June* 15, 1921.)

Two Text-Figures.

1. *Balladinopsis nuda* g. et sp. n., fig. 1.

The body is rigid and elliptical, somewhat narrow anteriorly, and rounded and wide posteriorly. The dorsal surface is convex. The ventral surface is slightly convex. The peristome is narrow and extends along the entire anterior margin and the anterior one-third of the left side; it then curves inwards nearly to the median line, reaching the junction of the anterior two-thirds and posterior one-

Fig. 1.

third of the body-length. The membranelles are long and numerous: the first five membranelles are stout and gradually increase in length, while the last few gradually decrease in length. The ventral cirri are three in number and are placed in an oblique longitudinal row parallel to and near the right peristomial margin anterior to the middle of the body-length. The anal cirri are long, five in number, and are placed a little in front of and protruding beyond the posterior margin; three on the left side are arranged in an oblique, and two on the right side in a transverse row. The marginal cirri are long, and arise from the ventral surface just inside the lateral margin; those on the right side extend along the entire margin, while those on the left side extend from the middle and stop short of the posterior end. The macronuclei are two and oval in shape, each with a micronucleus; the anterior one is placed anteriorly, while the posterior one is placed just behind the middle of the body. One contractile vacuole is placed in the middle of the body and near the right lateral margin. Lt. 0·063 mm. Br. 0·02 mm.

The animalcules were found in large numbers in vegetable infusion.

The present animalcule undoubtedly belongs to the sub-family Psilotrichinæ, in having a small body and in the great reduction and irregular arrangement in the number of and irregular arrangement of the cirri.

It resembles the two species of *Balladina* Kowalewski, in having a rigid body, in elongated marginal cirri, in the absence of frontal cirri, in the number and arrangement of anal cirri, in the somewhat elongated membranelles, in the number of macro- and micronuclei, and in having a single contractile vacuole. It, howeuer, differs from them, *B. parvula* Kowalewski (Biol. Centralb., Bd. III, 1883), and *B. elongata* Roux (Rev. Suisse Zool., T. VI, 1899), in the absence of a single row of ventral cirri, not differentiated into frontal and abdominal, and extending from near the anterior end of the body to the anal cirri parallel to and at a little distance from the right lateral margin (an important characteristic of the genus *Balladina*), and in the absence of bristles on the dorsal surface.

Aspidiscopsis bengalensis g. et sp. n., fig. 2.

The body is broadly ovate, narrow and tapering to a rounded end in front, and broadly and obliquely subtruncate behind. The right margin is evenly convex. The left margin presents a shallow notch just behind the anterior end, but is uniformly convex behind the notch. The notch is produced into a groove on the ventral aspect. The dorsal surface is convex and presents six or seven longitudinal ribs. The peristome is an obliquely crescentic area occupying the posterio-lateral portion of the ventral surface abutting on the left margin and extending about half its length. There are about eight membranelles in the peristome. The frontal cirri are four in number and are placed just in front of the notch. The abdominal cirri are five in number. Of the first two cirri, one is placed behind the notch and the other further behind and medianwise; the next two are stout and lie side by side; the fifth one is placed behind the last two and on the left side. The anal cirri are five in number. The four cirri on the right are long, stout and are placed side by side; the single one on the left is the smallest of all, and is placed on the right side of the peristome, being separated from others by an interval. The contractile vacuole is posterior. The macronucleus is bandlike, curved like a bow, and is placed obliquely to the left of the median line. Lt. 0·0214 mm. Br. 0·016 mm.

Fig. 2.

Numerous animalcules were observed in the pond water kept in the laboratory for a few days. They were brisk and capable of rapid movements.

The presence of a small peristome at the posterior end of the body and the absence of marginal cirri are sufficient characteristics for referring the present infusorian to the family Aspidiscidæ.

It differs from the only known genus of the family Aspidiscidæ, Ehrbg., in the presence of a row of frontal cirri, well-differentiated from abdominal cirri.

XIII.—A GREGARINE PARASITE OF THE EARTHWORM.

By M. T. Denne, O.B.E., A.Inst.P., F.R.M.S.

(*Read June* 15, 1921.)

I was led to choose *Monocystis agilis* as the subject of this paper because its life-history has not yet been fully worked out, while the further work necessary to complete our knowledge of this form lies not so much in the application of the usual methods of investigation into structure and function, as in the direction of experiments to determine the method of conveyance to new hosts, coupled with the systematic breeding of the worms, and it is hoped that this note will draw attention to the fact and result in the work being taken up,

Monocystis agilis, the spore of which has not been observed outside the sporocyst, first appears as a minute amœboid trophozoite in the seminal vesicles of the worm, embedded in a cell of the sperm elements. In growing it leaves the cell and moves freely in the contents of the vesicle, taking in food material by absorption through its epidermis.

In this stage it consists of an elongated sac with a zone of ectoplasm divided into three layers, the inner being contractile. Its endoplasm is granular, with food material stored in reserve for the reproductive process.

The association of two trophozoites may be abortive, but generally results in spore formation, commencing with encystment of the two individuals. No sexual union occurs at this stage, but the nucleus of each commences to divide, the resultant daughter nuclei being peripherally disposed, until a large number are present, all arranged immediately beneath the surface of the cyst.

As has been observed by Brasil, there is now a small difference observable between the gametes of the two associates, one group being smaller than the other, and containing more darkly staining material.

True sexual unions now take place, and the resultant zygotes gradually assume the form of the mature sporocyst. During this growth the nucleus divides to produce eight elongated spores with extremely fine pointed ends in which the darkly staining elements are collected at one end, leaving the remainder clear, but slightly granular with cytoplasm, very faintly stained. The eight sporozoites are arranged in two groups of four in the cyst, which has meanwhile developed a strong resistant envelope and taken its final shape. The envelope consists of a comparatively thick exterior shell in which is a delicate sac thickened at the ends, loose in the envelope. and containing the sporozoites embedded in granular cytoplasm.

The sporocysts remain in the vesicles during the life of the worm, when they may reach the soil or may be eaten with the host by a bird, but nothing is accurately known as to the subsequent history.

Seminal vesicles were dissected out in normal salt solution, fixed in picro-formol (Bouin), cut in paraffin at 4 μ, stained in iron-alum-hæmatoxylin, Heidenhain, and mounted in Gilson's euparal.

An adaptation of Apathy's chloroform embedding method was used to minimize shrinkage, in which the transference from chloroform to paraffin was very gradual, while the staining bath was prolonged to 7–14 days. It was then found possible to differentiate as usual in iron-alum, leaving the cyst walls nearly colourless, while the contents were darkly stained.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA).

MICROSCOPY, Etc.*

ZOOLOGY.

VERTEBRATA.

a. Embryology, Evolution, Heredity, Reproduction, and Allied Subjects.

Germ-cells of Brook Lamprey. — Peter Okkelberg (*Journ. Morphol.*, 1921, **35**, 1–151, 12 pls., 4 figs.). In the American Brook Lamprey (*Entosphenus wilderi*) the germ-cells are segregated very early in the life of the animal, even before the germinal layers are definitely established. They are first recognizable when the mesoderm separates from the endoderm. The definitive germ-cells take their origin from no other source than the primordial germ-cells, and the germ-cells take no part in the formation of somatic structures. Numerous germ-cells are produced which do not become functional. These degenerate and disappear during the process of development. The germ-cells of each gonad are usually of two kinds, those showing a tendency toward rapid division (katabolic) and those showing a tendency for growth (anabolic). The former are regarded as having a male, the latter a female potentiality. The relative proportion of anabolic and katabolic cells determines whether the larva becomes a male or a female individual. Observations seem to warrant the conclusion that each larva of this species carries the potentiality of both sexes, and that sex, therefore, is not irrevocably fixed at fertilization. J. A. T.

Osmotic Pressure and Egg-membrane in Salmonidæ. — J. Runnström (*Acta Zoologica*, 1920, **1**, 321–36). Unlike the eggs of the

* The Society does not hold itself responsible for the views of the authors of the papers abstracted. 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, etc., which are either new or have not been previously described in this country.

frog, those of *Salmo* and *Osmerus* develop in a physiological salt solution isotonic with the adult animal. Oviducal eggs of *Salmo* have the same osmotic pressure as the blood of the adult. Fertilized eggs have an osmotic pressure only a little lower than that of the oviducal eggs. An isotonic salt solution greatly delays the disorganization of the cell-plasm which occurs in fresh water. A thickening of the egg-membrane occurs after contact with fresh water or distilled water. This does not occur in Ringer's solution. In Ringer's solution the eggs retain for at least three days their capacity of being fertilized. The principal planes of the embryo are pre-determined in the unfertilized egg. The larvæ of *S. salvelinus* are permeable for potassium chloride. The egg-membrane greatly slows the diffusion of electrolytes. J. A. T.

Transplantation of Limbs in Amblystoma.—Ross G. Harrison (*Journ. Exper. Zool.*, 1921, **32**, 1–136, 136 figs.). Experiments with the fore-limb bud of *Amblystoma punctatum*, transplanted in various ways. In various stages of development the transplanted buds grow out in the direction of what was originally the posterior pole of the antero-posterior axis. The asymmetry of the new limb is determined by two factors, the polarization of the antero-posterior axis of the limb-bud, and the orientation of the limb-bud with respect to the dorso-ventral polarization of its organic environment. Duplex and multiplex limbs frequently arise from the transplanted buds. Limbs placed in abnormal places, where the specific blood and nerve supply is lacking, are frequently resorbed or are functionless or imperfectly functional if they do develop. There are some regulative phenomena. The limb-bud is an equipotential system. Except for the circumstance that the dorso-ventral differentiation of the limb-bud is a function of the orientation of the bud with respect to its organic environment, the limb-bud is a highly specific self-differentiating system. Its definitive form must, therefore, be represented in the organic elements (intimate structure) of the limb rudiment. One quality of these elements is their polarization. The transplanted limbs show both regulation of form and functional adaptation, but these do not necessarily go hand in hand. J. A. T.

Influence of Nerve on Taste-cells and Regeneration in Amiurus.—J. M. D. Olmsted (*Journ. Exper. Zool.*, 1920, **31**, 369–401, 4 pls.). The taste buds on the barbels of this fish are composed of one kind of cell, sense-cells, between which lie nerve fibres. The small leucocytes and larger wandering pigment cells included in the buds are different stages of the same phagocytic cell, which is extruded from the surface of the skin when filled with waste material. Within eleven to thirteen days after cutting the branches of the seventh nerve leading to the barbels, the taste buds disappear. They degenerate, are phagocytized, and replaced by indifferent epithelial cells. About the eighteenth day the nerve begins to regenerate at the base of the barbel; the taste buds begin to reappear; by the end of forty days the restoration is complete. New barbels regenerate where old ones are removed, and become fully equipped with taste buds. Barbels whose nerves have been cut do not regenerate. The presence of taste buds in a barbel is dependent on the presence of a normal nerve in the barbel, since the taste buds degenerate and disappear when the nerve degenerates, and reappear when the nerve has regenerated. Likewise, the power of a barbel as a whole to regenerate a missing tip is dependent upon the presence of a normal nerve in that barbel. The theory that certain chemical substances of the nature of hormones are given out by the nerves, and that such substances are necessary to the existence of taste buds and also for the regeneration of the barbel as a whole, accounts for all the phenomena of degeneration and regeneration in the barbel of Amiurus. J. A. T.

Development of Blood-vessels in Amphibia.—TANZO YOSHINAGA (*Acta Scholæ Med. Univ. Imper. Kioto*, 1920, **3**, 401–39, 6 pls., 5 figs.). The endocardium and endothelium and their caudal prolongation (vitello-intestinal veins) are laid down as discrete mesodermic cells of splanchno-pleural origin. The endoderm does not share in forming the heart or vessels. The free cells that form the primordium of the heart and vessels separate simply *in loco* from the splanchno-pleure, which is thereby thinned. The free cells do not wander from their place of origin. At an early stage the vascular system is thus represented by strands of cells. But these do not form indifferent cell-masses, but definitive vascular strands which form the endothelium. The separated-off cells which originate the primordia of heart and vessels should not be called mesenchyme; they arise as an histological differentiation of the mesoderm. J. A. T.

Myotomic Contractions in Dogfish Embryos.—P. WINTREBERT (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1467–70). In aneural embryos of *Scylliorhinus canicula* each of the lateral muscular bands acts independently of the other and of other organs. The amplitude of the movement remains the same for a definite period of growth, but changes of temperature have a marked effect. In a uniform medium warmth accelerates the rapidity of the movements and has still more effect in lessening the duration of the pause. In a variable medium abrupt changes of temperature disorganize the movements. Van't Hoff's law does not seem to apply, not in any case for minute changes of temperature. It is probable that each animal has a specific irritability in relation to warmth, and even different muscles of one and the same animal vary in their reaction. J. A. T.

Exaggeration of Islands of Langerhans in Offspring of Glycosuric Mother.—G. DUBREUIL and — ANDERODIAS (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1490–3, 2 figs.). In a new-born offspring, of abnormally large size, surviving only a few minutes, the islands of Langerhans in the pancreas were twenty to thirty times larger than the normal. This hypertrophy is interpreted as a response to the excessive quantity of sugar in the blood passing from the glycosuric mother through the placenta into the offspring, and causing fœtal hyperglycæmia. J. A. T.

Nerve and Plasmodesma.—H. V. NEAL (*Journ. Comp. Neurology*, 1921, **33**, 65–75, 5 figs.). One of the disputed points in the histogenesis of nerve is whether or not there exists previous to nervous (neurofibrillar) connexion between neural tube and myotome a connexion by means of undifferentiated protoplasmic threads or plasmodesmata. In embryos of *Squalus*, previous to the stage of 4·5 mm., there are no protoplasmic connexions between tube and myotomes. Neurofibrillar substance is present in the primary connexion between tube and myotome. Within the plasmodesmata of Paton and Held may be found in adequately stained Bielschowsky-Paton preparations deeply stained neurofibrils which may be traced to bipolar neuroblasts within the neural tube. The assumption of the Hertwigs, later supported by Paton and Held, that neuromuscular connexions are primarily effected by indifferent cells, and that the "plasmodesmata" thus formed are utilized as "paths" by the growing neuraxones, does not accord with the observed facts. J. A. T.

Influence of Sea-water on Myotomes and Heart of Dogfish Embryos.—P. Wintrebert (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1391–4). Sea-water or any saline solution different from the peri-embryonic fluid (of *Scylliorhinus canicula*) affects the reactions of the embryo, the influence differing according to the presence or absence of lesions in the skin. The musculature is unequally affected, for in aneural embryos with torn ectoderm the heart continues to beat while the myotomes are arrested. At different stages of development the skeletal movements are variably affected; the neuromuscular functioning continues in conditions in which the aneural contraction has stopped. J. A. T.

Heredity of Twin Births.—C. B. Davenport (*Proc. Soc. Exper. Biol. and Med.*, 1920, **17**, 75–7). About 1 p.c. of human births are twin births. But there are certain families in which the proportion rises to 5, 10, or even 15 p.c. There can be little doubt that, as in sheep, so in man, there are strains having a special tendency toward the production of twins. Twinning is due not merely to double ovulation, but upon such a quality of sperm as shall result in a high proportion of fertilization of eggs ovulated and a small proportion of fertilized eggs containing lethal factors. J. A. T.

Carunculi in Uterus of Sheep and Goat.—Ed. Retterer and S. Voronoff (*Comptes Rendus Soc. Biol.*, 1921, **84**, 187–90). If an ovary is grafted into the cavity of the uterus, after removal of the ovaries, carunculi appear. They are of connective tissue origin, they are hypertrophied, they become vesicular, and they disappear with the caduca. Where there is little caduca, as in Ruminants, the cells in question persist and are transformed into connective or epithelial cells. They might be called pulp-cells. A hormone from the engrafted ovary stimulates the formation of an epithelial syncytium in the uterine glands. The deeper portion is transformed into pulp-cells, which persist and take part in the reconstitution of the uterine mucosa. A more superficial portion of the pulp-cells may undergo retrogression and disappear. J. A. T.

Ovarian Grafts in Goats and Sheep.—ED. RETTERER and S. VORONOFF (*Comptes Rendus Soc. Biol.*, 1921, **84**, 104–6). In a goat ovaritomized on each side, one of the ovaries was embedded in the right cornu and the other in the left cornu; in another similar case a half of the ovary of another goat was inserted in the right cornu, and half of one of its own ovaries on the external surface of the uterus at the point of bifurcation. The grafts were wholly absorbed, but the presence of the ovary in the cornu was followed by the development of a maternal placenta. It looks as if the corpus luteum substance influences the placental development of the uterine mucosa, but the peri-follicular elements (interstitial cells, etc.) may also have their rôle in the production of internal secretions. This is consistent with what happened in the authors' experiments, where there was an absorption of all the elements of the implanted ovary. J. A. T.

Placenta of Goat.—ED. RETTERER and S. VORONOFF (*Comptes Rendus Soc. Biol.*, 1921, **84**, 296–8). The elements of the maternal part of the placenta, due to the hyperplasia and hypertrophy of the epithelial cells, constitute a complex into which the chorionic villosities penetrate and which is absorbed in contact with them. J. A. T.

Ovotestis in Hermaphrodite Mammals.—E. BUJARD (*Comptes Rendus Soc. Biol.*, 1921, **84**, 112–4, 114–6). According to the author the mammalian ovary is a gonad with protandrous hermaphroditism more or less latent. The male elements (medullary strands) may atrophy completely as in the cat, or remain rudimentary as in mole and bitch, or become fœtal seminiferous tubules as in pig and man, leading abnormally to an ovotestis. The teratogenic period is that of the formation of the primitive cortical strands, which normally leads to a thoroughly female gonad. The cause of a protandrous differentiation of the medullary strands, leading to an ovotestis, remains obscure.
J. A. T.

Stages in Conjugation.—JEAN MASSART (*Bull. Classe Sciences Acad. Roy. Belgique*, 1921, **7**, 38–53). There are four stages:—(1) the approximation of cells, (2) the union of cytoplasms, (3) the union of nuclei, and (4) the union of chromosomes. In *Coleochæte* and other green algæ the four stages follow in close succession, without any karyokinetic division between. In Metaphytes there is a long interval between (3) and (4); the fused nuclei undergo numerous karyokineses before their chromosomes are coupled. In Basidiomycetes it is the interval between (2) and (3) that is important. In a cell with fused cytoplasm the nuclei remain distinct, and this dualism persists for a long series of divisions. In Infusorians, Schizogregarines, Heliozoa and Diatoms there is a long interval between (3) and (4), but the characteristic feature is that the fourth phase does not occur unless it is prepared for by phase 1. A preliminary cohabitation is necessary if the gametes are to appear. In the Eugregarines there is furthermore a long interval between (1) and (2); they are paired early, but the cytoplasm do not unite till long afterwards. In many female animals a preparatory cohabitation is necessary for the formation of gametes. J. A. T.

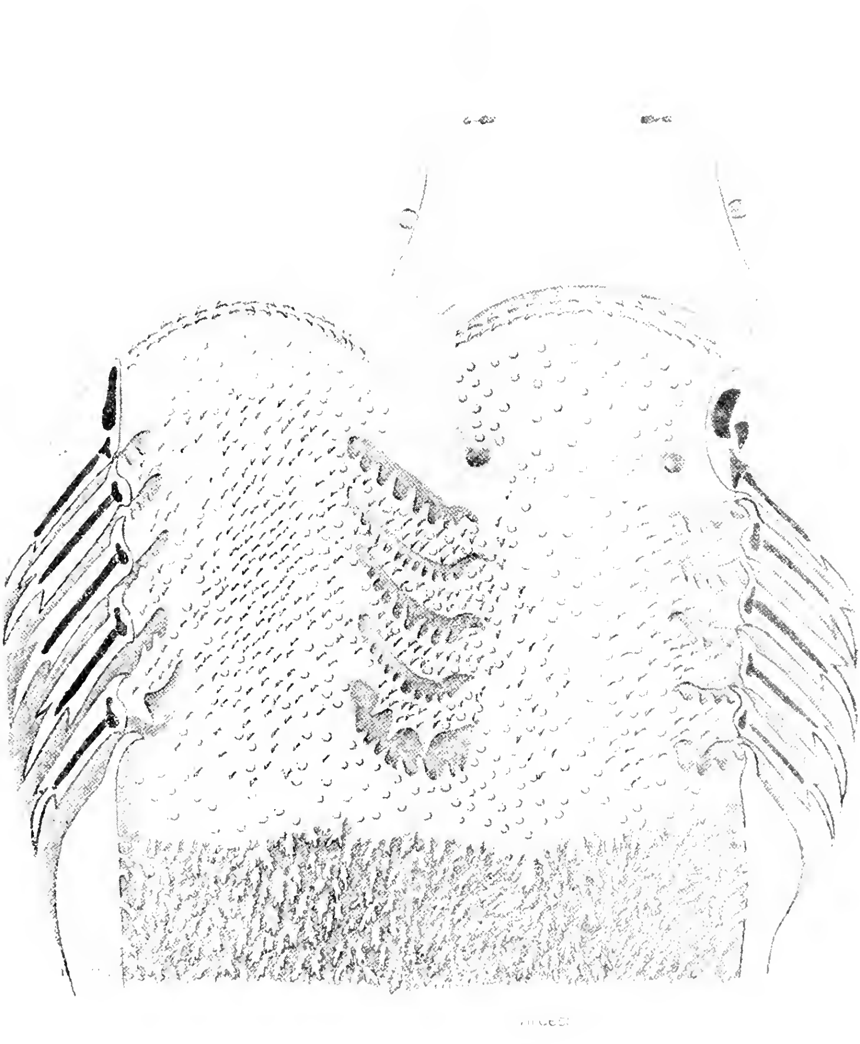
b. Histology.

Taste-buds of Elasmobranchs.—Margaret H. Cook and H. V. Neal (*Journ. Comp. Neurol.*, 1921, **33**. 45–63, 29 figs.). Taste-buds in *Squalus acanthias* are limited to the pharynx, where they are distributed over the floor. the roof, and the gill pouches. Their structure is like that in other forms. They are groups of slender cells slightly raised above the surface into a papilla. Each cell bears, externally, a hair-like process, and is connected internally with a nerve ending. These taste-buds are derived from the endoderm. They develop from the epithelial lining of the pharynx which at all stages shows itself as endodermic. There is no indication at any period of development of a migration inward of the ectoderm, except the slight invagination which forms the dental ridge. The pharyngeal scales arise in late embryonic stages. They resemble placoid scales in structure, but are derived from the endodermic lining of the pharynx. J. A. T.

Periodic Nuclear Division in the Cat.—C. E. Droogleever Fortuyn van Leijden (*Proc. Section of Sciences R. Acad. Amsterdam*, 1917, **19**, 38–44). In explanation of the small number of mitoses usually seen in growing tissues, it has been suggested by Child and by Paterson that this is because amitotic divisions occur. It is here noted, however, that for the mesentery, the outer stratified epithelium of the cornea, and the epithelial cells of Lieberkühn's crypts in newborn cats, a periodicity occurs in the mitotic nuclear division. There is a maximum in the evening, the night, and the early morning hours. There is a minimum in the later morning hours and the early afternoon. The maximum number of karyokineses does not always occur at the same time, but it is never in the daytime. The minimum is always in the middle of the day. If this is a general fact it may explain why in general in growing tissues few karyokineses are seen. For the fixing of tissues is usually effected in the middle of the day. J. A. T.

Striped Muscle of Pulmonary Veins of Rat.—F. Granel (*Comptes Rendus Soc. Biol.*, 1921, **84**, 291–4). Stieda reported the presence of striped muscle of a cardiac nature in the trunk of the pulmonary veins. Granel has studied this in *Mus decumanus*, and finds that in structure and in development it is closely allied to cardiac muscle, of which it is an extension. There is an internal longitudinal or oblique layer, and an external circular layer, both striped. There is a delicate connective lamella between the two layers, and the muscular sheath is rich in vessels and nerves. J. A. T.

Parasomes in Pancreas of Tadpole of Rana temporaria.—R. Hovasse (*Comptes Rendus Soc. Biol.*, 1921, **84**, 190–1). In a tadpole developed parthenogenetically most of the cells of the pancreas showed numerous parasomes, sometimes seven in one cell, either isolated in the cytoplasm or grouped within a larger parasome near the nucleus. Such parasomes have to do with the formation of fats, but there was little fat in the food. The significance of their occurrence in this case is obscure. J. A. T.



The pharynx of an adult spiny dogfish laid open, its floor reflected to the left, showing the distribution of the taste-papillæ and pharyngeal scales.

c. General.

Blood of Marine Animals.—G. Quagliariello (*Publ. Staz. Zool. Napoli*, 1918, **1**, 21–9). With few exceptions the blood of marine animals, both vertebrates and invertebrates, has a slightly alkaline reaction. In Cœlentera (*Alcyonium digitatum*) the fluid in the canals (it seems a pity to call it "blood") has a much higher degree of alkalinity. In Tunicates the reaction is slightly acid. Formulæ are given. J. A. T.

Luminous Animals.—G. Zirpolo (*Rivista Sci. Nat.* "*Natura*," 1919, **10**, 60–72, 6 figs.). Following Pierantoni, the author calls attention to the presence of photogenic symbiotic bacteria in various animals, e.g. *Sepiola intermedia*, *Rondeletia minor* and *Sepia officinalis*. He maintains that the "phosphorescence" of certain animals is due to

Photograph of branched culture of a photogenic bacterium from Sepia (Bacillus sepiæ Zirpolo).

their symbions, rather than to themselves. He has found the bacteria in the luminous organs of some Cephalopods, and he has injected the bacteria into *Carcinus mænas*, causing luminescence for about ten days, into *Sepia officinalis*, causing luminescence for three days, and into star-fishes. J. A. T.

Endolymphatic Sac and Canal in Pigeon.—Georges Portmann (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1488–90, 1 fig.). The endolymphatic sac, the endolymphatic canal, and the sacculus really form one cavity, elongated vertically, with the two ends slightly dilated. The one end is the intra-cranial sac: the other end is the intra-vestibular saccule. The whole is distinctly separate from the adjacent utriculus and cochlear canal, with which they communicate only by short straight canals. The state of affairs is similar to that described by Portmann in guinea-pig, dog, Torpedo and *Myliobatis aquila*. J. A. T.

Endolymphatic Organ of Batrachians.—GEORGES PORTMANN (*Comptes Rendus Soc. Biol.*, 1921, **84**, 133–6, 1 fig.). The endolymphatic organ of frog and toad consists of an intra-cranial sac of considerable size and of a short wide canal connecting the sac with the saccule. Moreover the endolymphatic sac gives origin to a postero-external diverticulum which traverses the cranial wall and comes into intimate contact with the lagena. Contrary to what the author has found to be the case in mammals and birds, the endolymphatic sac of Batrachians is quite surrounded by the arachnoid spaces. As in Selachians, birds and mammals, so in Batrachians: the endolymphatic sac does not communicate with the utriculus except by the intermediation of the sacculus. J. A. T.

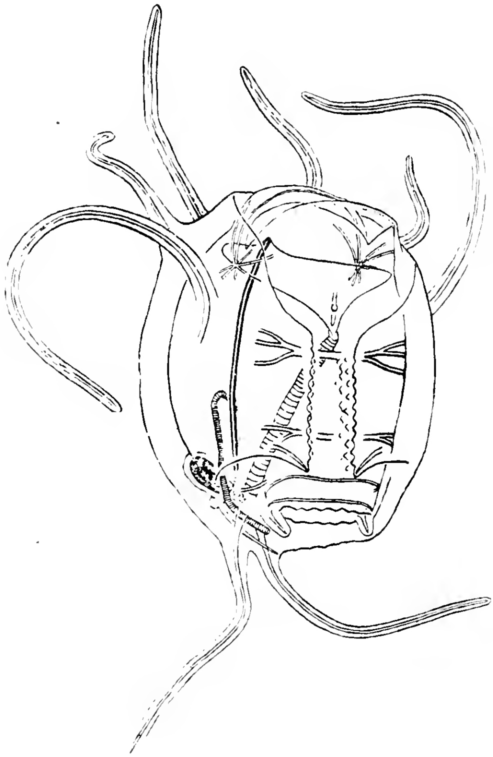
Scales of Twait Shad as Indices of Growth.—LOUIS ROULE (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1542–4). From readings of the markings of the scale of this fish (*Clupea* or *Alosa finta*), it is concluded that there are two annual periods, a period of summer growth and a period of winter arrest. This alternation is marked by the rings on the scales. It is also shown that the males are smaller than the females, and are able to reproduce when two or three years old, whereas the females are reproductive from the third to the fifth year inclusive.
J. A. T.

Study of Yellow Perch.—A. S. PEARSE and HENRIETTA ACHTENBERG (*Bull. Bureau Fisheries Washington*, 1920, **36**, 279–366. 1 pl., 35 figs.) The yellow perch (*Perca flavescens*), studied in Wisconsin lakes, is a versatile feeder, the favourite items being Chironomid larvæ, Cladocera, Corethra and other larvæ, fish, amphipods and debris. There are marked seasonal differences, and in general the favourite foods are eaten in proportion to abundance and availability. An adult perch eats about 7 p.c. of its own weight in a day. Digestion is three times more rapid in summer than in winter. Food varies with age. During youth there is a change from Cyclops and other Entomostraca to Hyalella and insect larvæ. At the end of the first season the food is much like that of the adults. Perch may remain in oxygen-free water for two hours without dying. When in water without oxygen they use part of the oxygen in the swim-bladder. Perch may become sexually mature in two years. Except during the spawning (in shallow water) most of the perch in the large lake remain in deep water. There appears to be an upward movement at night. They usually swim in school and move about. Pickerel and *Lota maculosa* are important enemies. Small lakes have fewer perch mainly because of the shallowness and exposure. J. A. T.

Neuromerism and Metamerism in Dogfish. — P. WINTREBERT (*Comptes Rendus Soc. Biol.*, 1921, **84**, 191–4). The head of the embryo of *Squalus acanthias* shows obvious neuromeres, but it is difficult to correlate these with the metameres of the head. J. A. T.

Tunicata.

A Rare Salp.—Asajiro Oka (*Annot. Zool. Japon.*, 1921, **10**, 1–14, 5 figs.). A description of a fresh specimen of the very rare *Salpa*



Solitary form of *Traustedtia multitentaculata*, seen from above and from the left. × 0·2.

(*Traustedtia*) *multitentaculata* (Quoy et Gaimard). One of its remarkable features is the possession of eight tentacles, which distinguishes it from *T. henseni* with a much larger number. J. A. T.

INVERTEBRATA.

Mollusca.

α. Cephalopoda.

Mediterranean Cephalopods.—Adolf Naef (*Publ. Staz. Zool. Napoli*, 1916, **1**, 11–19). A revised list, including fifty species, all but three found in the Bay of Naples. To Jatta's thirty-eight species, some of which require correction, twelve are added, nine of which are new species. This brings the list up to fifty species. J. A. T.

New Sepiolidæ.—ADOLF NAEF (*Publ. Staz. Zool. Napoli*, 1916, **1**, 1–10, 2 figs.). According to Naef the well-known *Sepiola rondeletii* of the Mediterranean is not a true species at all, but includes a whole series of forms. He establishes a new genus *Rondeletia*, with one species *R. minor* (based on about 8000 specimens), and a new genus *Sepietta*, including *S. obscura* sp. n. (800 specimens), *S. oweniana* Pfeffer (3000 specimens), and *S. neglecta* sp. n. (100 specimens). A satisfactory feature is the abundant material available in most cases. J. A. T.

Posterior Salivary Glands of Cephalopods.—F. BOTAZZI (*Publ. Staz. Zool. Napoli*, 1916, **1**, 59–146, 33 figs.). An elaborate investigation of the secretory activity of these glands, and of the nature of the secretion. A very small quantity added to smooth muscle in Ringer's solution provokes strong contraction, and the author discusses the biochemistry of the effect. J. A. T.

Liver Ferments of Sepia.—AUREL D. CRAIFALEANU (*Publ. Staz. Zool. Napoli*, 1916, **1**, 155–208). A study of the proteolytic ferments of *Sepia officinalis*. They are capable of breaking down its own proteids, during the post-mortem autolysis, by reducing them to soluble compounds. The natural acid reaction of the liver accelerates the proteolysis, but a proteolysis also occurs in alkaline media. The fact is that there are at least two different proteolytic ferments, one active in an acid medium, and the other in an alkaline medium. The proteolysis is more intense in the acid medium. J. A. T.

Luminescent Bacteria in Cephalopods.—UMBERTO PIERANTONI (*Publ. Staz. Zool. Napoli*, 1916, **1**, 105–46, 3 pls., 3 figs.). The accessory nidamental gland consists of variously ramified tubules due to epithelial insinkings and surrounded by vascularized connective tissue. They are not glandular, but they are full of living bacteria. There are three kinds of tubules, red-orange, white and yellow, and in Cephalopods with luminous organs (*Sepiola, Rondeletia*) the yellow tubules are absent from the accessory gland, but appear in the photogenic organ. Development shows that the luminous organ arises as a diverticulum from the accessory gland. The bacteria are handed on along with the ova—hereditary symbiosis. The accessory gland is not nidamental; it may be a culture area for the bacteria. J. A. T.

γ. Gastropoda.

Conditions Affecting Growth in Fresh-water Gastropods.—A. POPOVICI-BAZNOSANU (*Arch. Zool. Expér.*, 1921, **60**, 501–21, 9 figs.).

There are considerable individual differences among young specimens of Lymnæa. Of all the factors influencing growth nutrition is most important. Of all the kinds of food the microflora is most favourable for growth. The volume and the surface area of the water have only an indirect influence through the microflora. The number of individuals present operates indirectly. The presence of excreta is not injurious as Legendre maintained. In some cases it favours growth by favouring the multiplication of the elements of the microflora. J. A. T.

Granular or Basal Cells of Ovotestis of Snail.—LUIGI COGNETTI DE MARTIIS (*Atti R. Acad. Torino*, 1919–20, **55**, 353–60, 2 figs.). These cells are nutritive and phagocytic. The nucleus contains a very large number of minute chromosomes, sometimes twinned or in pairs. The meaning of this pairing is discussed. Attention is also directed to numerous pointed fusiform intra-nuclear bodies, the meaning of which is uncertain. J. A. T.

Double Spermatozoa in Turritella communis.—CH. BATAILLON (*Comptes Rendus Soc. Biol.*, 1921, **84**, 219–22, 10 figs.). The spermatozoa are always in couples, united by a cytoplasmic pellicle around the heads. This coupling is primitive and can be traced right through the spermatogenesis. The cytoplasmic fission remains incomplete. But there are two kinds of couples established in the first spermatocytic division. They differ in the presence or absence of a heterochromosome. They may be regarded as male-producing and female-producing. In *Turritella triplicata*, studied by Schitz, the peculiarities above noted do not occur. J. A. T.

δ. Lamellibranchiata.

Experiments on Ovum of Cumingia.—L. V. HEILBRUNN (*Biol. Bulletin*, 1920, **38**, 317–39). The egg of this bivalve is surrounded by a stiff vitelline membrane which tightly encloses the fluid cytoplasm. A release from the restraint of this membrane is followed by maturation. Such a release can be brought about in three ways—by membrane elevation, by membrane swelling, or by the removal or rupture of the membrane. Substances which themselves have a low surface tension produce a lowered surface tension of the membrane, and this results in its elevation from the egg surface. Acids, alkalies, and certain salt solutions cause the vitelline membrane to swell. The membrane may be removed from the eggs by shaking, or it can be made to rupture by immersion in dilute sea-water. All these treatments produce polar-body formation. All of them free the egg from restraint. Maturation in *Cumingia* is not dependent on an increase in oxidations. Cortical change in *Cumingia* produces no increase in permeability either to dissolved substances or to water. The essential features of cortical change in *Cumingia* are the same as those which have been described in *Arbacia*. J. A. T.

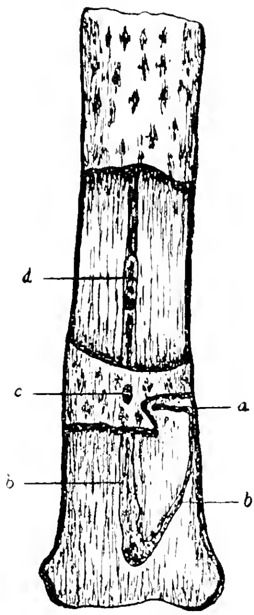
Arthropoda.

α. Insecta.

Wing-design of Mimetic Butterflies.—J. F. van Bemmelen (*Proc. K. Akad. Wetenschappen Amsterdam*, 1920, **23**, 877–86). The interesting suggestion is made that the pattern of mimetic forms belongs to a stock of features characteristic of the genus, the family, or the order. In some cases, and to some degree, mimicry may be explained by supposing the resemblance between two or more non-related forms to have started at an early period, when the ancestral types of different butterfly-families looked more like each other than nowadays, on account of the primitive colour-pattern common to them all. This view is in line with Haase's suggestion: "The mimetic transformation was preceded in most cases by atavistic phenomena from the side of the females, which in the beginning reached back to the patterns of the nearest relatives, but as the process proceeded, passed over to those of more distant forerunners, and in this way procured the material for the mimetic adaptation." J. A. T.

Fat-cells of Insects during Metamorphosis.—Charles Pérez (*Arch. Zool. Expér.*, 1920, **59**, *Notes et Revue*, **1**, 5–10). During the metamorphosis there is no evacuation of urates nor extraction of them by the Malpighian tubules from the blood. At the end, however, when the Malpighian tubules begin again to function there is "une véritable débâcle unique," which results in the rectum being filled with a sort of meconium which the imago gets rid of immediately after hatching. Now the appearance of urates in the lumen of the Malpighian tubes, coinciding with the disappearance of the urates in the fat-cells (pseudo-nuclei of the albuminoid inclusions), suggests that the urates pass from the fat-cells to the blood and thence to the tubules. The cells in question may be regarded as "accumulating kidneys." J. A. T.

Poplar Longhorn.—Walter Ritchie (*Annals Applied Biology*, 1920, **7**, 299–343, 3 pls., 25 figs.). An account of the structure and habits of *Saperda carcharias*, the Large Poplar Longhorn beetle, whose larvæ bore in the stems of poplars. There is considerable difference between the sexes, e.g. in size, colour and tarsal claws. The eggs are laid in the bast or the outer wood, and they resemble closely the surrounding tissues. The larva is a soft, fleshy, legless grub; the shiny-white pupa becomes gradually dark grey. A description is given of the reproductive organs of both sexes. After emerging from the tree the adult beetles feed on the leaves, biting on the surface, never at the margin. The males fly from tree to tree. In both sexes there is stridulation produced by rubbing the hind margin of the pronotum upon the central anterior portion of the prolonged mesonotum. Mating occurs on the twigs and branches. The female selects the site for oviposition with some care. The egg-bites, when newly cut, are very narrow thin lines; they gape afterwards into dark cracks. The galleries of the larvæ show horizontal, vertical, exit and pupal portions. Locomotion is secured through the use of well-developed dorsal and ventral ambulatory ampullæ. By far the greater proportion of the



Typical larval gallery of *Saperda carcharias*.

a, horizontal or initial portion in outer sapwood; *b*, vertical portion in wood; *c*, exit hole; *d*, pupal portion.

wood is passed behind into the gallery and not swallowed. When there are many larvæ there is cannibalism. The larva is parasitized by an Ichneumonid larva. J. A. T.

Variability in Coloration of Elytra.—G. TEODORO (*Bull. Soc. Entomol. Ital.*, 1919, **51**, 44–8). A brief discussion of changes in colouring, distinguishing pigmentary and structural coloration, cuticular and hypodermic colouring, colour due to waste-products and those induced by ferments from the hypodermis. The coloration is influenced by food, illumination, temperature, humidity, climate and sex. Nicolet called attention to the movement of large corpuscles in the blood circulating in the lacunæ of the elytra, and an examination of this is promised. J. A. T.

Spermatogenesis in a Fly.—CHARLES W. METZ and JOSÉ F. NONIDEZ (*Journ. Exper. Zool.*, 1921, **32**, 165–85, 2 pls.). The spermatogonial chromosomes in *Asilus sericeus* are ten, in five pairs. The sex chromosomes have not been identified. In the last spermatogonial anaphase, as in preceding anaphases, the chromosomes go to the poles associated in pairs. The paired association becomes more intimate in telophase, giving rise to bivalent chromosomes in haploid number. A brief diffuse stage (stage *a*) ensues in which the chromatin stains only slightly. Then the double chromosomes reappear, apparently in the same form and relative position as before, and condense into bivalent prochromosome-like bodies (stage *b*). The ordinary leptotene condition appears to be omitted entirely. The bivalent bodies of stage *b* elongate into diplotene threads that remain relatively condensed and clearly separate throughout the entire growth period, giving rise to the bivalent prophase chromosomes. In another species, *A. notatus*, the process appears to be essentially the same, but is somewhat confused by a spinning out and intertwining of the threads in the stage following stage *b*. The usual synaptic process is entirely wanting in *Asilus*. Synapsis is effected in telophase at the beginning of the growth period by an intimate association of chromosomes that were already paired in anaphase. Superficially the early growth stages resemble those of Hemiptera and other forms, but the chromatic structures are bivalent instead of univalent. Tetrad structures are not visible. The first division appears to be reductional for all the chromosomes. J. A. T.

Simulium Larva from Mountain Stream in Java.—A. L. J. Sunier (*Natuurkund. Tijdschr. Nederland-Indie*, 1919, **78**, 26–44, 2 pls.; and *ibid.*, 1920, **79**, 205–20, 1 pl., 1 fig.). In a mountain current of the Gunung Pangerango, in Java, at a level of about 1000 metres, numerous larvæ of a species of *Simulium* were found clinging to a submerged stone or moving against the current. There are hooked clinging-organs anteriorly and posteriorly, and threads of silk issue from the mouth. The anterior fan-like structures act as strainers which catch microscopic particles, which are brushed by the mouth-parts into the buccal cavity. The gut contained fine vegetable detritus, diatoms, a piece of the ectocyst of a Bryozoon colony, and minute remains of some small Arthropod.

The larva presses its head against the substratum, secretes a silk-loop, and fixes to this its anterior clinging-organ. The posterior clinging-organ grips about the same place, and then the anterior one lets go. The newly-produced silk is colourless and transparent. The clinging-organs are anchored exclusively to the silk-loops. In letting loose its grip the posterior clinging-organ is invaginated. During this process the rectal gills are completely retracted. They are protruded again after the re-anchoring of the posterior clinging-organ. Then the anterior organ is loosened and the body stretched forward. By alternately fixing its gripping organs the larva can move against a very strong current. The elaborate cocoon of netted silk-threads is described.
J. A. T.

Mutations in Drosophila.—H. J. Müller (*Journ. Exper. Zool.*, 1920, **31**, 443–73, 3 figs.). Discussion of three new mutations of the gene W in the X chromosome of *Drosophila melanogaster*. They have given rise respectively to: (*a*) Écru, causing the eyes to be of a light straw colour, not much darker than white: (*b*) ivory, causing a light yellow eye colour, only slightly darker than écru; and (*c*) white producing a colour identical with the original "white." Écru appeared in a single male, so that it is likely that the mutation occurred in a late oogonial cell, oocyte, or egg of the mother. Ivory appeared in nine out of one hundred and forty-one male off-spring of a single female, and must have occurred in an early stem cell of the ovaries of the mother. The new white appeared in a single male, which had one eye red and one white; this mutation therefore occurred at a stage corresponding to early cleavage. There is no evidence that mutations are more likely to occur in gametes or germ-cells near the period of maturation than in cells at any other stage in the life-cycle. The fact that mosaic mutants involving recessive sex-linked genes are always males indicates that mutations occur in only one member of a pair of chromosomes at a time. The event which produces the mutation is, therefore, exceedingly localized. The mutations of W are not quantitative variations of the whole gene. J. A. T.

Saccharomycete in Dipterous Larva.—D. KEILIN (*Parasitology*, 1920, **12**, 83–91, 3 figs.). The cavity of the body of a dipterous larva (*Dasyhelea obscura*), which usually lives in the thick brown sap filling the infected wounds of elm or horse-chestnut trees, was found filled with a Saccharomycete, *Monosporella unicuspidata* g. et sp. n. It is a budding, yeast-like fungus, each cell a potential ascus, producing one acicular spore. Metchnikoff's *Monospora bicuspidata* from *Daphnia magna* should be referred to this new genus, and there seem to be other species elsewhere, e.g. in *Tylenchus* as reported by Bütschli. The dipterous larva, though filled with *Monosporella*, is still able to move, but it finally dies and decomposes rapidly, thus setting free the resistant forms of the parasite. J. A. T.

Observations on Larvæ of Corethra punctipennis.—CHANCEY JUDAY (*Biol. Bulletin*, 1921, **40**, 271–86). The number of these larvæ in the bottom population in the deeper portions of Lake Mendota at Madison, Wisconsin, is 18,000–30,000 per square metre. The eggs, laid in the morning, sink to the bottom; they hatched in the laboratory in 48 hours; the adults emerge at night. The young larvæ migrate into the upper water at night as the full-grown ones do; they remain in the lower water, instead of the mud, in the daytime. The full-grown larvæ spend the daytime in the mud. This may be a protection from some fishes, as also is the disappearance of dissolved oxygen in the hypolimnion. The live weight produced is about 300 kilograms per hectare, and the dry weight about 25 kilograms. The deep-water area of the lake will produce 1,318 metric tons of living larvæ, or 110 metric tons of dry material. Crude protein and fat constituted more than 76 p.c. of the dry material. This gives these *Corethra* larvæ a very high rank as a source of food for other organisms. J. A. T.

New African Gall-midges.—E. P. FELT (*Annals Natal Museum*, 1920, **4**, 491–6). The gall-midge fauna of Africa is exceedingly interesting and peculiar, but it is safe to state that only a very small proportion of that fauna has come to the attention of entomologists. An account is given of two new species of *Xenhormomyia* g. n., probably related to *Hormomyia*, perhaps a connecting link between Asphondylariæ and Honididinariæ. It is marked by distinctly constricted flagellate antennal segments of the male, the numerous low-looped circumfila and the presumably narrowly oval lobes of the ovipositor. Another new genus is *Heterobremia*, a peculiar type easily distinguished from *Homobremia* by the two widely separated linear processes extending from the posterior lateral angles of the ventral plate and reaching to the tip of the style. The genitalia are very complex, and there are also marked structural peculiarities in the antennæ. J. A. T.

Antennæ of Termites.—CLAUDE FULLER (*Annals Natal Museum*, 1920, **4**, 235–95, 1 pl., 14 figs.). An account of the post-embryonic development of the antennæ in numerous termites. All are fundamentally composed of a two-jointed scape supporting a flagellum of a variable number of joints. In a developing antenna the flagellum shows an apical, an intermediate, and a basal zone, the last zone being formative. The internal metamorphosis is ordinarily in evidence inside the "conventional" joint which composes the basal piece. This joint (III) is a capsule enclosing a series of joint elements. The final number of joints in the antenna is due to the abjunction of many or few new joints in an aerogenous manner from joint III. The details of this are described. Soldiers tend to have fewer joints than their corresponding workers; the smaller castes of a species tend to have fewer joints than the larger: and the smaller species fewer than the larger. Variability in the jointing of the antenna is traceable to (1) a newer tendency to be few-jointed; (2) a fusion of joint elements; (3) nutrition (the well-fed individual having more joints); and (4) a probable correlation between the growth of the antenna and the development or degeneration of the gonads in unfertile castes. The jointing cannot be utilized for taxonomic purposes without thorough investigation of the community.
J. A. T.

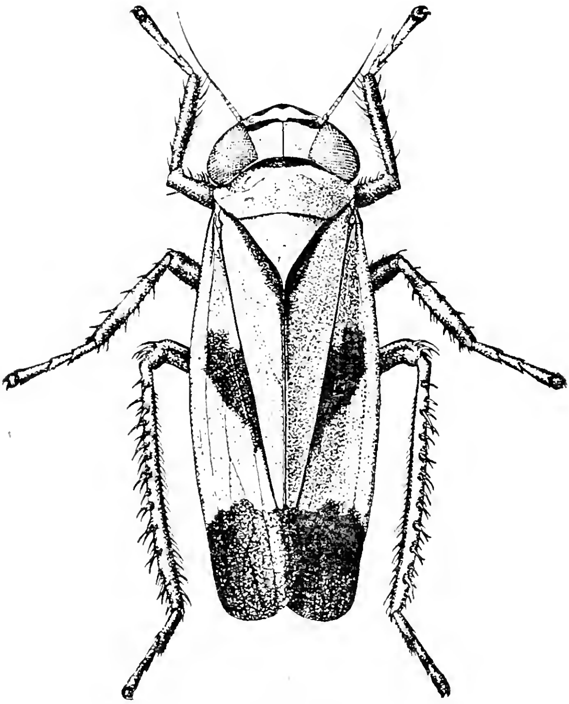
Parasites of Blow-flies.—A. M. ALSTON (*Proc. Zool. Soc.*, 1920, 195–243, 20 figs.). The Braconid *Alysia manducator* oviposits in the larvæ of several carrion-feeding Diptera; one parasite emerges from each host puparium; over-parasitism kills the larva: the mean duration of the life-cycle was 52 days; both sexes fly; the average contents of the ovaries was 366 eggs for 12 females. The Chalcid *Nasonia brevicornis* oviposits in the puparia of several species of stercoral and carrion feeding larvæ; from 1–62 were found in parasitized puparia; the life-cycle ranges from 11–22½ days; only the female can fly; the male remains near the vicinity of emergence, where its life is spent in fighting and mating: the average progeny was 133 per female. The Chalcid can act as an accidental secondary parasite on *Alysia*, if and when puparia containing the latter are within its limited reach. Both parasites in their hibernating stage, as full-grown larvæ, can successfully withstand over 6 weeks at 2° C. It appears that *Alysia manducator* is the more important as a natural control of the blow-fly; *Nasonia brevicornis* is more effective as a natural control of species which constantly breed in permanent refuse and garbage heaps, such as the house-fly.
J. A. T.

Blastophaga psenes of the Fig.—G. GRANDI (*Boll. Lab. Zool., Scuola Agric. Portici.*, 1920, **14**, 63–204, 31 figs.). A detailed description of the structure of this Chalcid insect concerned in the caprification of the fig. Both sexes are dealt with and the ova, larvæ and pupæ. An account is given of the behaviour of the insects, the sex-relations, the life-history, and the year's life. J. A. T.

Tracheal Air in Dragon-fly Larvæ.—HANS WALLENGREN (*Lunds Universitets Arsskrift*, 1915, **11**, No. 5, 1–12). In larval dragon-flies (*Aeschna*), breathing normally, the oxygen-content of the tracheal air is always lower, and the CO_2-content the same as or a little higher than that of the respiratory water. There is no reason to postulate any special cellular activity. Diffusion explains adequately what takes place. The composition of the tracheal air is directly dependent on that of the surrounding water, but has a lower O-content. From the tracheal gills the oxygen diffuses into the large dorsal and ventral tracheæ. By the breathing movements, the body-movements, and the contractions of the wall of the respiratory gut, as well as by diffusion, the oxygen passes into the finer tracheal branches and is absorbed by the blood, the tissue fluid, and the cells themselves. The CO_2 given off by the cells passes into the tissue fluid and the blood, but passes only to a slight extent into the tracheal system. It diffuses from the blood into the water through the body-wall, the tracheal gills, and the wall of the respiratory gut. When the oxygen of the water sinks 2·5 c.cm. per litre, and the larvæ are in respiratory difficulties, they ascend to the surface, where they take in oxygen to a degree far above that in the ordinary tracheal air in sub-aquatic conditions. When it is about 12 p.c. higher than the sub-aquatic normal the insects descend again. J. A. T.

Larva of Rhinocypha ignipennis.—F. C. FRASER (*Mem. Dep. Agric. India*, 1920, **7**, 13–4, 1 pl.). A single specimen of the larva of a dragon-fly common in the rivulets about Shillong. The legs are of great length, slim and spidery, adapted for clinging to weeds or roots. The larva has no caudal gills, and it is not likely that they were lost. Both *Rhinocypha* and *Micromerus* are thus apparently purely proctobranchiate: the caudal gills being only rudimentary in the latter. It is not known where the young insects hide themselves, for every conceivable place was searched and only one was found. The larva is interesting systematically in confirming the view that the Libellaginæ should form a distinct sub-family. J. A. T.

Rice Leaf-hoppers.—C. S. MISRA (*Mem. Dept. Agric. India*, 1920, **5**, 207–39, 4 pls., 9 figs.). These pests, *Nephotettix bipunctatus* and *N. apicalis*, recently did great damage in the Central Provinces, blighting the rice-fields. Prior to 1913 nothing was known of them as agriculturally important. Till then they were known as the "greenflies" of cities like Calcutta, where they swarm in thousands around the electric lamps in the streets as well as the bare lights in houses. They illustrate insects which are considered harmless for a time, but suddenly come into prominence, do considerable damage and wane again. After winter is over, the hoppers breed in succulent grasses, whence they move to the rice seedlings. They are small greenish insects which jump from plant to plant and suck the juices. The young ones do not fly so actively and are not attracted to light. The

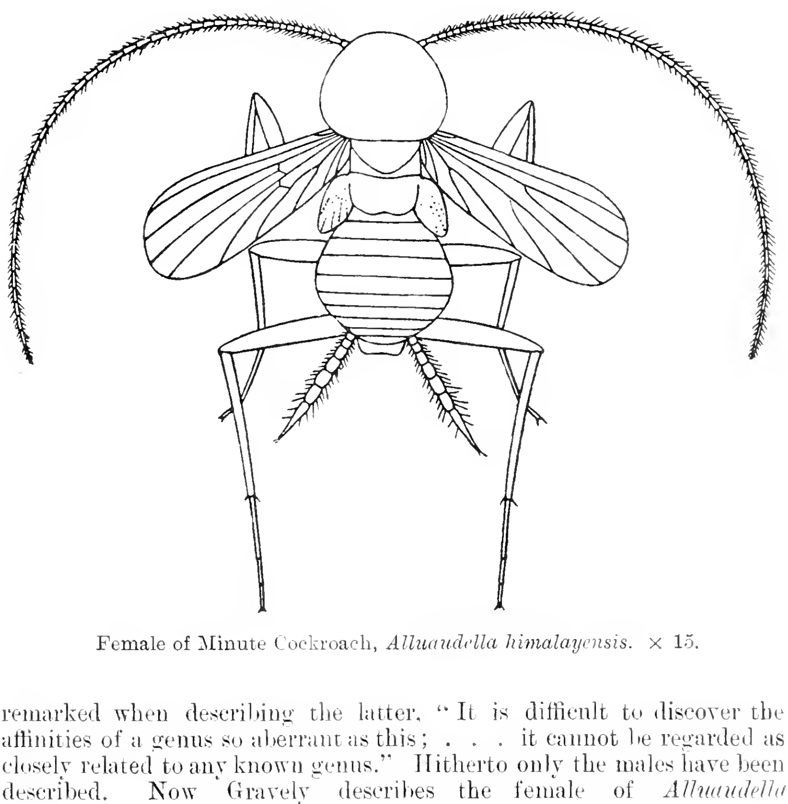


Rice Leaf-hopper, *Nephotettix apicalis*. Enlarged 24 times.

yellowish eggs are laid in a line at the bases of sheathing leaves. They are parasitized by a small pale yellow Chalcid, and turn black. The pests may be counteracted by clean cultivation and by grazing cattle in the grassy tracts. Bagging with cloth bags internally moistened with kerosene is effective, and likewise kerosene spraying. The adults may be caught in large numbers by light-traps. J. A. T.

Water-content and Metabolism in Grasshoppers.—J. H. Bodine (*Journ. Exper. Zool.*, 1921, **32**, 137–64, 6 figs.). The percentage of water a grasshopper contains decreases with age and increasing body-weight, down to a minimum for the species. During the life-cycle of *Chortophaga viridifasciata* the water-content falls to a minimum during "hibernation," rises again to a maximum when this is broken up, and falls to a minimum again as the animal grows old. These changes seem to be due to the effects of temperature and advancing age. Water and temperature are the controlling factors (in *Chortophaga*) in the emergence from "hibernation." Starvation results in losses of body-weight, water and solids, the greatest relative loss being water. When water only is supplied the losses are lower than with nothing. Larger individuals tend to lose relatively greater amounts during starvation. Lighter and younger animals have the higher rates of CO_2 output, and the possible relation of a surface law holding for grasshoppers is indicated. Higher temperatures cause increased rates of CO_2 output, and lower temperatures seem to have the reverse effect. Starvation decreases the rate of CO_2 output; feeding starved individuals increases it again. A noteworthy point is that when exposed to low temperatures the insects respond by a decrease in water-content and are thus prevented from freezing and possible destruction. J. A. T.

Female of Cockroach Alluaudella.—F. H. Gravely (*Records Indian Museum*, 1920, **19**, 17–18, 1 fig.). The genera *Alluaudella* and *Cardax* contain minute cockroaches of such unusual forms that Shelford



Female of Minute Cockroach, *Alluaudella himalayensis*. × 15.

remarked when describing the latter, "It is difficult to discover the affinities of a genus so aberrant as this; . . . it cannot be regarded as closely related to any known genus." Hitherto only the males have been described. Now Gravely describes the female of *Alluaudella himalayensis*, from about 3,500 feet in the Darjiling District. Its tegmina are small and its wings vestigial, so that it is obviously incapable of flight. But the tegmina presumably function as a protection to the body, for they are sufficiently developed to show that the venation is practically identical with that of the male. The total length is 2·5 mm.; the colour dull yellowish. J. A. T.

Prothoracic Endoskeleton of Mole-cricket.—P. Carpentier (*Bull. Classe des Sciences, Acad. Roy. Belgique*, 1921, **7**, 125–34). A careful description of the prothoracic endoskeleton of this burrowing insect. Although it is extraordinarily specialized it is not aberrant. The space between the right and left pleural lamellæ is much reduced by the new formation of another space between each lamella and the reflected external margin of the notum. This interpleural space contains the relatively feeble muscles which draw the limb inwards; the extrapleural space contains the enormous muscle which forces the limb outwards in burrowing. The other peculiarities are interpreted as adaptive to the underground habits. J. A. T.

Jura Protura.—E. Handschin (*Mt. Schweiz. Entomol. Ges.*, 1920, **13**, 81–7). A description of *Acerentulus tiarneus* Berl., which Berlese found in 1910 in the Trentino at a height of 1500 m., and *Eosentomon ribagai* Berl., which Berlese found in 1909 in the same place. Both were found by Handschin in moss from Jouxtal in the Jura, and their special interest is in their geographical distribution, for the record links together previously reported habitats. J. A. T.

β. Onychophora.

Salivary Glands of Opisthopatus cinctipes.—O. Duboscq (*Arch. Zool. Expér.*, 1920, **59**, *Notes et Revue*, No. 3, 67–74, 4 figs.). In the adult the glands have the structure of a differentiated nephridium, showing a cœlomic vesicle, a funnel, a descending portion with mucous cells, and an ascending portion with ferment-cells. These two portions are united by a common canal, forming a deep branch. The secretion of the ferment-cells is like that of a mammary gland. The same is true of the mucous cells, but the secretion is less active and the "decapitation" of the secretion is less brusque. At the level of the common canal there are blood-corpuscles along with the mucous and albuminoid secretions, and these corpuscles have doubtless some diastatic rôle. In lactation there are leucocytes mixed with the mammary secretion, especially in the colostrum. J. A. T.

Papillæ and Ventral Cerebral Organ in Onychophora.—O. Duboscq (*Arch. Zool. Expér.*, 1920, **59**, *Notes et Revue*, No. 2, 21–7, 6 figs.). The primordium of a tactile corpuscle in embryos of *Opisthopatus cinctipes* consists of a little group of epithelial nuclei. Above this the cuticle thickens into a disc, which becomes concave, and then button-like. This becomes a tube with an axial perforation. The nuclei at the base multiply and form a group of twenty or so at the base of the cuticular projection. Below the brain there are two vesicles, each with an intermediate ganglionic region. There is no hint of sensory or glandular function. In the adult, as in the embryo, the

Section of a ventral cerebral organ in *Opisthopatus cinctipes*.

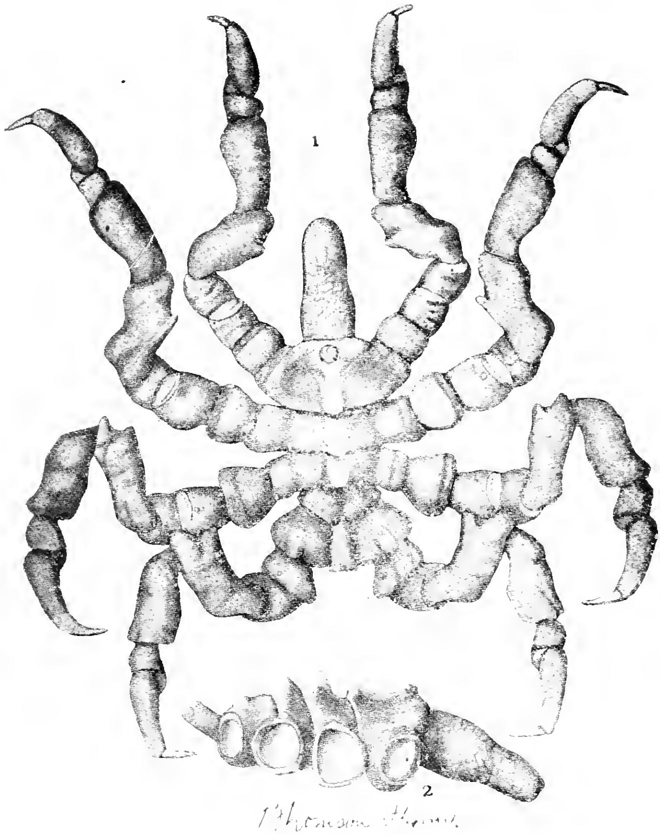
C, the brain; *c*, peripheral layer of fusiform cells with hyperchromatic nucleus; *g*, intermediate ganglion; *n*, group of young nerve-cells with hyperchromatic nucleus.

ventral organ produces nerve-cells or neuroglial cells, which are perhaps contributed to the brain above. J. A. T.

γ. Arachnida.

New Australian Pycnogonids.—T. Thomson Flynn (*Papers and Proc. R. Soc. Tasmania*, 1919, 91–100, 2 pls.). Descriptions of *Pycnogonum aurilineatum* sp. n. from S.E. Tasmania, somewhat closely allied to *P. gaini* from the Antarctic, and of the very minute *Ammothea australiensis* sp. n. from Shark Island, New South Wales, referable to the group containing *A. striata* and *A. glacialis*. Its over-all length is

4·28 mm., of which 1·12 mm. goes to the trunk; it is the smallest known member of the genus. Appearances point to the Southern Polar



Pycnogonum aurilineatum sp. n.
1. Dorsal view of the entire animal.
2. View of right side with legs removed.

Regions being the headquarters of the genus *Ammothea*, from which various species may have radiated northwards. J. A. T.

Movements of Heart and of Breathing in Spiders.—V. Willem (*Proc. Sect. Science R. Acad. Amsterdam*, 1917, **19**, 162–7, 2 figs.). A spider (*Epeira*) fastened by the thorax shows an oscillatory movement of the abdomen and of the palps. The posterior point of the abdomen moves upward and downward with a rhythm of 130 movements a minute. This is due to (1) the tension of the curved aorta under increased internal pressure; and (2) the increased curve of the pericardium during the systole of the heart when the pressure of the blood in the pericardial cavity decreases. The contraction of the heart in *Pholcus phalangiodes* was seen to be connected with a diminution of pressure in the pericardial cavity and in the pulmonary vein. thus influencing the lungs. The circulation of blood in the lungs is a passive consequence of the systole of the heart. The blood-pressure of the peripulmonary lacuna, which always exceeds the atmospheric pressure, keeps the air-cavities of the lungs and the cuticular portions of the lamellæ and of the vestibule compressed. Changes in the pressure due to palpitations of the heart cause the air-cavities to become alternately smaller and larger. The elasticity of the cuticular portions of the lamellæ is the intermediate factor in the movements of air in the lungs. In special cases the movements of the muscles of the body may help.

J. A. T.

New Pycnogonid.—T. Thomson Flynn (*Papers and Proc. R. Soc. Tasmania*, 1919, 11–15, 1 pl.). Description of a male specimen of *Halosoma haswelli* sp. n., found among the mussels on Shark Island, New South Wales. The genus differs from *Anoplodactylus* in the particularly small size, the crowded nature of the crurigers (hollow processes of the body wall to which the ambulatory legs are attached), the tendency of the trunk segments towards coalescence, the feeble development of the neck, the particular arrangement of the spines on the legs, and the structure of the tarsus and propodus. J. A. T.

δ. Crustacea.

Double-walled Sensory Setæ in Oxyrhyncha.—R. Issel (*Publ. Staz. Zool. Napoli*, 1918, **2**, 147–58, 1 pl.). A study of sensory setæ with an outer and an inner cuticular support, united by trabeculæ. In *Acanthonyx lunulatus*, *Pisa*, *Herbstia* and *Lissa* the detailed architecture is described. It may be that osmotic variations influencing the outer layer affect the internal wall and the contained nerve through the intermediation of the trabeculæ. The structures are peculiar to Oxyrhyncha. J. A. T.

Crustacea and Pantopods of Öresund.—W. Björck (*Lunds Univ. Arsskrift*, 1915, **11**, No. 7, 1–98, 1 map). A description of the Malacostraca and Pantopods from this area. The whole fauna is a *Macoma*-community. The littoral forms are almost without exception present in at least the west part of the Baltic, several extending far into that area. The sub-littoral forms inhabit the deeper parts (20–50 m.) of the Sound, and consist of forms which seldom (and as a rule only in solitary specimens) are met with in the west part of the Baltic. The species *Diastylis rathkii* and *Michtheimysis mixta*, which occur abundantly, are exceptions to this statement. The sub-littoral fauna inhabits for the most part the clay bottom, and may be classified as a *Haploops*-community. The composition of the fauna lends no support to the hypothesis, advanced by Lönnberg, of the persistence of an Arctic character in the fauna of the Öresund. J. A. T.

Crayfishes and Amphibolites.—Jean Couégnas (*Arch. Zool. Expér.*, 1920, **59**, *Notes et Revue*, No. 1, 11–13). In Limousin, a granitic region with little chalk, crayfishes are of rare and very local occurrence, e.g. near Sussac. It is interesting to find that the occurrence of crayfish in this region coincides very exactly with the occurrence of amphibolites, which include 13–23 p.c. of chalk.

J. A. T.

Terrestrial Isopods of Natal.—W. E. COLLINGE (*Annals Natal Museum*, 1920, **4**. 471–90, 6 pls.). Descriptions of new species of *Ligia*, *Alloniscus* and *Cubaris*, and the establishment of a new genus *Anchicubaris*, separated from *Cubaris* on account of the form of the pleural plates of the mesosome and the greatly produced anterior margin of the cephalon. J. A. T.

Parcorophium excavatum in Brisbane River.—CHAS. CHILTON (*Mem. Queensland Museum*, 1920, **7**, 44–51, 19 figs.). A note on the occurrence of this New Zealand Amphipod in the Brisbane River, Australia. A description is given. The genus, of which this is the only species, comes close to *Corophium*, but the mandible has the palp well-developed and three-jointed; the second gnathopod of the male is markedly different from that of the female; in both sexes the second gnathopod has the merus produced into a scoop-like process different from that in *Corophium*: the third uropods are two-branched. J. A. T.

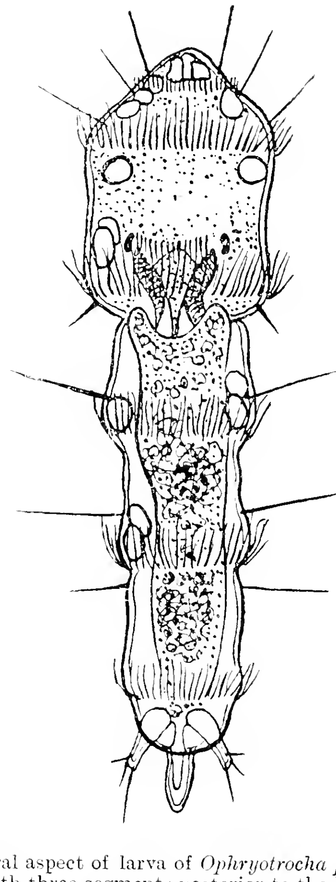
Genetics of a Daphnia Hybrid during Parthenogenesis.—W. E. AGAR (*Journal of Genetics*, 1920, **10**, 303–30, 3 figs.). On the hypothesis, now supported by a mass of indirect evidence, that segregation of hereditary factors is due to the segregation of homologous chromosomes in meiosis, it is clear that there should be no such segregation in parthenogenetic reproduction unaccompanied by reduction of the chromosomes. A hybrid clone, derived from a cross between *Daphnia obtusa* and *D. pulex*, was bred for ten generations. Throughout this period the hybrid clone was characterized by excessive production of males and sexual eggs, complete sterility of the males, partial sterility of the parthenogenetic eggs, and probably normal fertility of the sexual eggs. The ten parthenogenetic generations of this clone furnished no evidence of the occurrence of segregation. This experiment is complementary to Agar's former experiments on inheritance in parthenogenesis in the Cladoceran *Simocephalus*, and indicates that during the parthenogenetic reproduction of these forms, which is not accompanied by reduction of chromosomes, Mendelian segregation does not take place, nor does genetic diversity between parent and offspring normally arise. J. A. T.

Swedish Silurian Cirripedia.—J. C. MOBERG (*Lunds Universitets Arsskrift*, 1915, **11**, No. 1, 1–20, 2 pls., 2 figs.). Descriptions of some new forms, e.g. *Lepidocoleus suecicus* sp. n., and *Plumulites dalecarlicus* sp. n., and a discussion of primitive Cirripedia. J. A. T.

Annulata.

Ciliated Crown of Trochosphere of Protula meilhaci. — A. SOULIER (*Arch. Zool. Expér.*, 1920, **59**, *Notes et Revue*, No. 1, 1–4, 4 figs.). The ciliated crown is traced back to a girdle of sixteen cells, exclusively derived from the four trochoblasts that appear at the equator of the blastoderm. The four cells known as intermediary do not share in forming the ciliated crown. J. A. T.

Larva of Ophryotrocha puerilis.—A. D. PEACOCK (*Report Dove Marine Laboratory, Cullercoats*, 1920, **9**, 95–96, 3 figs.). Notes on larvæ with one to six segments behind the head. The larva moves forward and rotates on its long axis. The eyes by reflected sunlight



Ventral aspect of larva of *Ophryotrocha puerilis*, with three segments posterior to the head.

are red. The cilia of the anterior and posterior bands are strong, coarse and long, but those of the middle band and those in the regions of the mouth, anus and posterior segment are much finer. The incipient stages of parapodia and cirri were noticed. J. A. T.

Regeneration in Earthworm.—H. R. Hunt (*Bull. Mus. Comp. Zool. Harvard*, 1919, **62**, 571–81, 1 pl.). Following the excision of the anterior part of the nerve cord and digestive tube from a beheaded earthworm, these parts may regenerate, restoring the normal structure. The regeneration of the alimentary canal and nerve cord is independent of mechanical stimuli or support provided by either the cicatrix or the regenerating body wall at the anterior end of the worm. What may have been an abortive attempt to regenerate a head on the dorsal side of the body was observed in worms from which the anterior regions of both nerve cord and digestive tube had been removed. The development of a stomodæum is not contingent upon the presence of brain and connectives. The following structures can regenerate independently of any mechanical stimulation or support furnished by the digestive tube —stomodæum, connectives and brain, and a region of segmented body wall containing longitudinal and circular muscles. J. A. T.

Genera of Enchytræidæ.—Paul S. Welch (*Trans. Amer. Micro. Soc.*, 1920, **39**, 25–50). A revision of the sixteen genera (with approximately three hundred and twenty-five species) of this family. A diagnosis is given of each, followed by a discussion. Particular attention is paid to the penial bulb, which seems to be of much value in classification. A useful key for identification is given. J. A. T.

Limnatis nilotica in Seistan and Afghan-Baluch Desert.—N. Annandale and Amin-ud-Din (*Records Indian Museum*, 1920, **18**, 135–6). A record of this leech on the borders and even within the boundaries of the Indian Empire. Many were observed at Robat close to the point at which the Afghan, Baluch and Persian frontiers meet, and a specimen was got within the district of Seistan, on the tongue of a horse. It agreed in all essentials with specimens from Palestine. Dr. Annandale and Dr. Kemp saw a member of an Indian labour corps carefully skimming water from the top of a spring at Makki in Western Baluchistan. When asked why he did so, the man replied that he was afraid of leeches. This recalls the story of Gideon, separating men who lifted water in their hands from those who drank like dogs.
J. A. T.

Bryozoa.

New Japanese Bryozoa.—Yaichirô Okada (*Annot. Zool. Japon.*, 1921, **10**, 19–32, 7 figs.). Illustrated descriptions of the following new species:—*Flustra stolonifera*, with curious antler-like spines: *Euthryoides simplex*, with a thin bilaminar zoarium: *Carbasea sagamiensis*, with unilaminar zoarium, hexagonal zoœcia, and with rib like processes on the lower margin of the oœcia; *Brettia ijimai*, the oœcia of which are the first to be described for the genus. J. A. T.

Nematohelminthes.

Sclerostomes of Donkey.—Charles D. Boulenger (*Parasitology*, 1920, **12**, 27–32, 5 figs.). Nine species of Nematodes were obtained from donkeys in Zanzibar and East Africa, including (1) *Strongylus asini* sp. n., in some respects intermediate between *S. equinus* and

S. edentatus; and (2) *Cylicostomum adersi* sp. n., presenting much the same appearance as *C. insigne*. J. A. T.

Development of Strongylacantha glycirhiza. — L. G. Seurat (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1172–4). The ovum of this Nematode, a parasite of the small intestine of *Rhinolophus*, is elliptical, opaque, rich in yolk. It divides into a large clear anterior blastomere (initial somatic) and a much smaller posterior blastomere, opaque, and with much yolk (the primordial sex-cell). The latter divides into a meso-endodermic-stomodæal cell and a primordial sex-cell. The larva is remarkable in showing three distinct cuticles, a buccal cavity without trace of the adult hooks, an excretory pore far from its final anterior position, and a genital primordium of four cells. It does not feed: it moults twice; it becomes encysted; and in this state it passes from the foul soil of the grotto into the definitive bat host. The intestine remains very embryonic, consisting of two rows of very large cells with a narrow central space between. J. A. T.

Revision of Gnathostomidæ. — H. A. Baylis and Clayton Lane (*Proc. Zool. Soc.*, 1920, 245–310, 8 pls., 40 figs.). The chief characteristic of this family of Nematodes is the possession of a pair of large, fleshy, trilobed, lateral lips. Each lip is provided externally with three papillæ, while internally its cuticle is thickened and frequently raised into tooth-like prominences in the form of longitudinal ridges, which either meet or interlock with those of the other lip. The œsophagus is of a simple club-shaped type. There are two cervical papillæ, usually not prominent, in both sexes, and the tail of the female is provided with a pair of small lateral papillæ. The male has more or less well-developed caudal alæ and two spicules, usually ornamented. Most species are found in the anterior part of the alimentary canal, with a tendency to burrow. One genus (*Gnathostoma*) has been found as a rare, and probably abnormal, parasite of man, its habitat being the subcutaneous connective tissue. The genera of the sub-families Gnathostominæ and Spiroxyinæ are dealt with in detail. J. A. T.

Platyhelminthes.

Studies on Bilharziasis. — Philip Manson-Bahr and N. Hamilton Fairley (*Parasitology*, 1920, 33–71, 3 pls., 3 figs.). A discussion of the differences in structure and life-history between the two species of Egyptian Schistosomidæ — *Schistosomum hæmatobium* and *S. mansoni*. The former has terminal spined ova which are deposited in both urine and fæces. The ciliated miracidium hatched out in the water must find the correct species of *Bullinus* in thirty-six hours. It pierces the soft parts, probably in the pulmonary chamber, and reaches the digestive gland and the gonads. It becomes a morula, which is hollowed out into an elongated finger-like sporocyst. This gives rise, by internal budding of "germ balls," to cercariæ; and there may also be exogenous budding resulting in secondary cysts. When mature, the cercariæ are ejected into water, and in the subsequent twenty-four hours must find their way into their definitive host, usually man. After invading the tissues, either viâ the skin or the upper alimentary tract, they make their way to the portal veins, where they become adult males and females. In *S. mansoni* the lateral-spined ova are excreted mainly in the fæces, less commonly in the urine as well. The life-cycle is as before, but the intermediate host is a species of *Planorbis*. In internal structure the two species are markedly different, as is shown in detail. Wherever *Planorbis* is the common snail there will be rectal Bilharziasis; wherever *Bullinus* abounds the urinary form of the disease will be most prevalent. The prophylactic measures are destroying the ova in the excreta, destroying the molluscs, and purifying the contaminated water supplies. J. A. T.

Diagnosis of Parasites in Man.—ROBERT W. HEGNER and WILLIAM W. CORT (*Waverly Press, Baltimore*, 1921, 1–72, 8 pls.). The authors have prepared a very useful bulletin of the common Protozoa and Worms parasitic in man. It is compact and clear, and should be a great boon to students, as well as to physicians and public health workers. Rarities are of course left out, but all the very important forms are dealt with in a way that should admit of identification. The figures are careful and effective. We venture to suggest that subsequent editions should include the most important ecto-parasites. J. A. T.

Distome Larvæ in Gut-wall of Dytiscus marginalis.—A. CH. HOLLANDE (*Arch. Zool. Expér.*, 1920, **59**, 543–63, 12 figs.). The presence of numerous larval distomes does not seem very hurtful. The excretory tubules seem able to get rid of the toxins. There are many multiplying cells in the Malpighian tubes. The adipose cells are not much altered, but some show hypertrophied and budding nuclei. Around the encysted parasites considerable tissue changes are seen. There is a thick mantle of phagocytes; some peri-intestinal muscle fibres partly surround the cyst; a membrane is formed around the cyst, and is probably due to the peritoneum. The surrounding of the cysts, especially the phagocytic layer, may be regarded as arresting or neutralizing the parasite's toxins. J. A. T.

Revision of Indian Species of Phyllobothrium.—T. SOUTHWELL and B. PRASHAD (*Records Indian Museum*, 1920, **19**, 1–7, 1 pl.). Most members of this genus infest fishes, but one has been reported from a snake, one from the dolphin, and one from Sowerby's whale. The bothridia are sessile, very mobile, with puckered edges. A noteworthy point is the presence of supplemental discs on the bothridia of some species. The authors revise five Indian species. J. A. T.

Echinoderma.

Rare Anomaly in Astropecten aurantiacus.—G. ZIRPOLO (*Publ. Staz. Zool. Napoli*, 1918, **1**, 31–58, 3 pls. 10 figs.). Four specimens with four arms, instead of the normal five. The occurrence of four appears to be due to the loss of one arm with a considerable part of the disc, for in this case the missing arm is not regenerated. A process of cicatrization occurs. In the area of lesion the plates that are formed repeat the size and symmetry of the plates found at the corresponding place in the normal arm. The lost pyloric cæca are not regenerated; a cicatrization occurs. The inter-radial space is much reduced: the Polian vesicle is absent; the gonads are reduced in number. J. A. T.

Hermaphroditism in Viviparous Ophiuroids.—TH. MORTENSEN (*Acta Zoologica*, 1920, **1**, 1–18, 1 pl.). No fewer than sixteen out of the twenty species known to be viviparous are hermaphrodite. As hermaphroditism is otherwise unknown among non-viviparous Ophiuroids there must be some direct relation. In *Ophiacantha vivipara*, *Ophiomitrella clavigera* and *Amphiura borealis* the hermaphroditism is protandrous. In *Ophiomyxa vivipara*, *Ophiacantha imago* and *Ophiotjalfa vivipara* the sexes are separate. Self-fertilization appears to be possible in most of the hermaphrodites. It is striking that of the three viviparous species of *Ophiacantha*, one has separate sexes, another is a protandrous hermaphrodite, and a third is a true hermaphrodite. The problem is left unsolved. J. A. T.

Cœlentera.

Movements and Luminescence in Renilla.—G. H. PARKER (*Journ. Exper. Zool.*, 1920, **31**, 475–515, 1 pl., 12 figs.) Renilla shows two forms of peristalsis: peduncular, with waves running distally over the peduncle: and rachidial, with waves running in the opposite direction over both peduncle and rachis. Peduncular peristalsis is primarily concerned with sinking the peduncle into the sand and thus anchoring the animal. It is also the means of bringing about a complete withdrawal of the animal under the sand and of a certain amount of locomotion. It is secondarily concerned with the distribution of fluid within the animal during distention. Rachidial peristalsis raises Renilla out of the sand and distributes the fluids contained within its body. It is not concerned with effective locomotion. In the activities of Renilla the zoöid as a unit is dominated by the colony.

Renilla is naturally highly phosphorescent at night but not by day. At night the phosphorescence can be reduced by exposing it to light, and by day the phosphorescence can be developed by putting the animal in the dark. Renilla is excited to phosphorescence only by stimulation, particularly by mechanical or electrical stimuli. Concentric waves emanate from the spot stimulated. The impulses are temporarily interrupted by magnesium sulphate. Phosphorescence is limited to the upper surface of the rachis, and is produced by masses of whitish material that surround the siphonozoöids and the bases of the autozoöids. Peristalsis consists of muscular waves whose rhythm is probably myogenic in origin. Phosphorescence, the withdrawal of autozoöids, and general contractions are called forth by impulses, often wave-like in character, and probably neurogenic in origin. J. A. T.

Ciliary Movements in Beroë.—G. F. GÖTHLIN (*Journ. Exper. Zool.*, 1920, **31**, 403–41). In *Beroë cucumis* there occur conditions when all the swimming plates are inhibited in their movements, beat more slowly, or remain stationary in a position of rest, without any muscular retraction of the meridian rows. These conditions of primary inhibition can be produced by mechanical, chemical and electrical stimuli. Certain nerve poisons (chloral hydrate and atropin) abolish the primary inhibitory effect of a galvanic current. There are "formations" which serve as cilio-inhibitory nerves, and these are paralysed by the poisons. The primary cilio-inhibitory mechanism probably consists of receptors at the surface of the body, which transfer their impulses to a set of nerves, which transmit them to end apparatuses inhibiting the vibrations of the swimming plates, probably by blocking the neuroid conduction between them. The mechanism for primary inhibition also functions in specimens from which the statolith apparatus has been removed. There is an intimate connexion between primary and secondary (i.e. muscular) inhibitory mechanism in *Beroë*. It is probable that they both use the same receptors, but the primary mechanism can be caused to function by impulses of a weaker intensity.

J. A. T.

Two Japanese Ctenophores.—TAKU KOMAI (*Annot. Zool. Japon.*, 1921, **10**, 15–18, 2 figs.). Descriptions of *Lampetia pancerina* Chun and *Beroë ramosa* sp. n. The latter may be distinguished from its near ally *Beroë ovata* by the presence of much more numerous side-branches to the meridional and pharyngeal canals. J. A. T.

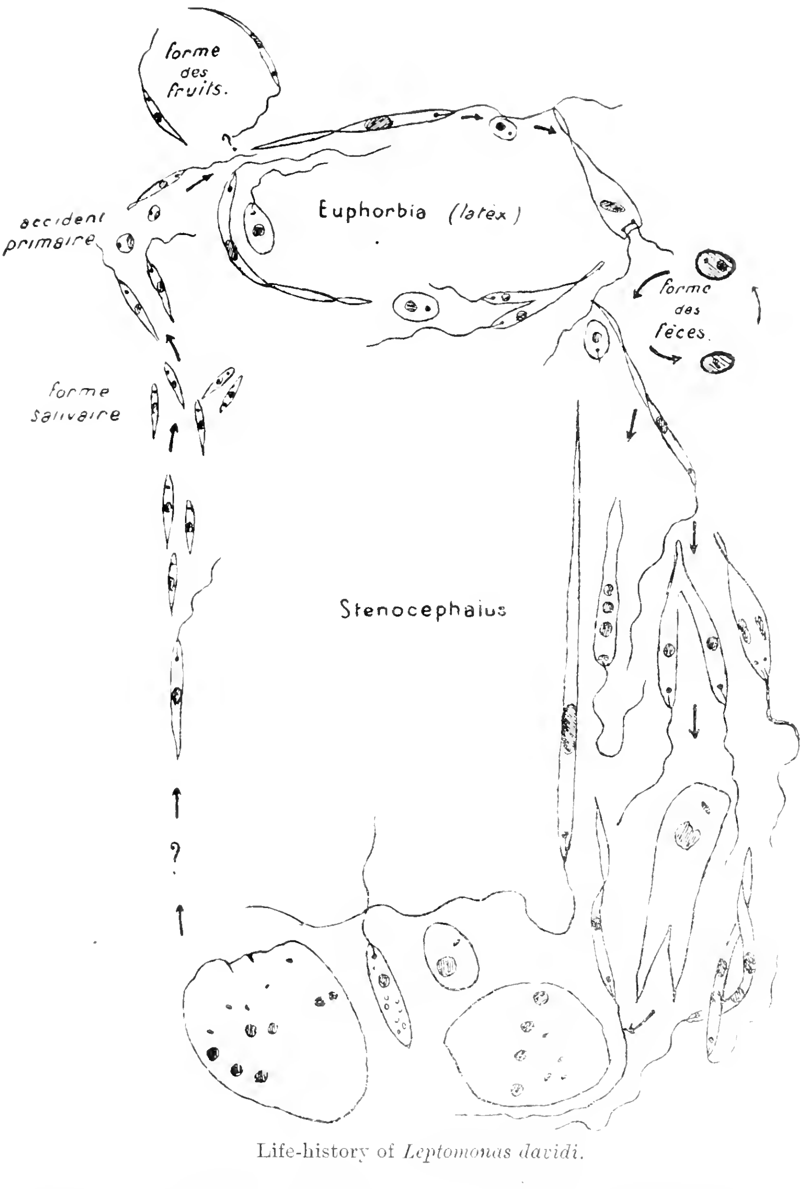
New Species of Sertularella.—ARMAND BILLARD (*Arch. Zool. Exper.*, 1920, **59**. *Notes et Revue*, **1**, 14–6, 1 fig.). A description of *S. singularis* sp. n. from the Siboga collection. It differs from all other members of the genus in the irregularity exhibited in the disposition of the hydrothecæ, showing that much stress cannot be laid on this character. In the same colony and on the same branch there are alternate, opposite, and verticillate (three or four) arrangements. The form of the margin and the nature of the operculum must be looked to as more important than the arrangement of the hydrothecæ. In *Sertularella* the hydrothecæ are usually alternate, save in *S. tamarisca*, where they are opposite. J. A. T.

Silurian Graptolites from Bornholm.—ASSAR HADDING (*Lunds Universitets Arsskrift*, 1915, **11**, No. 4, 1–40, 4 pls., 4 figs.). Descriptions of species of *Diplograptus*, *Climacograptus*, *Dicellograptus*, *Corynoides* and other genera, along with some new Brachiopods and Molluscs, from *Dicellograptus* beds at Bornholm. J. A. T.

Protozoa.

Flagellate Parasite of Euphorbias. — C. FRANÇA (*Ann. Inst. Pasteur*, 1920, **34**, 432–65, 2 pls., 2 figs.). In the latex of various species of *Euphorbia*, e.g. *E. peplus* and *E. segetalis*, there lives a Flagellate, *Leptomonas davidi*, discovered by David, first studied by Lafont. It is usually an elongated narrow form, twisted posteriorly twice or thrice on its axis, with an elliptical nucleus and a spherical karyosome, with a spherical blepharoplast bearing a delicate flagellum. It divides longitudinally in the latex, and a new flagellum is formed for one half. The nucleus and blepharoplast show in dividing the process known as panmitosis or monopanmitosis. In the alimentary system of

Invertebrates three genera of Flagellates occur—*Leptomonas*, *Herpetomonas*, and *Crithidia*, with pre-flagellate, flagellate, and post-flagellate



Life-history of *Leptomonas davidi*.

phases. The differences between the three genera are discussed. In Portugal the vehicle of *Leptomonas davidi* is a Hemipteron, *Stenocephalus* *agilis*, which feeds on the latex of the spurge, especially *Euphorbia helioscopica*. In the food-canal there is longitudinal division of the *Leptomonas* and isogamous conjugation. Curious giant forms occur, but their meaning is obscure. Very minute forms pass from the mesenteron into the salivary glands, where they form big masses. Encysted forms also occur in the rectum and the fæces. The Hemipteron is the primitive host and the life-history may be complete. Several different forms, besides the narrow elongated type, occur in the latex and fruit of the infected spurge. J. A. T.

Movements of Vorticella.—FAURÉ-FREMIET (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1382). The myoneme is extremely long in proportion to its diameter; the thickening on contraction is minimal. The stalk cannot be compared to a flagellum, though in the planktonic *Vorticella mayeri* it functions like a giant flagellum. In electrical excitability the stalk corresponds to that of rapid muscles in Invertebrates. The coiling of the stalk differs in different species and depends on the structure of the elastic sheath and the unequal contraction of the myoneme. The muscular filament is a differentiation of the central cord, which corresponds to the terminal portion of the body of the Infusorian. J. A. T.

New Flagellates.—W. CONRAD (*Recueil Inst. Bot. Errera*, 1920, **10**, 65–79, 2 pls.). Description of the structure and life-history of two new Chrysomonads. In *Mallomonas mirabilis* sp. n. there are amœboid and palmellar stages. The cell leaves its siliceous carapace and becomes a very active amœboid form, giving off short pseudopodia. It lives holophytically and by engulfing. In a few cases there are very fine pseudopodia. The amœboid stages come to rest, round themselves off, form a peripheral gelatinous layer, and pass into the palmella phase. Chrysomonads multiply by longitudinal division and by forming zoospores; in *Mallomonas mirabilis* Conrad observed longitudinal division, but no formation of free-swimming spores was observed. Endogenously-formed resting spores occur. A description is also given of *M. calva* Massart, in which the carapace, instead of consisting of imbricated scales, shows transverse rings bearing extremely short needles.

J. A. T.

Fresh-water Anaerobic Ciliate.—CHANCEY JUDAY (*Biol. Bulletin*, 1919, **36**, 92–5). In many Wisconsin lakes more or less of the bottom stratum (hypolimnion) and the muddy ooze at the bottom show no free oxygen for a certain time (three to four weeks to three to four months) during the summer stagnation period. When the minimum is reached for plankton Crustaceans they rise to a higher level where oxygen is more abundant, and so do some insect larvæ. But many remain, and a Ciliate (like a species of *Enchelys*) has been studied as illustrating true anaerobic life. It disappeared promptly when the water became well aerated. A definite correlation was proved between the occurrence of the Ciliate and the lack of dissolved oxygen. The stratum occupied had at most a minimal amount of oxygen, and most frequently none at all. J. A. T.

Spirochætes in Phlebotomus perniciosus.—E. PRINGAULT (*Comptes Rendus Soc. Biol.*, 1921, **84**, 209–10). Report of the abundant occurrence of Spirillum-forms in the intestine of this insect. The name *Spirochæta phlebotomi* sp. n. is suggested. J. A. T.

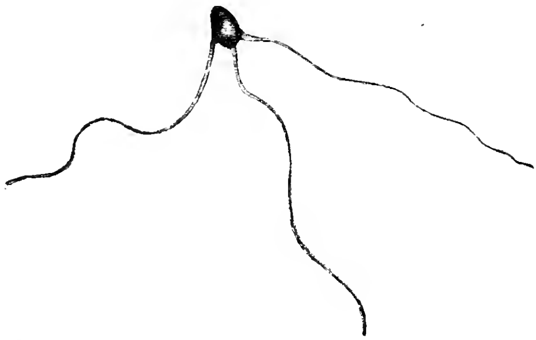
Parasitic Protozoa in African Gastropod.—FROILANO DE MELLO (*Comptes Rendus Soc. Biol.*, 1921, **84**, 241–2). In *Pachelabra mæsta* there were found the following parasites:—*Cristispira pachelabræ* sp. n., a large Spirochæt from the digestive gland; *Herpetomonas pachelabræ* sp. n., from the intestine: *Adelea pachelabræ* sp. n., a Coccidian from the digestive gland and free in the intestine. J. A. T.

Experiments on Verneuilina polystropha (Reuss).—E. HERON-ALLEN and A. EARLAND (*Proc. R. Irish Acad.*, 1920, **35**, 153–77, 3 pls.). An interesting and suggestive paper, finely illustrated. The normal *V. polystropha* is a remarkably "constant" form, singularly free from the variations and monstrosities which occur in ordinary circumstances among other Foraminifera. The species exhibits the phenomena of dimorphism in (*a*) a long form, which is megalospheric, and (*b*) a short form, which is always microspheric. The primordial chamber of the megalospheric form is sometimes divided into two by an internal chitinous septum. A short dwarf form sometimes occurs, which cannot be confused with a young specimen. Experimental evidence is given of the tendency of *V. polystropha* to select and incorporate heavy minerals among the normal siliceous sand grains. In a tank with a mixture of ordinary sand and crushed gems a proportion of the individuals had utilized gem-splinters of a size and shape utterly disproportionate to the size of the tests. Another experimental result was the production of monsters in a tank with superlimed (hypertonic) sea water. It is argued that in a natural system of Foraminifera more attention will have to be paid to processes of construction and habits of growth and reproduction, and less to the material employed. J. A. T.

Protozoan and other Parasites in Man.—R. W. HEGNER and W. W. CORT (*Diagnosis of Protozoa and Worms Parasitic in Man, Baltimore*, 1921, 72 pp., 8 pls.). The authors have done a very useful piece of work in preparing a succinct synopsis of the Protozoa and Worms parasitic in Man. Much of the new literature is scattered, and text-books get quickly out of date as regards parasitology. The diagnoses are short and clear: the illustrations are good. J. A. T.

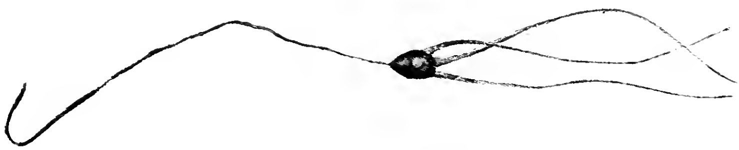
New Gregarine from Sandhopper.—R. POISSON (*Comptes Rendus Soc. Biol.*, 1920, **33**, 1396–8). In the intestine of *Orchestia littorea* were found specimens of *Didymophyes longissima* Sieb. and of *Cephaloïdophora brasili* sp. n. The latter is intracellular in its young stages; when 20–25 μ in length it emerges into the lumen. Solitary and syzygial forms occur. The cysts are spherical, the spores likewise. There is a general resemblance of the stages to those of *C. talitri*, but the dimensions are smaller. J. A. T.

Spore of Thelohania.—HELEN L. M. PIXELL GOODRICH (*Arch. Zool. Exper.*, 1920, **59**, 17–9, 2 figs.). From the teased muscle of a prawn, *Leander* (*Palæmon*) *serratus*, infected with *Thelohania octospora*, spores with three long tails were obtained. The tails are delicate prolongations of the epispore. Inside the sporocyst they are curled round the spores and take up a considerable amount of space. When



Spore of *Thelohania* drawn from the living at an approximate magnification of 2000, showing the three tails.

the sporocyst is only ruptured at one spot a tuft of tails from the enclosed eight spores often projects through the fissure. When dilute iodine solution is run into the preparation a polar filament is sometimes shot out from the end opposite the tails. This is apparently the first



Spore of *Thelohania* after treatment with iodine and blue black ink, showing the polar filament extruded from the opposite end from the tails.

recorded instance of a tailed spore in true Microsporidia, and furnishes another point of resemblance between these parasites with minute spores provided with a polar filament and the family Haplosporidiidæ, many members of which have tailed spores but never a polar filament.

J. A. T.

BOTANY.

(Under the direction of A. B. Rendle, M.A., D.Sc., F.R.S., F.L.S.)

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Structure and Development.

Vegetative.

Xylem Tissue in Cycads.—H. B. Sifton (*Bot. Gaz.*, 1920, **70**, 425–34, 2 pls., 1 fig.). A study of the primary and secondary wood of Cycads indicates that the reticulate, alternate and opposite pitting all develop from the scalariform type. The grouped, uniseriate and scattered pits found in higher types result from the elimination of pits. The Cordaites have similar pits, but they are not of so fixed a character as in the Cycads: the latter, like the Araucariaceæ, have the more primitive form of pit at the ends of the tracheids, in contact with the parenchyma. Some Cycads have tertiary spiral thickening in the xylem, while both the primary and secondary wood have bars of Sanio similar to those of the Araucariaceæ, together with other bars of an elongated type. S. Greves.

Morphology of Cicer.—T. Holm (*Bot. Gaz.*, 1920, **70**, 446–52, 3 pls.). An account of the morphology of *Cicer arietinum*; the follow-

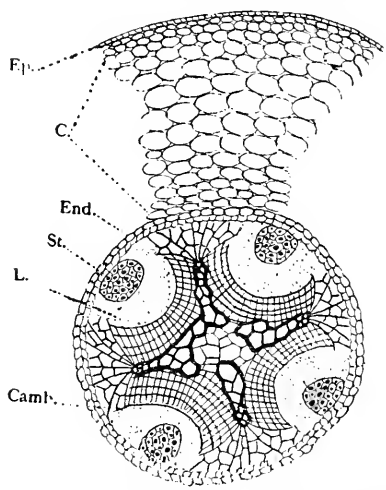


Fig. 1.—Cross-section of young root of *Cicer arietinum*. × 112.
Ep., epidermis; *C.*, cortex; *End.*, endodermis; *St.*, stereome; *L.*, leptome; *Camb.*, cambium.

ing points are characteristic of this species. In the seedling stage the cotyledons remain underground, the epicotyl is erect, and the first leaves subtend branches; the whole plant is glandular and pubescent. Increase in thickness of the root begins within the stele itself and not in the pericambium; the cambium develops as a circular band between the secondary leptome and hadrome, so that normal increase in thickness is brought about in exactly the same way as in a dicotyledonous stem. The full-grown root has numerous stereids. The stem has an interfascicular cambium, and an endodermis is present in the epicotyl,

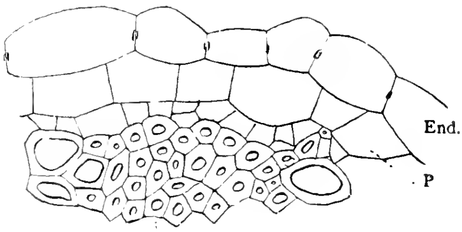


Fig. 2.—Part of same root. × 744.
P., pericambium; other letters as given under fig. 1, on preceding page.

but disappears in the internodes above. Spherical crystals are found in the cortex and pith, and especially characteristic are the glandular hairs covering the surface of the stem. The mechanical tissues of the leaf are very poorly developed, but there is a dense chlorenchyma, and a parenchyma-sheath containing crystals. Stomata are distributed over both surfaces of the blade. Thus the structure is that of a xerophilous plant, which evidently originated in a warm dry climate, possibly Greece or round the Caspian Sea. S. G.

Structure of Resin-secreting Glands in some Australian Plants. —Marjorie I. Collins (*Proc. Linn. Soc. New South Wales*, 1920, **45**, 329–36, 12 figs.). An account of the development of glandular hairs found in certain species of the Sapindaceæ, Leguminoseæ, Compositæ and Myoporineæ. In *Dodonæa viscosa* the hairs are similar to those previously described for *Melanodiscus*, being large in proportion to the thickness of the young leaf, and showing a tendency towards a radial arrangement of the peripheral head cells. The first sign of growth is a projection from the epidermis of a papillose cell: the nucleus divides, and the first wall is formed in a vertical direction. Either of the two cells thus formed may then divide, and the division may be either in a vertical or oblique direction. The mature glands are large peltate hairs which overlap and spread to a considerable distance over the epidermis.

In *Acacia rupicola*, *A. verniciflua*, *A. armata* and *A. pycnantha* four types of hairs were found, which have not been previously described. In *A. rupicola* (Fig. 1) the gland consists of a uniseriate stalk of three to six small cells formed from a single stalk-cell, surmounted by a large head-cell of active secretory character. In *A. verniciflua* (Figs. 2, 3) the stalk consists of one to four rows of four or more cells surmounted by a shield-like head composed of a single layer of eight to sixteen radiating cells. In *A. armata* the head is always vertically elongated and never shield-like. In *A. pycnantha* (Fig. 4) the hairs are elongated and club-shaped, and have probably arisen from the same type

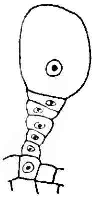


FIG. 1.—Mature gland of *Acacia rupicola*, showing uniseriate stalk and inflated head-cell. × 230.

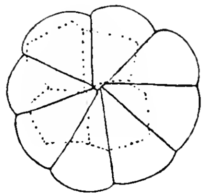


FIG. 2.—Surface view of gland of *A. verniciflua*. × 230.

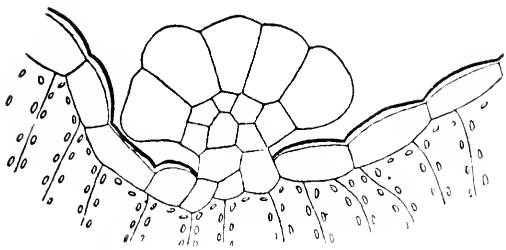


FIG. 3.—Mature gland of *A. verniciflua*. × 230.

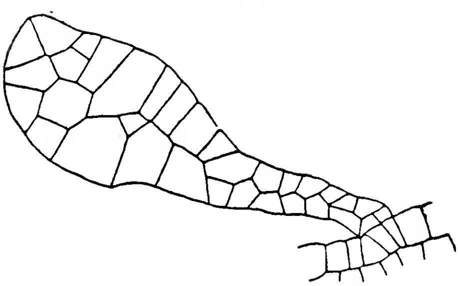


FIG. 4.—Glandular hair from base of phyllode of *A. pycnantha*. × 200.

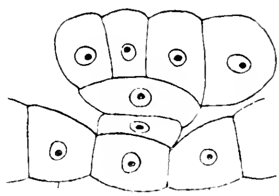


FIG. 5.—Glandular hair of *Myoporumserratum*. × 280.

as that of *A. armata*. They are restricted to the zone at the base of the phyllode.

In the Compositæ the most common type of gland is shortly stalked and has a head divided by a median vertical wall into two rows of cells. Two methods of development are seen in *Ixodea achilleoides* and *Helichrysum semipapposum*.

Observations made by the writer on the two genera of the Myoporineæ—*Myoporum* and *Eremophila*—confirm Solereder's opinion that the glands of this group are of an unstable, transitional form. The most common type found in *Myoporum* is that seen in varieties of *M. serratum* (Fig. 5). In *Eremophila latifolia* the general plan of development resembles that of *Myoporum*, but the head-shield is composed of eight cells, and shows two distinct forms; in one type the vertical divisions are radial and form a sub-spherical shield of eight radiating cells. In the other type two sets of approximately parallel divisions meet the original vertical division at equal angles and form a shield of eight cells arranged in two rows of four. All the gland-cells of this species contain clustered crystals of calcium oxalate. S. G.

Reproductive.

Embryo of Gnetum.—H. I. HAINING (*Bot. Gaz.*, 1920, **70**, 436–44, 3 pls., 1 fig.). The earliest stage of the development of the embryo was observed in *G. funiculare*, where the pro-embryo consists of a single cell giving off suspensors in different directions. In most species the suspensors form a coiled rope-like structure in the cavity of the endosperm, but in *G. funiculare* and *G. Gnemon* they branch through the endosperm. In all species except *G. Gnemon* a peculiar cell at the end of the true suspensor divides to form a long multicellular secondary suspensor, and occasionally the tip of the secondary suspensor divides into a number of branches. Polyembryony is the rule, and usually the secondary suspensors develop equally for some time, but ultimately one separates out, while the others are abortive. The entire development is typical of the gymnosperms except for the reduction in the amount of free nuclear division in all species, and in the character of the suspensor in *G. Gnemon*. S. G.

Flower and Seed of Hedyosmum—J. G. EDWARDS (*Bot. Gaz.*, 1920, **70**, 409–24, 3 pls.). An account is given of the development of the seed in *Hedyosmum nutans* and *H. arborescens*, which constitute the two chief subgenera of this genus of Chloranthaceæ. The male flowers occur in two long-stalked ovoid catkins at the base of the female inflorescence, and each stamen has four microsporangia. The female flowers are in few-flowered panicles, and each has a single ovary apparently formed from three carpels. The perianth, which arises before the carpels, is attached to the ovary at its three corners and by two bands of tissue connected respectively with the apex and base. The perianth is persistent. The ovary is one-celled, with a wall which becomes thickened into three distinct layers, forming a protective covering for the seed. The ovule is pendulous and orthotropous, and has two integuments, the inner of which is the longer; both are thickened round the micropyle, but elsewhere are almost imperceptible. The hypodermis of the nucellus gives rise to the primary archesporium, which divides to form a tapetal cell and an archesporial cell; the latter divides into three or four megaspores, of which only the lowest one is functional. The embryo-sac is of the type common among angiosperms. The endosperm nucleus is formed from two polar nuclei and possibly a male nucleus. It divides before the oospore and forms abundant endosperm, but the cells immediately surrounding the embryo are devoid of starch for some time. The ripe seed has a poorly developed suspensor embedded in a globular mass of cells, and a thin seed-coat. At germination the cotyledons remain embedded in the endosperm until all the starch is exhausted, when they assume their usual functions. S. G.

CRYPTOGAMS.

Pteridophyta.

Size, a Neglected Factor in Stelar Morphology.—F. O. Bower (*Proc. Roy. Soc. Edinburgh*, 1920, **41**, 1–25, figs.). An address upon the correlation that may be observed between the size of a plant and its internal structure. The relation of surface to bulk is discussed and the effect which this would have upon the diffusion of gases and salts. The endodermis is a living barrier placed between the stele and the surrounding tissues, and controls the diffusion of gases and solutions between the outer tissues and the conducting system. The case of protostelic ferns is first considered; and it is shown how with increasing size the cylindric stele becomes more and more deeply fluted, the area of the endodermis being thereby immensely extended. The solenostely, polycycly, perforation, and dictyostely of the Leptosporangiate ferns are then discussed: the breaking up of the vascular tracts into meristeles, each surrounded by its endodermis, leads to free communication between cortex and medulla, and increases the proportion of endodermal surface. Other instances are found in the tubers of *Nephrolepis* and *Equisetum*, in the stipes and the root of ferns, in *Selaginella*, in the large prop-roots of certain palms, in small Monocotyledonous stems. In plants which possess secondary thickening, such as the Dicotyledons and Gymnosperms, the endodermis soon becomes disorganized under the stress of the growing cambium. It is suggested that by examining the sheaths which surround the vascular tracts, their presence or absence, their structure and permeability, and their approximate relations to size, a better understanding of the vascular systems of plants, and especially of the ferns, will be arrived at than by the most carefully drawn comparisons of mere formal anatomy. Size must be considered not only from the point of view of strength and external form, but also from its tendency to modify internal structure and disposition of tissues. A. Gepp.

Grouping and Mutation in Botrychium.—Charles J. Chamberlain (*Bot. Gaz.*, 1920, **70**, 387–98, figs.). A discussion of the status of *Botrychium dissectum*. While in *Ophioglossum* there is abundant vegetative propagation by branching of the rhizome, this is not the case in *Botrychium*; for in *Botrychium* reproduction is by means of spores and prothallia of the subterranean tuberous type which need to be associated with an endophytic fungus. The plants always occur in groups, and such groups have been carefully studied and plotted on charts for some years by the author. Plants of *B. virginianum* are much more numerous than those of *B. obliquum*, which again are far more numerous than those of *B. dissectum*. The distinguishing characters of *B. dissectum* and *B. obliquum* are indicated, the most suggestive difference being in the fertile spike, where in *B. dissectum* a large number of abortive sporangia occur. Examination shows that *B. dissectum* is partially, or probably, entirely sterile; and the conclusion is reached that this plant is a sterile mutant from *B. obliquum*. It never occurs save in association with *B. obliquum*, and there is no evidence that it reproduces itself. A. G.

Gametophyte and Embryo of Botrychium obliquum Mühl.—D. H. Campbell (*Annals of Botany*, 1921, **35**, 141–58). The summary of this paper runs as follows:—1. The gametophyte and sexual organs of *Botrychium obliquum* do not differ essentially from those of other species. 2. The embryo differs in several important particulars from both *B. Lunaria* and *B. virginianum*, resembling the latter in having the cotyledon well developed, but differing in the endogenous origin of the root, in the bipolar arrangement of cotyledon and root, and especially in the presence of a suspensor. The embryo is much more like that of some species of *Ophioglossum* and *Danæa* than it is like other species of *Botrychium*. 3. The stem apex grows from a single apical cell, which is much like that of *Ophioglossom vulgatum*. The young cotyledon also has a single apical cell. 4. There is a single primary vascular strand which extends without interruption from the cotyledon into the root. There is no cauline stele, and the primary vascular strand is augmented later by additions from the traces of the second and third leaves. 5. The cotyledon has a ternate lamina with dichotomous venation. The bundle of the petiole is collateral in structure. 6. The root early develops a conspicuous tetrahedral apical cell, and its development is much like that of the later roots. The bundle is usually diarch, but may be monarch.

B. lunaria, *B. obliquum* and *B. virginianum* represent three types of adult sporophyte which differ in a number of particulars—viz. form, texture, and venation of the leaf; size of sporangium; position of sporangiophore; character of leaf-base. The author believes *B. virginianum* to differ from other species sufficiently to justify the raising of the sub-genus *Osmundopteris* to generic rank, and would restrict the name *Botrychium* to *B. lunaria* and its near allies; whereas, should the other species of the Ternatum group agree with *B. obliquum* in the structure of the embryo, there would be ample reason for accepting Lyon's genus *Sceptridium*. A. G.

Missing Link in Osmundites.—M. C. Stopes (*Annals of Botany*, 1921, **35**, 55–61, 1 pl. and fig.). A description and discussion of a waterworn fossil specimen of *Osmundites* from Wollumbilla Creek, Queensland, described as probably cretaceous, and now preserved partly in the British Museum (Natural History) and partly in the National Museum at Melbourne. It represents a portion of a rhizome with the surrounding leaf-bases, and is remarkable in possessing a solid stele and normal, simple Osmundaceous meristeles in the leaf-bases. It is of importance as indicating the type of structure from which the vascular systems of the Osmundaceæ were derived. A. G.

Anatomy of Equisetum arvense.—A. Maillefer (*Atti Soc. Elvetica Sci. Nat. Lugano*: 6–9 Settembre, 1919, pt. II. Aarau: 1920, p. 110). The bundles of the leaf-sheath have a centripetal xylem placed below a phloem bundle: the anatomical arrangement in the leaf is the excentric arrangement of Chauveau (1911). In the stem the leaf-trace is reduced to two vessels placed side by side so that the xylem is formed neither in a centrifugal nor in a centripetal manner: it should however be regarded as virtually centripetal; a lacuna is soon formed round these vessels: the metaxylem is also centripetal: one must not however follow Gwynne-Vaughan (1901) in regarding it as the analogue of the cauline centripetal xylem of the Lycopodiaceæ: for it is formed after the leaf-traces (protoxylem), and is clearly in relation with the roots formed at the base of the adventive buds, to which it bears the same relation as the xylem of a branch does to its radicels. One could explain this curious anatomy of the *Equisetum* stem by saying that it is a combination of a stem with an excentric arrangement and a root, or again that the stem contains at the same time a siphonostele and an actinostele: the vascular lacuna represents the xylem of the stem, and the metaxylem the xylem of the root: the phloem is in common. This combination of the anatomy of a stem with that of a root is due to a physiological cause—the fact that the stem is a rhizophore. A. G.

Further Notes on the Ecology of Phyllitis hybrida.—V. Vouk (*Oest. Bot. Zeitschr.*, 1916, 397–9). A continuation of the discussion between the author and Morton on the subject. The former designated *Phyllitis hybrida* as a mesophyte with well-developed xerophytic adaptations. Morton describes it as a typical hygrophyte. In the present paper Vouk meets Morton's complaints of insufficient attention to his argument, discusses the change of ecological conditions caused by the felling of woodland, and maintains that though forest plants are shade plants they are by no means always hygrophytes. Xerophyte and hygrophyte designate ecological extremes, and the same species cannot tolerate both conditions. Since *P. hybrida* is found in shady damp clefts and hollows in limestone rocks, as well as often in open sunny xerophil localities, Vouk regards it (as stated above) as a mesophyte with well-developed xerophytic adaptations. By no means is it a hygrophyte. Its xerophytic characters are its compact, rosette-like habit; coriaceous, thick and ligulate leaves; firm epidermis: hairiness (scales); the same characters as those of Christ's xerophytic form of *Elaphoglossum*. The author maintains that the factors "shade" and "damp" must be regarded as absolutely distinct, and proposes to carry out experiments to prove his contention. As regards its ecology, *P. hybrida* entirely resembles *Ceterach officinalis*, which is on the whole a xerophyte, provided with all xerophytic characters; but at the same time a dweller of clefts and hollows under a somewhat altered appearance. Both species are capable of adaptation. Since the cardinal points of light-requirement are very wide for both plants, they may be regarded as euryphotic, in contrast to *P. hemionitis*, which is apparently stenophotic. They might also be regarded as euryxerophil, while *P. hemionitis* is stenohygrophil. E. S. GEPP.

Ferns of Papuasia.—G. BRAUSE (*Engler's Bot. Jahrbuch*, 1920, **56**, 31–160). An account of the ferns collected by C. Ledermann during his Sepik River expedition in 1912–13, and of previous collections in Papua, together with an enumeration of all species hitherto recorded from Papuasia. This includes some 550 species comprised in 43 genera, and provides by far the most complete list of the rich Papuan fern-flora yet produced. A. G.

New or Interesting Malayan Ferns. II.—C. R. W. K. VAN ALDERWERELT VAN ROSENBURGH (*Bull. Jardin Botan. Buitenzorg*, 1920, **2**, 129–186). A supplement to the author's works on Malayan ferns, with descriptions of fifty new species of ferns and ten new fern-allies. A. G.

Bryophyta.

Gametophyte and Sex Organs of Reboulia hemisphærica.—ARTHUR W. HAUPT (*Bot. Gaz.*, 1921, **71**, 61–74, figs.). An investigation into the structure of this plant, with the following summary :—(1) *Reboulia* comprises a single polymorphic species, *R. hemisphærica*, belonging to the Operculatæ division of the sub-family Marchantioideæ. (2) The thallus bears both smooth and pegged rhizoids and two-ranked ventral scales without appendages; it is differentiated into a dorsal and a ventral region, and grows by means of a single cuneate apical cell. (3) Air chambers are abundantly formed, and develop by centripetal splittings; they are sub-divided by secondary partitions, but contain no chlorophyllose filaments. (4) The air pores of the female receptacle are barrel-shaped, while those of the thallus and male receptacle are made up of a single layer of concentric cells. (5) *Reboulia* is monœcious (autoicous). The antheridial receptacle is sessile, and several may be produced during the growing season; but the formation of the archegonial receptacle terminates apical growth of the thallus and represents a definite branch system, as among the higher members of the order. (6) The antheridia develop like those of the other Marchantiales. (7) In the development of the archegonium the three vertical walls follow the appearance of a transverse wall in the initial cell, and further development is typical; eighteen to twenty neck canal cells are formed, but only four are present at the time of division of the ventral cell. (8) Several growing points are organized in the female receptacle from segments of the apical cell of the thallus, and each new apical cell comes to lie in a receptacle notch. Only one (rarely two) archegonium is formed from the immediate segment of each apical cell. A. GEPP.

Variations of the Gametophyte of the Cephaloziellaceæ.—C. DOUIN (*Revue Générale de Botanique*, 1916, **28**, 251–6, 257–88, 300–20, 329–49; see also *Bot. Centralbl.*, 1918, **138**, 239). The aim of this paper is (1) to show the variations of the several organs under different ecological conditions; (2) to indicate concisely the development of the leaves with a view to deriving a practical and rational method of measuring the cells: (3) to estimate the systematic value of the organs of the gametophyte. The author made a great number of cultures with a view to testing the variability of the species under the influence of such external conditions as light, heat, moisture, soil; and gives his results. In the matter of cell-measurement he discusses such questions as whether the mere lumen should be measured, or whether half the thickness of the cell-wall should be included at each end of the diameter; whether extreme cells, the largest and the smallest, should be measured, or whether the average of the cells measured provides a better character: whether both the length and the width of the cells should be taken, or the width only: which cells ought to be measured. In summing up, the author finds it advisable to employ the characters of the sporogonium for defining the *family* Cephaloziellaceæ, while the *genera* are based upon the characters of the involucre and the propagula; the *sub-genera* and *groups of species* upon the leaf-lobes, the insertion of the leaves, the amphigastria, the involucre, the inflorescence; the *species* and *varieties* upon the size of the cells, the papillæ, the inflorescence, the width of the lobes, the denticulation of the perigonial leaves, the perianth (whether cladocarpous or acrocarpous), the lateral and dorsal denticulation of the leaves, etc. A. G.

New or Rare British Hepatics.—W. E. NICHOLSON (*Journ. of Bot.*, 1921, **59**, 202–4) Critical notes on the following species:—*Riccia Huebeneriana* Lindenb., discovered at Horsted Keynes, Sussex, and compared with *R. pseudo-frostii*. *Cephalozia spiniflora* Schiffn., gathered on Ambersham Common, Sussex, and issued in Schiffner's exsiccatæ as *C. macrostachya* Kaal., but now shown to be distinct from the latter species, and therefore constituting an addition to the British Flora. *Cephaloziella elachista* (Jack) Schiffn. var. *spinigera* (Lindb.) K. Müll., discovered with well-developed perianths in the bogs of Ashdown Forest: the affinities with *C. striatula*, etc., are discussed.

A. G.

Contribution to a Knowledge of the Hepaticæ of Katanga (Belgian Congo).—G. GOLA (*Nuov. Giorn. Bot. Italiano*, 1920, **27**, 244–50, 1 pl.). An account of a small collection of hepatics collected on the bark of shrubs on the pastoral savannah near Elizabethville by Dr. Bovone. Descriptions of nine new species are given, belonging chiefly to the genera *Plagiochila* and *Lejeunea*. A. G.

Influence of Water on submerged Mosses.—A. HAMMERSCHMID (*Mit. Bayer. Bot. Gesell.*, 1917, **3**, 395–401; see also *Bot. Centralbl.*, 1918, **138**, 313). The upper part of *Hypnum aduncum* Hedw. (= *H. Kneiffii* Schimp.), when submerged, becomes *H. pseudofluitans*, showing that the latter is merely the waterform of *H. aduncum*. *H. fluitans* and *H. submersum* stand in similar relation. *H. rotæ* is the waterform of *H. exannulatum*, and *H. fallax* is the springwater form of *H. filicinum*. Springwater acts very strongly on *H. commutatum* either by lengthening the leaves or by a reduction; while rushing water causes also a strengthening of the midrib. *Hygroamblystegium crassinervium* is probably merely a waterform of *H. commutatum*. *Dichodontium flavescens* is the waterform of *D. pellucidum*. Fourteen other species are discussed in connexion with waterforms, certain of which become specially modified morphologically by dripping water, and form so-called " drip-forms."

E. S. GEPP.

New British Sphagna.—J. A. WHELDON (*Journ. of Bot.*, 1921, **59**, 185–8, 1 fig.). A critical account with diagnoses of new varieties and forms of *Sphagnum* detected in Britain. The most interesting of these is *S. hercynicum* var *Binsteadii*, from Cefn Hill in Herefordshire, a variety of a rare and local species only once found in the Harz Mountains. The new British variety also approaches the common *S. inundatum*, but is separated from it by some very distinct characters.

A. G.

Reports on Two Collections of Mosses from British East Africa.—H. N. DIXON (*Smithsonian Miscell. Collections*, 1920, **72**, No. 3, 20 pp., 2 pls.). The first collection, made by the Dümmer-Maclennan Expedition to Mount Elgon in 1918, contains nearly fifty species, ten of which are described as new, including interesting new species of *Holomitrium*, *Bryum* and *Braunia*. The second is small (eight species), but contains the type of a new genus, *Kleioweisiopsis*, which has the habit of *Astomum*.

A. G.

Bryological Notes.—H. N. DIXON (*Journ. of Bot.*, 1921, **59**, 132–9). This seventh chapter of the author's *Miscellanea Bryologica* contains critical notes on, inter alia, the misunderstood *Hypnum replicatum* Hampe, which really is a *Sematophyllum* of quite unusual habit. *Hypnum limatum* Hook. f. & Wils. and *H. australe* C. Müll. from Campbell Island are synonyms, and must be referred to *Isothecium* and not to *Ectropothecium*. A remarkable species of *Schwetschkea* from East Africa has highly papillose leaves. *Hypnum lithophyllum* Hook. f. & Wils. from Hermite Island is synonymous with *H. secundifolium* C. Müll., and is certainly not a *Rhaphidostegium*, but should be placed in the genus *Drepanocladus*. *Porotrichum elegantissimum* Mitt. from Samoa is shown to be identical with *P. kuhlianu* of the Bryologia Javanica, and both have been placed in the genus *Pinnatella* by Fleischer.

A. G.

Distribution of Mosses in Sweden. V. Polytrichaceæ: Part I.—HJALMAR MÖLLER (*Arkiv för Botanik*, 1921, **16**, No. 3, 84 pp., 2 pls.). This part deals with the genera *Catharinæa*, *Psilopilum*, *Oligotrichum*, *Pogonatum*. It is written in Swedish, and discusses the synonymy, ecology and local distribution of each species and variety, including critical notes, and, where necessary, a description. Valuable figures of the lamellæ are given in plate 2, showing them as they appear when detached from the leaf.

A. G.

Thallophyta.

Algæ.

Phytoplankton of some Norwegian Lakes.—K. M. STRØM (*Videnskap. Skrift. I. Mat.-Nat. Kl.*, 1921, No. 4, 51 pp. 3 pls.). The material of this investigation was collected at various times by H. Huitfeldt-Kaas from lakes in all parts of Southern Norway. A short account of each lake is given, with details of the samples taken and the species they contained; followed by a tabulated list of the species and their frequency in the various lakes, as well as their presence or absence in British and Danish lakes. After a systematic account of the more interesting species, the author gives a summary of the conclusions resulting from the investigation. The Desmidiaceæ are among the very few fresh-water algæ that have a really geographical distribution, owing to the fact that they soon perish by desiccation in a vegetative state, and they rarely produce zygotes. Geographical communities of Desmids already differentiated are Caledonian, Indo-Malayan, Australian and Arctic. Barriers are probably formed more efficiently by large tracts of unfavourable localities than even by the oceans. The Desmidiaceæ that have the most distinctive geographical distribution are chiefly those that make the greatest claims on the physical resources of the growing-places. The author considers that absence of lime is the main condition on which the occurrence of Desmids depends, which confirms the view held by Messrs. W. and G. S. West. The replenishment of the Desmid flora in lakes is provided by the washing down of benthos species from surrounding bogs, and those species that have been most fit for the pelagic life have flourished and propagated there, and developed into new species of plankton. Examples are given of the process, which is in course of evolution. Three groups of plankton Desmids are characterized as follows:—(1) Desmidiaceæ belonging to the microphytic benthos, washed off into the plankton accidentally but not propagating there; (2) Desmidiaceæ originating from the microphytic benthos, but propagating under the pelagic conditions of life; (3) varieties or species only occurring in the plankton, specified by Messrs. West as (Pv) and (P), in their "British Freshwater Phytoplankton," 1909.

At present only one plankton formation can be clearly defined—namely, the Caledonian—and this is frequently found in lakes in Sweden, Norway up to 71 N. Lat., the Faroes, Iceland, the British Isles, etc. The Danish plankton has, on the other hand, a typical Baltic character. The Desmidiaceæ constitute about one-half of the plankton species and varieties in the lakes discussed in the present paper.

E. S. GEPP.

Phytoplankton from Lake Wigry near Suwalki in Poland.—B. SCHRÖDER (*Ber. Deutsch. Bot. Gesell.*, 1917, **35**, 256–66; see also *Bot. Centralbl.*, 1918, **138**, 294). Material collected on Aug. 24, 1917, contained a considerable quantity of *Anabæna flos-aquæ*, and a still larger proportion of *Microcystis æruginosa*, *Characium de baryanum*, *Ceratium hirundinella*, *Fragilaria krotonensis*, *Eudorina elegans*, and *Sphærocystis schröteri*. On the other hand, many species characteristic of Baltic lakes were lacking. Possibly they occurred at other times of the year. *Ceratium hirundinella* was present in three forms: with two ant-apical horns; with two normal and a third rudimentary; and with three normal ant-apical. The preponderating form in the Wigry lake is that with three horns, a form which in the Kochel lake has only a 7 p.c. representation. On the whole, these forms from the Wigry lake resemble those from the Alpine mid-European or Northern lakes; which refutes the theory of local variations of the organism. Temporary variations in the formation of horns in the Wigry lake is considered improbable by the author. Special attention is drawn to the occurrence of five plankton epibionts, which are enumerated.

E. S. G.

Notes on the Systematics of Fresh-water Algæ.—E. Naumann (*Ark. f. Bot.*, 1921, **16**, No. 2, 16 pp., 12 figs.). A series of five notes on algæ of systematic interest, which have attracted the author's attention during years of biological study of fresh-water algæ.

I. *On Siderocelis, a new section of the genus Chlorella (Beyerinck).*—This section is formed for the reception of a species which appeared in a pond at Ugglehult in Småland, Sweden, after befoulment with fish- and flesh-meal. The cells, not exceeding 8 μ, are planktonic and roundish, having a green cup-shaped chromatophore, and are surrounded by a brown warty membrane. Reproduction is by autospores. The warts on the membrane consist almost entirely of iron oxide, and in consideration of their chemical morphology they are placed in a special section of *Chlorella*. Three species are described, two of which occurred in an open-air basin in the Botanic Garden of Lund.

II. *On some new species of the Helophil nannoplankton.*— Formal diagnosis of five new species and varieties formally submitted to Lemmermann for description in a proposed work on Swedish plankton. They are already known as forming constituents of "water-bloom."

III. *Chrysococcus cordiformis* sp. n.—A description of an organism occurring in the intestinal-contents of Entomostraceæ. Owing to a failure to separate off living material by centrifugal action, the author is unable to draw up a complete diagnosis, but he puts forward the present account with a view to eliciting further information.

IV. *Brachionococcus, a new genus of Chlorophyceæ.*—A description of an alga found some years ago in an investigation of the influence of certain refuse matters on the biology of fresh water. It is fairly round, not exceeding 7·5 μ diam., has one parietal chromatophore, and contains starch. Reproduction is by autospores in the manner typical of *Chlorella*. Occasionally the daughter cells remain connected by delicate strands to the old remains of the shell, forming a kind of transitory colony.

V. *Nannochloris, a new genus of Chlorophyceæ.*—The organisms in question are very small, 2·5 μ–3·5 μ. Each has one parietal chromatophore and an unsculptured, though in preserved material sharply marked, membrane. Reproduction by simple division. No colonies. Gelatine not present, or at the most in irregular scattered filaments. Two species are described. The systematic position of *Nannochloris* is probably near *Nannochloster* Pascher. E. S. G.

Notes on the Biology of Fresh-water Algæ.—E. Naumann (*Ark. f. Bot.*, 1921, **16**, No. 1, 11 pp., 7 figs.). The first of a series of notes. It is entitled, "On the Occurrence of Iron Oxide in a Species of the Genus

Lyngbya." After a short reference to previous work on the subject, the author describes an active growth of a *Lyngbya*-association, found in the autumn of 1916 on a surface of mud which contained a considerable precipitation of Fe_2O_3–gel. in an aquarium tank at Aneboda. He identified the species as *L. martensiana*, although it differed in the size of the sheath. Gradually a deposit takes place of granules of iron oxide in irregular quantities on the sheath, attaining its maximum only on dead individuals. The deposit is not connected in any way with the activity of the *Lyngbya* cells, but is purely chemical and mechanical. Various stages of deposition and consequent malformation are figured. A discussion on *L. achracea* (Kütz.) Thur. proves its identity with *Chlamydothrix ochracea* (Kütz.) Mig., the latter name having the priority. The author has not found his species of *Lyngbya* again in any of his further researches in localities where iron abounds, and he concludes that it is a sporadic form. The formation of the well-known forms of iron ore—"Bohnen" and "Gelderz"—are quite independent of an algal substratum. E. S. G.

Algological Notes.—K. M. STRØM (*Nyt Mag. Nat.-vidensk.* 1921, **59**, 14 pp. 1 pl.). The first contribution to a series of short notes on algæ and plankton.

I. *Some Desmids from North Australia.*—This is a list of species of desmids found growing on algæ, which themselves grew abundantly on a tortoise from the lagoons near Daly River. Twenty-four species are recorded, among them many rare ones, hitherto recorded only once or twice. The collection is markedly of an Indo-Malayan and Australasian type.

II. *Fresh-water algæ and plankton from Finmark.*—The algæ were from Skjøtningberg and Oksefjord in the extreme north of Finmark. Twenty-seven species are recorded, only one of which, *Euastrum crassicolle*, has an essentially northern distribution. The plankton was collected in Nedre Oksefjordvand, a lake of considerable size, in July 1920. It was rich and varied, and was of a striking Caledonian type. *Mallomonas acaroides*, *Dinobryon divergens*, *Staurastrum lunatum* var. *planctonicum*, and *S. paradoxum* occurred in great abundance. Among the desmids, *Pleurotænium ehrenbergii* was present in the form described by Messrs. West from Loch Fadaghoda.

III. *The Germination of the zoogonidia of Stigeoclonium tenue.*—The process is described. The author finds that this alga very often survives the winter in a vegetative state, and her own experience is that perhaps the greater number of algæ pass the winter without producing resting spores.

IV. *Resting spores of Pediastrum.*—These were collected in 1907 by Dr. N. Wille at Lyngør, a small fishing village in S.E. Norway. The cells when dry looked like red sand, possibly owing to the presence of hæmatochrom, and they contained a fat oil. The contents were surrounded by a separate cell-wall. The resting form of *Pediastrum* must therefore be regarded as an aplanospore, in the Wille sense. In September 1919 the material was cultivated, and germinated into normal *Pediastrum* colonies, after a lapse of twelve years. E. S. G.

Contributions to a Knowledge of the Algal Flora of Litau.—J. Woloszynska (*Bull. Acad. Sci. Cracovie. Cl. math.-nat.* sér. B, *Sci. Nat.*, 1917, 123–30: see also *Bot. Centralbl.*, 1918, **138**, 214).

I. Lake Switez near Nowogródek shows a poor development of plankton algæ. Diatoms are entirely lacking. Flagellates almost entirely: Dinoflagellates are only represented by a few common species: Schizophyceæ are not frequent. The commonest algæ are Protococcaceæ and Desmidiaceæ, belonging partly to the plankton, partly to the shallow shore-zone. *Scenedesmus antermatus* Bréb. is characteristic of the shallow sandy shore exposed to strong wave-action. Its cœnobia attach themselves to the sand grains to avoid being dragged down to deeper darker levels. The new var. *tetradesmiformis* shows the characteristic cell arrangement of *Tetradesmus* Sm., which genus might be regarded as a sub-genus of *Scenedesmus*. It would then include *T. wisconsinensis* Sm., *S. antermatus* var. *tetradesmiformis* and *Victoriella ostenfeldii* Wol. The following species are shown to be polymorphous:—*Scenedesmus costatus* Schmidle, *S. armatus* Chod., *Oocystis solitaria* Wittr. with vars. *asymmetrica* and *pachyderma*, *Pediastrum boryanum*, *P. angulosum* var. *acaneosum*, *P. integrum*, and *P. tetras* with var. *lithuanica*. Nine species of Desmids are characteristic of the lake. The commonest Flagellate and Peridinian are respectively *Dinobryon cylindricum* Imh. var. *palustre* Lemm. and *Staszicella dinobryonis* Wol. Cosmopolitan, mountain and northern, and some endemic species are also present.

II. Jezioro Czarne near Bereza Kartuska has a rich plankton, particularly *Pediastrum*, *Scenedesmus*, *Ankistrodesmus*, *Gloiotrichia echinulata* ("water-bloom"), and *Lagerheimia Chodati* Bern., hitherto recorded only from Java. For certain species of *Scenedesmus* a spiral curve of the colonies (*S. acuminatus*), for others a wave-like one, is characteristic. In many species of *Pediastrum* the processes curve towards each other in the same way as in *P. kawraiskyi*. The sterile filaments, free of heterocysts, of *Aphanizomenon flos-aquæ*, resemble exactly *Oscillatoria agardhii*, and are possibly identical. E. S. G.

Some Algæ from Hot Springs in Spitzbergen.—K. M. Strøm (*Bot. Notiser*, 1921, 17–21). This list of twenty-four species of Myxophyceæ, Diatomaceæ, Chlorophyceæ, Conjugatæ, and Characeæ includes all the algæ known from the hot springs in Spitzbergen. Thirteen of them are new records to the country, and were collected from the hot springs Troldkilderne and Jotunkilderne in the vicinity of Bock Bay. The temperature of the water varies generally from 20–25° C., but rises occasionally to 28·3° C. Prof. Nordstedt determined the single *Chara* record as a new form, *Spitsbergensis*, of *Ch. aspera*. From that species it differs however conspicuously, and he suggests that it may when cultivated change into a more common form. E. S. G.

Biological Investigations of the Thermal Water of Croatia and Slavonia.—V. Vouk (*Prirodoslov. istraživanj. Hrvatske i Slavonije. Zagreb*, 1919, **14**, 127–42, 1 pl.: see also *Izvjesca* (*Bulletin*) *Mat.-Prir. Razreda Zagreb*, 1919, Sv. 11, 12, 49–56). In this, the second instalment of results, the acrothermal springs of Topusko and the euthermal springs in Daruvar are principally considered. Notes are also given on the thermal waters of Sv. Helena near Samobor; Lešće near Generalski stol: and Podsused near Zagreb. Three springs of Topusko were examined, the temperature of the water varying from 52–57° C. The springs in the open meadows showed a surface encrusted with algæ, and layers of membranous green algæ at the bottom of the basin. They were both composed of two species, *Mastigocladus laminosus* Cohn and *Phormidium laminosum* var. *acœrulescens*, a new variety founded on the absence of reaction with chlorzinc-iodine. Species of *Oscillatoria* and *Phormidium*, etc., occurred according to the lower degrees of temperature in the waste channel, but no general marked effect in the vegetation of the thermal area was observed which could be traced to the action of the raised ground temperature. The Daruvar springs are next described. Several of them show a remarkable dissimilarity of their algal flora. *Lyngbya molischi* was the principal constituent of one spring. The three other thermal waters and their respective floras are briefly discussed. In the original Czecho-slovak edition of this paper the Cyanophyceæ formations in the hitherto investigated euthermal waters are set forth in tabular form, together with the temperature limits of each species. The individuality of the various localities is there demonstrated, although certain species, *Mastigocladus laminosus*, *Phormidium laminosum*, *Hypheothrix thermalis*, *Oscillatoria cortiana*, and *O. Okenii* are more widely distributed. Desmids are entirely lacking, and Diatoms are very rare. Chlorophyceæ barely reach to a temperature of 35° C., though in Asia and America they are found in hotter waters. The Czecho-slovak hot springs are almost entirely characterized by pure Cyanophyceæ-formations. E. S. G.

Observations on Glœotaenium Loitlesbergerianum Hansg.—G. Huber (*Att. Soc. Elvetica Sci. Nat.* 100° Congresso, Lugano, 1919. Part II. Aarau, 1920, p. 111). Material found in Canton Glarus by the author in 1907 constituted the first record for Switzerland. An examination of the morphology and development gives the following results:—The "concrements" formed in the cœnobial membrane and the polar chambers are composed of calcium carbonate, a fact which was the more difficult to establish since the contact with acid, either organic or inorganic, produced no effervescence. This was owing to the carbonate being finely broken up and enclosed on all sides by colloids. *G. loitlesbergerianum* was found in stages of one, two, three and four cells, the four-celled tetrahedral cœnobia being especially noteworthy. A newly observed condition is the so-called Hemicœnobium, which must be regarded as a completely developed two-celled cœnobium which has arisen through subsequent division. The girdle-shaped "concrements" probably serve principally to keep the cells in position: any physiological rôle they may play has yet to be discovered. Reproduction is carried on exclusively by daughter-cells, which escape by dehiscence. The very early foundation and development of the girdle-concrements and of the polar chambers was observed and followed. A new variety, var. *irregulare*, is described. The author records further the occurrence of *G. loitlesbergerianum* in the Beetsee in N.E. Switzerland. E. S. G.

Contributions to a Knowledge of the Fresh-water Algæ of Croatia.—V. Vouk (*Prirodoslov. istraživanj. Hrvatske i Slavonije. Zagreb*, 1919, **14**, 145–50, 1 pl.: see also *Izvjesća* (*Bulletin*) *Mat.-Prir. Razreda Zagreb*, 1919, Sv. 11, 12. 57–60). The first note is entitled "*Lemanea fucina* Atk. and other algæ from the neighbourhood of Gospic." *L. fucina* was found growing in rushing water under a weir in the river Lika. It did not correspond wholly with Sirodot's diagnosis, having three to five or even seven to eight antheridial papillæ, as against two to three. Other differences are the abrupt narrowing of the stem at the base and the extraordinarily copious branching of the almost piliform branches. It generally begins first in the middle of the fruiting portion of the thallus. Atkinson's diagnosis fitted the Lika plant better. Unfortunately no *Chantransia* stage was found. *L. fucina* is a well-marked reikophyte, i.e. an inhabitant of rushing water. The reikophytic adaptation is shown in the rich branching and in the copious development of carpospores. The entire inner surface of the hollow fruiting thallus is filled with sporangia which remain sheltered till maturity. After their escape through the torn thallus, the large number of spores increases the chance of survival. Another well-marked character of this reikophyte is the unusually well-developed power of vegetative regeneration of portions of the thallus. A short list of other species from the vicinity of Gospic is given, including *Hydrurus fœtidus* f. *penicillatus*. The second note in this paper records the finding of *Thorea ramosissima* Bory in Croatia, in the brook Toplica near Sv. Jana, by Jaska. Small plants were growing at the exit of the thermal spring from the basin, while in the brook itself quantities of it were growing, reaching a length of a metre. The nearest locality to this record is in the Danube near Beograd. The Toplica material showed the short assimilators which have been called monospores. E. S. G.

On the Ferruginous Cyanophyceæ.—V. Vouk (*Rad Jugoslav. Akad. Zagreb*, 1920, **223**, 128–37). Records a new species of *Lyngbya*, *L. molischi*, which has abundant deposits of ferric oxide in its sheaths. It was found in the thermal waters of Daruvar. This discovery led to an examination of preserved material of about fifty different species of Cyanophyceæ, only eight of which gave a positive iron reaction. These all had pectinous sheaths and mucilaginous strata, but did not include any species of *Oscillatoria*. All preserved material from the thermal waters of Topusko and Daruvar reacted positively with potassium ferrocyanide: but the author regards this infiltration of iron as a post-mortem process. *L. molischi* alone shows marked deposits of iron in its sheaths. Of all other algæ investigated only three species have given the positive reaction, *Phormidium papyraceum* f. *lutescens*, *P. antliarium*, and *P. tinctorium*. In all these the ferruginous deposit was in the mucilaginous layers and not in the pectinous sheaths. The distribution of iron was irregular. Most was found in *P. tinctorium*. The author regards them as belonging to Gaidukov's second group of iron-organisms, which deposit iron only on the surface, and calls them "optional iron-organisms." *Lyngbya molischi* and probably also *L. ferruginea*, *L. ochracea* and *Hydrocoleus ferruginus* belong to the first group of "obligatory" iron-organisms, like *Trachelomonas* and *Closterium*. Iron is not however absolutely necessary to them. E. S. G.

Desmid Flora of a Triassic District.—G. T. HARRIS (*Journ. Quekett Micros. Club*, 1920, **14**, 26 pp.). The district in question lies in E. Devon, between the estuaries of the Exe and the Axe. The object of this investigation was to compare the Desmid flora of this district with that of Dartmoor, in order to estimate the influence of geological beds in the species density of the Desmid flora. The methods of collecting, the time expended in field work, and the number of gatherings made were roughly the same for both districts. A comparative table of the two floras is drawn up, which gives a total of 287 species for E. Devon (Triassic) and 282 for Dartmoor (Palæozoic): indicating therefore that the factors influencing the richness or poverty of Desmid floras must be sought for elsewhere than in the geological beds upon which the habitats stand. This conclusion is confirmed by a recent investigation of the Desmid flora of a district on Eocene beds. A census list at the end of this paper adds 122 species and varieties to the Desmid flora of Devon, bringing it up to a total of about 500. Zygospores are specially noted in connexion with their respective species, principally because they occurred in the spring gatherings. They appear to be freely produced in March and April, and were even found in the winter months in a condition which indicated recent conjugation. A description is given of the physical features of the bogs from which collections were made, followed by special notes on certain of the species. E. S. G.

Subterranean Algal Flora.—G. T. MOORE and J. L. KARRER (*Ann. Minnesota Bot. Gard.*, 1919, **16**, 281–307; see also *Bot. Gaz.*, 1921, **71**, 78). An account of the discovery of a subterranean algal flora, independent of the terrestrial flora and to a great degree of the character and locality of the soil. An analysis was made of a variety of soils collected in Missouri, California and Massachusetts. The samples were collected at different depths under sterile conditions and in localities where the soil had not been disturbed for a number of years. These were placed in bottles containing an amount of sterile algal nutrient solution and sterile sand. After several weeks algæ were found in small amounts sufficient for study. It was thus shown that algæ exist in the soil to a depth of 1 metre at least, under conditions which preclude the possibility of surface infection. A wide variety of species were found, but of particular interest is the fact that *Protoderma viride* Kütz. occurred at all depths and in all the samples obtained in the widely separated localities. E. S. G.

New Species of Laurencia from Chile.—G. B. DE TONI, A. FORTI and M. A. HOWE (*Nuov. Notar.*, 1921, **32**, 149–53, 3 figs.). The species here described, *Laurencia chilensis*, was collected on the coast of Chile and in the Magellan region by R. Espinosa. It bears some resemblance in size, habit and consistency of the frond to *L. heteroclada* Harv., *L. forsteri* Grev., *L. filiformis* Mont., and *L. scoparia* J. Ag., but appears to differ from all in its brownish colour, in the irregularly thickened or often somewhat pitted walls of the epidermal cells, in the heteromorphy of the epidermal cells of the main axes, and in the proliferating habit of many of the ultimate ramuli. E. S. G.

Some Marine Algæ recently introduced into Danish Waters. —L. K. Rosenvinge (*Bot. Tidsskr.*, 1920. **37**, 125–35). The four species in question are *Gigartina mamillosa* J. Ag., *Trailliella intricata* Batters, *Codium tomentosum* Stackh., and *C. mucronatum* J. Ag. *Gigartina mamillosa* was discovered in 1869 at Thisted in the Limfjord, and was also found there in 1890 and 1893, but nowhere else in the fjord. The isthmus separating the Limfjord from the North Sea was broken through in 1825, before which date the salinity in that part was very slight. It is now 29 p.m. The alga must have been carried in by a vessel on which it was growing. It is also recorded from Aarhus harbour, probably introduced in the same manner. *Trailliella intricata* is now very common and abundant in the Western Limfjord, whither it is supposed to have immigrated about 1900. It also occurs in the Kattegat, but is always sterile in Danish waters. *Codium tomentosum* was found in 1919 at Hirsholm, a harbour never visited by foreign vessels. Its appearance may perhaps be connected with a mine-field at Herthas Flak during the war. *C. mucronatum* appeared in the Limfjord in the summer of 1920, undoubtedly introduced by vessels. E. S. G.

Botanical Results of the Swedish Expedition to Patagonia and Tierra del Fuego, 1907–9. Marine Algæ: I. Phæophyceæ.—C. Skottsberg (*K. Svensk. Vetenskapsakad. Handl.*, 1921, **61**, No. 11, 56 pp., 20 figs.). The original intention of the author was to make a very detailed study of the large algal collections made on this voyage, but, owing to various delays and the increased cost of publication, the paper has been of necessity reduced to a list of the species with notes on some of them. These notes contain information of great interest and value, and clear up many doubtful points hitherto unsolved owing to lack of living or sufficient material. Some of the Ectocarpaceæ and Elachistaceæ had been handed over to Dr. Kuckuck for inclusion in his proposed monograph, and after his untimely death his notes were returned to Dr. Skottsberg, who embodied them in the present paper. One of these notes treats of the two Falkland Islands species, *Ectocarpus pectinatus* and *Elachista* (?) *ramosa*, which are placed in a new genus *Gononema*. Two new species of *Elachista* provoke a discussion on the validity of species of that genus and of *Myriactis*. Further material of *Cæpidium antarcticum* shows that it possesses a marked periodicity. During the winter it consists of horizontal thalli, sometimes with small cups, from which very short simple upright shoots arise. Later, these upright shoots develop into large branched fronds like a typical *Chordaria* and with typical sporangia, which are here described for the first time. The bladders or "colpomenia-sprosse" were found in all sizes, and consist of hollow and swollen protuberances on the horizontal thallus. Their development and structure are described and figured. They bear gametangia in large irregular sori. The theory that the bladder-like structures are "*Colpomenia*," and not an integral part of *Cæpidium*, is here disproved. *Cladothele* Hook. f. et Harv. is restored as a genus. The characteristic papillæ are well figured, and the difference between this genus and *Stictyosiphon* is clearly shown. In *Cladothele* the termination of each branch shows an apical cell; in *Stictyosiphon* the growth is trichothallic, each branch ending in a hair—a difference which implies not only different genera but different orders, according to Kjellman. Notes are given on *Adenocytis* and *Utriculidium*, with figures of their structure, and a discussion of their relationship and systematic position. Additions are made to our knowledge of many other genera and species, *Myrionema*, *Stereocladon*, *Scytothamnus*, *Lessonia*, *Macrocystis*, *Ascoseira*, etc. Two new genera and ten new species are described. The figures are of value. E. S. G.

Biochemistry of Marine Algæ.—H. Kylin (*Zeitschr. Phys. Chem.*, 1913, **83**, 171–97; see also *Bot. Centralbl.*, 1918, **138**, 269–70). An account of some important investigations made in the Medico-chemical Institute at Upsala. Fucosan is that substance which is contained in the fucosan-bases of the Fucoideæ, and is coloured red by vanilla-HCl. Phycophaein is merely oxidized fucosan. When boiled in dilute H_2SO_4, fucosan splits off no sugar, and therefore does not belong to the glucosides. Mannite was found also in *Laminaria cloustoni* and *Pylaiella litoralis*, but not in the red alga *Furcellaria fastigiata*. *Ascophyllum nodosum*, *Fucus vesiculosus*, *Laminaria saccharina* and *L. digitata* contain simple sugars—dextrose and levulose. Apparently the Florideæ contain only traces of these sugars; but in the Fucoideæ they are the first visible products of assimilation. And in the four brown algæ above-mentioned there is a dextrin-like polysaccharide called Laminarin, which is a reserve-material formed by a condensation of the dextrose; physiologically it corresponds with the starch of the higher plants. As regards Floridean starch, by hydrolysis with dilute acid it yielded dextrose; when made into a paste with warm water it is quickly converted into sugar by malt-diastase, but raw unaltered grains are not acted on by the ferment. Chemical investigations were made as regards the precipitability of the mucilages—Algin, Fucoidin, also the mucilages of *Ceramium* (in *C. rubrum*), of *Furcellaria* (in *F. fastigiata*), of *Dumontia* (*D. filiformis*). The three latter were all precipitated by an acid "Leinlösung" (solution of linseed). The mucilages of *Ceramium* and *Furcellaria* are very closely allied to one another (and probably also to that of "Carrageen," *Chondrus*); while that of *Dumontia* is the type of another group of Floridean mucilages, which are not precipitated by ammonium sulphate, and do not congeal on cooling. A. Gepp.

Some Plants from Tropical Sea Gardens.—M. A. Howe (*Nat. History*, 1920, **20**, 560–68, figs.; see also *Contr. New York Bot. Gard.*, 1921, No. 226, 560–68). A popular and vivid account of the habit and surroundings of marine algæ in the subtropics of the North American coasts and adjacent islands. The richest areas visited were Bermuda, Florida Keys, and the coast of California. The masses of Siphoneæ which in many places carpet the sea bottom, the mats of *Bryothamnion triquetrum*, the kelps and other brown algæ, are picturesquely described, together with their economic uses, and the importance of the lime-secreting species in reef-building. Two of the figures show the plants in situ. E. S. G.

Fungi.

Notes on the Genus Comesia Sacc.—RENÉ MAIRE (*Bull. Soc. Hist. Nat. Afrique du Nord*, 1918, **9**, 18–19). The species *Comesia felicitalus* was transferred by Boudier to *Epiglia*, both genera of *Pezizæ*. A species found by Maire and referred to *Comesia* has now been recognized by him as similar to the lichen *Biatorella fossarum*. That lichen, he now decides, must be classified among fungi as *Tromera fossarum* in the family Patellariaceæ. A. LORRAIN SMITH.

Laboulbeniales of North Africa: 3rd Contribution.—RENÉ MAIRE (*Publications de l'Univ. d'Alger*, 1920, 44 pp., 2 pls., 8 figs.). The author here records and describes many species, a large number of them new to science. The list for N. Africa now comprehends eighty-one species; he has also added three families of Coleoptera parasitized by these fungi. Lists of the insects affected are given with their parasites. A. L. S.

Aspergillus flavus, A. oryzæ and Associated Species.—CHARLES THOM and MARGARET B. CHURCH (*Amer. Journ. Bot.*, 1921, **8**, 103–26, 1 fig.). The fungi experimented with are employed in fermentation processes in the East. Other types of *Aspergillus* are frequently present, but are probably contaminations. The authors have made a series of cultural studies. The first two types, *A. flavus* and *A. oryzæ*, are so connected by bridging forms that they conclude there is only one species, *A. flavus-oryzæ*. The others chiefly concerned with food fermentation are *A. wentii* and *A. tamari*. Many other forms were grown, and the results are described in detail. A. L. S.

New African Species of Ustilago—RENÉ MAIRE (*Bull. Soc. Hist. Nat. Afrique du Nord*, 1919, **10**, 46–7). The new species *Ustilago brachypodii-distachyi* was found by the writer in N. Africa: it is related to *U. bromivora*, but with larger, less densely warted spores. The spores germinate only after one or two days in water, and at the time of the autumn rains, that is after having passed the summer in the open. A. L. S.

Inheritance of Susceptibility of Sorbus Species to Gymnosporangia.—ED. FISCHER (*Atti Soc. Elvet. Sci. Nat.* (1919), 1920, 112–3). Fischer experimented with *Gymnosporangium tremelloides* and *G. juniperinum*. He tested a number of F_2 plants and was able to deduce certain laws: for *Gymnosporangium juniperinum* all F_2 plants with free pinnate leaves were susceptible, while entire leaves were only partly so. For *G. tremelloides* leaves that were entire or incised were susceptible to inoculation, while pinnate leaves were only rarely susceptible. A. L. S.

Study of Puccinia Caricis.—JAKOB ERIKSSON (*Ark. Bot.*, 1921, **16**, No. 11, 1–64). The *Puccinia* on *Carex* has been the subject of much research. Eriksson has gone over the whole ground and made many cultural experiments. He considers that even yet there have been too few experiments with the *Uredo* stages, and some of his decisions are only provisional. He has delimited three species:—(1) *Puccinia caricis, diffusa* n. nom., the Uredo-telento stage of which is on eight different Carices, the æcidium stage on *Urtica dioica* (*U. urens*), and also on *Ribes grossularia* (*R. rubrum*, *R. aureum*); (2) *Puccinia caricis-urticæ* on eighteen species of *Carex*, the æcidia on *Urtica dioica* (*U. urens*); (3) *Puccinia caricis-ribis*, the æcidial form of which grows on species of *Ribes*. He distinguishes here three sub-species:—*Puccinia caricis-ribis-diffusa* n. nom., and *P. caricis-grossulariæ* n. nom., with a wider range of æcidial hosts within the genus *Ribes*; lastly, *P. caricis-ribes-nigri* n. nom. on *Ribes nigrum*, chiefly with three forms, according to the *Carex* on which the Uredo-telento stages are developed. Full details are published of the various cultures. A. L. S.

Indian Hymenomycetes.—S. R. Bose (*Reports Ind. Assoc. Cult. Sci.*, 1920 (1918), 136–43, 13 pls.). A series of Agarics and Polypores illustrated by photographic slides has been published by Bose. A full description of each species is given, with notes as to habitat and biological data. A. L. S.

Contribution to the Study of Fructicolous Fungi in Belgium.—El. and Em. Marchal (*Bull. Soc. Roy. Bot. Belgique*, 1921, **54**, 109–39, 2 pls.). The investigation was conducted mostly on fleshy fruits. The fungi found on these were isolated by cultivation, and an account of them is given. The species determined belonged to Phycomycetes, Ascomycetes and Fungi Imperfecti. In all, sixty-seven different species were identified; twenty-four of these as species or varieties are new to science, and twenty-one new to Belgium. Those known to be harmful to fruit are indicated. The research is still being prosecuted, and considerations affecting fruit preservation are attended to. A. L. S.

Schedæ ad Mycothecam Boreali-Africanam.—René Maire (*Bull. Soc. Hist. Nat. Afrique du Nord*, 1917, **8**, 242–61, 6 figs.: 1919, **10**, 130–51, 3 figs., 1 pl.). In these two papers the author records the fungi of fascicles 10–12 and of fascicles 13–16. The numbers run from 251–400: the list consists mostly of records of species already described, but with new localities and with habitats. A number of species, mostly Uredineæ, are diagnosed. The plate gives a fine representation of a new *Pleurotus*, *P. yuccæ*, which grew on dead or dying trunks of *Yucca elephantipes* Reg., of which it is a wound parasite, killing the tree in one to three years after attack. A. L. S.

Studies of Basidiomycetes.—A. Sartory and L. Maire (*Saint-Nicolas-de-Port*, 1918). The authors have issued three pamphlets. The first, "Synopsis du genre *Collybia*" (226 pp.), gives diagnoses, synonymy and critical notes of the species found in France. Synoptic tables are drawn up and a few figures are used to interpret difficult points. The second, on *Tricholoma* (158 pp.), follows the same lines. Habitats, and in some instances localities, are included in both monographs. The third paper deals with Bolton's *History of Fungusses*. The authors discuss each plate and give their interpretation of the drawings. In most instances they change the name: thus *Agaricus campestris* becomes *Psalliota pratensis*: *Agaricus latus*, they find, represents *Pluteus cervinus*, etc. Tables are given of the old and the modern names.

A. L. S.

Development and Dispersion of Spores in Coprinus sterquilinus.—A. H. Reginald Buller (*Jahr. Wiss. Bot.*, 1915, **56**, 299–329, 2 pls., 2 figs.). The author finds that the sporophores of *Coprinus sterquilinus* in the formation and dispersal of spores are similar to those of *C. comatus*. There are no cystidia present, but thickened projecting cells at the edges of the gills keep the lamellæ apart. There are two types of basidia—long and short—and the spores of the former mature first. Stout paraphyses which separate the basidia occur in all *Coprinus* species. A comparison is made with other Agarics and with other fungi. Spore liberation in *Puccinia*, for instance, is not unlike spore liberation in Hymenomycetes.

A. L. S.

Thelephora terrestris, T. fimbriata and T. caryophyllea on Forest Tree Seedlings.—James R. Weir (*Phytopathology*, 1921, **11**, 141–4, 1 pl.). It has been known for some time that *Thelephora terrestris* overruns and kills conifer seedlings by smothering them. During damp weather the fungus grows quickly, and may envelop a small seedling in a comparatively short time. It is not parasitic. The other two species are also reported as causing the same trouble.

A. L. S.

Influence of Light on the Fructification of an Agaric in Pure Culture.—René Maire (*Bull. Soc. Hist. Nat. Afrique du Nord*, 1919, **10**, 94–106, 1 pl.). The author gives a list of Hymenomycetes that have been successfully cultivated. The Agaric he experimented with is a Mediterranean plant, *Pholiota cylindracea*. He gives the results of his various cultures of the fungus. It develops perfectly in complete darkness. Direct white light prevents spore germination. Other lights were also experimented with. Carpophores were formed in the laboratory at seasons when none grew in the open. As transpiration and desiccation have considerable influence on development, these factors were strongly influenced by the laboratory environment, and explained the unseasonal growths.

A. L. S.

Rare Phalloid, Pseudocolus javanicus (Penzig) Lloyd.—Ch. Bernard (*Ann. Jard. Buit.*, 1921, **31**, 93–101, 4 pls.). The occurrence of a number of specimens of this "very rare Phalloid" at Tjiater, in a forest of bamboos, enabled Bernard to make a thorough study. The plant is so fragile that it disappears within a few minutes of its birth. The volva is brown, sometimes very clear, and almost white, but oftener a deep shade above; the receptacle is red, and of a very bright colour at the summit of the three or four arms, rose at the base; the gleba like that of other *Phalloideæ* was greenish or almost black and viscous; the odour was strong and repulsive. Bernard gives a detailed account of the tissues and reproductive parts, noting the points of distinction from other allied fungi. The fungus measured up to 65 mm. from the base of the arms to their tips; the "foot" varied in size, the largest recorded being 66 × 25 mm. A. L. S.

Agaricaceæ of Michigan.—C. H. KAUFFMAN (*Michigan Geol. and Biol. Survey*, Publ. 26, Biol. Ser. 5, 1918, 1924 pp., 2,172 pls.). The first volume, containing the text, gives a very detailed account of gilled fungi; a general account of the group, instructions for collection and examination; a complete classification with keys to genera and species; a chapter on mushroom poisoning; finally, a bibliography, glossary and index. The plates, which form the second volume, are photographic illustrations of a representative series of plants. A. L. S.

Mycetes Boreali-Americani.—P. A. SACCARDO (*Nuovo Giorn. Bot. Ital.*, 1920, **27**, 75–98). The fungi were sent by Dr. J. R. Weir, of Spokane, Washington, to Saccardo, and the work was completed in 1919, though now published posthumously. The list of 98 species, a number of them new to science, includes only two Basidiomycetes and one Mycetozoon, the others belong to Uredineæ, Ascomycetes and Fungi Imperfecti, all of them more or less microfungi. A. L. S.

Heterothallism and Similar Phenomena.—E. M. CUTTING (*New Phytologist*, 1921, **20**, 10–16). The author of this paper gives an important summary on the behaviour of varying strains of mycelia as represented in researches on very different fungi. He cites Burgeff's work on *Phycomyces nitens*, where neutral strains were secured from spores formed after grafting a + and a – mycelium. The sporangia formed contained + and – as well as neutral spores. Work on *Zygorhyncus* by several authors is quoted. Atkinson considers that this fungus is a lowly form of Ascomycete. In *Glomerella*, an Ascomycete, the conjunction of different mycelia produces an increased number of ascocarps. Work on Oomycetes and on Basidiomycetes is also described and criticized. A full bibliography of papers dealing with the subject is given. A. L. S.

Mycological Studies. I. On the "Spotting" of Apples in Great Britain.—ARTHUR S. HORNE and ELEANOR VIOLET HORNE (*Ann. Appl. Biol.*, 1920, **7**, 183–201, 6 figs.). The authors give a sketch of work done on this subject by students in America, the causal agents of spotting including a considerable number of fungi. They record and describe the various fungi formed on spots in this country. These include a new genus of Phormatales (*Polyopeus*) and nine new species, one of which, *Pleospora pomorum*, is capable of parasitizing apples. None of the fungi recorded on apple spots in America were found on British apples. A. L. S.

Spotting in Apples.—A. S. HORNE and E. V. HORNE (*Gard. Chronicle*, 1920, **68**, 216–7, 4 figs.). The authors give an account of the spotting, of the fungi that cause the trouble, the districts affected and the varieties of apple that have been affected. They consider that the fungi attack the apples through the lenticels, and after gaining an entrance they follow the air-spaces and hinder respiration. The surrounding cells are killed and a brown area is formed. The writers recommend spraying by Bordeaux mixture towards the end of July and careful fumigation of the store rooms. A. L. S.

Observations on Wheat Scab in Pennsylvania and its Pathological Histology.—J. F. ADAMS (*Phytopathology*, 1921, **11**, 115–24, 2 pls., 1 fig.). The disease known as wheat scab is due to the fungus *Gibberella saubinetii*, and "everything which tends to weaken the plant or retard its ripening renders it more subject to attack." The writer discusses the opinions of previous workers as to the causal organism and its development. Generally the head of wheat is affected, though under favourable conditions the fungus may become a virulent parasite of seedlings. It has been noted that scab is more prevalent in fields that have been previously planted by corn, probably from the fungus growing on dead corn stalks. The prevalent type of infection occurs after the flowering stage, and the developing embryo is completely destroyed. A. L. S.

Resistance to Citrus Canker.—FORMAN T. McLEAN and H. ATHERTON LEE (*Phytopathology*, 1921, **11**, 109–14*a*, 1 fig.). The authors comment on the resistance to this, the bacteria canker, a disease which affects the foliage and stalks of the *Citrus* trees, causing pustules and blisters. The research has proved that on the horticultural varieties of *Citrus nobilis* var. *deliciosa* (mandarin orange) the infections are largely wound infections. They conclude that penetration cannot take place through the epidermis of that plant, and by graft hybrids (periclinal chimeras) with other species of *Citrus* resistant characters might be transferred. A. L. S.

Experimental Data on Losses due to Canker of Rose.—L. M. MASSEY (*Phytopathology*, 1921, **11**, 125–34). The disease is due to the fungus *Cylindrocladium scoparium* which causes cankers at the crown of the plants. Infection takes place from the soil, and losses are due to diminished yield of blossoms and not to the death of the host. A decrease of about ten blossoms per plant (amounting to one dollar) represents the annual loss to the grower. A. L. S.

Lotus Leaf-spot caused by Alternaria nelumbii sp. n.—ELLA M. A. ENLOWS and FREDERICK V. RAND (*Phytopathology*, 1921, **11**, 135–40, 1 pl., 1 fig.). The disease appeared in summer 1918 at Kenilworth D.C. and in the autumn of the same year at the New York Botanical Gardens on leaves of Egyptian lotus (*Nelumbium speciosum*), causing spots which in time may coalesce, the leaf gradually drying and curling from the margin inward. Morphologically the fungus was similar to *Alternaria brassicæ-nigrescens*, but no cross infections could be obtained between that species and the lotus plant. No further stage of growth was developed, but the conidia were viable after two years in the laboratory, and the fungus can thus be carried on from season to season by conidia alone. A. L. S.

Notes on Species of Colletotrichum and Phoma in Uganda.—W. SMALL (*Kew Bulletin*, 1921, 57–67). *Colletotrichum coffeanum* is the cause of a troublesome disease of leaves of the coffee plant; it also attacks the twigs and the berries. It has been proved by methods of cross inoculation that it is the same species as *Colletotrichum theobromicolum*. The perfect fruiting stage is *Glomerella cingulata*. Another species, *Colletotrichum Camelliæ*, grows on tea: though morphologically similar to the above species, inoculations were unsuccessful on coffee leaves. The same type of fungus has been found on some garden plants and on cotton. *Phoma* is also a frequent parasite on coffee branches, etc. The writer concludes from his experiments that the spores are introduced into the softer tissues of the plant by the Variated Bug. Surface inoculations were singularly ineffective. A. L. S.

Phoma sp. parasitic on Cupressus in South Africa.—A. M. Bottomley (*S. African Journ. Sci.*, 1919, **15**, 613–7; see also *Bull. Agric. Intell. Pl. Diseases, Rome*, 1920, **11**, 401). A severe disease of young plants caused by the *Phoma* was first noticed in March 1915. Other fungi had invaded the leaves, but culture and other experiments identified a *Phoma* of unusual shape and large fusiform spores as the causal organism. The disease is recognizable by the discoloration, withering and death of the leaves and stems attacked. Wounded plants were easily infected, unwounded plants with difficulty, and only after some weeks. Moisture is essential for the development of the disease. Spraying with Bordeaux mixture is recommended. A. L. S.

Mildew Disease on Prunus Laurocerasus.—Ed. Fischer (*Atti Soc. Elev. Sci. Nat.* (1919), 1920, 112). The tree on which the fungus (*Podosphæra Oxyacanthæ*) was detected had been destroyed by frost down to the base during the winter. New shoots made their appearance, and the young leaves were attacked and deformed by the mildew, while the older leaves seemed to be immune. A. L. S.

Pier Andrea Saccardo.—G. B. Traverso (*Nuovo Giorn. Bot. Ital.*, 1920, **27**, 39–74). In an address to the Italian Botanical Society, Traverso gives a sketch of the life and labours of the renowned mycologist, P. A. Saccardo, who was born in 1845 and died in February 1920. A love of plants was shown by him at the early age of thirteen, when he had already collected a herbarium of 230 plants. His first contribution to Mycology was the *Mycologiæ venetae specimen* in 1873, a list of fungi found in the neighbourhood of Venice. From that time onwards Mycology became his chief study. Traverso touches on the various aspects of his work, and on the great service he rendered to the science. A list of his published works occupies nearly seventeen closely printed pages of this memoir. A. L. S.

Lichens.

Lichen Life-cycle.—A. H. Church (*Journ. Bot.*, 1921, **69**, 139–45, 197–202). Dr. Church has resumed his study of the lichen plant, and in this contribution he resumes his previous views on the general development of lichens, then discusses Basidiolichens with reference to their symbiotic or intrusive algæ. These instances he concludes "grade biologically from such cases as that of the indigenous *Polyporus igniarius* on trees which are green with intrusive *Cystococcus* and to similar cases of *Stereum*, etc." The author then traces the reproductive development in Ascomycetes and notes the divergences from fungi. In the second issue (pp. 197–202) he discusses the origin and development of Laboulbeniaceæ, noting their morphological and reproductive likeness to Florideæ and to Lichens, their marine origin and their adaptation to dry conditions, and to the short life of the host. Church traces back the origin of Laboulbeniaceæ and Lichens to algæ of older structure than existing Florideæ, but with the same reproductive mechanism of trichogynes and spermatia. A. LORRAIN SMITH.

Cultures of Lichen-gonidia.—H. WARÉN (*Akad. Abh. Helsingfors und Öfvers. Finsk. Vet.-Soc. Förh*, 1920, **61**: see also *Zeitschr. Botanik*, 1921, **13**, 182–3). The author cultivated carefully isolated gonidia from twenty-one different species of lichens. He tested their nutrition by growing them on different nitrogenous media and found that they grew most freely on amino-acids. Further, he finds that the alga in most lichens is *Cystococcus*, which he divides into two sections, *Eucystococcus* and *Eleuterococcus*, which differ in the formation of autospores. The former is characterized by the vegetative division into autospores, the latter by the formation of rounded autospores. The results seem to indicate that each lichen species has its own peculiar species of gonidial alga. An exception was found in *Xanthoria parietina*, of which specimens from two different localities enclosed a different type of gonidium.

A. L. S.

Different Forms of Lichen Symbiosis in Solorina saccata Ach. and Solorina crocea Ach.—M. et Mme. FERNAND MOREAU (*Rev. Gén. Bot.*, 1921, **33**, 81–7). The authors discuss chiefly the internal cephalodia of these two lichens. They trace the development of these bodies and their subsequent fate in the tissues of the thallus. In some instances the intruding algæ are so surrounded by a plectenchyma of hyphæ that their development is circumscribed, and they may finally disappear. In other instances, as in *Solorina crocea*, the foreign alga extends and forms a second gonidial zone. The authors consider from these observations that their view of the pathological nature of the lichen symbiosis is confirmed. A. L. S.

Systematic Researches on Lichen Parasites and Lichenoid Fungi.—KARL VON KEISZLER (Wien) (*Beih. Bot. Centralbl.*, 1920, **37**, 263–78). A careful examination of a number of fungi, many of them on the border-land between lichens and fungi. Descriptions are given and citations of literature with critical observations. Two new species are described, *Leptosphæria galligena* on *Parmeliæ* and *Ovularia peltigeræ* on the thallus of *Peltigera rufescens*. A. L. S.

Handbook of British Lichens.—A. LORRAIN SMITH (*British Museum*, 1921, 158 pp., 90 figs.). The book (of pocket size) has been issued for work in the field as well as the home. Many lichens can be identified with or without a hand lens: others require a microscope. The book is arranged to meet both classes of work. There is an introduction of general information about lichens. The systematic part, which includes all British lichens, consists of descriptions of families and genera, with keys to the species. A. L. S.

Mycetozoa.

New or Rare Species of Mycetozoa.—G. LISTER (*Journ. Bot.*, 1921, **69**, 89–93, 1 pl.). Several new species are recorded, and along with these, forms and varieties now deemed worthy of specific rank are described, mostly from this country or from the Continent. A note is published concerning *Physarum gyrosum* from Japan. In that country the plasmodium changes from white to clear blue, and K. Minakata has suggested that an old tradition in China that the blood of a murdered victim reappears year after year as sky-blue on the spot where the murder took place may be explained by a growth of the plasmodium of *Physarum*. A new genus found by Minikata on bark and lichen in Japan has been determined, and named *Minikatella* in honour of the finder. A. LORRAIN SMITH.

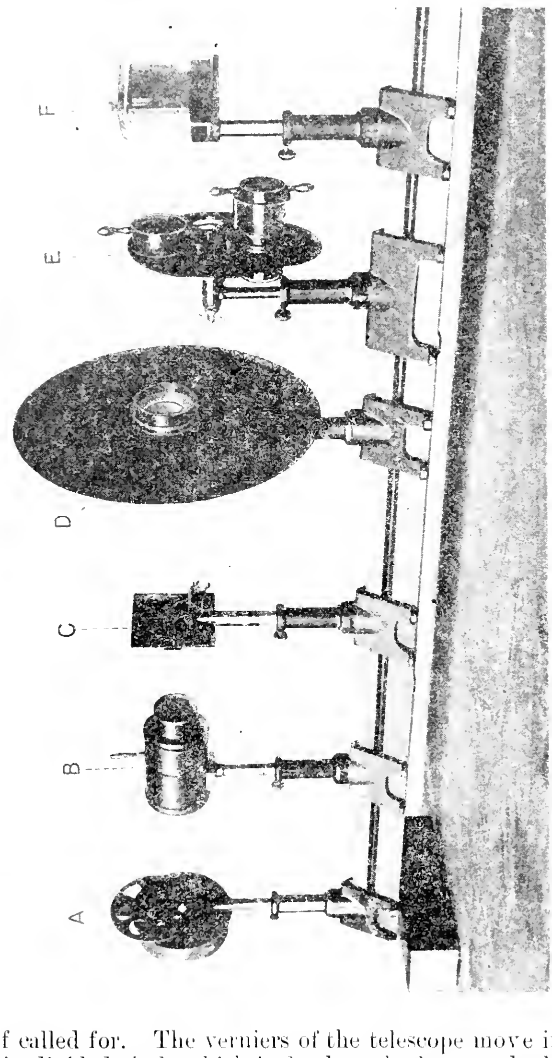
Mycetozoa on the Midland Plateau.—W. T. ELLIOTT (*Journ. Bot.*, 1921, **59**, 193–6). The district included in the Midland Plateau embraces a radius of about fifteen miles from Birmingham as the centre, including portions of Warwickshire, Worcestershire and Staffordshire. The altitude varies from below 300 feet to just above 1,000 feet. The geological character of the area receives special attention, and the gathering grounds are noted. Elliott records 121 species and varieties, many of them new to the district; there are 89 for Warwickshire, 100 for Worcestershire, and 63 for Staffordshire. In the latter county the principal collecting district was Hamstead Park. There is a wider range of localities given for the other counties. The writer has marked with E the Mycetozoa collected by himself: there are very few that have not the letter appended. A. L. S.

MICROSCOPY.

A. Instruments, Accessories, etc.

A Projection Spectropolariscope.—F. J. CHESHIRE (*Trans. Optical Soc.*, 1919–20, **21**, No. 3, 102–3). A projection spectropolariscope specially adapted for class and lecture work, as shown in figure on p. 315, consists of a triangular metre-bar upon which the necessary fittings are mounted. The fitting A consists of a rotatable disc with a number of different sized holes. The fitting B carries a double-image prism which can be rotated through 180°. The end of the prism casing next to the diaphragm A is fitted with a lens, the focal plane of which coincides with the diaphragm A. A second lens, at the reduced end of the casing, serves to condense the light upon an adjustable slit C. This slit is focussed upon the screen by the projection lens D, the light passing through a double-image prism, or it may be an analyser E and a bottle prism F. In use an arc light is focussed by the usual lantern condenser upon a suitable aperture in the disc A. In this way the light source becomes virtually a sharply defined circular disc. The collimated beam of light passes through the double-image prism in B, one of the resulting beams passing direct along the axis of the instrument, whilst the second beam is deflected through a sufficient angle to throw it out of the apparatus. In virtue of the sharply defined light source there is practically no intrusion of one beam on the other. The direct beam of plane polarized light (vibrations vertical) is focussed upon the slit C. When therefore a crystal plate, cut parallel to the axis, is placed against the slit with its extinction directions at 45°, and the double-image prism is turned to transmit vertical and horizontal vibrations, two vertically superposed images of the slit are projected upon the screen in the absence of the dispersing prism F. In one of these images the light is polarized in a vertical plane, whilst in the other the light is polarized in a horizontal plane. When the prism F is inserted, these images are drawn out horizontally into spectra, which are seen to be crossed by absorption bands corresponding to the retardation of the plate, one spectrum being complementary to the other. In the case of a plate of axis-cut quartz, the rotation of a Nicol in the fitting E results in a spectrum on the screen with dark absorption bands travelling continuously to the right or to the left according as the particular crystal is right- or left-handed. The apparatus lends itself to the performance of a number of very interesting experiments. The placing of the crystal immediately against the slit results in much sharper definition of the bands than is obtained with the more usual apparatus. (The illustration on p. 315 is inserted by the courtesy of the editor of *The Transactions of the Optical Society.*)

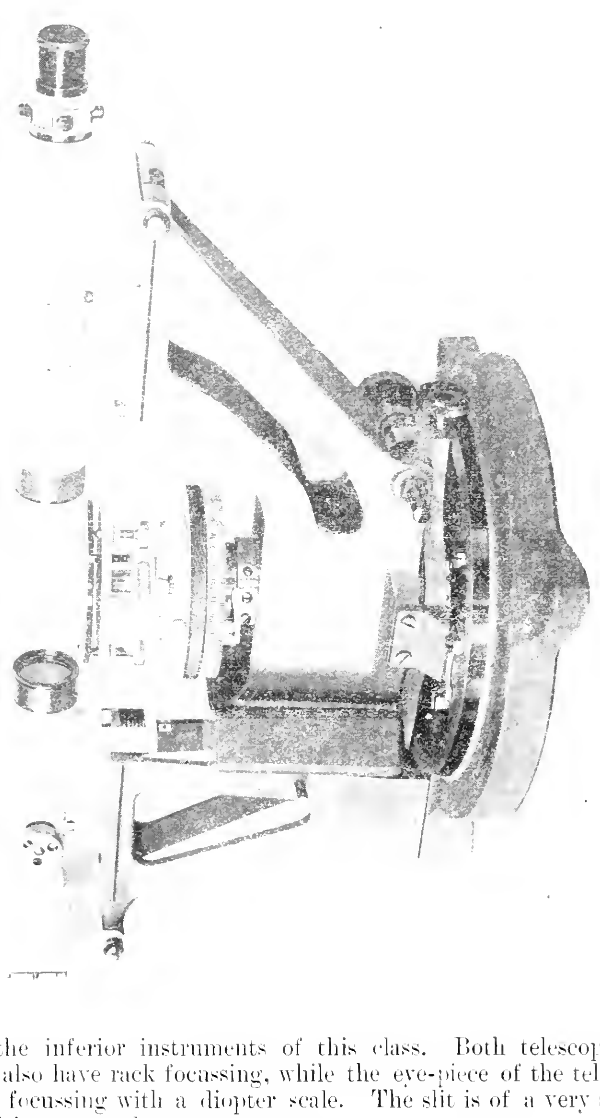
A Spectrometer (made by Messrs. E. R. Watts and Son).—L. C. MARTIN (*Trans. Optical Soc.*, 1919–20, **21**, No. 3, 104–5). This instrument is designed on lines at once simple and strong. While the present arrangement includes only such parts as are strictly necessary for the performance of the simpler goniometric measurements, yet the construction is such that verniers of greater sensitiveness and telescopes of greater magnifying power could well be used, and such indeed could be



provided if called for. The verniers of the telescope move in the plane of the main divided circle which is fixed to the base, and which is 8 in. in diameter. A smaller divided circle and verniers are provided for the table.

The telescope axis appears to be longer than is usual in the majority of spectrometers and it is well counterbalanced, features which will doubtless make for long wear and freedom from shake.

Both telescope and collimator may be given small altitude and azimuth adjustments on their supports, and these adjustments do not necessitate any deformation of the tubes, a grievous fault of design in



many of the inferior instruments of this class. Both telescope and collimator also have rack focussing, while the eye-piece of the telescope has helical focussing with a diopter scale. The slit is of a very simple nature and is easy to clean.

Tested in the Optical Engineering Laboratory of the Imperial

College, the instrument has shown itself to be satisfactory as regards the accuracy of construction of circle and verniers, and the optical definition is good; while the design is generally convenient in use. It has been incidentally found that fixed magnifiers for reading the lower circle are desirable, but as the dividing in the present instrument is very clear and easy to read these magnifiers could have a longer focus than usual, thus preventing the usual shadowing of the circle by the head of the observer. No doubt such lenses could be provided very easily by the makers.

Owing to this clearness of dividing of the circles, also to the simplicity and great strength of the design, the instrument is likely to be very useful for teaching purposes. It should also find a sphere of usefulness in the testing laboratory, especially if a micrometer fine adjustment similar to that of the Pulfrich refractometer and to those of certain old Steinheil spectrometers were given to the telescope. Results for the *dispersions* of prisms could then be obtained with an accuracy comparable with that of the value for absolute refractive index—an impossibility when the ordinary vernier measurements are alone possible.

If a more elaborate instrument were desired, micrometer microscopes for the main circle could doubtless be provided, and, as was previously indicated, a larger telescope and collimator could easily be carried by the same supports.

This is surely a praiseworthy principle of design that the workmanship of even the simpler types of instrument should be the very best. Any improvements or additions later found to be necessary will not be wasted on the original. The illustration shows one of the earlier trial models. Verniers are now supplied to the table circle in addition to the main circle. (The illustration on p. 316 is inserted by the courtesy of the editor of *The Transactions of the Optical Society*.)

B. Technique.

Suggestions for Methods and Apparatus, by N. A. Cobb. United States Department of Agriculture*:—

Systematically Examining Large Series of Microscopical Objects.—There are various methods of recording the position and character of each member of a large series of objects mounted on a microscope slide. One of the commonest methods involves the use of a recording, mechanical stage. Each object on the slide receives a record-number consisting of two separate readings from scales engraved on the mechanical stage. The following method, however, is successful without a mechanical stage or finder of any sort, and is characterized by simplicity and expedition. It may be called the method of charting.

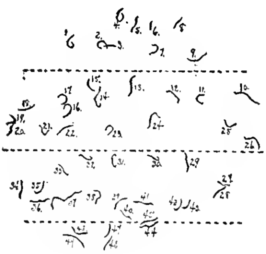
The method consists in making a camera lucida drawing or chart, at low magnification, of all the objects of which it is desired to make record. The chart is diagrammatic; each object is represented on the chart by a simple, characteristic diagram, and the diagrams are then

* This article was contributed to the Transactions of the American Microscopical Society, October, 1920.

numbered in series. The sheet that carries the chart may also carry a series of printed numbers with corresponding spaces for records. (See fig. 1.) Where the objects belong to a few great groups, such as land-inhabiting, fresh-water, and marine, the printing of the blank sheets in correspondingly assorted colours is an advantage.

The chart is made by using a camera lucida and an objective of about 5-in. focus.* In order to reduce the magnification, the objective may be screwed into the end of the draw-tube of the microscope barrel.

Soil - Imported roots of plants,
Brazil - Diff. #510
No. 7
1-11



1	Tylenchus spiral.	26	See 11
+(2)	Cephalobus ?	27	" "
3	Doryl. styracturus	28	" "
4	Achromadora brazil	29	" "
5	Doryl. caudatus?	30	Mononchus minor
6	Elassonema - two	31	" fragment minor
(7)	Tylenchus perfectus	32	Rhabditis
8	Doryl. additicius	33	Y. Doryl. protrudens
9	" protrudens	34	See 11
10	" "	35	Y. Doryl.
11	?	36	Achromadora
+(12)	Tropiconema tenuicolle	37	See 11
(13)	See 11 Egg	38	Rhabditis
(14)	Achromadora-papillae?	39	Elassonema
15	Fibre	40	Y. Doryl.
16	Mononchus	41	See 11
17	Achromadora	42	Fibre
18	Rhabditis	43	See 11
19	Ironus	44	Doryl. poor
20	Elassonema	45	Rhabditis
21	"	46	"
22	Rhabditis	47	Doryl. sl. tl.
(23)	Tylenchus	(48)	?
24	Mononchus minor	(49)	Doryl. sl. Eggs
25	Rhabditis	50	

FIG. 1.—Record chart used in tabulating large numbers of microscopic objects arranged on a series of slides. As printed the chart was 5 in. by 8 in., and carried only the two columns of figures 1 to 50 inclusive. At the left is seen the camera lucida drawing, or chart, recording the form, size, and relative position of forty-nine microscopic objects—in this particular case, nemas. Immediately above the chart are seen the data relating to the particular slide charted, which was No. 7 in a series of eleven slides (1–11), and which carried a collection of forty-nine nemas gathered from soil attached to the roots of plants imported from Brazil. Names and other notes with regard to the nemas were typewritten opposite the appropriate numbers. Nos. 2, 7, 12, 13, 14, 23, 48 and 49 were encircled to indicate that these specimens were of especial interest. One-half size.

A low power eye-piece is used with the objective, so that all the objects on the slide can be seen at one time. A chart having a magnification of five diameters is of convenient size. The suitable illumination is secured by using a concave mirror without sub-stage condenser. The light may be direct, in which case the objects are seen as dark bodies on a light background, or a dark-ground effect can be produced by inserting between the concave mirror and the objects a small opaque disc. A suitable disc may be made by stripping the barbules from a

* A very strongly magnifying spectacle lens will serve the purpose.

dark-coloured 6-in. wing or tail feather so as to leave only a small fan-shaped tip at the end, from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. across. With scissors, this is trimmed so as to have a somewhat rounded contour. While the right hand is engaged in making the chart, the left hand can flirt this little disc in and out between the objects and the concave mirror and so produce a dark-ground effect as desired. To do this the feather "disc" must be materially smaller than the mirror.

The charts are nothing more than rude camera lucida drawings of the objects, and with practice can be made with great rapidity. A lot of fifty nemas mounted under a $\frac{3}{4}$-in. round cover-glass can be drawn in two to three minutes with sufficient accuracy to make a very useful chart. (See fig. 1.) Each nema-diagram on the chart has four very distinct properties: (1) position; (2) form; (3) size: (4) orientation. For the most satisfactory work, it is desirable that a certain optimum number of objects exist on the slide. This optimum is determined by the number of them that will appear in a single field of the lens afterward used in searching. Suppose a 16-mm. objective is used as a searching objective, and a 4-mm. for the examination; then the optimum number of objects under the cover-glass is that number which brings into each field of the 16-mm. objective one to three objects.

After the chart is made, the short, crooked lines, representing the nemas, say, are numbered in transversely arranged groups. Each transverse group of the series constitutes a band of nemas running across the mount and having such width as comes fairly well within the scope of a single field of the 16-mm. objective. These imaginary bands are illustrated in fig. 1. It will be seen that there are four such bands. The nemas are numbered more or less consecutively. Proceeding in this manner, on reaching the end of the first band, one numbers the second band, also more or less consecutively, and so on to the end.

In recording, begin with No. 1, placing it in the field of the 16-mm. objective. It is recognized by its size, form and orientation. Having recorded No. 1 and examined it with the 4-mm. objective, a glance at the chart will indicate at what distance, and in what direction, No. 2 lies from No. 1. Revolving to the 16-mm. objective and looking through the microscope at Nema No. 1, the slide is moved in the indicated direction until No. 2 is found and recognized. After recording No. 2, No. 3 is found in the same way, and so throughout. The novice will be surprised to find how easy it is, with a little practice, to follow the series through without error.

The drawings should be so made and numbered that the chart and the objects as seen under the microscope will resemble each other. If no care be taken in this respect, the chart may be found to be "left-handed." Securing a "right-handed" chart is merely a matter of properly arranging the paper at the time the chart is drawn. Diagrams should be so made with reference to the printed matter that when it is right side up, the objects as viewed through the microscope will have the same orientations as the diagrams.

This completes the description of this method, except to explain that in the example illustrated, the numbers encircled are so marked in order to indicate that those particular specimens present noteworthy features.

The method may be elaborated in a variety of ways for the recording of nemas, rotifers, protozoa, desmids and a vast array of other microscopic objects. If the charts are of card-system size, say 5 in. by 8 in., they lend themselves to all sorts of convenient methods of filing. By using thin paper, carbon copies can be made at the original draft.

The charts can be made and used by a grade of assistant that might hardly be entrusted with the use of a recording mechanical stage, and who may lack training in the accurate reading of scales and the recording of numbers. Floating of the objects, of course, disarranges them. Newly made slides are sometimes subject to this disadvantage. The difficulty is avoided by keeping the slides always in a horizontal position.

Object Support for a Freezing Microtome.—In this freezing microtome attachment, the object is to reduce the metal parts to a minimum and to concentrate the effects of the freezing mixture as much as possible upon the object to be frozen. To this end the object is placed on a thin metal plate, only about one to three thousandths of an inch thick, to which the necessary rigidity is imparted either by soldering it to a

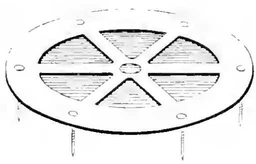


Fig. 2.

radiating framework in the form of a flat wheel sawed from somewhat thicker metal, or, preferably, by giving to the metal the form of a dome. These metal supports are illustrated in fig. 2 and fig. 3, in which they are shown full size. A six-spoked wheel, having a hub-hole one-eighth of an inch across, is sawed from a sheet of German silver about one two-hundredth of an inch thick. The edges of the central aperture are bevelled so that the mixture frozen on it becomes dove-tailed to the plate. In a similar way, the small, washer-shaped piece of German silver fastened to the top of the dome, as shown in fig. 3, *r*, is also bevelled.

The German silver wheel is soldered throughout to a round sheet of exceedingly thin brass or German silver. Then into six marginal perforations in the German silver wheel, brass pins are soldered, giving to the whole affair the appearance of a six-legged table. The heads of pins are filed off so as to give clearance for the microtome knife. The pins serve to fasten the plate to a perforated cork, being thrust into the cork as shown in the illustration. The rim of the dome of thin sheet metal is somewhat similarly stiffened by soldering to it a ring of German silver which is perforated and supplied with six brass pins in the manner just described.

Though the dome form is somewhat more difficult to construct than the flat, it is more efficient for three reasons: It is more rigid, it gives a better clearance for the microtome knife, and it contains less material.

In the case of small and moderate sized objects of which only a few sections are required, the method is extraordinarily expeditious. Objects of such a size that they can be embedded in a few drops of the freezing mixture placed on the control part of either of these metal supports can be frozen in a few seconds by applying an ordinary ether spray to the under side of one of these thin metal supports. The exceeding rapidity of the congelation gives rise to a consistency favourable to section cutting.

To obtain an End View of a Nema, Rotifer, or other similar Small Object.—Suppose the object is a nema of which an end view of the head is required: decapitate the nema behind the pharynx with the aid of an eye knife, or similar very small tool having a very slender, thin blade.

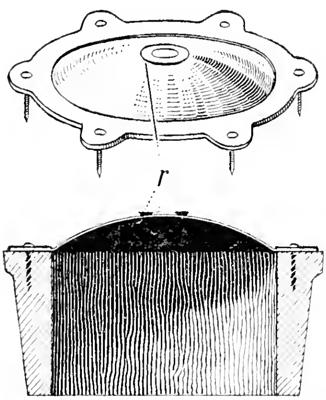


Fig. 3.—Perspective view and longitudinal section of a freezing-microtome object-holder mounted on a cork cylinder. The holder is made of metal only about two thousandths of an inch thick. The edges of the ring (*r*) are bevelled so that the embedding mixture when frozen is dovetailed to the holder.

The smallest and most slender-bladed knife used by oculists in operations on the eye is a very suitable tool, and it must have the degree of sharpness characteristic of surgical instruments in good order. Bring the nema by appropriate methods into glycerine; the decapitation should be done in a drop of glycerine placed on the surface of a transparent piece of celluloid. Push the nema to the bottom of the glycerine and against the celluloid; decapitate by pressing the edge of the knife against the nema as the latter rests on the celluloid. The celluloid is sufficiently soft so that the edge of the knife will not be dulled. If the knife is sharp, the cut will be clean, and the object satisfactory. If the knife is dull, the nema will be more or less crushed at the point of section and the preparation may prove unsatisfactory.

Mount the head in melted glycerine jelly, using sufficient jelly so that the object may stand on end after being covered in. Place the mount on the stage of a microscope, bring the object into focus, and with a dissecting needle gently shove the cover-glass slightly back and forth until the object is seen to be on end. Allow to remain on the stage of the microscope until the jelly sets, watching from time to time to see that the object maintains the desired position.

According to my experience, this is a better method of obtaining end-on and sectional views of the heads of free-living nemas and other similar small organisms than that of sectioning and embedding. The trouble with the method of sections is that the microtome knife very seldom cuts the object to advantage. It is quite likely to cut in the wrong place. If the ends of the setæ or the surfaces of the lips are removed in the first cut, it is a very troublesome matter to obtain a good view or good sketch of the structures. Even if some of the parts should not be lost or offer difficulty in mounting, there are so many chances that the microtome blade will cut through at a disadvantageous place that, as a rule, a very considerable number of nemas will have to be sectioned before a good preparation is secured.

The method of sections has the further disadvantage that the following of such small objects through the various dehydrating and staining fluids, and the final orientation of them, is a tedious and difficult matter. Moreover in the case of nemas, there is considerable difficulty in properly embedding the object. The cuticle of nemas is so impenetrable that unless special precautions are taken, the paraffin will not thoroughly penetrate the tissues, and the results will be unsatisfactory.

End views may be obtained by mounting the nemas in a microscopic well made from a thin section of thermometer tubing. The tubing should be like that used in the most delicate medical thermometers, that is to say, with the smallest aperture procurable. This tubing may be bought under the name thermometer, or barometer tubing. It is well to have on hand ground sections of varying thickness, from one-quarter of a millimeter thick to one millimeter or more. The discs are cemented to a glass microscope slide at the time of using by means of smoking hot wax or other suitable cement. Before cementing the disc to the slide, fill the capillary aperture in the disc with mounting fluid. This may be easily done by placing on the slide a very tiny drop of the mounting fluid, and laying the disc on to the small drop. The mounting fluid will enter the aperture by capillarity. If it be desired to look at the head end of a nema, it is placed in the microscopic well, tail down. If the nema is too long for the well, it may be cut to fit it. The point is, to see that the object has about the same length as the depth of the well, so that the end portion of the object it is desired to view will come close to the under side of the cover-glass when this latter is placed on the top of the well, or rather on the disc of the glass containing the well. In placing the nema in the well, a suitable tool is a small, curved hair cemented to the end of a dissecting needle. Human eye-brow hairs are suitable for this purpose. Using this method, the specimen can be examined in clove oil, cedar oil, or any mixture of these or any other similar thin mounting fluid. Cedar oil, having the same refractive index as the glass composing the well, has advantages in connexion with illumination. The illumination in aqueous media is less satisfactory.

When the glass discs are not in use, it is best to keep them in absolute alcohol in a glass-stoppered bottle. They should not be allowed to become dry with mounting fluid in the capillary orifice, otherwise they will be very troublesome to clean out.

Destaining of Nemas or other Small Objects in the Differentiator.—In handling a mass of small organisms by the differentiator method, there is sometimes considerable difficulty in securing satisfactory destaining. There is little difficulty in getting a mass of organisms thoroughly impregnated with the stain, no matter how varied they may be in species and in size; it is simply a matter of time. The trouble comes in destaining. If the destaining process is carried on until the largest of the objects, or the most impenetrable ones, are sufficiently destained, it will generally happen that smaller specimens, or those more easily penetrated, are deprived of too much of their colour. It is therefore a matter requiring considerable experience and judgment to successfully destain such a miscellaneous collection. The difficulty is considerably increased by the fact that when enclosed in the differentiator tube, the specimens are not very easy to examine critically by any ordinary method. If the differentiator be held toward a strong light, the organisms may be examined by the aid of an ordinary pocket lens, but not very critically. The most satisfactory piece of apparatus for this work is what is sometimes known as the chemical microscope, in which the objective is below the stage and the light that passes through it from above is reflected by a prism placed below so as to pass obliquely upward through a barrel carrying an eye-piece. If the differentiator tube containing the destained nemas is laid on a glass stage over the objective of such an inverted microscope, and a little water, or still better, cedar oil, be placed between the differentiator tube and the glass stage, it will be found that the nemas or other objects will sink to the bottom of the fluid in the differentiator tube so as to come as near as possible to the objective of the microscope. If the glass stage is thin, there is no difficulty in using a one-half to two-thirds inch objective. In this way, the nemas may be examined more critically with regard to the extent of the destaining.

If it is desired to use a lens of higher power, it is sometimes possible to do so by resorting to another method. Place a cover-glass on a horizontal surface, and on the cover-glass a good-sized drop of cedar oil. Lay the differentiator tube into this drop of cedar oil in such a way that the nemas come opposite the cover-glass. It will now be found that the cover-glass will adhere to the differentiator by capillarity, so long as the differentiator is held in a horizontal position. If the chemical microscope stage has a large aperture, it will be possible to lay the differentiator across the stage, cover-glass downward. In this way, if the differentiator tubing is thin, it will be possible to use even quarter-inch objectives of long focus.

Where considerable work is done with differentiators, a chemical microscope used in this way is a valuable accessory.

Compressorium for Chromosomes.—When chromosomes or other similar minute bodies are so massed together that one lies behind another and is thus liable to be missed in counting, the compressorium described below may prove useful in overcoming the difficulty, which none of the ordinary compressoria will do.

When such a mass of chromosomes is flattened out by pressure, the individual chromosomes behave somewhat as would the seeds of a pulpy fruit under similar circumstances. They appear to be of a different consistency from the material in which they lie, and behave under pressure as if harder and more compact than the surrounding matter. Under moderate pressure they do not show much tendency to break in pieces, but rather to accommodate themselves to the narrower quarters by rearranging themselves more nearly in one plane. So far as enumeration of the chromosomes is concerned, this new arrangement has two advantages: 1st, they may all be more readily brought into a single

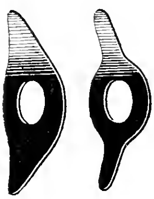


Fig. 4.—Two curved, perforated, steel springs made from thin, safety-razor blades, as described in the text. These two forms, while of the same length, nearly 1 in., are of different degrees of springiness; that at the left being the weaker.

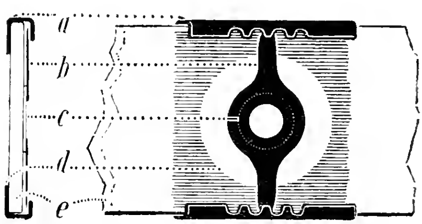


Fig. 5.—Portion of a 3 by 1 in. glass microscope slide enwrapped with thin metal as described in the text. *a*, thin metal wrapper; *b*, one of the springs shown in fig. 4, placed in position on the slide so as to press the small round cover-glass, *c*, against the slide, *e*; *d*, aperture in the back of the metal wrapper, *a*. The ends of the spring, *b*, enter through the notches on the edges of the wrapper, *a*, so that in being applied the spring does not need to be rotated more than a few degrees.

view, that is, all brought into focus at one time; 2nd, in the flattening-out process, they slip one over another somewhat, and recede from each other—for instance, as the seeds inside a grape will do, when similarly pressed.

The compressorium I have devised to secure this effect is constructed as follows: Take a safety-razor blade—one of the thinnest kind, having perforations an eighth of an inch in diameter—and soften it by heating it to a red heat. With shears, cut a somewhat diamond-shaped piece from the softened blade, so that the "diamond" is about three to four times as long as wide, and has one of the round apertures in its centre; bend this elongated "diamond" into a symmetrical bow whose depth is $\frac{1}{8}$ in. or more. (See fig. 4.) Heat the bow in a flame to a cherry-red and plunge it into cold oil or water to harden it. This will result in a springy piece of metal that can be utilized to exert pressure on a small cover-glass under which are mounted cells containing the chromosomes it is desired to scatter. The length of the piece of springy steel may conveniently be made to be about 1 in., so that it will just reach across an ordinary 3 by 1 in. glass microscope slide. Bind the slide in a piece of thin metal having a ¾-in. perforation at the back—that is to say, so bend a piece of thin sheet metal that an ordinary slide will slip into it through grooves along the two sides of the folded piece of metal. (See fig. 5.) This metal should simply pass around the edges of the slide and lap over about a sixteenth of an inch at each edge leaving one face of the slide uncovered. The grooves should be a little wider than the thickness of the slide—at least enough wider so as easily to admit the thin perforated metal spring. Place the cells, the chromosomes of which are to be studied, on the slide opposite the middle of the ¾-in. aperture. Use very little mounting medium; cover the cellular tissue to be treated with a small round cover-glass. Tuck the ends of the bowed piece of springy perforated steel under the edges of the metal slide-case or holder, holding the spring against the small cover-slip in such a way that the cells to be compressed lie opposite the centre of the small perforation. Press and lock the spring in the same way as in the case of the springs at the back of an ordinary photographic printing frame. The cells will now be under pressure at or near the centre of the perforation in the steel spring. The entire contrivance will differ but very little in form and size from an ordinary microscope slide, and can be placed on any microscope stage in the same way as a slide. The piece of springy steel is so thin that it in no way prevents the use of a high-power immersion objective. Needless to say, it is for this reason that it is made from such thin metal. The spring may be manipulated with the aid of matches or wooden toothpicks.

Ordinary slides and cover-glasses are almost never perfectly flat. Better results will be obtained by this method if the slide has its convex surface up and the cover has its convex surface down, so that the cellular tissues to be treated lie between two very slightly convex surfaces. It will be found that in this way very compact groups of chromosomes and other similar objects can sometimes be scattered so as to be counted, when otherwise they could not be counted.

There seems to be comparatively little danger of exerting too much pressure. The beginner's tendency at first is to exert, if anything, too little pressure. The greatest difficulty arises from sliding the glasses on each other, since much of this ruins the preparation. To overcome this difficulty, a series of three or four notches, close together, may be filed in the edges of the metal holder before it is folded about the slide—or rather about the metal core on which it is bent, or formed, and which naturally has a little greater width and thickness than the slide. If now the bowed string has a length a little less than the distance between the bottoms of the notches in the edges of the slide-holder, it will be found when it is pressed down that the pointed ends can be tucked through the notches and under the edges of the holder without materially sliding or rotating the spring. The accompanying illustrations will assist in understanding this simple and effective device.

The particular cells to be compressed are prepared and searched out in the usual way, then dissected out together with as little of the surrounding tissue as possible, an operation performed with the aid of an ordinary dissecting microscope. It may be advisable to look at the group of chromosomes from both sides. To do this, the metal holder, instead of having a three-quarter inch perforation, should have a much smaller perforation, say about one-eighth of an inch. Instead of using a 3 by 1 in. glass slide, cement to the inside of the metal holder a thin cover-glass several sizes larger than that to be placed

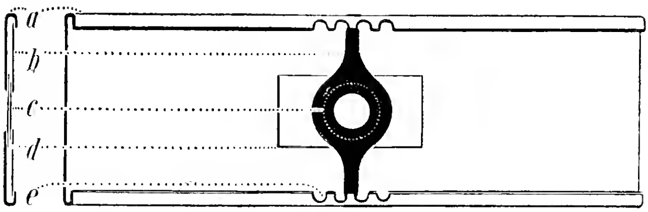


Fig. 6.—A metal holder for clamping a microscopic object between two thin cover-glasses. *a*, metal holder; *b*, steel spring as illustrated in figs. 4 and 5; *c*, small round cover-glass; *d*, rectangular cover-glass underneath the round cover-glass; *e*, notches in the metal holder for the reception of the spring. This holder enables the microscopist to look at the object with an immersion lens from either direction.

over the object. As the metal holder, in order to be stiff enough, has to be several times thicker than the bowed spring, it may be advisable to bevel the edge of the round aperture in the holder, so that it will interfere as little as possible with the use of an immersion objective. On a slide constructed in this manner, the object is held between two cover-glasses, and hence may be viewed from either side with equal ease. Such a slide furthermore permits the use of an immersion lens as a condenser, a proceeding that has advantages.

PROCEEDINGS OF THE SOCIETY.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W., ON WEDNESDAY, JUNE 15TH, 1921, PROFESSOR JOHN EYRE, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of five Candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows :—

Mr. William Ewart Hall.
Mr. Lancelot T. Hogben, M.A., D.Sc.
Mr. Ernest Channing Matthews, F.R.G.S.
Mr. Ernest A. Mignot.

Mr. Conrad Beck, for Messrs. R. and J. Beck, Ltd., exhibited a High-Power Dark Ground Illuminator and an $\frac{1}{8}$th-in. Oil Immersion Objective.

The thanks of the meeting were accorded to Mr. Beck.

The following papers were read :—

Dr. Charles F. Sonntag, F.R.M.S.—
"Some Points in the Histology of the Three-Toed Sloth."

Mr. Frederick Chapman, A.L.S., F.R.M.S.—
"On Ostracoda, Foraminifera, and some Organisms related to Calcisphæræ, from the Devonian of Germany."

Mr. G. T. Harris—
"A Note on Mounting in Glycerine Jelly."

Dr. Monica Taylor and Miss Catherine Hayes—
"The Technique of Culturing Amœba Proteus."

Mr. M. T. Denne, O.B.E., F.R.M.S.—
"A Gregarine Parasite of the Earthworm."

Professor E. Ghosh, M.Sc., M.D., F.R.M.S.—
"New Hypotrichous Infusoria from Calcutta."

The thanks of the meeting were accorded to the authors of the papers.

Professor Frederic J. Cheshire, C.B.E., F.Inst.P., F.R.M.S., read a number of holograph letters written about 1876 by the late Professor Abbe to J. W. Stephenson, on the subject of Abbe's diffraction theory of microscope vision: and exhibitions of interference and diffraction experiments were given by Mr. J. E. Barnard, Mr. J. Rheinberg, Dr. Clay, Mr. H. Emsley, Mr. L. C. Martin, Mr. F. Harrison Glew, Mr. B. K. Johnson, and Professor Cheshire. Mr. Fredk. W. Shurlock, B.A., B.Sc., F.Inst.P., Principal of the Derby Technical College, exhibited in the form of lantern projections some of his diffraction photographs.

As the President had to leave at this stage, the Chair was occupied by Mr. Earland and afterwards by Dr. Murray.

Professor Rama, Mr. Rheinberg and Mr. Conrad Beck took part in the discussion that ensued.

A hearty vote of thanks was accorded to Professor Cheshire and to those gentlemen who had assisted him with exhibits.

Thanks were also accorded to Mr. H. C. Whitfield for his kindness in operating the lantern.

It was announced from the Chair that the next meeting would be held on October 19, and that the Rooms would be closed for the Summer Vacation from August 15 to September 10 inclusive.

The business proceedings then terminated.

JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

DECEMBER, 1921.

TRANSACTIONS OF THE SOCIETY.

XIV.—ON OSTRACODA, FORAMINIFERA, AND SOME ORGANISMS RELATED TO CALCISPHÆRÆ FROM THE DEVONIAN OF GERMANY.

By FREDERICK CHAPMAN, A.L.S., F.R.M.S., etc., Palæontologist to the National Museum, Melbourne, Lecturer in Palæontology, Melbourne University.

(*Read June* 15, 1921.)

ONE PLATE.

INTRODUCTION.

BEING naturally interested in the question of the rarity of Foraminifera in the Devonian Limestones of the world, I have continually looked for opportunities of discovering additional occurrences to those recorded by Terquem.

During the writing of a paper on the Devonian Foraminifera of the Tamworth District, New South Wales,* I had occasion, a few years ago, to re-examine† Terquem's evidence for Devonian Foraminifera recorded by him from Paffrath in the Eifel.‡ At that time I sliced several pieces of Devonian limestone carrying other fossils, specimens of which are in the collection of the National Museum, Melbourne. These gave some good results which I promised to record at a future date. Hence the present paper.

* Proc. Linn. Soc. N. S. Wales, vol. xliii. pt. 2, 1918.

† Op. cit., p. 386.

‡ "Observations sur quelques fossiles des époques primaires," Bull. Soc. Géol. France, sér. 3, vol. viii. 1880, pp. 414–18, pl. xi.

2 A

The Foraminifera described from Tamworth, in the paper just referred to, comprise representatives of the genera *Psammosphæra*, *Valvulina*, and *Pulvinulina*. In alluding to my discovery of micro-organisms in the Devonian of Silesia and Bavaria, as well as that of Paffrath, I there mentioned* that I had found, amongst other remains, those of Radiolaria. From a further study of these and additional examples, I have concluded that they are not of Radiolarian affinities, but are most probably of vegetable origin, and related to *Calcisphæra*, *Sporocarpon*, and *Traquairia*.

The Ostracoda.

In thin sections of the Silesian and Bavarian limestones numerous Ostracods are seen, cut through in all zones. No attempt is made here to indicate their generic relationship. The limestone of Paffrath, Rhenish Prussia, being of a more friable nature, was readily amenable to crushing, whereby the separate carapaces were liberated from the matrix.

In the paper already alluded to,† Terquem states ‡ that he also found "moules d'Entamostraces." He does not figure any of the specimens, but says they belong "propres aux *Bairdia*, *Cythere*, et *Cytherella*." These genera have all been found in the present series, with the addition of *Bythocythere*.

Section PODOCOPA.

Family Bairdiidæ.

Genus *Bairdia* McCoy.

Bairdia curta McCoy. (Pl. VIII, fig. 11.)

Bairdia curtus McCoy, 1844, Synopsis Charact. Carbonif. Fossils Ireland, p. 166, pl. xxiii, fig. 15.

B. curta and vars., Jones and Kirkby, 1879, Quart. Journ. Geol. Soc., vol. xxv. p. 567, pl. xxviii, fig. 8. Jones and Kirkby, 1896, Sci. Trans. R. Dublin Soc., vol. vi. ser 2, p. 196, pl. xii, figs. 21*a*, *b*.

Observations.—The present specimens belong to a narrow, elongate variety. Jones and Kirkby (op. cit., 1896), remark that this Carboniferous species is not known as coming from anywhere abroad; found in the Carboniferous Limestone of England, Scotland and Ireland. We are inclined to look on the present Devonian specimens with a certain amount of reverence, seeing they are

* Proc. Linn. N. S. Wales, vol. xliii. pp. 386–7.
† Bull. Soc. Géol. France, 1880.
‡ Op. supra cit., p. 418.

ancestral to one of the most abundant Carboniferous Ostracods, and hitherto restricted to that and the succeeding Permian formations. The Paffrath specimens show some likeness also to *Bairdia plebeia*, which ranges into the Permian, and is a broader or higher form. *B. curta* has also been recorded * by McCoy from the Carboniferous of Dunvegan, New South Wales.

Dimensions.—Length, 1 mm.; height, 0·4 mm.

Occurrence.—Middle Devonian; Paffrath. Several specimens.

Range.— Middle Devonian to Permian.

Family Cytheridæ.

Genus *Cythere* Müller.

Cythere intermedia Münster. (Pl. VIII, fig. 13*a*, *b*.)

Cythere intermedia Münster, 1830, Neues Jahrb. für. Min., p. 65, No. 22.

C. subreniformis Kirkby, 1859, Trans. Tyneside Nat. Field Club, vol. iv. p. 154, pl. xi, fig. 23.

C. intermedia Münster, Jones and Kirkby, 1865, Ann. Mag. Nat. Hist, ser. 3, vol. xv. p. 409, pl. xx, figs. 9*a–c*.

Observations.—The formerly known range of this species was Carboniferous to Permian. The specimen here figured is generally typical of the species, having an elongate-ovate outline seen laterally, broader anteriorly, and with moderately compressed sides.

Occurrence. — Middle Devonian (*Stringocephalus* Limestone); Paffrath.

Range.—Middle Devonian to Permian.

Genus *Bythocythere* G. O. Sars.

Bythocythere eifeliensis sp. n. (Pl. VIII, figs. 14*a*, *b*.)

Description.—Carapace seen from the side, subrhomboidal, oblique. Hinge-line straight; ventral border gently concave, sloping away to the posterior. Anterior, obliquely truncately rounded to the dorsal margin; posterior, acuminate at the dorsal angle, the margin being fringed with denticles. Carapace compressed ovate, with a depressed marginal flange. Surface distinctly pitted or areolate.

Dimensions.—Length, 1 mm.; height, 0·4 mm.; thickness of carapace, 0·33 mm.

* Ann. Mag. Nat. Hist., vol. xx. 1847, p. 229.

Observations.—There is a Carboniferous species which somewhat resembles the present form in a general way, viz. *Bythocypris antiqua* * from the Lower Carboniferous of Northumberland. That species, however, has a more ovate carapace seen from the side, with a discontinuous marginal flange, and an arched, rather than straight, dorsal line. The surface in both forms is pitted.

Occurrence.—Middle Devonian ; Paffrath. Two specimens.

* Jones, Kirkby and Brady, Ann. Mag. Nat. Hist., ser. 5, xviii. p. 263, pl. ix, figs. 5*a*, *b*.

EXPLANATION OF PLATE VIII.

Fig. 1.—*Sporocarpon aculeatum* sp. n. Upper Devonian : Ebersdorf, Silesia. × 26.

,, 2.—(?) *Sporocarpon dentatum* sp. n. A fragment of the wall. Upper Devonian : Ebersdorf, Silesia. × 52.

,, 3.—*Traquairia tentaculifers* sp. n. Upper Devonian : Schübelhammer, Bavaria. × 26.

,, 4.—*Sporocarpon aculeatum* sp. n. Upper Devonian : Schübelhammer, Bavaria. × 26.

,, 5.—*Calcisphæra spinosa* Williamson. Middle Devonian : Paffrath, the Eifel. × 216.

,, 6.—(?) *Calcisphæra* from interior of *Sporocarpon* shown in fig. 1. × 216.

,, 7.—*Polymorphina archaica* sp. n. *a*, side view ; *b*, oral view. Middle Devonian : Paffrath. × 26.

,, 8.—*Cassidulina devonica* sp. n. Middle Devonian : Paffrath. × 52.

,, 9.—*Polymorphina seminis* sp. n. Middle Devonian : Paffrath. × 26.

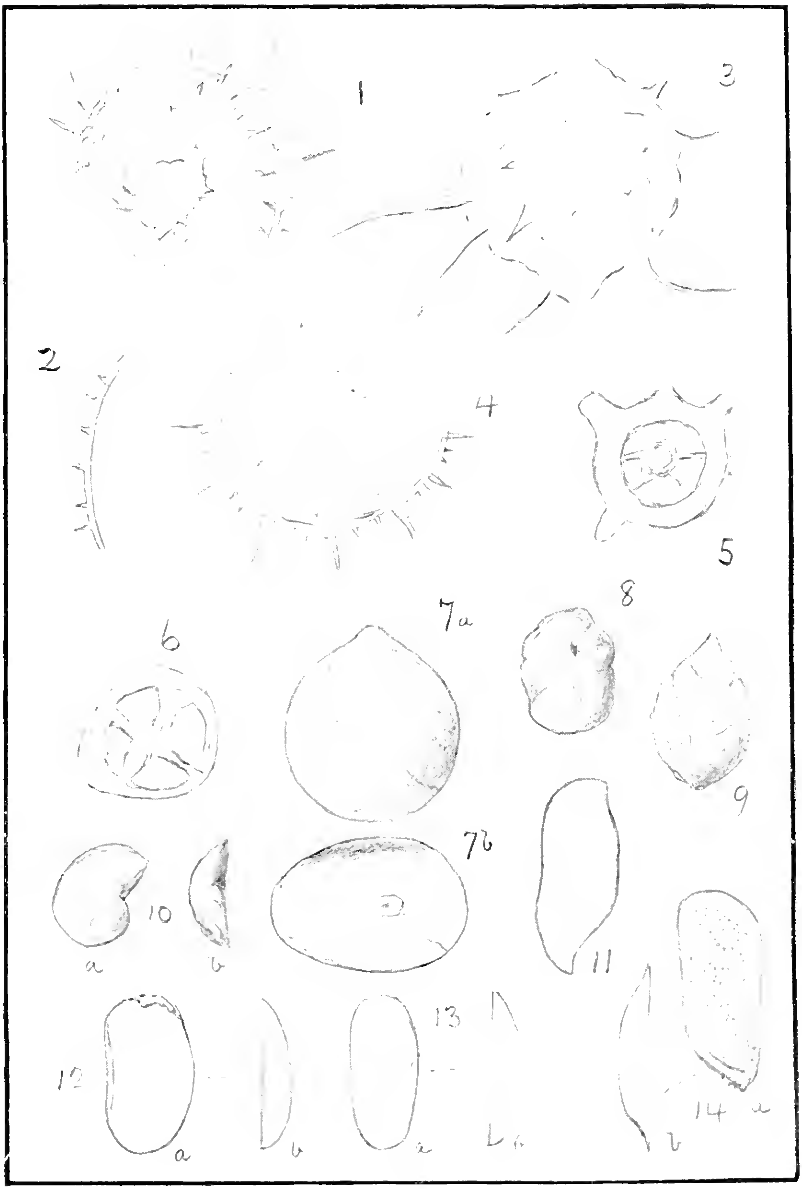
,, 10.—*Truncatulina lobatula* Walker and Jacob sp. *a*, inferior view ; *b*, peripheral view. Middle Devonian : Paffrath. × 26.

,, 11.—*Bairdia curta* McCoy. Carapace seen from the left side. Middle Devonian : Paffrath. × 26.

,, 12.—*Cytherella prevalida* sp. n. *a*, seen from the left side ; *b*, edge view. Middle Devonian : Paffrath. × 26.

,, 13.—*Cythere intermedia* Münster. *a*, carapace seen from the left side ; *b*, edge view. Middle Devonian : Paffrath. × 26.

,, 14.—*Bythocythere eifeliensis* sp. n. *a*, carapace seen from the left side ; *b*, edge view. Middle Devonian : Paffrath. × 26.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Section MYODOCOPA.

Family CYTHERELLIDÆ.

Genus *Cytherella* Jones.

Cytherella prevalida sp n. (Pl. VIII, figs, 12*a*, *b*.)

Description.—Carapace seen from the side, bean-shaped or elongately ovate; ventral margin gently incurved, dorsal widely arched; anterior broadly rounded, posterior narrowly rounded. Edge view depressed ovate, median area compressed.

Dimensions.—Length, 0·78 mm.; height, 0·44 mm.; thickness of carapace, 0·3 mm.

Observations.—This form is fairly common in the small amount of residue from the limestone. In general form it resembles the Carboniferous species *Cytherella valida*, Jones, Kirkby and Brady,* but is smaller, more compressed, and broader anteriorly.

Occurrence.—Middle Devonian; Paffrath.

THE FORAMINIFERA.

Family LITUOLIDÆ.

Genus *Ammodiscus* Reuss.

Ammodiscus incertus d'Orbigny sp.

Operculina incerta d'Orbigny, 1839, Foram. Cuba, p. 49, pl. v, figs. 16, 17.

Trochammina incerta d'Orbigny sp., Brady, 1876, Carboniferous and Permian Foram., Pal. Soc. Mon., vol. xxx. p. 71, pl. ii, figs. 10–4.

Ammodiscus incertus d'Orbigny sp., Chapman and Howchin, 1908, Mon. Foram. Permo-Carb. N. S. Wales, Pal. Mem., No. 14, Geol. Surv. N. S. Wales, p. 10.

Observations.—A minute test of this species was seen in one of the thin sections of the limestone, consisting of several convolutions, and having a fine sandy test. I have found this species in the Silurian of Lilydale, Victoria, and it ranges upward to recent times.

Occurrence.—Upper Devonian (*Clymenia* Kalk); Schübelhammer, Bavaria.

* Pal. Soc. Mon. 1884, Mon. Brit. Foss. Bivalved Entom. of Carbonif. Form., pt. 1, No. 2, p. 70, pl. vi, figs. 2*a–e*.

Genus *Endothyra* Phillips.

Endothyra bowmani Phillips.

Endothyra bowmani Phillips, 1845, Proc. Geol. Tech. Soc. West Riding, Yorkshire, vol. xi. p. 279, pl. vii, fig. 1. Brady, 1876, Mon. Carb. and Perm. Foram., p. 92, pl. v, figs. 1–4. Chapman and Howchin, 1905, Mon. Foram. Perm. Carb., Pal. No. 14, Geol. Surv. N. S. Wales, p. 12, pl. i, figs. 13*a–c*.

Observations.—Several tests were found, which represent a rather tumid variety of this otherwise typically Carboniferous fossil.

Occurrence.—Middle Devonian (*Stringocephalus* Limestone); Paffrath.

Family Textulariidæ.

Genus *Cassidulina* d'Orbigny.

Cassidulina devonica sp. n. (Pl. VIII, fig. 8.)

Description.—Test very minute, apparently arenaceous, and thus differing from the typical *Cassidulinæ*; in all other respects similar. Ovoid or roundly oblong, with numerous sub-tumid chambers and slightly incised suture lines. Aperture, subcircular, bulimine. Length of figured specimen, 0·3 mm.

Observations.—Several examples, of fairly uniform size, were found in the washings. The form of the test resembles *C. subglobosa* Brady,* but the aperture is more centrally placed.

Occurrence.—Middle Devonian (*Stringocephalus* Limestone); Paffrath, the Eifel.

Family Lagenidæ.

Genus *Polymorphina* d'Orbigny.

Polymorphina archaica sp. n. (Pl. VIII, fig. 7.)

Description.—Test sub-globose, compressed on two sides. Chambers few, lageniform. Aperture phialine and corrugated on the margin. Surface slightly granulate. Colour pale brown.

Dimensions.—Length, 0·99 mm.; greatest width, 0·99 mm.; width on axis of compression, 0·66 mm.

Observations.—In its general shape this species resembles *Polymorphina gibba* d'Orbigny,† but has a more exsert aperture, less tumid chambers and a sub-granular surface.

Occurrence.—Middle Devonian (*Stringocephalus* Limestone); Paffrath, the Eifel.

* Rep. Chall., vol. ix. 1884, p. 430, pl. liv, figs. 17*a–c*.

† *Polymorphina (Globulina) gibba* d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 266, No. 20; Modèle, No. 63.

Polymorphina seminis sp. n. (Pl. VIII, fig. 9.)

Description.—Test ovate, apiculate at the aboral end; oral aperture prolonged, tubular. Surface rough or acerate, with short blunt prickles. Sutures few, test not compressed.

Dimensions.—Length, 0·74 mm.; breadth, 0·48 mm.

Observations.—This species shows some resemblance to *P. sororia* Reuss,* but is rather shorter than typical specimens of that form; moreover it is distinguished by the prickly or acerate surface and tubular orifice.

Occurrence.—Middle Devonian (*Stringocephalus* Limestone); Paffrath, the Eifel.

Family Rotaliidæ.

Genus *Truncatulina* d'Orbigny.

Truncatulina lobatula Walker and Jacob sp. (Pl. VIII, figs. 10*a*, *b*.)

Nautilus lobatulus Walker and Jacob, 1798, Adams' Essays, p. 642, pl. xiv, fig. 36.

Truncatulina lobatula W. and J. sp., Brady, 1884, Rep. Chall., vol. ix. p. 660, pl. xcii, fig. 10; pl. xciii. figs. 1, 4, 5; pl. cxv, figs. 4, 5.

Observations.—The specimen figured here is a typically shaped, though somewhat starved example. It has a comparatively high test, fairly numerous chambers, and the re-entrant oral region is conspicuous.

Dimensions.—This Devonian specimen measures 0·52 mm. in width, whereas living examples can be found with a width of more than 2 mm.

Range.—This appears to be the oldest recorded occurrence of *Truncatulina lobatula*. Other palæozoic representatives of the genus are to be found in the Carboniferous of Belgium,† the Carbo-permian of Pokolbin, New South Wales,‡ and the Carbopermian of Collie, W. Australia.§

Occurrence.—Middle Devonian (*Stringocephalus* Limestone); Paffrath, the Eifel.

The Calcisphæræ and other Related Organisms.

Whilst searching over thin sections of Devonian Limestone for any evidence of Foraminifera or Ostracoda, I came across numerous

* *Polymorphina* (*Guttulina*) *sororia* Reuss, 1862, Bull. Acad. Roy. Belg., ser. 2, vol. xv. p. 121, pl. ii, figs. 25–9.

† *Truncatulina carbonifera* Brady, Mon. Carbonif. and Perm. Foram. Pal. Soc. Mon., vol. xxx. 1876, p. 138, pl. vi, fig. 10. *T. boueana* d'Orb. sp., Idem. ibid., p. 139, pl. vi, fig. 11.

‡ *Truncatulina haidingeri* d'Orb. sp., Chapman and Howchin, Mem. Geol. Surv. N. S. Wales, Pal. No. 14, 1905, p. 18, pl. iii, figs. 3*a–c*.

§ *Truncatulina haidingeri* d'Orb. sp., Chapman, Bull. 27, Geol. Surv. W. Australia, 1907, p. 17, pl. ii, figs. 7*a*, *b*.

minute organisms which at first sight seemed to be Radiolarians. Upon sketching them I was struck with their comparatively large dimensions. Their average diameter was about 1 mm., whereas the Spumellarian Radiolaria generally measure one-sixth of that. Moreover the bent and twisted appearance of some of their spines seemed to point to a flexibility seen in spores, but not so strikingly exhibited in the Radiolaria.

The late Dr. W. C. Williamson made a special study of small bodies in Carboniferous rocks, which he named *Sporocarpon* and *Zygosporites*, and also referred to the genus *Traquairia* of Carruthers. These organisms are generally spherical and with radiating spines. The spheres frequently enclose smaller rounded bodies, and were consequently regarded by Williamson as megaspheres having Lepidodendroid affinities.*

The present examples are about twice the diameter of those found by Williamson in the Carboniferous of Yorkshire and elsewhere, but in every other way resemble them. Other smaller bodies, often numerously represented in the Carboniferous Limestone of Britain, were termed by Williamson *Calcisphæræ*. They were regarded by Professors Sollas and Judd as true Radiolaria, with which they compare both in size and shape, and in having in some cases slender spines. The ornament of the *Calcisphæræ* is moreover, often like the meshwork of a Radiolarian, but as a rule much finer in texture. The chief objection that has been raised against their Radiolarian affinities is the fact that they are now in the form of calcite ; but in view of the calcified Radiolaria in the Chalk this difficulty is not insuperable.

The chief argument against their being siliceous Radiolaria replaced by calcite is that they are invariably calcareous, so far as I am aware, whilst other, siliceous, bodies in the same rock are not replaced by calcite. At present I am inclined to think that the balance of evidence is in favour of these minute bodies bearing a relationship to certain calcareous algæ such as the *Rhabdospheres* and *Coccospheres*, which are so abundant in modern calcareous oozes.†

Seeing the present rock samples are marine limestones (*Orthis*, *Stringocephalus* and *Clymenia* faunas), to find the spore-like bodies, here referred to *Sporocarpon* and *Traquairia*, may seem anomalous. But it is just as feasible as it is to discover drifted wood in Chalk (Purley, England), or in the Rolling Down Limestone (Queensland), for these apparently difficultly destructible organisms may easily have survived the ordeal of drifting by streams flowing into a clear deep sea.

* See Williamson, W. C., "On the Organization of the Fossil Plants of the Coal Measures," pt. 10, Phil. Trans. R. Soc., vol. clxxi. pt. 2, 1889, pp. 493–539, pls. xiv–xxi.

† This was also reservedly suggested by Williamson, Phil. Trans., 1880, vol. clxxi. p. 525.

The genera *Sporocarpon* and *Traquairia* were actually found *in situ* in the strobils of *Lepidodendron*, so that in their case the relationship is certain. As regards the *Calcisphæræ*, if these *are* the microspores of Lepidodendroid plants—and the similarity of one occurrence in the present series seems to point in that direction (Pl. VIII, fig. 6)—one difficulty would be their extreme abundance in some limestones, as in the Devonian "Corniferous Limestone" of Kelly's Island, U.S.A., cited by Williamson.*

Description of the Organisms.

Genus *Sporocarpon* Williamson, 1878.†

Sporocarpon aculeatum sp. n. (Pl. VIII, figs. 1, 4, 6.)

Description.—Body spherical. The surface covered with a fine reticulum, and having a fairly close ornament of short and long spines. The longer spines are slightly flexed, the shorter spines apparently rigid. Under a high magnification the interior is seen to contain small spherical bodies which resemble the *Calcisphæræ* of the Carboniferous Limestone. These small bodies are roughly orbicular, and have fairly thick walls supported by radial partitions, and sometimes with a central rounded nucleus.

Dimensions.—Diameter, 1·07 mm.; length of longer spines, 0·42 mm.; length of smaller spines, 0·15 mm.

Observations.—These bodies might easily be mistaken for Radiolaria of the genus *Heliosphæra*, as indeed the writer did at the outset. They are, however, about six times as large, and the cortex has a different appearance from that of the Radiolarian structure, giving the impression of a thin chitinous or calcareous investment. The genus is clearly of Lepidodendroid affinities, as shown by Williamson.

Occurrence.— Upper Devonian; Ebersdorf, Silesia. Upper Devonian; Schübelhammer, Bavaria.

(?) *Sporocarpon dentatum* sp. n. (Pl. VIII, fig. 2.)

Description.—The capsule wall is never complete in the sections, only fragmentary arcs being preserved. The wall is extremely thin and the exterior covered with short denticles. This form differs from *Sporocarpon*, as described by Williamson, in the thinness of the wall.

Dimensions.—Diameter of an average completed sphere, about 1·3 mm.

* Phil. Trans., vol. clxxi. 1880, p. 523.

† Phil. Trans., vol. clxix. p. 347 (footnote).

Observations.—In *Zygosporites* * the spinules on the exterior are short and sparse, but usually blunt or expanded at the tip. *Sporocarpon, sensu stricto*, has a thick and even cellular wall.

Occurrence.—Upper Devonian; Ebersdorf, Silesia. Also Schübelhammer, Bavaria.

Genus *Traquairia* Carruthers, 1872.†

Traquairia tentaculifera sp. n. (Pl. VIII, fig. 3.)

Description.—The body of the (?) megaspore is roughly spherical, with numerous depressions between the bases of the flexuous spines. The irregular shape of the sphere suggests a thin cortex which has shrunk. The larger spines number about 12 to 14 on the entire surface. Smaller spines more numerous.

Dimensions.—Diameter of body, 1·27 mm.; length of primary spines, 0·92 mm.; length of secondary spines, 0·23 mm.

Observations.—This form might also easily be mistaken for a *Heliosphæra*. Its large size and shrunken body with very flexible spines makes its plant origin more certain.

Occurrence.—Upper Devonian; Schübelhammer, Bavaria.

Genus *Calcisphæra* Williamson, 1880.‡

Calcisphæra spinosa Williamson. (Pl. VIII, fig. 5.)

Calcisphæra spinosa Williamson, 1880, Phil. Trans. Roy. Soc., vol. clxxi. p. 522, figs. 70–77 (especially figs. 74 and 75).

Observations on Present Specimens.—Body spherical, inner sphere about one-fourth the diameter of the outer. Connected to the outer sphere by numerous slender radii. Wall of outer sphere with about five blunt processes showing in one plane.

Dimensions.—Diameter of outer sphere, 0·08 mm.; diameter of inner sphere, 0·022 mm.

Occurrence.—Middle Devonian (*Stringocephalus* Limestone); Paffrath, the Eifel.

Calcisphæra within a *Sporocarpon*. (Pl. VIII, fig. 6.)

Description.—A spherical body, one of many less distinct in appearance, seen under a high magnification resting within the

* Phil. Trans., vol. clxxi. pt. 2, p. 516, pl. xix, fig. 55.

† Quart. Journ. Micr. Sci., n.s. vol. xviii. 1872, p. 397. Also Rep. Brit. Ass. Adv. Sci. Brighton, 1872, p. 126. See also Williamson, W. C., Ibid., Dublin, 1878. p. 534. *Note.*—The original spelling is correctly given as *Traquairia*, but later references have it written *Traquaria*.

‡ Phil. Trans. Roy. Soc., vol. clxxi. p. 521.

cortex of *Sporocarpon aculeatum* (see fig. 1), from the Upper Devonian of Ebersdorf. The dimensions of this example are almost exactly that of the typical *Calcisphæra spinosa* Williamson, being 0 092 mm. in diameter. In this specimen the central sphere usually present is reduced to a mere junction of the radii.

Remarks on the Affinities of the Genera Treated.

Traquairia.—This genus was referred to in the original note in the Quarterly Journal of Microscopical Science (ref. *antea*) as a Radiolarian rhizopod, by Carruthers. In the discussion on that paper, Prof. Thiselton Dyer thought they were not related to *Xanthidia*, but were probably the resting stage of some animal organisms.

From the cellulose appearance of the outer covering or "capsule wall," and the frequent inclusion of smaller spore-like bodies, it seems highly probable that they must be referred to plant structures, and indeed there seems quite satisfactory evidence in support of this, given by Williamson,* who found *Traquairiæ* in a crushed strobilus of *Lepidodendron* from the Carboniferous of Yorkshire. It is quite easy to conceive how such megaspores, showered in myriads and drifted by the wind into tidal lagoons, might float into a deep-water area, and so become included in the moderately deep-water marine limestone of the Carboniferous and Devonian sea-beds.

Sporocarpon.—It is of much interest to note that the organisms referred to this genus by Williamson had the assumption of their plant origin well supported by the presence of little microscopic bodies within the capsule. Should the specimens here figured as *Sporocarpon* be rightly assigned to that genus, the little *Calcisphæra*-like bodies found within one of them seem to point conclusively to the relationship and even identity of those and the true *Calcisphæræ* of the Carboniferous Limestone. Both the free and included forms were found in the Devonian Limestones examined during the writing of this present notice.

Calcisphæra.—In these, mostly minute bodies, the outer capsule is usually of considerable thickness, and the form regularly spherical. The Carboniferous Limestone examples generally have a fine spinose covering, but sometimes with stronger radii, as seen in a similar form figured here in fig. 5. The figure 6, from the interior of a *Sporocarpon* from Ebersdorf, is so like the typical *Calcisphæræ*, both in shape and structure, that their relationship seems apparent. If of the nature of the *Coccospheres*, as Williamson

* Phil. Trans. Roy. Soc., vol. clxxi. pt. 2, 1880, p. 532.

suggests,* but with a complete capsule instead of a platy one, what is the nature and function of the enveloping capsule-wall as seen in *Sporocarpon?* On the other hand, there is some ground for thinking with Williamson, that they are the reproductive capsules of certain marine vegetable organisms. In both cases we would therefore assume that in regard to the included bodies found in *Sporocarpon* they are only similar in form, but widely different in origin.

* Phil. Trans., vol. clxxi. 1880, p. 525.

XV.—A PRELIMINARY ACCOUNT OF THE SPERMATOGENESIS OF SPHENODON.

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Eighteen Text-Figures.

Seeing that the Tuatara is rapidly becoming extinct, the opportunity of making some observations upon the chromosome component of the germ cells merits record; and it is the first duty of the author to tender cordial thanks to Prof. Dendy, who generously placed the material for the research at his disposal. Hitherto no publications dealing with the cytology of Sphenodon have appeared; and our knowledge of gametogenesis among Reptilia as a whole is remarkably limited. The only data available refer to two Chelonian and two Lacertilian genera. Jordan (1914) issued a brief note on the first spermatocyte mitosis in *Chrysemis* and *Cistudo,* indicating the presence of an X-element in the former. Trinci (1908) gave an admirable account of the synaptic phenomena of *Anguis,* but was unable to furnish accurate data respecting the diploid complex. Tellyesnicsky (1897) in an early memoir on the histology of the testis quotes the number twenty-four for dividing spermatogonia in *Lacerta*; and Mlle. Loyez in a monograph on vitellogenesis mentions the same figure for the oogonial chromosomes of *Anguis* and *Lacerta.* There is thus no complete study of gametogenesis in any reptile available at present. Yet judging from the illustrations of Trinci and the phenomena observed in Sphenodon the Reptilia should provide a most profitable field of enquiry for those interested in chromosomal heteromorphism and its bearing upon the theory of synapsis.

The material here described consisted of a series of sections 7 to 10 mm. in thickness from the testis of a single individual preserved by Prof. Dendy with aceto-bichromate; though the gonads were fixed *in situ* the microscopic detail proved on examination to be remarkably good; and, while some of the more elusive stages were not adequately treated, for most purposes the preparations were quite satisfactory. It would appear that the strength of the reagent chanced to be approximately appropriate to the osmotic pressure of the tissue fluids; and owing no doubt to the paucity of adipose tissue in any part of the organ penetration was not unduly impeded in the outer layers upon which all the observations recorded were founded. For staining Prof. Dendy's assistant, Mr. Biddulph, employed iron brazilin with excellent results; a few preparations, however, were restained with iron-hæmatoxylin. In view of the limited amount of material available for study and certain intrinsic difficulties which made further confirmatory data desirable, I should not have ventured to place on record the fruit of my studies were it not for the fact that Sphenodon is now very rare; and that some acquaintance with the gametogenesis of the sole surviving member of an extremely archaic stock may prove of considerable interest when our knowledge of reptilian cytology has been further extended. The work of E. Browne Harvey in collecting an exhaustive index of the chromosome numbers of the Metazoa raises possibilities of such signal genetic and systematic interest as to encourage this expectation. In any event, the facts cited may stimulate others to undertake further investigation, should the author be unable to renew the study of this species.

Owing to the confused state of the terminology employed with reference to the reduction divisions, etc., at Prof. Dendy's suggestion the following glossary notes are introduced. The *premeiotic* phase of nuclear history (Farmer and Moore) comprises all the cell generations characterized by the diploid number of chromosomes, including thus the oogonial and spermatogonial as well as somatic mitoses. For the different stages in nuclear division Strassburger introduced the terms *pro-*, *meta-* and *anaphase* (1884); Haidenhein (1894) added *telophase* for the processes immediately antecedent to the resting stage, for which Bolles Lee (1912) proposed *spirophase* or *interphase*. The *meiotic* phase (Farmer and Moore, 1905) in animals includes the series of nuclear phenomena between the last spermatogonial or oogonial telophase and fertilization or the inception of cleavage; Flemming's terms for the first and second reduction divisions, the *heterotype* and *homotype* respectively, are still in use. The nomenclature of *synapsis*, or the means by which the reduction of the chromosomes is effected in preparation for the heterotype mitosis, is entirely modern. Moore originally defined synapsis as the contraction of the chromatin content of the nucleus from the nuclear membrane in the primary spermatocyte or oocyte; but as the belief has gained ground that this contraction synchronizes with numerical reduction, the term has been used by later writers for the actual pairing of the univalents, although McClung (1905) and Hacker (1909) have since distinguished the former from the latter as respectively *synizesis* (contraction) and *syndesis* (pairing). Two interpretations of synapsis have been put forward by animal cytologists: parallel conjugation (*parasynapsis* or *parasyndesis*), reduction by the lateral approximation in pairs of the representatives of the premeiotic chromosomes; and terminal union (*telosynapsis* or *metasyndesis*), reduction by the adherence of the univalents end-to-end.

Parasynapsis and telosynapsis are used in an altogether different sense by plant cytologists (cf. Farmer, Ann. of Bot., vol. 26). For the events which occur between the last premeiotic telophase and the heterotype metaphase the system of de Winiwarter (1900) is now generally employed—viz. (1) *leptotene* stage, or *leptonema*, for the initial stages in which the nucleus is filled with fine attenuated filaments, generally (a notable exception being Wilson's Hemiptera) displaying a polarized or "bouquet" orientation. Those who advocate parasynapsis contend that the leptotene threads are diploid in number and identify a succeeding *zygotene* (Gregoire, 1907 = *amphitene* of Janssens, 1905) phase, in which they are seen to be assorted in laterally approximated pairs, contracted from the nuclear membrane in very many cases. (2) *pachytene* stage, or *pachynema*, in which the reduced number of thickened and undivided filaments is present in the nucleus: when contraction (synizesis) occurs it attains its maximum at this stage. (3) *diplotene* stage (also called *strepsitene*), in which the reduced chromatin filaments display a well-marked longitudinal cleavage (4) *diakinesis*, in which the definitive heterotype chromosomes or *tetrads* lie well separated upon the nuclear membrane, the term tetrad being used descriptively whether the bivalents are quadrangular or not, and without any theoretical implication as to their constitution or mode of subsequent division. The reality of synapsis is inferred from the existence of similar heteromorphic groups (diploid chromosomes) in different individuals of the same species: in the interpretation of synapsis the difficulty of referring the axes of fission in the reduction divisions to the plane of cleavage in the diplotene filaments from which the tetrads are derived is the centre of controversy.

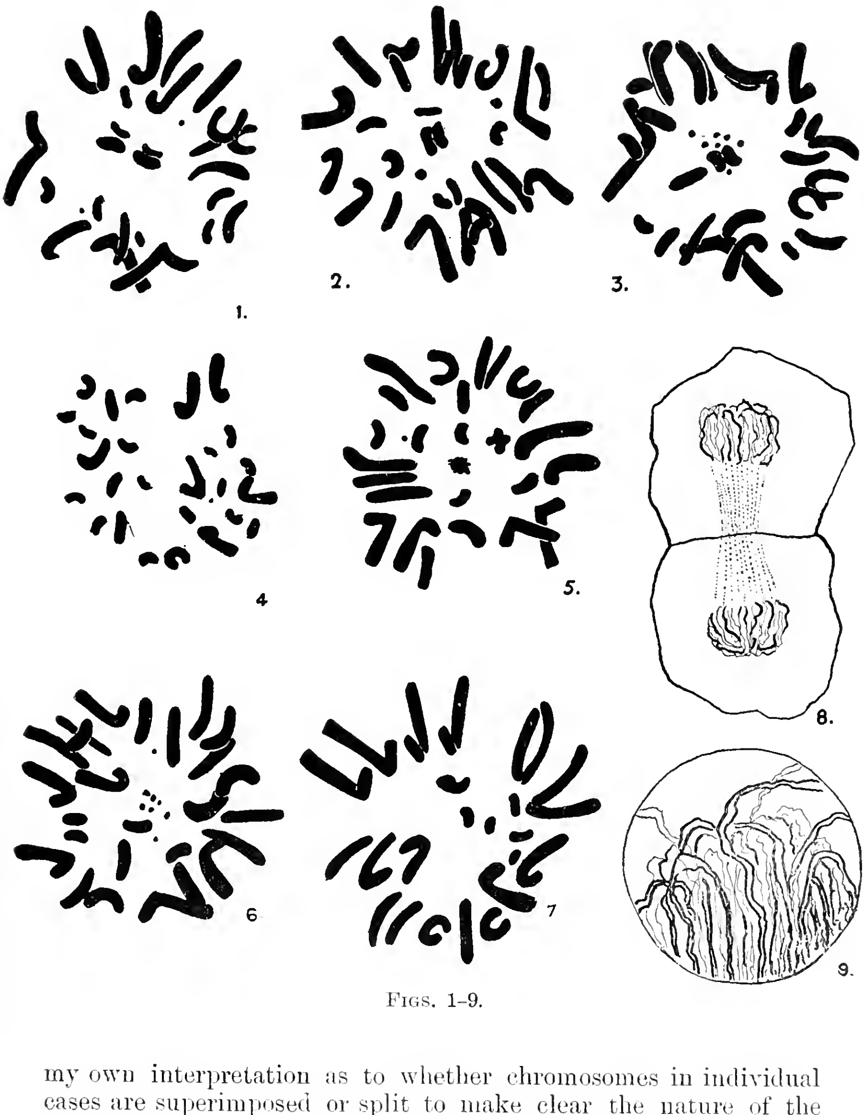
The testes of Sphenodon consist of masses of tubules made up of spermatogonia, spermatocytes, spermatozoa and sustentacular cells, arranged as in Mammals except that there is only a very small amount of vascularized connective tissue in their interstices, and no signs of interstitial epithelioid elements are recognizable. The spermatogonia constitute the outermost layer; and as is frequently the case, contiguous cells on the whole show similar stages in nuclear history, so that mitoses commonly occur in groups. The prophase chromosomes exhibit the same type of behaviour that I have described in *Libellula*, appearing first as attenuated convoluted filaments which progressively become shorter and stouter in anticipation of the cleavage which is not manifest until metaphase: at no stage is there anything suggestive of a *continuous spireme*. An insufficient sequence of well-preserved cells in telophase were observed to provide critical data; but a few figures clearly indicated vacuolization and well-marked polarity in the disposition of the filaments. The polarity of the telophasic units has been emphasized again and again by botanical cytologists, though with the exception of a very few, notably Bolles Lee and Bonnevie, investigators of animal forms, have not directed attention to it: its revelance to the interpretation of synapsis in animals I have pointed out in a previous paper.

The estimation of the metaphase complex is rendered difficult by the fact that the heteromorphic elements are closely packed and to some extent always superimposed, so that mitoses in which each individual chromosome is completely separate from its neighbours, and any chance of confusing V-shaped elements with rods that are contiguous at one extremity only is eliminated, are extremely rare. A more striking case of the differentiation of a diploid complex into pairs of different sizes and shapes could hardly be cited: not two pairs of chromosomes are precisely the same size, and with respect to shape at least five distinct types are recognizable. Of these three pairs may be stated to display subterminal attachment to the fibres of the achromatic spindle; two of them are most conveniently described as J's, the other having the form of a square root sign. The latter are well seen in text-figs. 1 and 3. Of the remainder, which appear to be uniformly symmetrical, one pair is similar in shape to a horseshoe, and the remainder, probably nine pairs, are straight or bent rods and small arcs.

In most equatorial plates a varying number of minute granules is seen, usually in the centre; these are comparable to the cloud of particles seen in the polar metaphase of the oöcytes of *Phragmatobia* by Seiler. According to Seiler they are chromatinic. I have not had the opportunity of testing their reactions in the Tuatara, since in differentiating nucleolar (plasmosome) material from chromatin by such methods as that of Auerbach, previous treatment with acetic acid must be avoided; consequently I am not in a position to be dogmatic as to the nature of these granules. But I may at the same time add that I am not satisfied with the evidence for Seiler's interpretation.* They occur prolifically in the heterotype mitosis of *Hatteria*, and are found clustered round the polar ends of the spindle, as indicated in text-fig. 14. On the whole they are reminiscent of the persistent remnants of the plasmosome in *Libellula* and *Periplaneta*; and in this connexion it may be remarked that Jordan refers to the formation of chromidia in the Chelonian genera. Owing to the confusion arising especially from the binuclearity hypothesis, it has been of late the fashion to disregard the existence of nuclear emissions, as Beckwith, and in earlier work, Gatenby, have done; but the work of Dendy, Buchner,

* Shortly before his death the late Prof. Doncaster wrote to me stating that on reinvestigation of similar granules to those of Seiler in *Abraxas*, he was convinced that they were not chromatinic. Since he was unhappily prevented from publishing any results under this heading, as one of his pupils I take the opportunity of adding this footnote.

Jörgensen and myself has amply established that the plasmosome can both in the interphase and the kinetic stages of nuclear history discharge material into the cytoplasm. Altogether I have figured seven out of a dozen fairly satisfactory metaphase sections, giving



Figs. 1–9.

my own interpretation as to whether chromosomes in individual cases are superimposed or split to make clear the nature of the difficulty. Text-fig. 4 was in every way most satisfactory, and taken with fig. 1 would suggest a complex of 28 units, including a pair of m-chromosomes: on the other hand figs. 2, 5, 6, 3 indicate stages in the disintegration of the nucleolar remnant; and other sections showed many more granular bodies. In fig. 7 it is not possible to recognize more than 26 elements with certainty. Having made clear the possible sources of error, I should quote this number tentatively for the diploid complex; this is slightly greater than the number characteristic of Amphibia, uniformly found in the *Urodela*, and, according to Loyez, in *Anguis* and *Lacerta*. As the last-named author gives no figures, and proffers the observation quite incidentally to her main purpose, serious importance is not due to it in view of the difficulty in estimating heteromorphic complices of high number. One suggestion may however be submitted—namely, that the three pairs of chromosomes which show subterminal attachment to the spindle are compound. It is not my purpose to discuss the possible value of studying the heterotype division from this standpoint for the elucidation of numerical chromosome relations in phylogeny. If the above speculation is sustained by subsequent research, the correct diploid number for reptiles would be primitively 26 + 6, or 32, for which the haploid equivalent would be 16, that cited by Jordan for the Chelonian *Cistudo*.

Close scrutiny of the mitotic figures given will reveal a clear correlation in size and shape of the component elements of the different complices. To appreciate this constancy it is of course necessary to take into account the fact that the shape of any element is conditioned by the plane in which it is viewed; and when, as in the present instance, the number of chromosomes is considerable, one rarely finds showing every member of the group lying in the same plane without prolonged and patient searching. Thus the extra pair of apparently J-shaped elements in fig. 2 are seen on changing focus to be bent rods. Furthermore, comparison must always be made at precisely the same stage of condensation upon material, showing as far as possible identical condition as regards preservation. Fig. 4, it should be noted, is an early anaphase. Thus purely negative criticism of the constancy of heteromorphic groups such as that of Foot and Strobell is of little weight in comparison with the positive testimony of a large body of workers in the same field. I have considered the possibility that the granular bodies referred to are supernumerary chromosomes such as were originally described by Stevens in insects and in one vertebrate type, *Necturus*, by King. This is excluded by their inconstancy. There does not appear to be an unpaired element nor a chromatin nucleolus corresponding to such a structure in the spermatocytes; neither has the study of the reducing divisions indicated the presence of X or Y chromosomes. That the inconstant (? nucleolar) bodies are seen to pass to the poles of the spindle is interesting in the light of Carleton's demonstration of the continuity of an intranucleolar element. Carleton's suggestive work makes it imperative that the whole subject of supernumerary, and it may be added, many instances of m-chromosomes, should be handled very carefully, particularly in the absence of specific staining diagnosis of chromatin; it would be profitable to repeat such observations on material fixed by the newer methods introduced for the study of the extranuclear cell inclusions.

The nuclear history of the first spermatocyte in Sphenodon so closely resembles earlier meiotic stages of *Anguis* that Trinci's excellent illustrations of the latter may be referred to as typical of the salient features of corresponding phenomena in the former. As in Vertebrates generally, the seriation of the various stages of maturation roughly corresponds to the radial axis of each testicular tubule; but for practical purposes no assistance is afforded by the structure of the testis in the study of individual stages in the sequence of events which intervene between the last spermatogonial telophase and the first reducing division. The order of these can only be recognized by the characteristic peculiarities of the synaptic processes and actual continuity based on the study of a large number of cells.

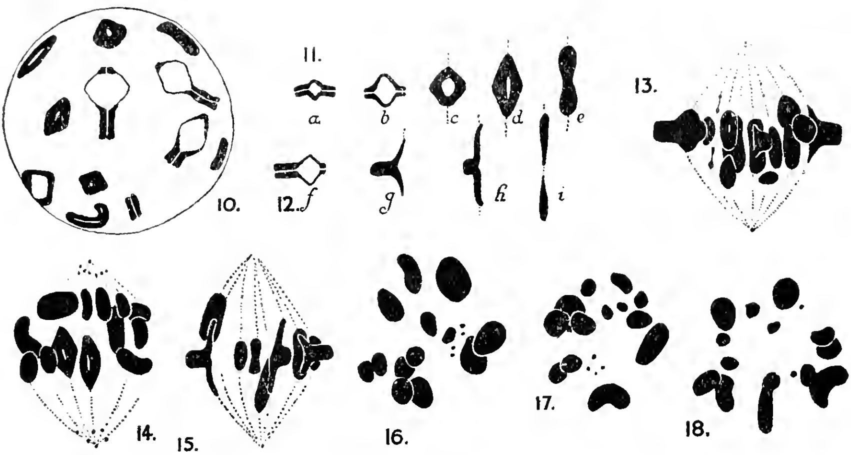
A few late spermatogonial telophase figures indicate as in fig. 8, which is somewhat diagrammatic, that the telophase chromosomes spin out directly into the fine attenuated and convoluted filaments of the earliest meiotic stage or leptonema without the intervention of a diffuse condition. Since with the exception of the interphase (resting nucleus) structure the leptotene threads are more difficult to fix than any other stage in the history of chromosomes in the germ cell cycle, the value of the data obtained is limited by the technique employed, and none of the preparations examined were in such a perfect condition that the number of loops could be estimated in optical sections, as I have been able to do in the study of *Periplaneta.* Clearly the number of leptotene loops is very much greater than in the succeeding stages, when reduction has taken place; clearly, too, the leptotene stage does not partake of the nature of a continuous spireme such as is described by those who advocate telosynapsis. In good sections the leptone loops show the orientation so characteristic of this stage, and, as I have elsewhere insisted, the reduction in number of loops that retain their polarized disposition throughout the synaptic processes can only be effected by lateral approximation. The filaments at first lie peripherally in contact with the nuclear membrane, contracting slightly in the succeeding phase. In process of contraction they become more closely approximated, and reduction in number of the loops is effected thereby; in a few cases it could be definitely seen that this does actually take place by their lateral association in pairs. The slight degree of contraction in *Anguis* and Sphenodon as in Mammals (cf. de Winiwarter and Federley) indicates that the Reptiles should prove specially favourable for the study of synapsis. That this process of pairing actually constitutes syndesis or synapsis cannot be strictly inferred, seeing that the actual numerical relations of the loops were not actually estimated before and after the process; it can, however, be said that the whole course of events is entirely characteristic of other forms where the correspondence of the leptotene loops and telophase chromosomes has been established.

Previous remarks on the genesis of the leptotene loops indicate that for *Hatteria*, as in the case of *Libellula*, I regard the polarity of the telophase as affording the key to the interpretation of the "bouquet" figure (fig. 9). I am aware that some of the most competent animal cytologists who have investigated the meiotic phase, as, for example, de Winiwarter and Agar, describe a diffuse and tangled leptotene stage before the bouquet arrangement is manifest; but, since the arrangement of the leptotene filaments is often so intricate that only when seen in a plane parallel to the axis of the bouquet can its character be recognized, and since moreover the susceptibility of the leptotene filaments to defective technique is notorious, the interpretation that I have given in the case of *Libellula* merits a renewed attention to the origin of the bouquet loops. Dr. Ruggles Gates has pointed out to me as an objection to a telophasic interpretation of centrotaxis that the position of the attraction sphere with reference to the convergence of the loops is different in the two cases; but Morse's observation on the position of the centrioles in relation to the synaptic processes of Blattids weaken this contention. Further light on this point should be obtainable from the study of meiotic nuclei from cells showing spindle remains such as are frequently found in the rosettes of oocytes in ovarioles of Hymenoptera.

The approximation of the contracted filaments to form the thickened reduced pachytene threads is soon followed by a loosening of the bouquet figure, so that the still polarized chromatin loops become once more contiguous with the nuclear membrane, and now display the marked longitudinal fission which defines the diplotene stage and leads up to the elaboration of the heterotype chromosomes. The uniformity which prevails in the meiotic phase of animals is specially emphasized at this point, for the diplotene stage is one that is universally present; and this, it appears to me, constitutes a formidable, if not indeed an impregnable, objection to the view that conjugation of homologous chromosomes is effected in some species by lateral association and in other cases by a terminal union. The validity of the parasynaptic interpretation originally put forward in 1900 by de Winiwarter as applied to those forms which have provided pre-eminently favourable material for investigation (Felis, Batrachoseps, Tomopteris, Stenobothrus, Lepidosiren) may now be regarded as established, and creates an overwhelming presumption in favour of the applicability of the same scheme to a vast range of animal forms showing similar features in general, even though points of detail remain obscure. Nowadays, therefore, the field of discussion with reference to the mode of reduction narrows down to the claim of those who advocate telosynapsis that in certain cases a leptotene stage is wanting. This purely negative proposition loses much of the cogency it might otherwise possess for two reasons: first, that the stage in question is very refractory to fixation; secondly, in many cases where earlier work failed to reveal such a phenomenon subsequent study has shown that it does actually exist, as in the case of certain Orthoptera and Platyhelminthes. Since it is the concern of a scientific hypothesis to interpret phenomena in terms of experience, it rests with those who advocate terminal conjugation to provide an alternative method of deriving the reduced segments of the universally characteristic diplotene stage from the chromosomes of the spermatogonial telophase. The earliest theorists made use of the conception of a continuous spireme in the normal interphase, as introduced by Flemming's school, to envisage the process; but the more precise knowledge of the relation of metaphase chromosomes to the constitution of the resting nucleus gained of recent years through the work of Bolles Lee, Bonnevie, Digby, Gates and others dismisses from further attention the adherence in pairs during the meiotic phase of chromosomes formed by the segmentation of a continuous spireme. There is no sound justification for entertaining the reality of synapsis, unless definite evidence can be advanced in favour of the underlying assumption of the persistence of chromosomes in the germ-cell cycle as integral units; and direct information on this point involves a recognition of the fundamental discontinuity of the elements in the so-called spireme (pro- and telophase) stages. The objections of Meves, Fick and Duesberg, who, reserving a sceptical attitude to the persistent individuality of chromosomes, maintain that the character of the reducing division in certain forms is incompatible with a belief in parallel conjugation, is therefore more intelligible than the standpoint recently revived by Nakahara. For while it may still provide scope for profitable enquiry to elucidate the compatibility of the genesis and subsequent fate of the heterotype chromosomes with the parasynaptic view as a critique of the actual validity of synapsis, the hypothesis of telosynapsis, it appears to me, will only necessitate reconsideration (as applied to animals) when it is possible to rehabilitate it in terms that are consonant with accredited facts respecting the kinetic processes both in the premeiotic and meiotic phase.

The frequently very complicated metamorphosis which is involved in the transformation of the diplotene segments into the definitive chromosomes of the heterotype prophase has provided more fruit for controversy than any other stage in the meiotic phase; but from the material examined the nature of the process in Sphenodon was readily elucidated. Heterotype prophase nuclei were abundant and well preserved. The point of unique interest here concerned is the reference of the longitudinal cleavage in the diplotene filaments to the axis of fission of the derivative chromosomes in the maturation division which ensues. In a large number of animals the plane of division in both succeeding mitoses is undoubtedly the same as that in which the long axis of the diplotene segments lies—that is to say, the heterotype chromosomes divide by the drawing apart of each half of the longitudinally split diplotene filaments; and the subsequent division is normal. This fully coincides with the requirements of the parasynaptic view, since the fission of the diplotene loops lies in precisely the same plane as the interspace between the conjugating elements in synapsis. In diakinesis (late heterotype prophase) the chromosomes assume the form of rings in the case of Sphenodon. The annular type of bivalent according to the earlier telosynaptic view was thought to be formed individually from a single diplotene loop by the junction of its free extremities after the dissolution of the bouquet; and since the rings segment diametrically it thus seemed that the segregation of homologous chromosomes could only be effected on the assumption that the diplotene filaments consisted of univalent halves united end-to-end. This view was put forward by Meves for Amphibia, Farmer and Moore for *Periplaneta* and Fishes, and by various workers on Orthoptera. Subsequent study by Jannsens, Morse and other investigators has however demonstrated that a much more intricate and elaborate process intervenes with, in some cases, a rapidity that readily explains the failure of earlier workers to obtain the entire sequence of events. The diplotene loops are first abbreviated into stout double rods, and then drawn apart along the line of cleavage to form the rings, each half retaining contiguity with the other by its extremities only. Sometimes in the process of division the halves become detached by one extremity first, thus confirming the impression of telosynaptic junction, when previous events have escaped observation. In any case the diameter of the ring represents the actual line of cleavage in the diplotene stage. This is precisely what occurs in Sphenodon, in which the heterotype prophase is reminiscent of Amphibian spermatogenesis.

The actual course of events in Sphenodon is as follows:—After a period of rest in the bouquet stage the diplotene loops become detached, losing their polar orientation; they become less curved and progressively abbreviated, and finally assume, in anticipation of the formation of the definitive bivalents of the first spermatocyte mitosis, the form of straight rods or arcs. Many figures clearly showed twisting of the longitudinal halves as described originally by Janssens; but whether they become untwisted subsequently, or whether an actual chiasma is effected in Sphenodon, cannot be affirmed. In the majority of these the interspace in the middle of the rods first widens so that a more or less quadrangular element is formed; this assumes finally the characteristic annular form. In other cases the separation of the two halves is asymmetrical—i.e. the interspace widens first nearer one extremity than the other, so that there is a conspicuous lug to the ring (fig. 10). There appear to be three of these, corresponding it will be noticed to the three pairs of chromosomes in the spermatogonial group which are asymmetrical and display subterminal fibre attachment; one of them is the largest element in the diakinesis stage, and it will be



FIGS. 10–18.

remembered that the ✓ shaped pair are the largest in the spermatogonial group. It must be added however in qualification of this correlation that asymmetrical heterotype chromosomes occur both in *Periplaneta* and in *Libellula*, genera in which all the premeiotic chromosomes are approximately alike.

The metamorphosis of the heterotype chromosomes of *Hatteria*, as in *Libellula*, takes place before the dissolution of the nuclear membrane; consequently it is not easy to refer the axis of division of the symmetrical bivalents which show median fibre attachment to the plane of fission in the diplotene stage. The conspicuous lugs of the asymmetrical ones which display subterminal attachment does, however, make it possible to identify the two in keeping with the parasynaptic view. This is illustrated in text-figs. 10, 13, 14, 15. Text-figs. 11 and 12 show two series, the asymmetrical and symmetrical type, the relation of the axes of cleavage in the symmetrical type being inferred from the former.

Numerical estimation of the bivalents is rendered difficult by the disintegration of the plasmosome in diakinesis and the presence of nucleolar fragments in metaphase sections, as indicated in figs. 16–18. There was no sign of an accessory element in the material at my disposal.

The secondary spermatocyte division follows rapidly on the first with intercalation of a short interphase; such mitoses were exceedingly rare in my material. The chromosomes show clumping as Guyer and Cutler have recorded in Avian spermatogenesis; this may be an artefact due to defective technique. The recent work of Hance and others on Diptera, as well as one or two lateral views of anaphase in which the chromosomes seemed to be well separated, would suggest that such is indeed the case. Consequently the reduction divisions did not supply any critical data for estimating the chromosome number of the species. The nature of the reagent used for fixation excludes the possibility of adding any significant observations respecting spermateleosis.

The descriptive part of this research was carried out in the laboratory of Prof. E. W. MacBride, F.R.S., to whom acknowledgment is made by the author for time placed at his disposal for original work.

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XVI.—MERMIS PARASITIC ON ANTS OF THE GENUS LASIUS.

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H. A. Baylis, M.A., D.Sc., F.Z.S.

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Twelve Text-Figures.

I. Account of the Occurrence of the Worm and its Effect on its Hosts.—W. C. Crawley.

It was hoped to give in this paper a complete account of the life-history of the parasite, but the evidence obtained after nearly a year's continuous observation suggests that it may possibly be longer than was anticipated, and we have therefore thought it better to give the results already obtained, with the hope of adding to them later on.

There is a fair amount of literature dealing with the infestation of ants by nematode worms. W. Gould, whose little book, "An Account of English Ants," published in 1747, contains many shrewd observations on the habits of these insects, says, "Amongst other incidents that tend to lessen and destroy Ant-Flies" (by this he means the males and winged females) "it is observable that abundance of them are demolished by a white and long kind of worm, which is often met with in their bodies. You may frequently take three from the insides of the large, but seldom more than one from a small Ant-Fly. These worms lie in a spiral form, and some of them may be extended half an inch." As will be seen below, Gould's account, as far as it goes, is remarkably accurate. By the "small ant-flies" he presumably means the males, as he is speaking of the common yellow ant, *Lasius flavus*, but it is possible he may be mistaken here, as no *Mermis* has since been found to be parasitic on the male ant of this species. Gould's worm was subsequently named *Gordius formicarum* by Diesing, but no description of it appears to exist. Forel (1874) mentions having found nematodes in the abdomen of *L. flavus*, and refers to Gould's account. A small worm was found in the labial glands of *Formica fusca* by Janet (1893, 1894, 1897), and in the pharyngeal glands of *F. rufa* and *L. flavus* by the same author, and this latter form was described by de Lacaze-Duthiers under the name of *Pelodera janeti*, and later referred to *Rhabditis*.

W. M. Wheeler (1901, 1907) found in the gaster of the Texan ant *Pheidole commutata* a worm which he considered to belong to the genus *Mermis*, with which we are here concerned. He concluded that the worm lay in the crop of the worker ant, whose fat body and reproductive organs seemed to have disappeared entirely. The worms were 50 mm. in length, ten times that of the host, and one host contained two worms. He says ("Ants," p. 420):—

"They enter the larva and apparently by unduly stimulating its appetite cause it to be fed excessively, so that it becomes unusually large at the time of pupation, and produces a gigantic worker form, with ocelli." This large form of worker he called a "mermithergate." It is not clear how it was ascertained that the worm actually entered the larva. Though it is fairly certain that the parasite enters its host in the larval stage, the results of my experiments so far do not show how and at what period this takes place. Wheeler goes on to say that the parasitized ants were in a constant state of hunger owing to the presence of the parasite. This I have also noticed in the case of *Lasius*. Emery had seen these mermithergates in 1890, but without realizing to what their increased size was due until later, and he then also recorded their presence in several other neotropical ants of different genera, and concluded that the worm must enter the larva.

Mrázek (1908) appears to have been the first to write in any detail of the parasitization of *Lasius* by *Mermis* in Europe, though I found the parasitized ants in 1898, and recorded them as brachypterous forms (1910). Mrázek showed that the wings of the host (in this case *Lasius alienus*), which are the most prominent secondary sexual characters in most female ants, only developed to about one-quarter or one-third of their normal size. Later, in 1910, Wheeler found small-winged females of *L. neoniger*, a closely related form from Colorado, some of which contained worms from 53 to 55 mm. in length.

My first discovery in England of female ants parasitized by *Mermis* (and known as mermithogynes) was in 1898 at Oddington near Oxford. Along a road bounded on each side by a deep ditch, which for the greater part of the year contained water, had occurred a marriage flight of the common yellow meadow ant, *Lasius flavus*. This was towards the end of August, and alate and dealate females were to be seen on the road for some days afterwards. Amongst these I picked up several short-winged forms, which some years later were found on dissection to contain *Mermis*. Two or three days later in the same place I found some mermithogynes of *Lasius alienus*, the species which formed the subject of Mrázek's paper ten years later. Again in 1900 and 1901 I found several more parasitized females of both these species in the same locality. These females are readily recognized by their abnormally small but otherwise perfectly formed wings. I tested their powers of flight by throwing some of them into the air, but in no case were they able to fly at all.

It was not until 1916 that I again met with mermithogynes, this time in Somerset, in the marshes by the sea at Porlock, where examples of both *L. flavus* and *L. alienus* were abundant early in July (Crawley, 1916). The proportion of parasitized to normal females varied considerably according to the colony, but it was only in a small number of cases that the parasitized females outnumbered the others. The colonies were all large and flourishing in appearance.

Again, in July 1917, I came across many more mermithogynes of both the above species in the same locality, but in every case the normal females greatly outnumbered the mermithogynes, the average proportion not being more than 1 to 12, and in one nest only a single mermithogyne was found.

On my return home I placed these ants in "Janet" plaster nests with workers, males and pupæ.

At the end of the month two of the *L. flavus* mermithogynes became very restless, elevating their wings and curving their abdomens as if disturbed by the movement of the worms. One constantly bit the end of her gaster from which the head of the worm could be seen to protrude. At night one of the ants, presumably this one, was dead, and the worm had emerged and was lying dead among the worker ants, who were biting it. This seemed to indicate that in nature the worm would not emerge until the female had left the parent nest on the marriage flight. As stated above, the parasitized females do leave the nest at this period, though unable to fly, with the normal females. Within the next few days three more mermithogynes had died, without the parasites having emerged, and all had shown restless symptoms previously. The movements of the worms could be distinctly seen through the distended walls of the gasters of the dead ants. One day after the death of a female the parasite pierced the integument just below the anus and began to emerge. After attempting in vain to force its head under the soil, it succeeded in getting clear of its host's body in just over an hour. I then placed the worm on a piece of turf, but it was unable to pierce the turf, and eventually died.

By August 10 all the mermithogynes, except one *L. flavus*, were dead, but in only one case had the parasite completely emerged, and in one or two others it had partially done so. Sometimes the worm pushed its head through the anus itself, in other cases it was between two of the ventral plates of the gaster that the aperture was made by the parasite. It should be noted in passing that the thoraces of all the mermithogynes I examined were almost completely empty, and did not contain the large wing-muscles of the normal female which are later on used as food to support the insect during the long period (often many months) occupied in rearing her new colony.

It now became clear that the worms could not satisfactorily emerge from their hosts and continue their existence if left on ordinary dry earth. I therefore varied the experiments as follows: I took a *L. alienus* mermithogyne that had been dead for twenty-four hours without the *Mermis* having emerged, and placed it in a saucer containing a little earth covered with water. In less than ten minutes the worm had emerged and was sluggishly lashing to and fro in the water, keeping up these movements all day.

In the evening I drained off the water in the saucer, and the

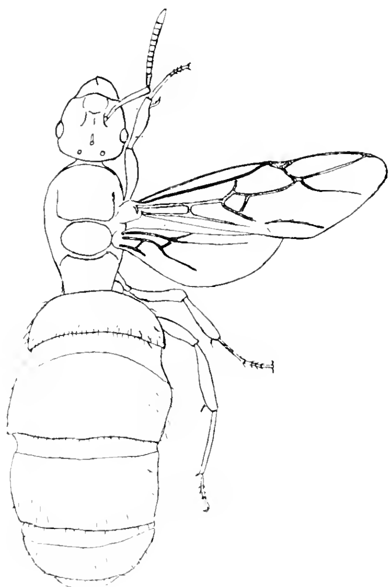


FIG. 1.—Mermithogyne of *Lasius alienus*.

worm then spent hours trying to bore into the wet earth, which was not deep enough to allow its whole body to be buried at one time.

When the earth dried up the worm became motionless, but flooding it with water was sufficient to arouse it to renewed activity. On August 13 the remaining *L. flavus* female died. I placed the body, as before, on earth barely covered with water, and the worm, a very small one, emerged with some rapidity, and at once began burrowing in the wet earth. From this time till the end of November, more than three months, this *Mermis* remained alive, increasing somewhat in size. After the first few weeks it spent most of the time out of sight under the soil, only appearing when the earth became dry. War duties necessitated my leaving home for some months, and the *Mermis* in consequence died.

The size of the worms found in these two species of ant varied considerably (see description). In more than one case an ant contained no less than three worms. The illustrations show the relative size of the host and the parasite, also the manner in which the parasite is coiled up in its host.

My friend Dr. J. Brontë Gatenby very kindly cut a series of excellent sections of the abdomen of a *L. alienus* female with the

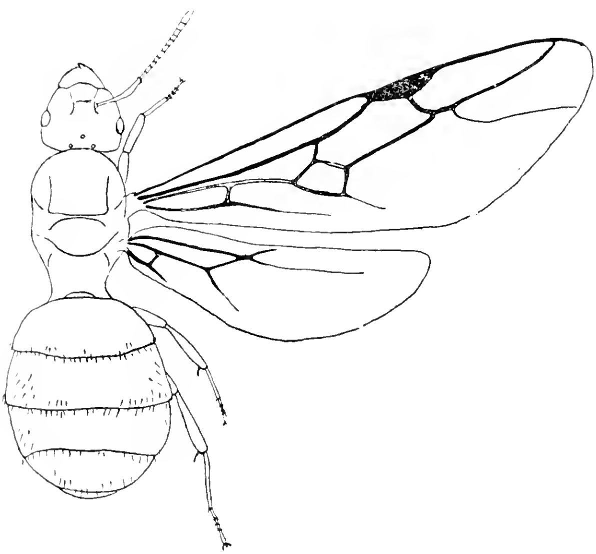


Fig. 2.—Normal female of *Lasius alienus*.

parasite *in situ*. These sections, and also the simple dissections of the abdomens of the hosts, show very clearly how considerably the ovaries are reduced in size compared with those of a normal female. The sections also distinctly show the beginning of degeneration of the nurse cells. Both these conditions are directly traceable to the starvation of the organ caused by the parasite. Other conditions pointed out by Gatenby as caused by the parasite are the hypertrophied tracheæ and the almost entire absence of fat-bodies in the host. The Malpighian tubules are normal.

A careful examination of the ant fails to reveal any external modification except the reduced wings and the distension of the abdomen caused by the presence of the worm. This distension disappears after the emergence of the worm, and the ant has then a normal appearance except for the small wings. The size of the latter varies to a certain extent, a series of *L. flavus* showing a variation in the upper wing of 4·6 mm. to 5·3 mm., and one of *L. alienus* of 5·0 mm. to 6·2 mm., whereas the normal wing of the first species measures 9·0 mm. in length and that of the latter 10·0 mm. The variation in *L. niger* is 5·3 mm. to 6·0 mm., the normal wing being 10·0 mm.

Until 1920 the only two species of ant known as hosts of *Mermis* in this country were *L. flavus* and *L. alienus*, but in July 1920 my friend Mr. H. Donisthorpe found in Cornwall a colony of *L. niger* containing numerous mermithogynes (1921). The

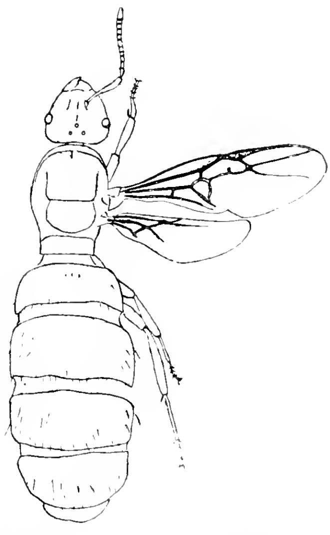


FIG. 3.—Mermithogyne of *Lasius flavus*.

habits of all three species are to a great extent similar. *L. flavus* throws up mounds which become covered with grass and may reach a diameter of over 2 ft. and a height of 1 ft., and these nests are generally in meadows. A certain amount of moisture is necessary for these ants, and nests are often found in damp situations, and stones, logs, etc., are often utilized as cover. *L. alienus*, though equally a hypogæic species, rarely throws up mounds, but is more fond of stones as shelter, and its nests are very frequently in damp situations. *L. niger* has habits similar to those of *alienus*, but lives more in the open air, and in damp places will erect earth mounds. All three species have the following important habits in common: they nest underground, preferably in damp earth; they rarely have more than one fertile queen in each colony, the females are very much larger than the workers and are reared in large numbers every year, and are therefore specially suitable as hosts; and, finally, the larvae hatched from eggs laid in spring and summer live through the winter and do not complete their metamorphosis till the following summer. Thus there are always larvae in the nests of all three species all the year round. Every colony that I have found to contain *Mermis* (some 15 to 20 in all) was either in damp ground or near marshy ground or standing water, and it is interesting to note that Donisthorpe found his colony of *niger* near a stream running from a marsh into the sea. These facts support the conclusion arrived at from my experiments, viz. that water or marshy ground is necessary to the development of the worm after leaving its host. The behaviour of the worm when attempting to escape from the ant's body in water and on moist earth shows that the emergence is more easily effected in water. When the infected ant was placed on moist earth, the *Mermis* first protruded its head and attempted to burrow under the soil, but the movements of the ant, always very agitated, usually prevented this. After a time the worm succeeded in hooking itself round a projection of earth and held tight until the ant by pulling in all directions drew it clear from her body. This operation often took a considerable time, but when the ant was placed on the surface of the water the evacuation usually occupied but a few seconds, or at most a minute or two. The ant after getting free from the worm invariably performed a very complete toilet, and then seemed to take on a renewed lease of life, which, however, in the majority of cases only lasted a few days, and sometimes only twelve hours or so. A normal female of these species after fertilization lives from five to ten years and sometimes much longer.

It should be mentioned in passing that I brought back from Porlock in May 1920 (i.e. before the winged females were present) a colony of *L. flavus* containing two queens, and among the females when they eventually hatched was a single mermithogyne, proving that at least one larva had been infected, though I was unable to find any traces of the worms in numerous full-grown female larvae that I dissected. This colony was used in a further experiment later on.

The infected colony of *L. niger* (the third species of this genus which is a host of *Mermis*) referred to above was very kindly handed over to me by Donisthorpe to enable me to continue the study of the further history of the worm. These mermithogynes are exactly similar, except for specific differences, to those of the other two species, but there is one structural anomaly not present in the former cases. In about nine-tenths of the *L. niger* mermithogynes there is a hole in the anterior border of the mesonotum at its junction with the pronotum. On dissection this aperture is seen to consist of an invagination of the cuticle ending in a point inside the thoracic cavity. The hole in a typical specimen is situated 0·43 mm. from the anterior border of the mesonotum, with which it is connected by a shallow groove, rather narrower than the diameter of the hole itself. The actual aperture measures 0·21 mm. long by 0·12 mm. wide. Seen from the interior of the mesonotum, the funnel-shaped invagination measures 0·68 mm. from the border of the segment, and 0·32 mm. from the opposite edge of the hole to the point. The point itself is generally rounded. Several other specimens were examined and measured, the aperture

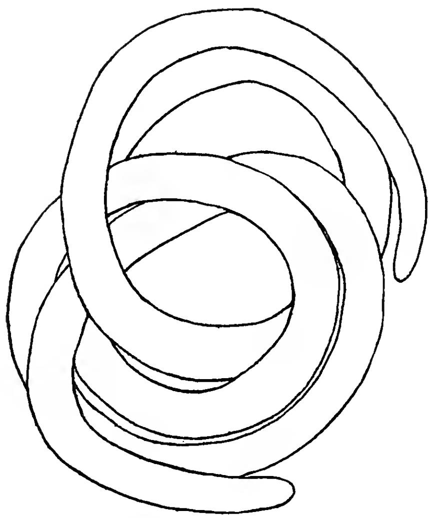
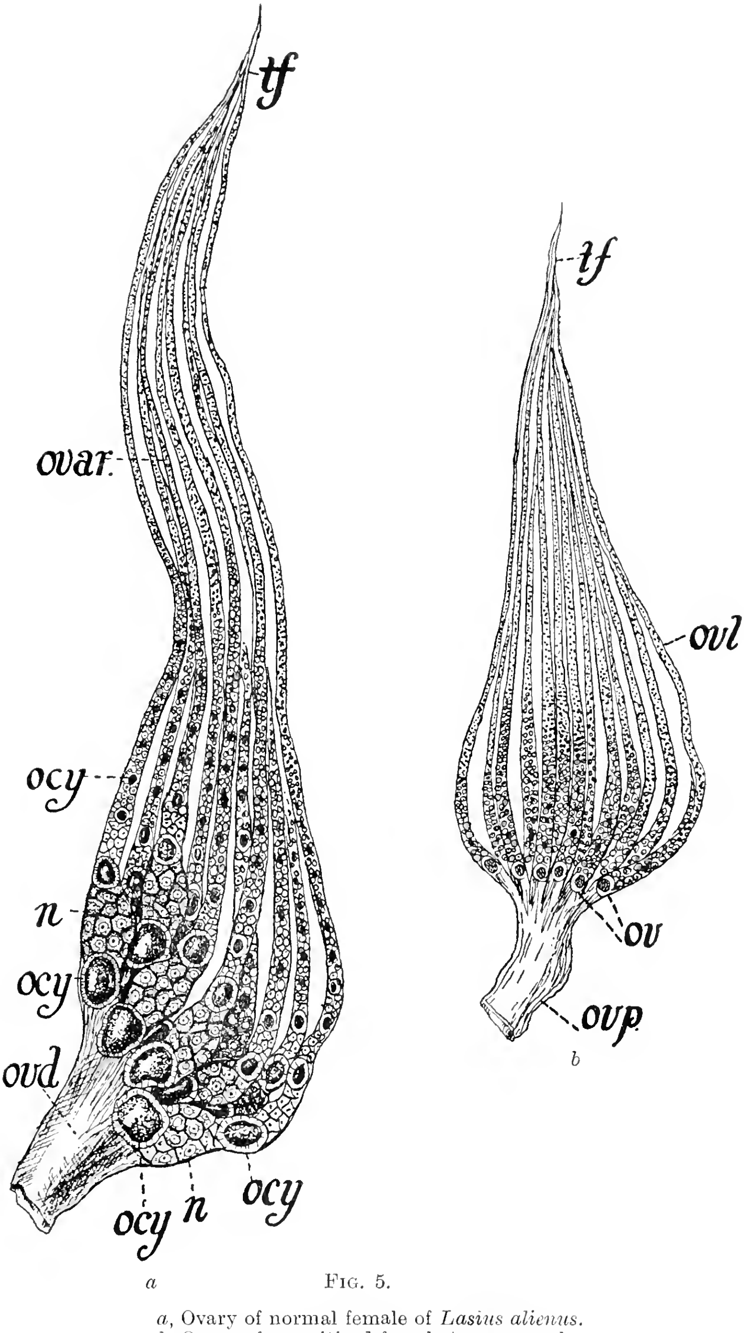


FIG. 4.—Worm *in situ* in abdomen of female ant.

and length of the point varying very slightly in different individuals according to their size.

This condition may be, and probably is, connected in some way with the parasitized state of the ant, but the hole is, at any rate immediately after the emergence of the ant from the pupa, large enough to admit a nearly full-grown larval ***Mermis*** which would have been obliged to pass through the minute aperture connecting the thorax with the abdomen in order to take up its position in the latter. The worm too would have been free in the nest previously, and, as has been seen, the worker ants kill an unprotected worm. Other reasons also compel one to seek for another cause for this aperture than the entrance of the worm, not the least of which is the fact that a proportion of the infected ants were with-



a

Fig. 5.

a, Ovary of normal female of *Lasius alienus*.
b, Ovary of parasitized female to same scale.
ovd, oviduct; *ocy*, oocyte; *n*, nurse cells.

out the hole, and it does not exist in any of the more numerous specimens from the other colonies previously examined.

There is another case of malformation in this colony, occurring in a normal female. It consists of a semicircular excision in the apical border of the third segment of the gaster, and is probably unconnected with the parasite.

I dissected a number of full-grown female larvæ and also several pupæ from this colony, but failed to find any trace of the worm. These mermithogynes were very active, often assisting callow ants to emerge from their cocoons, and were also very ravenous, devouring flies that I put into the nest, and also crippled and damaged pupæ and callows, besides always asking the workers for food. Occasionally one would be seized with a kind of paralysis, lie on its back with legs and antennæ extended and twitching, and a movement of the worm inside the gaster could be seen at the same time. Such ants usually recovered, but in one or two cases they died. After the emergence of the worms the ants became very active, but their death was only deferred a short time.

By constantly placing each mermithogyne, as soon as she became restless or died, on damp earth in a pan I succeeded in obtaining thirty-seven worms, which I transferred to a larger and deeper vessel with damp earth. At the beginning of November they were all still in the larval stage, the outer skin being very distinct, but the genital organs were beginning to develop. By Nov. 20 four had cast their larval skins, the operation consisting in piercing the skin a short distance from the head and then peeling off the skin by burrowing into the earth. When the earth became dry most of the worms came to the surface and remained motionless, with about a third of the body projecting in a coil in the air. A sprinkling of water invariably caused them to descend below the earth again. The first eggs were noticed in the uteri on Dec. 5. The problem of keeping them alive began to be acute about this time, mould making its appearance on the surface of the soil. Sand was tried in place of soil, but rapidly became matted with mould and destroyed the worms. Finally, the best method was found to be to keep them in small flower-pots with a layer of plaster of Paris at the bottom to close the hole. The terra-cotta being porous allowed drainage to take place, so that the earth remained very nearly free from mould, and the only drawback was the necessity of frequent watering to replace the evaporated moisture. Four or five worms had assumed a brown colour, but were quite healthy, though not so active as the others, and on casting their skins they were again white.

The process of egg-laying was easily observed under a low power. The eggs moved slowly down the vagina, and each egg became slightly compressed as it reached the orifice, where it halted a moment and then shot out to a short distance, but still remained attached to the worm by a colourless gelatinous substance. When a sufficiently large group of eggs had in this manner collected round the orifice, it broke away by its own weight. When laid inside the larval skin, in which there appears to be no vulvar aperture, the eggs assumed the form of a flat ribbon as wide as

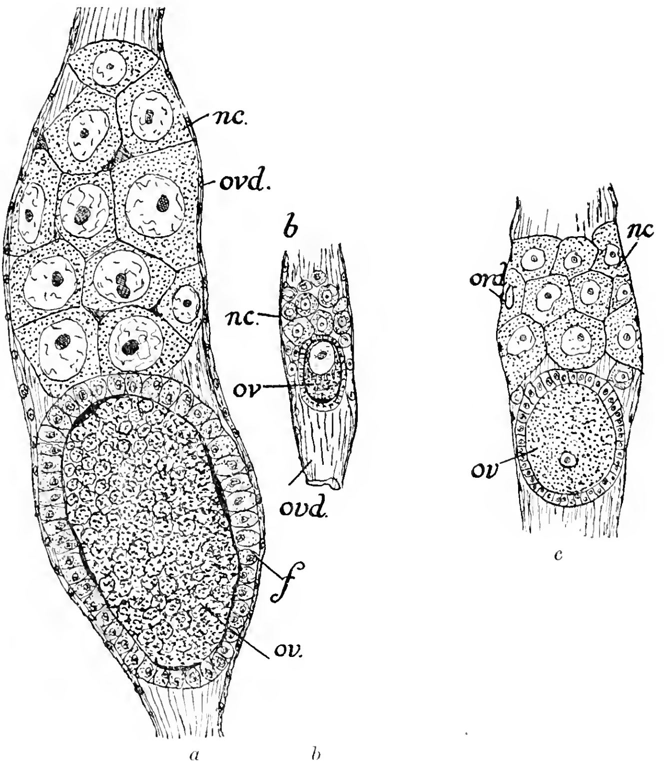


Fig. 6.

a, Largest oocyte of normal female of *Lasius alienus*.
b, Largest oocyte of worker of *Lasius alienus*.
c, Largest oocyte of parasitized female of *Lasius alienus*.
All to same scale.
ov, ovum ; *ovd*, oviduct ; *nc*, nurse cells.

the diameter of the skin, each egg being separated from its fellows by the gelatinous material. Almost all the cast skins were full of eggs, the egg-laying going on before, during and after the casting of the skin. It is possible that the skin forms a useful protection to the eggs, but the uterus after the casting of the skin contained about as many eggs as were left in the skin. Some of the later eggs laid were already segmented.

I carefully counted the eggs in two typical cast skins. In the first there were over 6,560 eggs, and in the second over 5,900. Allowing for an equal number still in the uterus, this gives an average of about 12,000 eggs for each worm. Probably the number is even greater than this, as all the worms continued laying for some weeks after casting their skins.

By the beginning of May 1921 all but three or four worms had died, and I left them with their eggs in the flower-pots.

At the beginning of July I connected one of the pots with the nest of *L. flavus* referred to above, in the hope of tracing eventually the method of infection. The ants readily took up their quarters in the flower-pot.

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II. Description of Mermis myrmecophila sp. nov.—H. A. Baylis.

General Characters of Adults and Larvæ.

The worms are colourless, with the exception of a slight tinge of reddish-brown near the head in some specimens. The cuticle is smooth externally, but provided with criss-cross fibres below the surface. It consists of a thin outer and a thick underlying layer. The subcuticular layer (fig. 10, *sc.*) is very thin, and gives rise to the six longitudinal bands or "fields" characteristic of the genus *Mermis, sensu stricto.* These consist of a pair of very broad and conspicuous lateral fields, a pair of very slender subventral, a broad ventral and a narrow dorsal field, the last-mentioned being subdivided into three parallel portions (fig. 10, *d.*). The cells composing the lateral fields are very conspicuous (fig. 9), consisting of a row of large, tall, granular cells at the edges, fitting together like pieces of a mosaic, and an irregular double row of smaller cells in the middle, with clearer protoplasm.

The musculature of the body-wall (fig. 10, *m.*) is divided by the longitudinal fields into six broad strips, each of which is composed of a large number of narrow, ribbon-like muscle-cells with one edge hanging freely in the body-cavity.

Almost the whole of the body-cavity is occupied by the "fat-body," representing the degenerate intestine of the worm. This is simply a sausage-like sac, blind at each end, consisting of a thin membrane enclosing an accumulation of fat-like globules of reserve food-material. As the worms increase in size and age, this reserve material is gradually absorbed. In the earlier stages, however, it is so abundant as to render the worms very opaque, and their structures difficult to make out.

The mouth is subterminal, being situated towards the ventral side of the head, in a shallow cuticular depression. The œsophagus, as is usual in the later stages of Mermithidæ, is vestigial, being reduced to a long, narrow, cuticular tube. It is doubtful whether it is connected with the fat-body at all. As is the rule among Mermithidæ, there is no anus.

The nervous system is of the usual kind, the central ganglia being situated in a broad ring of nervous tissue which surrounds the œsophagus at some little distance from the head. No excretory organ has been made out.

We have no information as yet as to the earlier stages in the larval history of the worm. It is probable that the young larvæ penetrate into the body-cavity of the larvæ of the ants, and remain in this position throughout the latter's metamorphoses. Our account, for the present, must begin with the larva in the later parasitic stage of its existence, when it lies coiled up in the body-cavity of the imago of the ant, from which it presently emerges to lead a free existence in the soil.

The larvæ grow to a length of 20 to 50 mm. before emerging from the host, and attain a diameter of 0·3 to 0·65 mm. During the subsequent free existence some further growth may take place, though the greatest dimensions here given for the larvæ are greater than we have actually observed in the adult.

The newly-emerged larva has few characters which enable it to be distinguished from the larvæ of other members of the genus. It appears, however, to be exceptionally short in proportion to its

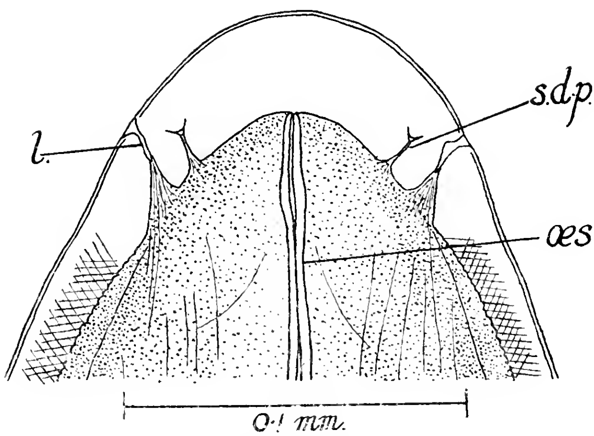


Fig. 7.—*Mermis myrmecophila.* Head of adult female; dorsal view. *l.*, lateral organ; *œs.*, œsophagus; *s.d.p.*, subdorsal papilla of right side.

thickness. The head-papillæ characteristic of the adult are as yet unrecognizable. Of the internal organs little can be seen in whole preparations owing to the great development of the fat-body. In a series of sections through a larva still *in situ* in an ant it has, however, been possible to establish the fact that internal genital organs are precociously developed. This larva shows a long, strip-like organ (fig. 10, *t.*) squeezed up between the fat-body and the musculature on one side of the body, and lying between the lateral and the subventral fields. On examination with high powers, this organ proves to be a testis, already containing numbers of spermatozoa, apparently fully developed. The testicular tube appears to be single, and, so far as can be judged from the sections, it runs throughout nearly the whole length of the larva. A similar organ has been seen in a stained whole preparation of a newly-emerged larva. This is the only evidence we have been able to obtain, up to the present, of the existence of males. No adult males have been found among the individuals that we have succeeded in rearing to maturity. The females, however, produce numbers of fully-formed eggs capable at least of going through the process of segmentation, and the question arises whether we have here a case of protandrous hermaphroditism, or whether, in the absence of males, the females are capable of reproducing parthenogenetically. Instances of both these conditions are to be found among nematodes, though we know of no record of them in this comparatively little-known family. It should be mentioned,

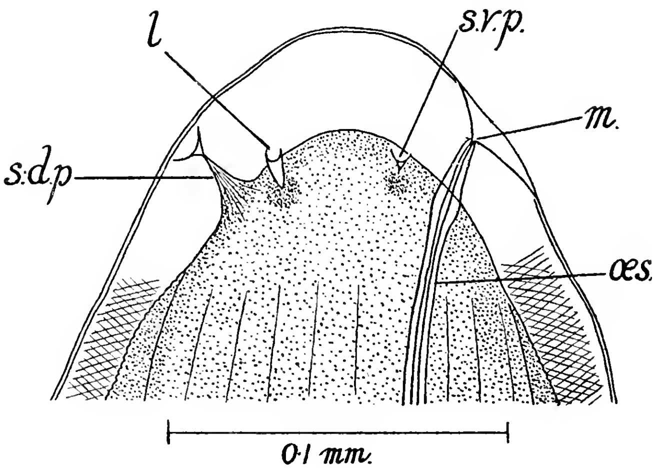


FIG. 8.—*Mermis myrmecophila.* Head of same individual as in Fig. 1; lateral view. Lettering as in Fig. 1, with the addition of *m*, mouth, and *s.v.p.* subventral papilla of right side.

however, that in the present species no evidence is available of the existence of both male and female organs or germ-cells in the same individual; while the evidence for the total absence of males among the adults cannot yet be regarded as conclusive.

The larvæ, which emerge from the ants during the month of July, enter upon a period of free existence lasting for six or seven months, during which they probably undergo at least two moults. Our specimens completed their last moult during the month of January.

It is a curious fact that the female organs are fully developed, and contain many eggs apparently ready for laying, some time *before the last moult.* That is, the worms are to all appearance sexually mature and capable of reproduction while still in the last stage of their larval existence. If, therefore, the worm is diœcious, copulation must take place during the larval stage; but the fact that no vulvar opening has been seen in the larval cuticle is not in favour of this hypothesis.

Crawley has described how oviposition begins during the shedding of the last cuticle, and the old cuticle itself appears to act as a protecting cocoon for some of the eggs. The remaining eggs are probably deposited later in the soil.

The following are the chief characters of the adult female:—

The largest specimen measured was 48 mm. in length and 0·6 mm. in thickness. The anterior end is somewhat more tapering than the posterior, which is bluntly rounded. The cuticle at the tip of the head is greatly thickened. Two pairs of small cephalic papillæ are present—one pair subdorsal, one subventral (figs. 7 and 8, *s.d.p.*, *s.v.p.*)—the terminations of which are at the

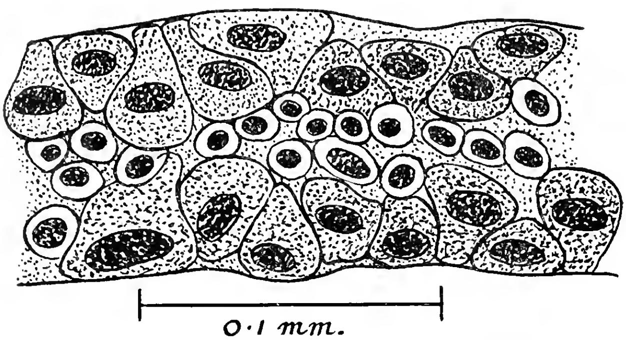


FIG. 9.—*Mermis myrmecophila.* Larva from *Lasius flavus.* Surface view of a portion of the lateral field in a stained whole preparation.

bases of shallow conical depressions in the cuticle. A pair of structures which appear to be the "lateral organs" (figs. 7 and 8, *l.*) are situated laterally in the position usually occupied by the third pair of papillæ (which, on this interpretation, appear to be absent in this species). These lateral organs have the form of simple, deep, tubular pits in the cuticle, with a papilla-like conical structure, doubtless carrying nerves, rising to meet them from the subcuticular layer. (It is, of course, possible to interpret these organs as lateral papillæ, their only difference from the other papillæ being the greater depth of the cuticular depression. In this case the missing organs would be the "lateral organs" which are said to be always present in other members of the family.) The diameter of the head at the level of the papillæ is 0·1 mm.

The œsophagus (figs. 7 and 8, *œs.*) is a long, sinuous, slender cuticular tube, which can be traced back alongside of the fat-body for a distance of 12·5 mm. (more than a quarter of the length of the worm), at which point it appears to end blindly. The outside diameter of the tube is about 0·0125 mm. Close to the mouth there is a slight thickening of the walls of the tube. The nerve-ring is massive, and surrounds the œsophagus at 0·57 mm. from the anterior end.

The vulva, in the form of a transverse slit, is situated a little behind the middle of the body (at 21 mm. from the posterior end

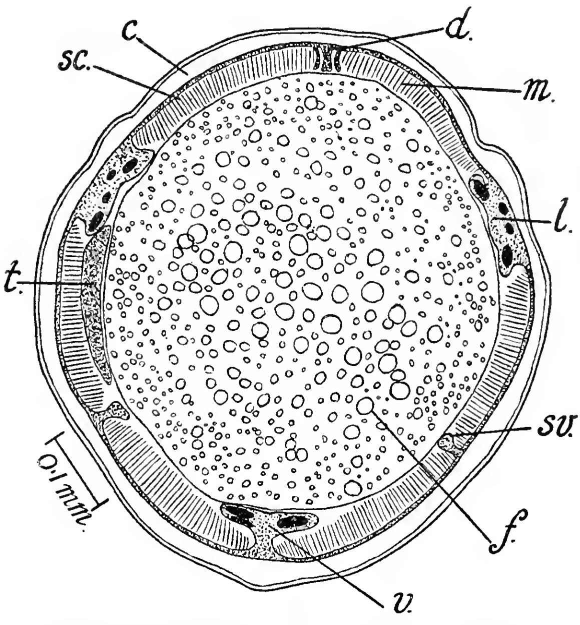


FIG. 10.—*Mermis myrmecophila.* Larva from *Lasius alienus*; transverse section through the body.

c., cuticle; *d.*, dorsal field; *f.*, globules contained in the "fat-body"; *l.*, lateral field; *m.*, muscles; *sc.*, subcuticular layer; *sv.*, subventral field; *t.*, testis; *v.*, ventral field.

in a specimen 48 mm. long). The distal portion of the vagina, or "vestibule" (fig. 11, *ve.*) consists of an invagination of the cuticle, running slightly in the direction of the head. After passing through the ventral longitudinal field it becomes a narrow duct ("ovejector") with thick muscular walls (fig. 11, *o.*). This describes an S-shaped curve, and gives off at right angles to itself the two directly opposed uteri. The uteri proper are very short (each not more than 1·6 mm. long) and somewhat club-shaped, expanding gradually in diameter on passing further away from the vagina.

Their walls are of moderate thickness, and have a layer of circular muscles which is strengthened internally by annular thickenings at

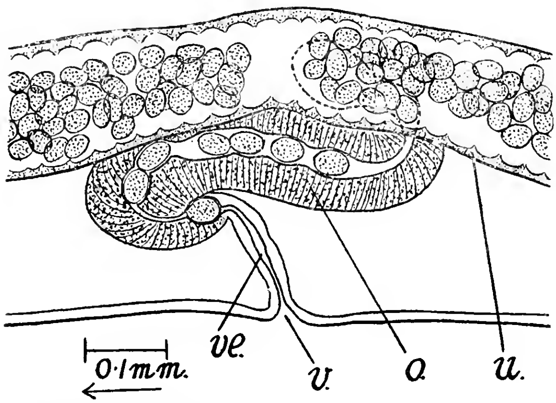


Fig. 11.—*Mermis myrmecophila.* Lateral view of vagina and its connexions in an adult female. The arrow points towards the head. *o.*, ovejector ; *u.*, uterus ; *v.*, vulva ; *ve.*, vestibule.

regular intervals. Each uterus passes suddenly into a narrower duct, about 0·3 mm. long and with thick muscular walls. After forming a half-turn of a spiral, this duct in turn opens into a very

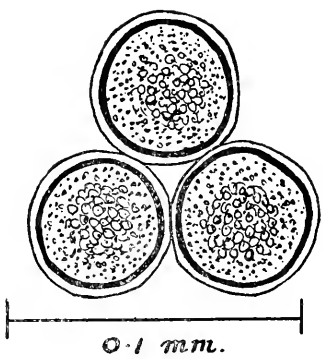


Fig. 12.—*Mermis myrmecophila.* Three adjacent ova as seen in position when laid in the cast-off cuticle. The solid black circle represents the actual shell of the egg ; the clear space outside it the hyaline covering.

wide tube, about 5 mm. long and filled with eggs. This may be regarded as the oviduct. Its walls are scantily provided with muscles. It passes gradually into the ovary, which runs almost straight, and maintains almost the same diameter, throughout its length. The blind, rounded terminations of the two ovaries are situated at 6·5 mm. from the anterior and 1·5 mm. from the posterior end of the worm respectively.

The fully-formed ova are of discoid or lenticular shape, with a thin shell, measuring 0·045–0·05 mm. in greatest diameter. At the time of laying, the content of the egg consists of very granular protoplasm, but is as yet unsegmented. When the eggs are laid (fig. 12) they are surrounded by a coat of some clear secretion, probably of an albuminous nature, which keeps each egg in the mass apart from its neighbours, and prevents the shells from coming into contact.

Specific Diagnosis.

Mermis myrmecophila sp. n.

(? = *Gordius formicarum* Diesing, 1851—*nom. nud.*)

Mermis: adult (female) up to about 50 mm. in length. Thickness about 0·6 m.m. Body tapering anteriorly, less so posteriorly. Both extremities rather bluntly rounded. Head with two subdorsal and two subventral papillæ, at the bases of slight conical cuticular depressions, and two lateral organs, in the form of tubular depressions in the cuticle, in the usual position of the lateral papillæ. Lateral fields wide, composed of two outer rows of large cells and two inner rows of small cells. Mouth subventral. Œsophagus at least one-quarter of the total length. Nerve-ring at about 0·57 mm. from the anterior end. Vulva slightly behind the middle of the body. Uteri directly opposed. Ova colourless, discoid, thin-shelled, 0·045–0·05 mm. in greatest diameter, surrounded at the time of laying by an external hyaline coat, and with unsegmented content. The worms live in soil in wet places, in the neighbourhood of nests of ants of the genus *Lasius*, in the females of which the larva is parasitic.

The species of *Lasius* in which the larvæ have been found at present are *L. alienus*, *L. flavus* and *L. niger*.

Among the nearest relatives of *M. myrmecophila* appear to be *M. pachysoma* v. Linstow, 1905, recorded in *Vespa germanica*; and *M. brevis* Hagmeier, 1912, recorded in *Iulus sabulosus* and in various soil-inhabiting dipterous larvæ, but also found in the free-living stage under a nest of ants (*Myrmica rubra*). From *M. brevis* the present species differs chiefly in its considerably greater size and in the absence of the lateral pair of cephalic papillæ in the adult; while there is little of diagnostic value in the description of *M. pachysoma* (of which only the late parasitic larval stage is known), except the much greater thickness of the body (0·72–1·26 mm.).

In the recorded cases of infection of ants by supposed Mermithidæ, the worms themselves do not appear to have been adequately described. In no case, we believe, have the larvæ been kept alive and allowed to reach maturity. It is not improbable, therefore, that some of these cases may be referable to *Mermis myrmecophila*.

XVII.—NOTES ON RESOLUTION.

By Conrad Beck, C.B.E., F.R.M.S.

A. The Influence of Colour-Filters on the Resolution of "Dark Ground" Illuminated Objects.

I have been devoting considerable time to working with dark ground illumination under different conditions, and I have found several interesting points which bear on microscope resolution. Such work can scarcely be done without a focusing illuminator, as it involves the examination of many different mounted specimens.

It has been stated that the resolution by dark ground illumination is not equal to that of transparent illumination—I cannot confirm this. Under some circumstances, if not all, I find it fully equal and far more easily accomplished.

A good example is the resolution of *Pleurosigma angulatum* into dots with an 8 mm. achromatic object glass with a N.A. of only 0·5. Unless the zones of this lens were almost perfectly corrected I doubt if it could be resolved with so small an aperture. Carpenter mentions 0·65 N.A. as the smallest aperture with which *P. angulatum* has been resolved.

With transparent illumination and a condenser with a cone the full 0·5 N.A. and a × 50 eye-piece, it cannot be resolved with red or orange light, rather faintly with green, and brilliantly with blue light.

Such an object is therefore on the limit of resolution of this lens and on the theoretical limit of this aperture, and it forms a good test of resolution by dark ground illumination.

The resolution with dark ground illumination is far more brilliant than with transmitted light. With transmitted illumination I failed to get resolution unless the diatom was mounted in realgar or dry. With the dark ground illumination the resolution was also perfect with specimens in styrax or monobromide of naphthalene. I could not, however, get any resolution with red or orange light. It would therefore appear that dark ground gives equal but no greater resolution, but much greater contrast, so that diatoms practically unresolvable because of lack of contrast by transmitted light are readily resolved by dark ground illumination.

A further example of resolution with dark ground illumination with a high power object glass gives the following results:—

A 1/8 (3 mm.) oil immersion Beck achromatic object glass, 0·95 N.A., on *Amphipleura pellucida*, light "Pointolite," perfectly corrected achromatic 1·3 N.A. condenser, solid cone about 1·0 N.A., gave no resolution with light of any colour on specimens mounted in styrax or monobromide of naphthalene. With specimen in realgar and dark blue light, resolution just glimpsed, but not actually seen, but signs of structure are visible.

With dark ground illumination and specimens in either realgar, styrax or monobromide, resolution was thoroughly distinct with blue and green light. In realgar it was thoroughly black with blue light, good with green, and faint with white light, not visible with red light.

The possibility of the application of these observations to medical microscopy is evidenced by the examination of stained slides of such every-day objects as anthrax, tubercle and malaria, by dark ground illumination in combination with colour-filters. Anthrax stained so that by transmitted light it appears blue, when viewed by opaque illumination and a purple screen which transmits only blue and red light reflects red and appears of a blood-red colour. Under similar conditions tubercle stained red appears by reflected light a light green. The tubercle stands out much more vividly than is the case with transparent specimens. Indeed, the way in which stained bacteria mounted in balsam stand out from their surroundings, quite apart from their colour, suggests that they have a very different refractive index to balsam. A specimen of the signet ring form of malaria in a similar manner is very distinctly differentiated from the blood corpuscle in which it is encysted.

The question of contrast, glare and flooding in transmitted illumination are subjects on which I am making a series of observations, and I hope at some future date to report some results.

B. The Influence of the Area of Illumination on the Resolution of Grayson's Rulings.

Mr. E. M. Nelson has demonstrated that for the resolution of diatoms and Grayson's rulings with a solid axial cone of light, the finest resolution was obtained when the illuminating cone of light was not as large as the full aperture of the object glass, but was about $\frac{7}{8}$ or $\frac{3}{4}$ of the maximum angle. Amongst others, some time ago I repeated and confirmed his experiment. In recent work with an 8 mm. Achromatic and an 8 mm. Apochromatic, in both of which all zones of the lenses were more perfectly corrected than has generally been the case, I was unable to confirm the well-known experiment, and I have made a large number of observations with lenses of different powers to investigate the matter.

These observations were made with a 100-candle power electric

Pointolite lamp about 12 inches from the stage of the microscope, no bull's-eye or mirror being used.

An adjustable pair of neutral glass wedges was placed immediately in front of the lamp, by means of which the brilliancy of the light could be varied to an almost unlimited extent, so that different intensities could be used or the same intensity could be maintained when the aperture of the substage condenser was varied or colour screens were interposed in the beam of illuminating light. Blue and green light were produced by the use of Wratten filters C and B, giving moderately monochromatic light with predominant wave-lengths of about 4,600 and 5,200.

The substage condenser was as perfectly corrected as an oil immersion object glass, sufficiently so as to resolve *Navicula rhomboides* with a brilliantly black resolution. Aperture 1·3, focal length 8 mm. The condenser was focused so that the Pointolite tungsten ball was very slightly out of focus. Eye-pieces used, X17, X25 and X50 compensating eye-pieces. In some cases blue light was used in order to give greater resolution; in others green, on account of the unpleasant colour of the blue light.

The Grayson's rulings employed for low powers were bands which increase in fineness in steps of 5,000 between 5,000 and 60,000 lines to the inch; for high powers those which increase in steps of 10,000 from 10,000 to 120,000 lines to the inch.

The following out of a number of similar observations are sufficient to illustrate the point. All the lenses were Achromatic and Apochromatic lenses made by my Company, and with the exception of the specially corrected 2 mm., had all their zones very perfectly corrected.

1. 2 mm. Achromatic 1·3 N.A.

Blue Light.—Iris diaphragm behind object glass 120,000 lines resolved full aperture—evidently finer lines, if available, could be resolved. It thus formed no test and the iris diaphragm behind object glass was, therefore, closed till only 80,000 lines could be resolved. (This band was a very regular ruling, and was therefore selected for the purpose.) The iris diaphragm under the condenser was then closed down till only about seven-eighths of the full aperture of the object glass was filled, and it was then found that the aperture of the object glass could be further closed without destroying resolution, and a point was reached where the 80,000 band was visible with the illuminating cone about seven-eighths the aperture of the object glass, and either increasing or decreasing the aperture of the illuminating cone destroyed resolution. This entirely confirmed Nelson's experiment.

2. 8 mm. Achromatic 0·5 N.A.
   Green Light.—45,000 lines well resolved.
   Blue Light.—50,000 lines well resolved. Full cone of illumination. Cutting down illuminating cone damaged resolution, and resolution disappeared when it was below 0·45 N.A. Cutting down aperture of object glass so as to only just resolve 45,000 lines, the least cutting down of aperture of illuminating cone below full aperture destroyed resolution. 30,000 lines, the same result.

2A. *Green Light*—Full aperture of object glass used. Ground glass placed in front of lamp. Aperture of illuminating cone 1 N.A. 30,000 lines faintly visible. Aperture of illuminating cone 0·5 N.A. 35,000 lines faintly visible. Aperture of illuminating cone 0·45 N.A. 40,000 lines faintly visible.

3. 8 mm. Apochromatic 0·65 N.A.
   Blue Light.—60,000 lines well resolved with full aperture. 0·65 N.A. illuminating cone, resolution destroyed directly aperture of illuminating one is reduced; only 55,000 visible.

4. 16 mm. Apochromatic 0·35 N.A.
   Green Light.—30,000 lines clearly resolved, but faint, full aperture, 0·35 N.A. illuminating cone. The least reduction of illuminating cone destroyed resolution.
   Blue Light—35,000 lines resolved with full aperture cone, but not if illuminating cone was reduced.

Observations 2, 3 and 4 are in direct contradiction to observations 1, 2a, and to Mr. Nelson's experiment, and I was inclined to think that the perfection of the corrections of the different portions of the objective for zonal aberrations might have some bearing on the question. I therefore adjusted a 2 mm. object glass so that it had a steadily progressive aberration from the centre to the edge; but beyond the fact that it had to be used with different lengths of tube for lines of different fineness, and did not reach so high a point of resolution, it gave no results of interest.

It was, therefore, evident that the conditions in the different observations were dissimilar in some respect, and the only condition that I could notice was that the area of light on the object in observation 1 and 2A was of a larger proportion of the field of the microscope. With a X25 eye-piece and 2 mm. objective it was larger than the field of view, whereas in all other cases it was a small brilliant patch in the centre of the field, the rest of the field being almost black. Until the introduction of the Pointolite such a condition had not been easy to obtain, and had not been the condition of Nelson's test, where the edge of a lamp flame which more than filled the field in at least one direction was employed.

There was a further difference in that the light from a lamp flame more than half an inch deep may not produce the same result as a source of illumination which is almost a surface at right angles to the plane of illumination. This would not, however, explain the discrepancy in my observations, and experiment 2A pointed to the idea that the size of the area of object illuminated might influence the question. I therefore placed a negative lens combination of a focal length of about 1 inch in front of the lamp, which reduced the size of the image of the Pointolite to about one-quarter of its previous size, with the following result:—

5. 2 mm. Achromatic 1·3 N.A.

Green Light.—Aperture of object-glass reduced by iris diaphragm at back till 80,000 lines could be just resolved with full illuminating cone. The least reduction of the illuminating cone destroyed resolution.

6. 2 mm. Achromatic 1·3 N.A.

Green Light.—All conditions exactly the same as observation 5, except that negative lens in front of lamp was removed. No trace of the resolution of 80,000 lines could be obtained with any aperture in the illuminating cone.

The result of these observations appears to show that Mr. Nelson's experiments and the conclusions he drew were correct for an illumination which extended over a large area of the object, and that under such conditions the full aperture of an object glass can never be utilized; but that with a small portion of the object illuminated, the full aperture of an object glass can be utilized and further resolution obtained. I am not at present putting forward any explanation of these results. A great deal of research on the question is required. In the meantime it will be interesting to see if others will confirm the above results. In carrying out these experiments one important condition is that both the iris diaphragm and the optical portion of the substage condenser should be accurately centred, as in the resolution of lines a spurious resolution can be readily obtained by even a small obliquity of the light.

XVIII.—A KEY FOR THE IDENTIFICATION OF BACTERIA.

By Joseph Kitchin, F.R.M.S.

In working on the culture and identification of bacteria in 1906, the writer found great difficulty in comparing the characters of a large number of organisms, and to assist in comparing and differentiating them he then devised a system of index numbers which is covered by the table given on page 379.

A numerical index for comparing the morphological and physiological characters of organisms used by the Society of American Bacteriologists is described by Mr. J. Percival in "Agricultural Bacteriology," p. 60, and a modification of the system was put forward by Mr. John Golding in the "Journal of the Board of Agriculture," March 1912, pp. 1001–4 (noticed also in the "Journal of the Royal Microscopical Society," of August 1912). It is suggested that the index described in this note is simpler and easily memorized, so that characters can be read at sight without need of reference to the index table.

The idea is to form an index number for the microbe examined, consisting of eleven digits, of which the first two (which may consist of any of the numbers from 1 to 9) indicate respectively the kind of microbe and the colour of the colony. The remaining nine digits, divided by commas into sets of three (as in ordinary numbers), give the characters of the microbe, and as only one of the numbers 1 to 9 occupies each space, one knows at sight (after memorizing the index) what character is indicated by each number, and if the number is represented by 0 one sees at once, by reference to the numbers to left or right, what character it is that is absent.

The index need not be a rigid one, and the number of digits can be increased or decreased, and different characters can be assigned to the various positions. It may be useful both in medical, botanical and industrial bacteriology.

Numeral	1	2	3	4	5	6	7	8	9
1st	Micro-coccus	Strepto-coccus	Staphylo-coccus	Tetra-coccus	Sarcina	Bacillus	Vibrio Spirillum		-thrix
2nd		White	Yellow	Orange	Green	Red	Violet	Blue	Brown

3rd	Motile	= 1
4th	Stains by Gram	= 2
5th	Aerobic	= 3
6th	Pathogenic	= 4
7th	Liquefying	= 5
8th	Gas production	= 6
9th	Acid production	= 7
10th	Coagulates milk	= 8
11th	Sporing	= 9

0 in place of any digit = Not, no.

A blank in place of any digit = Not determined.

Underlined = Very, rapidly.

Overlined = Slightly, slowly.

Under and overlined = Quaere.

Example.

An organism on examination gives the number 62,023,406,780. This indicates:—

6	A bacillus.
2	Colour of colony—white.
0	Non-motile.
2	Stains by Gram.
3	Aerobic.
4	Pathogenic.
0	Non-liquefying.
6	Produces gas.
7	Produces acid.
8	Coagulates milk.
0	Non-sporing.

On reference to a prepared list of organisms represented by such numbers one identifies the one under examination as *Bacillus pneumoniæ*, the Pneumo bacillus of Friedlander.

OBITUARY.

HENRY WOODWARD, LL.D., F.R.S., F.G.S., F.Z.S., F.R.M.S.

1832–1921.

Dr. Henry Woodward, late Keeper of Geology in the British Museum, and past President of the Royal Microscopical Society, died on September 6th in his 89th year; he had followed with unabated interest almost up to the last the progress of the science to which he had devoted the energies of a long life.

He was the youngest son of Samuel Woodward, the well-known geologist and antiquary of Norwich, and was born in 1832. At an early age he began to take an interest in natural history, which was fostered by his eldest brother, S. P. Woodward, at that time Professor of Natural History at the Royal Agricultural College, Cirencester. Henry came to London in 1848 with his brother, when the latter was appointed an assistant in the British Museum, but, failing to find congenial employment, returned to Norwich two years later, and for the next seven years held a clerkship in Gurney's Bank. In 1858 fortune smiled upon him, and he became an assistant in the Geological Department of the British Museum. Here he utilized to the full the oportunities that offered for scientific research, and from this time onwards made numerous and notable contributions to palæontology. In 1880 he was made Keeper of the department, succeeding Mr. G. R. Waterhouse, and held that office until his retirement from the Museum in 1901.

Although Dr. Woodward's scientific interests were very wide indeed, he had from the beginning devoted much attention to the special study of the Crustacea, and his chief contributions to science were in the form of detailed descriptions of fossil forms of this group. The results of his work were published in the "Quarterly Journal of the Geological Society," and in the form of monographs for the Palæontographical Society, of which Society he became President in 1895 on the death of Professor Huxley. He retained the Presidentship to the time of his death.

His influence on the progress of geology and palæontology was much extended when, in conjunction with T. Rupert Jones, he founded the "Geological Magazine," of which he was sole editor from the beginning of 1865 until the end of 1918. This monthly journal provided a medium for the publication of results of much valuable research, and the adequate presentation of much of this work was due to the experienced guidance of Dr. Woodward.

Woodward joined the Geological Society in 1864, and was

President in 1894–96, receiving the Wollaston Medal in 1906; he was elected F.R.S. in 1873, and received the honorary degree of LL.D. from St. Andrew's in 1878. He was elected to the Fellowship of the Royal Microscopical Society in 1880, and occupied its Presidential chair during the years 1902 and 1903. It is interesting to note that his first publication was a small pamphlet issued in 1860 on "The Prize Microscopes of the Society of Arts, with Plain Directions for Working with them."

From an early date Dr. Woodward began writing semi-popular articles for the "Popular Science Review," the "Intellectual Observer," and other journals, thus making known to a wider circle of readers the results of research in palæontology.

For many years an active member of the Council of the British Association, he served as President of the Geological Section in 1887. He was also President of the Geologists' Association 1873–1875.

A. W. Sheppard.

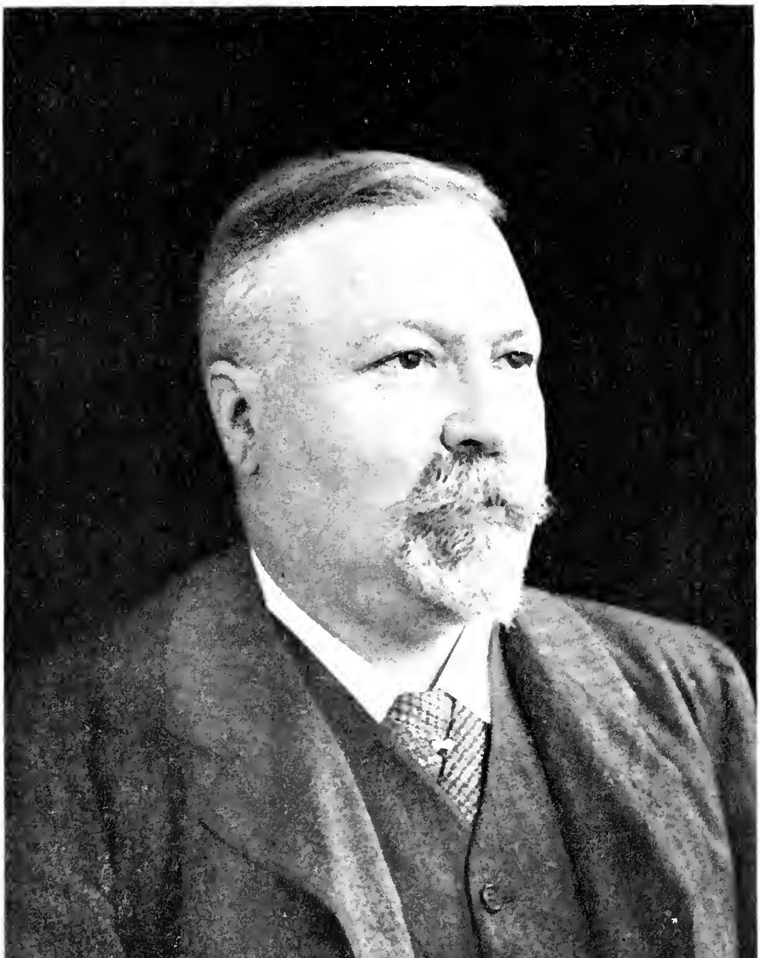
CHARLES FREDERIC ROUSSELET.

1854–1921.

It is with great regret we have to record the death of Mr. C. F. Rousselet, who for over a quarter of a century was a familiar figure at our meetings. He was born at Friederichsdorf in 1854, and died on October 25, 1921, after a long illness of several years.

Rousselet came of an old Huguenot family, and his direct ancestor, Esaïe Rousselet, left his home at Perrière, near Soissons, after the revocation of the Edict of Nantes. He and several others, some thirty families in all, founded a French settlement afterwards named Friederichsdorf, from the Landgrave of Hesse-Homburg—Friederich II. Here their descendants have continued to live, speaking French as their mother-tongue, to the present day. Mr. Rousselet came to London in 1873 and was naturalized in 1889. During the years 1881–1902 he was the London representative for the Bordeaux firm of A. de Luze et fils.

Even before the publication of Hudson and Gosse's "Rotifera," Rousselet's general interest in this group had given place to serious study, and by unremitting research he soon became the recognized authority on the subject. His contributions to the Journal of this Society, as well as of that of the Quekett Microscopical Club, embodying the results of his original observations, were as valuable as they were numerous, and resulted in considerable additions to the number of known species. His work was very methodical and exact, and his descriptions were always accompanied



Charles Frederic Rousselet.

by accurate drawings representing both the species and the details necessary for its determination. In this way Rousselet set an excellent example to the band of workers he gathered round him. His method of preservation and mounting is perhaps more widely known than his descriptive work; and the process of "narcotizing" which he introduced, or some modification of it, is now practised in all laboratories where biological work is in progress. His last paper, "Some Further Notes on Collecting and Mounting Rotifera," was published in Vol. 13, Journal of the Quekett Microscopical Club, p. 321 (October 23, 1917), where a bibliography is given of his various papers in this subject, in which he achieved such marked success.

He was elected to the Fellowship of the Royal Microscopical Society in 1888, and served for many years on the Council. In January 1898 he was appointed Honorary Curator, and in this capacity his knowledge of the history of the microscope enabled him to render valuable service to the Society in the preparation of the Catalogue of the Collection of Instruments. He held office until December 1918, when increasing physical distress compelled him to relinquish the work. In January 1917 Mr. Rousselet presented to the Society an extensive collection of reprints, etc., which he had received from his many correspondents in all parts of the world. These papers, numbering about a thousand, form probably the most valuable collection of papers on the Rotifera available to workers for reference in this country.

A. W. Sheppard.

SUMMARY OF CURRENT RESEARCHES

RELATING TO

ZOOLOGY AND BOTANY

(PRINCIPALLY INVERTEBRATA AND CRYPTOGAMIA),

MICROSCOPY, ETC.*

ZOOLOGY.

VERTEBRATA.

a. Embryology, Evolution, Heredity, Reproduction, and Allied Subjects.

Effect of Hydrogen Ion Concentration and Oxygen Content of the Water on Regeneration and Metabolism in Tadpoles.—MINNA E. JEWELL (*Journ. Exper. Zool.*, 1920, **30**, 461–507, 24 figs.). The optimum hydrogen ion concentration for regeneration of the tadpoles of *Rana clamata* is neutrality or near neutrality. Unfavourable concentrations inhibit regeneration directly and indirectly. The direct effect on the regenerating tissue is relatively independent of the size of the tadpole; the indirect effect is greater in smaller tadpoles. In water of low oxygen content both the rate of regeneration and the total amount regenerated are dependent upon the amount of oxygen present. Both rate and amount decrease with decrease in temperature. Differentiation in regenerating tissues, as indicated by the appearance of pigmentation, is not retarded by unfavourable conditions so much as growth or elongation. It is suggested that unsuitable hydrogen ion concentrations, insufficient oxygen, low temperatures, and toxic substances affect development, regeneration, oxygen metabolism, and duration of life in the same way and according to the same laws. J. A. T.

When does the Reducing Division Occur?—EMILE GUYÉNOT (*Comptes Rendus Soc. Phys. Hist. Nat. Genève*, 1921, **38**, 53–5, 1 fig.). In opposition to the usual view that the first maturation division is the reducing division, halving the number of chromosomes, and that the second division is an equation division, it is maintained that the real reduction is effected by the second maturation division. In naturally parthenogenetic animals there is no chromatin reduction, and that is due to the suppression of the *second* maturation division. In Daphnids, Ostracods, Aphides and Rotifers there is a first polar body formed, but no reduction. In *Cyclops strenuus* and *Artemia salina* there is an

* The Society does not hold itself responsible for the views of the authors of the papers abstracted. 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, etc., which are either new or have not been previously described in this country.

abortive second division, but the chromosomes about to be rejected are seen to return again to the ovum and re-unite with their former neighbours. In the case of the bee's parthenogenetic ova (those that develop into drones) there is a second maturation division, and the number is reduced to half the normal. In the spermatogenesis of the drone the second maturation division is suppressed, and there is no reduction. The author's conviction is that the first maturation division is homeotypic, separating bivalent chromosomes, while the second is heterotypic and reducing. J. A. T.

Dictyokinesis in Germ-cells.—R. J. LUDFORD and J. BRONTÉ GATENBY (*Proc. Roy. Soc. London*, 1921, **92**, 235–44, 2 pls.). Most animal cells show two categories of cytoplasmic inclusions—the mitochondria and the Golgi apparatus. The latter generally takes the form of an excentric juxta-nuclear system or network, composed of rodlets, platelets or beads, arranged, in many cases, around and over the surface of the centrosphere or archoplasm, in which lies embedded the centrosome. In highly differentiated cells such as the oocyte or the nerve-cell, the Golgi apparatus becomes dispersed into the farthermost parts of the cell-cytoplasm, and in most cases therefore loses its relationship to the centrosome. The Golgi rods or dictyosomes are divided in mitosis, but they are very elusive during the process. The authors have followed the distribution or dictyokinesis in various types. It is sometimes very irregular, notably in mammals. In contrast with karyokinesis it does not entail any sort of fission of individual elements as occurs with chromosomes, but merely an unprecise sorting out of parts of the Golgi reticulum between the two daughter-cells. Everything indicates that the Golgi apparatus takes a part less precise and less important, in the hereditary processes of the cell, than that fulfilled by the chromosomes. J. A. T.

Transplanting Sections of Spinal Cord.—S. R. DETWILER (*Proc. Nat. Acad. Sci.*, 1920, **6**, 695–700, 2 figs.). In *Amblystoma* embryos the portion of the spinal cord from which the normal brachial plexus is derived (third, fourth and fifth segmental nerves) was removed, and there was transplanted into the excised area a more posterior portion of the spinal cord of another embryo—the portion that normally gives origin to the seventh, eighth, and ninth segments. These nerves, in their normal position, are capable of producing but very limited movements when innervating transplanted limbs. Now in the embryos operated on the limbs performed normal adaptive and co-ordinated movements in 50 p.c. of cases. A microscopic study showed the presence of a perfectly developed brachial plexus with normal intrinsic nerve distributions. Moreover, the nerves were larger than the normal seventh, eighth and ninth. Even the cord itself and the spinal ganglia showed distinct hyperplasia of the nerve-cells, thus indicating that the hypertrophic development was due to excessive proliferation of the neuroblasts rather than to a compensating increase in the volume of a specific number of cell bodies and their axons. The factor involved in the over-production of the motor-cells is the stimulus afforded by the connexion with the central neurones (bulbo-spinal fibres). J. A. T.

b. Histology.

Eye of Alligator.—H. Laurens and S. R. Detwiler (*Journ. Exper. Zool.*, 1921, **32**, 207–34, 13 figs.). The eye of *Alligator mississippiensis* has a well-developed tapetum in the dorsal and posterior portions of the retina, formed by inclusion of guanin in cells of the epithelial layer. The pecten is a slightly raised pigmented cap covering the entrance of the optic nerve. Typical rods and cones occur throughout the retina—one type of rods, two types of cones. The actual change in position of the pigment in the visual cells between eyes in light and in darkness is slight, but when combined with the change in the length of the visual cells gives an effective migration equal to the sum of the two. J. A. T.

Retina of Phrynosome.—S. R. Detwiler and Henry Laurens (*Journ. Compar. Neurol.*, 1920, **32**, 347–56, 6 figs.). The general structure of the retina of *Phrynosoma cornutum* bears a close resemblance to that of the chameleon. There is a prominently developed area centralis in the form of a circular convexity above the point of entrance of the optic nerve, with a maximally developed fovea at its centre. A highly vascular conical pecten projects dorso-anteriorly about 1 m.m. into the posterior chamber of the eye. The retina possesses only cones, resembling in this respect other diurnal saurians. The cones exhibit a considerable variety in size, shape, and structure. The cones of the fovea are greatly attenuated and cylindrical in form as compared with the conical form in the extra-foveal region. No double cones were seen. The pigment under ordinary conditions of illumination extends down over the visual cells, almost to the paraboloids, except in the foveal region, where only the outer segments are covered.

J. A. T.

c. General.

Changes in Intensity of Oxidation.—W. E. Burge and E. L. Burge (*Journ. Exper. Zool.*, 1921, **32**, 203–6). The low rate of oxidation in the unfertilized ovum (potato-beetle) is attributed to its low catalase content. The increased oxidation in the fertilized ovum, with resulting development, is attributed to an increase in catalase brought about by the stimulation of the egg to an augmented production of this enzyme by the spermatozoon. Similarly, the increase in the respiratory metabolism or oxidation in youth and the decrease in old age is attributed to the increase in catalase in the young animal, and its decrease in the aged. J. A. T.

Eye-muscles of Eagle-Owl.—M. Bartels and G. Dennler (*Zool. Anzeiger*, 1920, **52**, 49–55, 3 figs.). Although the eye of the eagle-owl is not known to move during life, and cannot be moved after death, the usually six muscles are present. There are two strong muscles which draw the nictitating membrane downwards over the immobile eye. J. A. T.

Recent Advances in Parasitology.—Ernest Carroll Faust (*Trans. Amer. Micr. Soc.*, 1921, **40**, 75–88). An interesting review and bibliography of recent progress. Attention is called to investigations like the following:—Dobell's study of amœbæ and coccidia in man, La Rue's monograph on Proteocephalidæ, Leiper's study of Bilharzia, Nakagawa's unravelling of the life-cycle of *Paragonimus westermani*, Magath's monograph on *Camallanus americanus* ("the most significant work on a single nematode species since the researches of Looss on *Ancylostoma duodenale*"), and the work of the Rockefeller Commission in connexion with hookworm. J. A. T.

Variations and Modifications.—ARNOLD PICTET (*Comptes Rendus Soc. Phys. Hist. Nat. Genève*, 1921, **38**, 64–7). Geographical races of Lepidoptera with hereditary characters must be and can be distinguished from false races, with acquired modifications (or "somations") similar to the local peculiarities of the true geographical races, but not lasting. On mountain plateaux there are found forms with the hereditary peculiarity A B, due to a crossing of A and B forms which belong to different sides of the mountain, but meet at the top. But there are likewise absolutely similar A B forms, which are A's and B's that have migrated to the plateaux and have been individually modified there. But the A B peculiarity of these migrants is not hereditary. Experimental results will be discrepant if two kinds of A B (variational and modificational) are confused. Pictet's experiments are quite against the hypothesis of the transmission of somatic modifications. J. A. T.

Increase in Quantity of Anti-bodies.—A. SORDELLI (*Comptes Rendus Soc. Biol.*, 1920, **83**, 1526). The presence of anti-bodies may be due to placental transmission from the mother, or to the milk, or they may be formed as a reaction to an intruding microbe, or they may arise spontaneously. The author's point is that the quantity of an anti-body increases as the animal grows older. This is seen in the diphtheritic anti-toxin in man and in horse, in the cholera agglutinin in the guinea-pig, and in the dysenteric agglutinin in the horse. The author concludes in favour of the spontaneous production of anti-bodies. J. A. T.

Secondary Sex-characters in Elasmobranchs.—W. HAROLD LEIGH-SHARPE (*Journ. Morphol.*, 1921, **35**, 359–80, 15 figs.). A study of the structure and functions of the claspers, clasper siphons, and clasper glands in various Elasmobranchs—*Galeus vulgaris*, *Mustelus vulgaris*, *Lamna cornubica*, and *Rhina squatina*. The functions of the clasper gland, in the *Lamna* type at least, are comparable to those of the prostate—e.g. (1) lubrication and provision of a vehicle for the spermatozoa; (2) control of erection; (3) activation of the spermatozoa; and (4) providing nourishment for the spermatozoa. The clasper glands are developed, however, as invaginations of the epidermis. On the outer borders of the upper lip of *Rhina squatina* there is a patch of cells of the same type and structure as the clasper gland: it is evidently a mucus-secreting gland and not an organ of special sense. The rectal gland of Scyllium has a kidney-like structure, except that there are no Malpighian bodies and the blood-supply is slight. It may be an excretory organ, getting rid of poisonous substances not eliminated by the kidneys. J. A. T.

INVERTEBRATA.

Arthropoda.

a. Insecta.

Scent-organ in Moth-flies.—JACOB FEUERBORN (*Zool. Anzeiger*, 1920, **51**, 279–85, 3 figs.). In certain Psychodidæ (e.g. *Ulomyia fuliginosa*) there are in the males peculiar structures which look like scent-organs. In *Ulomyia* there is under the tegula of the mesonotum, beside the first stigma, a stalked vesicular body, with a thin-walled folded surface and a papillary plate. No similar structure occurs in Diptera, but it may be analogous with scent-secreting structures in some Lepidoptera. Similarly, in some species of *Pericoma* there are on the prothorax what look like scent-hairs. It is curious that these tiny insects, which get their name moth-flies because of their moth-like wings and hairs, should also approach Lepidoptera in having scent-organs.

J. A. T.

Tachinid Parasite of Crane-fly.—J. RENNIE and CHRISTINA H. SUTHERLAND (*Parasitology*, 1920, **12**, 199–211, 1 pl.). Larvæ of *Bucentes* (*Siphona*) *geniculata* occur regularly as parasites inside larval forms of *Tipula paludosa* and other species. The winter months are spent as larvæ within the host; pupation occurs in early spring; the imagines emerge during April and May; a second generation appears in June; after a larval period of about three weeks and a pupal period of about seventeen days the adult flies emerge towards the end of July; infection of young *Tipula* larvæ probably occurs in autumn. The larva is always attached by a chitinous sheath-like structure to one of the main tracheal trunks of the host. A description is given of the three different stages of larva, and of the bucco-pharyngeal apparatus of the mature larva.

J. A. T.

Hancock's Gland in Œcanthus.—ARATA TERAO (*Annot. Zool. Japon*, 1921, **10**, 41–4, 1 fig.). Hancock described (1905) a remarkable allnring gland in the striped meadow cricket (*Œcanthus fasciatus*). Terao finds it in the Japanese *Œ. longicauda* and describes its structure. It is a complex of hypodermal gland cells of two kinds, and of a sub-hypodermal multicellular gland with a spacious central duct. The unicellular hypodermal glands of the second type line two pairs of depressions or fossæ, and these depressions hold the secretion. There is also a projecting nipple-like process, perforated by many openings, and thin-walled at the top. It may serve as an object to be licked.

J. A. T.

New Mosquitoes and Filaria bancrofti.—SHINICHIRO YAMADA (*Annot. Zool. Japon*, 1921, **10**, 45–81, 4 figs.). Descriptions of no fewer than ten new species of the mosquito genus *Aëdes*, found in Japan. The mosquitoes of this genus are not generally able to serve as intermediate hosts of *Filaria bancrofti*, but the investigator found that *Aëdes togoi*, which is very common in Japan, can act as such.

J. A. T.

δ. Arachnida.

Critical Study of Sarcoptes.—Cecil Warburton (*Parasitology*, 1920, **12**, 265–300, 1 pl.). It is probable that *Cnemidocoptes* from birds and *Notœdres* from small mammals will be found to be generically distinct from *Sarcoptes*, but it is necessary to revise the various forms of *Sarcoptes*—e.g. as to chætotaxy and armature—to see whether there are distinct species in the genus. These should be transferred from one host to another to see what difference may be thus brought about.

J. A. T.

Capitulum of Psoroptes.—P. A. Buxton (*Parasitology*, 1920, **12**, 234–6, 2 figs.). A careful description of the capitulum and mouth-parts of *Psoroptes equi*. The mite carries its head tucked down between the bases of the first pair of legs. The chelicerae are extremely small and colourless. It may be assumed that the mite obtains a secure hold on the skin of its host by aid of its ambulacra and tarsal claws, and that it then steadies itself by applying the finger-like processes closely to the skin. It would then bring the chelicerae into action, probably using "setæ 1 and 2" as organs of touch.

J. A. T.

ε. Crustacea.

Eyes of a Cave Decapod.—W. Harms (*Zool. Anzeiger*, 1921, **52**, 101–15, 7 figs.). A study of a Galatheid, *Munidopsis polymorpha* Koelbel, from a Lanzarote cave (Canaries). The colour is translucent white: the animal hides quickly under stones: the compound eyes are difficult to see: there are no corneal facets, and the cornea itself is degenerate, and may be represented only by a few cells. There is considerable individual variation in the eye, and two types—more or less reduced—can be distinguished. The minute structure is described. There can be no vision, but doubtless a perception of light and shade. Crystalline cones persist, probably in adaptation to some light that enters by the fallen-in roof of the cave. The other species of *Munidopsis* are in the deep sea.

J. A. T.

Annulata.

Nerve Cord and Spindle Muscle of Physcosoma.—W. Harms (*Zool. Anzeiger*, 1920, **22**, 67–76, 8 figs.). In a species of this Sipunculid, very abundant at Lanzarote, there is extraordinary power of longitudinal contraction. In association with this there is a coiling of the nerve cord into a close spiral, especially in the proboscis region. The spindle muscle which runs freely from the posterior end of the body, along the spirally twisted gut, to a point immediately in front of the anus, is also adapted to the extreme contraction. The fibres assume a remarkable corkscrew appearance. Both nerve cord and spindle muscle retain their position parallel to the long axis of the body. An account is given of the details of the contraction in both the nerve strand and the spindle muscle, but the important point is the corkscrew disposition.

J. A. T.

Nematohelminthes.

New Nematodes from Elephants.—H. A. Baylis (*Parasitology*, 1921, **13**, 57–66, 7 figs.). Description of a new genus *Parabronema*, referable to the Spiruridæ. The mouth is bordered by paired lateral lips, external to which there is a dorsal and a ventral shield of cuticle. Each lip bears one large, median lateral papilla and a pair of small sublateral papillæ. Each of the shields carries a pair of larger papillæ, situated at some distance behind the extremity of the head. The cuticle of the head is thick, and folded in a complicated manner so as to form a circlet of six horseshoe-shaped auricular appendages, of which two are lateral, two subdorsal, and two subventral. The open anterior end of the horseshoe is partly filled up by a vesicular swelling of the cuticle. The edge of each of these appendages is further folded to form a groove somewhat resembling the cervical grooves of the *Acuaria* group. Truly a remarkable head. J. A. T.

New Species of Myzostoma.—Juta Hara and Yaichiro Okada (*Annot. Zool. Japon.*, 1921, **10**, 33–9). Descriptions of two undoubtedly new species of this interesting genus. The first, *M. robustum* sp. n., was found on the ventral side of the arms of *Metacrinus rotundus*. It is nearest *M. clarki*, but differs in the following characters: the lack of a pair of vestigial cirri at each end of the body, the absence of longitudinal wrinkles on the dorsal surface, two main intestinal diverticula instead of three, the situation of the mouth in a notch at the anterior dorsal end of the body, and the position of the cloaca near the posterior margin of the ventral surface. The second species, *M. ijimai* sp. n., was found in the subdermal tissue of the disc of *Antedon macrodiscus*. As in many other cysticolous species, the body is very parenchymatous, with feeble musculature and parapodia. J. A. T.

Classification of Ascaridæ.—H. A. Baylis (*Parasitology*, 1920, **12**, 411–26, 7 figs.). A discussion of the *Polydelphis* group, and an account of other Ascarids parasitic in snakes. A new genus, *Ophidascaris* is established alongside of *Polydelphis*. J. A. T.

Nematodes of Domestic Pigeon in Australia.—Vera Irwin-Smith (*Proc. Linn. Soc. N.S.W.*, 1921, **45**, 552–63, 19 figs.). The only Nematode previously recorded from the domestic pigeon in Australia was *Ascaridia columbæ*. To this is now added *Cephalostrongylus quadriradiatus* (= *Strongylus quadriradiatus* Stevenson), a new genus being erected, differing markedly from *Strongylus* or *Trichostrongylus* on account of the relative sizes and positions of the bursal rays, the form of the spicules, and the inflation of the cuticle of the head to form a vesicular enlargement. There is also added *Capillaria columbæ* Rudolphi. J. A. T.

Distribution of Hookworms.—Samuel T. Darling (*Parasitology*, 1920, 217–33). The races of mankind living in tropical and subtropical regions are infested with one or more species of hookworms —*Agchylostoma duodenale*, *A. ceylonicum*, *A. braziliense*, and *Necator americanus*. In the migrations of peoples the immigrants have carried their peculiar species of hookworms into regions occupied by people having a different worm-species-content, and by an examination of the intestinal worms of a people the geographical and ethnic origin of their hosts can, within certain limits, be divined. J. A. T.

Classification of Ascaridæ.—H. A. Baylis (*Parasitology*, 1920, **12**, 253–64, 1 fig.). Revised classification based on the characters of the alimentary canal. Five types are distinguished :—

1. Œsophagus muscular throughout, opening directly into the intestine without posterior ventriculus or distinct bulb; with a forwardly-directed cæcum springing from the intestine; with no œsophageal appendix. Examples: *Ascaris holoptera*, *A. colura*.

2. Œsophagus slender, with a more or less globular bulb at the base: the intestine produced forwards as a long cæcum; with no œsophageal appendix. Examples: *Ascaris halichoris*, *Dujardinia helicina*.

3. Œsophagus with a posterior glandular portion, or ventriculus, of elongate or oblong shape, and often bent in a sigmoid manner; with no œsophageal or intestinal cæca. Examples: *A. rosmari*, *A. similis*.

4. Œsophagus with a posterior glandular portion, or ventriculus, often bent so as to open into the intestine laterally; with an intestinal cæcum; with no œsophageal appendix. Examples: *A. decipiens*, *A. depressa*, etc.

5. Œsophagus with a reduced posterior ventriculus, giving off a backwardly-directed glandular appendix; with an intestinal cæcum as well. Examples: *A. aucta*, *A. microcephala*, etc.

In accordance with these differences a reclassification is offered of the sub-families Anisakinæ and Heterocheilinæ. J. A. T.

Platyhelminthes.

Species of Fasciola.—Harold G. Jackson (*Parasitology*, 1921, **13**, 48–56, 1 pl., 4 figs.). It is shown that *Fasciola angusta* (Railliet) and *F. ægyptiaca* (Looss) are connected by intermediate forms, and that they cannot be separated from *F. gigantica* (Cobb). A key is given of the species of *Fasciola*, including the common liver-fluke, which have been hitherto described. J. A. T.

New Trematode from Heron.—Eleanor E. Chase (*Proc. Linn. Soc. N.S.W.*, 1921, **45**, 500–4, 1 pl., 1 fig.). A description of *Holostomum repens* sp. n., from the intestine of the white-fronted heron. In all the described species of *Holostomum* the oral sucker and the pharynx are both well-defined structures, but in this new species only one cavity with thick muscular walls is found in connexion with the mouth. The probability is that the oral sucker is not represented. The rather complicated clinging plug occupies a much larger proportion of the body than in *H. variabile*. J. A. T.

Japanese Digenetic Trematodes.—Harujiro Kobayashi (*Parasitology*, 1920, **12**, 380–410, 3 pls.). Descriptions of a number of new species from mammals, birds, reptiles, amphibians, and fishes. Three new genera are established, *Microbrema*, *Leptolecithum* and *Exorchis*.

J. A. T.

Larval Flukes from Georgia.—ERNEST CARROLL FAUST (*Trans. Amer. Micr. Soc.*, 1921, **40**, 49–55, 2 pls.). A description of a number of new forms of cercaria from the snails *Goniobasis carinifera* and *Anculosa carinata*. They are all Distomes and show interesting relations to previously described forms. J. A. T.

Life-cycle of Echinostoma revolutum.—JOHN C. JOHNSON (*Univ. California Publications Zoology*, 1920, **19**, 335–88, 7 pls., 1 fig.). The stages in the life-history of this Trematode are described in detail —egg, miracidium, mother-redia, daughter-redia, cercaria, encysted agamodistome, and adult. Two hosts are necessary, the snail *Physa occidentalis* and a duck or goose. Apparently any duck or goose forms a suitable host. J. A. T.

Tapeworms of Poultry.—F. J. MEGGITT (*Parasitology*, 1920, **12**, 301–9, 2 pls., 1 fig.). Descriptions of *Cotugnia digonophora* (Pasquale, 1890) from chickens, *C. fastigiata* sp. n. from domestic ducks, *Hymenolepis columbæ* (Zeder, 1800) from pigeons, *H. coronula* (Dujardin, 1845) from ducks, and *H. gracilis* (Zeder, 1803) also from ducks.

J. A. T.

New Cestode in Hedgehog.—F. J. MEGGITT (*Parasitology*, 1920, **12**, 310–3, 1 pl.). Description of *Oochoristica erinacei* sp. n., and a key to the genus. Five other Cestodes have been recorded from the hedgehog. From all of these this new species is distinguished by its possession of numerous testes, situated posteriorly to the female organs.

J. A. T.

New Tapeworms from Ostrich.—F. J. MEGGITT (*Parasitology*, 1921, **13**, 1–24, 1 pl., 2 figs.). Descriptions of *Davainea beddardi* sp. n. and *D. linstowi* sp. n.; a revision of the genus *Davainea* and a key to the species: a list of species of *Davainea* with their hosts. The species fall roughly into four groups, the division being based upon the armature of the suckers and the position of the genital pores. J. A. T.

Echinoderma.

Locomotion of Stichopus panimensis.—G. H. PARKER (*Journ. Exper. Zool.*, 1921, **33**, 205–8, 1 fig.). This Holothurian creeps on its trivium by means of locomotor waves of a direct monotaxic type. These waves progress over the animal at a rate of about 0·39 cm. per second, and they enable the animal to creep a metre in about a quarter of an hour. The part of the trivium moved forward is lifted well above the substratum to which the remainder of the trivium is attached by the tube-feet. J. A. T.

Reversal of Asymmetry in Plutei of Echinus miliaris.—HIROSHI OHSHIMA (*Proc. Roy. Soc. London*, 1921, **92**, 168–78). Description of a number of abnormal plutei which had the hydrocœle developed on the right side instead of on the left. In other respects also the larva was a perfect mirror-image of the normal larva. They developed normally, and the young urchins were externally normal. The interesting point is the recovery of the left hydrocœle. MacBride and Ohshima attribute the development of two hydrocœles to a latent power in the right anterior cœlom developing a hydrocœle, a power which is normally inhibited by the development of the functional hydrocœle from the left anterior cœlom. MacBride regards the latent power of the right side as an indication of ancestral bilaterality. Ohshima finds the explanation in homœosis. J. A. T.

Cœlentera.

Luminescence of Renilla.—G. H. PARKER (*Proc. Amer. Phil. Soc.*, 1920, **19**, 171–5). Louis Agassiz observed that *Renilla reniformis* "shines at night with a golden green light of a most wonderful softness." This is also true of *R. amethystina* of southern California. At night the stimulated colony glows with a wonderfully clear blue-green light. There is probably a rhythm in the animal's metabolism, for the luminescence induced by day never reaches the degree of brightness seen at night. The luminescence is induced by mechanical or electrical stimulation. Luminous ripples emanate from the spot stimulated (on the upper surface) and spread out concentrically over the disc, like waves on the smooth face of a pond into which a pebble has been thrown. The luminescence is limited to light-coloured material surrounding the bases of the zooids on the upper surface. This light-coloured material consists of a whitish chalky substance and a light-yellowish one, the former being the photogenic substance. The impulses that induce the luminescence are profoundly influenced by such anæsthetics as magnesium sulphate. It seems that the transmission of the phosphorescent waves is neurogenic rather than myogenic; its rate varies with the temperature; it is probably due to chemical rather than to physical processes. J. A. T.

Porifera.

Irish Sponges.—JANE STEPHENS (*Fisheries Ireland, Sci. Invest.*, 1921, **2**, 1–75, 6 pls.). An account of the Tetraxonida of the sub-order Sigmatomonaxonellida found on the coasts of Ireland. There are descriptions of thirteen new species, the majority of which have been found growing on coral (chiefly *Lophohelia prolifera*) in deep water. In one haul 37 species of sponges were obtained (5 Tetractinellida, 30 Monaxonellida, and 2 Euceratosa). All of these, with two exceptions, were new to the Irish area, and six were new to science. Twenty-three of the entire number were growing on coral, while a small piece of sandstone had 6 species growing on an area of about 75 sq. mm.

J. A. T.

Protozoa.

Intestinal Protozoa from Lizards.—C. M. WENYON (*Parasitology*, 1920, **12**, 350–65, 2 pls., 2 figs.). A full description of a flagellate of the Leptomonad type from the rectum and cloaca of the chameleon.

The author also deals with *Prowazekella lacertæ* from *Lacerta agilis* and *Agama stellis*, besides species of *Chilomastix* and *Entamœba* from the same two hosts. J. A. T.

Cytamœba bacterifera in Red Blood Cells of Frog.—R. W. HEGNER (*Journ. Parasitology*, 1921, **7**, 157–61, 8 figs.). An interesting organism, which Labbé found in amphibian blood and Grassi in the red blood corpuscles of the tree-frog (*Hyla viridis*), has been observed by Hegner in the red cells of *Rana clamitans* and *R. catesbiana*. It is regarded as *a stage* in the life-cycle of a Protozoan parasite, and it has living within it, either as hyper-parasites or in symbiosis, a bacillus named by Laveran *Bacillus krusei*. J. A. T.

New Intestinal Amœba in Man.—C. A. KOFOID and OLIVE SWEZY (*Univ. California Publications Zoology*, 1921, **20**, 169–98, 5 pls., 3 figs.). Description of *Councilmania lafleuri* g. et sp. n. found free and encysted in the human intestine. It is carefully compared with and distinguished from *Entamœba coli*. The free stage has hyaline pseudopodia, abruptly formed, with endoplasm full of food vacuoles and even ingested red blood corpuscles. The resting nucleus has a moderately-thin zone of peripheral chromatin; the karyosome is generally excentric, often with a small halo, in premitotic stages composed of dispersed particles and more nearly central in position. The pseudopodia are broad, rounded, usually less than the diameter of the cell in width, and generally there is only one. The cysts have one, two, four or eight nuclei, rarely more. There is a thick wall to the cyst, triple-contoured, spheroidal, ellipsoidal or asymmetrical, less frequently spherical. The nuclei of the cysts have little peripheral chromatin and large, excentric or central, spheroidal, renifo.m, or lobed karyosome often divided into scattered particles, eight chromosomes, and an intradesmose joining polar masses seen best in the first and second mitoses. The cysts form a chromophile ridge from which cytoplasm emerges through a pore in the cyst wall as a chromophile bud. A nucleus migrates into the bud, which is detached as an amœbula. The process is repeated till the cyst is emptied of nuclei. Budding may occur in the intestine. The dimensions of free stages are 65 by 35 microns to 20–35 microns when rounded up. The spheroidal cysts are 16–20, rarely 8–34, microns in diameter. J. A. T.

Plasmodial Parasite of Laminaria.—O. DUBOSCQ (*Comptes Rendus Soc. Biol.*, 1921, **84**, 27–33, 3 figs.). A description of *Labyrinthomyxa sauvageaui* g. et sp. n., one of the Proteomyxa, which occurs as a parasite in *Laminaria lejolisii*, in the form of fusiform bodies, small amœbæ, large amœbæ, small flagellates and large flagellates. Plasmodia are also formed, spreading from cell to cell, sometimes in a network of fusiform units united by delicate pseudopodia, sometimes in a network of amœboid units, similarly united. J. A. T.

Survival Value of Conjugation.—L. L. WOODRUFF and HOPE SPENCER (*Proc. Soc. Exp. Biol. and Medicine*, 1921, **18**, 303–4). Experiments on *Spathidium spathula* indicate that conjugation in the majority of cases increases the length of life of the exconjugant line. In 80 p.c. of cases the total number of generations attained by the exconjugant exceeds those attained by the parent from the date when the exconjugant arose to the death of the parent. The fact is evident that conjugation increases the number of fissions to a total which could not otherwise have been reached. Over 80 p.c. of the exconjugant lines attained more generations than their respective parent lines. By conjugation it has been possible to increase the number of fissions to more than double that obtainable without conjugation. In short, the survival value of conjugation is marked in the majority of cases—the exconjugant lines exhibiting a higher division rate than the non-conjugant lines and outliving them. J. A. T.

Effect of Conjugation on Division Rate.—L. L. Woodruff and Hope Spencer (*Proc. Soc. Exp. Biol. and Medicine*, 1921, **18**, 240–1). Experiments with *Spathidium spathula* lead to the conclusion that the exconjugant lines of a pedigree culture exhibit, in the great majority of cases, a higher division rate for the first fifteen days after conjugation than the parent lines. Exconjugation lines which are derived from old parent lines (i.e. from lines which have undergone many generations since conjugation) show a relatively greater increase in the division rate, during the first fifteen days, as compared with the parent lines, than do exconjugant lines which are derived from young parent lines (i.e. from lines which have more recently conjugated). J. A. T.

Amicronucleate Race of Didinium nasutum.—Mary W. Patten (*Proc. Soc. Exp. Biol. Medicine*, 1921, **18**, 188–9). From a micronucleate parent race a single amicronucleate exconjugant appeared, and the condition persisted for 652 generations. At various intervals during the life-history of this culture there were periods showing a tendency for encystment and conjugation, but the animals which encysted or conjugated invariably died, a fact undoubtedly related to their amicronucleate condition. There was no endomixis. The amicronucleate state doubtless arose from some irregularity in conjugation. J. A. T.

Measurements of Trypanosoma diemyctyli.—R. W. Hegner (*Journ. Parasitology*, 1921, **7**, 105–13). Every one of seventy-eight aquatic specimens of the newt *Diemyctylus viridescens* was found to be infected with *Trypanosoma diemyctyli* Tobey. Measurements were made of trypanosomes from ten newts, which showed differences in their range of variation in total length exclusive of the flagellum, in the length of portions, and in the width of the body, and in the averages of length and width. Length and width show a positive correlation, and on an average the longer the specimen the wider it is. Two different types occur in one and the same host. Two different types obtained from the different newts are probably races of one species that are heritably diverse in size. They may, however, belong to different species, or may be sexual phases of a single species, or may differ because of changes due to the environment. J. A. T.

New Flagellate with Trichocysts.—W. Conrad (*Bull. Acad. Roy. Belgique Classe des Sciences*, 1920, No. 11, 541–55, 4 figs.). A description of *Reckertia sagittifera* g. et sp. n., a colourless Chloromonad, belonging to the series *Vacuolaria*, *Trentonia*, *Gonyostomum*, and *Thaumatomastix*. It is near the last in its general appearance, in its pseudopodia, in its mode of nutrition, and in its contractile vacuoles. But it has a ventral groove and trichocysts. It was found in an aquarium in the Botanic Gardens in Brussels. Below the cuticle the

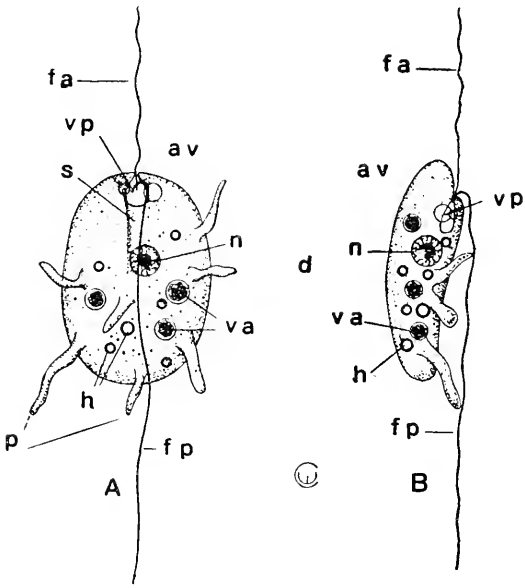


FIG. 1.—*Reckertia sagittifera* seen from the ventral surface.

FIG. 2.—Seen from the side.

av, anterior; *d*, dorsal; *v*, ventral; *fa*, anterior flagellum; *fp*, posterior flagellum; *s*, ventral groove; *vp*, contractile vacuole; *va*, food-vacuole; *n*, nucleus; *h*, droplets of oil; *p*, pseudopodia.

ectoplasm shows a thick cuticle, a structureless hyaline layer, a striated alveolar layer with trichocysts. There is a large vesicular nucleus which divides by karyokinesis. There are numerous food-vacuoles in the endoplasm, and reserve carbon-compounds are represented by droplets of oil. The trichocysts are regarded as specialized vacuoles containing a peculiar substance, perhaps a pectosic gel. J. A. T.

Experiments with Insect Flagellates.—C. A. HOARE (*Parasitology*, 1921, **13**, 67–85). Experiments towards infecting various Vertebrate types with *Crithidia melophagia*, *Herpetomonas jaculum*, and *H. calliphoræ* yielded negative results. There seems no warrant as yet for believing that the natural Herpetomonads in insects, especially in those not associated with Vertebrates, may become pathogenic when introduced into the latter. J. A. T.

Hereditary Rickettsia-like Parasite of Bed-bug.—J. A. Arkwright, E. E. Atkin, and A. Bacot (*Parasitology*, 1921, **13**, 27–36, 2 pls., 1 fig.). The organism called "Rickettsia" are like very small bacteria, but not motile and otherwise peculiar. They occur in very large numbers in the gut and in some cases in other organs of blood-sucking insects and in ticks. The supposed cause of typhus fever is *Rickettsia prowazeki* found in the louse. In the case of the bed-bug it seems that the organism occurs in the undifferentiated egg mass, and is thus continued from generation to generation. It is suggested that they change from the form of minute granules to a long bacillary form in suitable places such as the large cells of the Malpighian tubes of the bed-bug, and that the long threads in turn release minute bodies.

J. A. T.

Structure of Cnidosporidian Spores.—R. Kudo (*Trans. Amer. Micr. Soc.*, 1921, **40**, 59–74). Discussion of structures characteristic of cnidosporidian spores. The spore membrane of *Nosema apis* and *N. bombycis*, taken as representative of the Microsporidia, is proved to be composed of a substance similar to chitin in its chemical reaction. The spore membrane of *Henneguya salminicola*, taken as a representative of the Myxosporidia, is not so like chitin. The polar filaments of cnidosporidian spores are not composed of glycogen as was suggested by Erdmann. They consist of a mixture of a part of the nucleus and a substance differentiated in the capsulogenous cell. There follows a discussion of the methods which cause extrusion of the filament. The so-called iodinophilous vacuole of the spores of the family Myxobolidæ contains a substance like glycogen in its reactions. J. A. T.

Fish Myxosporidia.—J. S. Dunkerly (*Parasitology*, 1920, **12**, 328–33, 6 figs.). Descriptions of *Ceratomyxa lata* sp. n. from *Capros sanglier*, *C. dubia* from *Cottus bubalis*, *Myxidium intermedium* sp. n. from *Pleuronectes flesus*, *Sphæromyxa longa* sp. n. from *Gadus minutus*, and *S. ovata* sp n. from *Onos tricirratus*. Reports of other Myxosporidia, not new species, from many other hosts. J. A. T.

BOTANY.

(Under the direction of A. B. RENDLE, M.A., D.Sc., F.R.S., F.L.S.)

GENERAL,

Including the Anatomy and Physiology of Seed Plants.

Structure and Development.

Vegetative.

Cuticle of Leaves in Conifers.—R. FLORIN (*Arkiv. Bot. Stockholm*, 1921, **16**, 1–32, 1 pl., 9 figs.). The author has studied the structure of the leaves in *Tsuga*, *Sequoia*, *Taxodium*, *Saxegothæa*, *Podocarpus*, *Cephalotaxus*, *Torreya* and *Taxus* in order to discover any features of systematic importance. Three types of margin can be distinguished—viz. (1) That most frequently seen in species of *Podocarpus*, *Sequoia*, *Torreya* and *Taxodium*, where the margin is entire and with little cutinization. (2) That found in *Sequoia sempervirens* and *Tsuga canadensis*, where the marginal cells are papillose, sometimes protruding like teeth, especially near the apex, and the outer cell-walls are strongly cutinized. (3) That found in *Saxegothæa* and *Taxus*, where the margin is undulate and strongly cutinized. The first type is of no special systematic importance. The second is specially characteristic of two genera, and may prove to be of use in determining species, although it will not be possible to lay much stress upon it when dealing with fossil forms, since the relatively weak walls of the papillæ render them very liable to destruction. The third type will probably be of great use in determining fossil species. The form, size and arrangement of the marginal papillæ, taken in conjunction with the strong cutinization of the cuticle, will afford a ready means of identifying different species of *Saxegothæa* and *Taxus*.

An investigation of the stomata proved of great interest. In most of the species examined they were confined to the under surface of the leaf, but in *Sequoia gigantea*, *Taxodium distichum*, *Podocarpus elongata*, etc., they were also present on the upper surface, but this fact has no systematic significance. There was a great similarity in the number of rows or bands, which were usually parallel, with varying distances between the rows and between the individual stomata. In *Sequoia sempervirens* and in *Taxodium distichum* the rows are indistinct, while their position with respect to one another and to the direction of the light varies. In the former the majority of the stomata are lengthwise and never transverse, while the reverse is the case in the latter. These characters have no systematic value, since similar irregularities occur in *Podocarpus* and *Torreya*. The epidermal cells surrounding the stomata have no special interest; those between them vary in both size and form, except in *Torreya*, where they are unusually long.

The two fossil specimens examined were *Sequoia Langsdorfii* and *Taxodium distichum miocenum*. As a whole the investigation afforded only negative results, but two interesting observations were made—viz. the structure of the epidermis of the leaves confirms the previously proved close relationship of *Sequoia* and *Taxodium*: also, these genera were represented in the tertiary polar flora, although probably by other species and forms than those of the present day. S. GREVES.

Physiological and Morphological Correlations in Herbaceous Angiosperms.—JEFFREY and TORREY (*Bot. Gaz.*, 1921, **71**, 1–31, 7 pls., 4 figs.). Herbaceous dicotyledons appear to have developed from

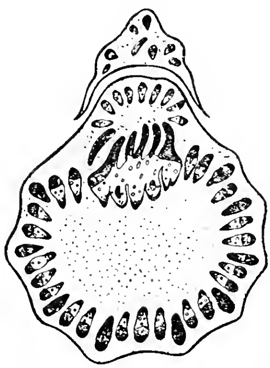


FIG. 1.—Nodal region of *Rumex* sp., showing fusions between opposed strands of axis and branch.

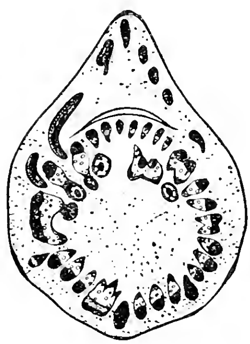


FIG. 2.—A lower plane of section of same with a greater number of amphivasal bundles.

FIG. 3.—Nodal section of *Zea*. The leaf base has just fused with the axis, and shows a very large number of bundles.

arboreal types by a development of storage rays about the leaf-traces. In the more primitive types these rays are shallow longitudinally, but deep in the radial direction; in higher types these rays diminish in radial dimensions, but show an increase in the vertical direction, often through several nodes. As the leaf increases in efficiency the leaf-traces increase in number. Advanced types of dicotyledons show a progressive disappearance in cambial activity in the leaf-traces, although these are often of greater size than the bundles of the stem. The greater number and importance of the leaf-traces, together with the relatively greater importance of the secondary axes of higher types, result in a crowding of strands at the nodes and a more scattered distribution of the stem bundles, while at the same time amphivasal strands are formed. Physiological advantage probably explains the disappearance of secondary growth in leaf-traces; this disappearance may extend also to the bundles in the stem and results in a practically monocotyledonous structure.

S. G.

Leaf-structure in Nilssonia.—R. FLORIN (*Tom. cit.*, 1–10, 1 pl., 1 fig.). A study of the leaf-structure of *Nilssonia polymorpha*, with special reference to its systematic position, confirms the results obtained by Nathorst, Thomas and Bancroft as to the sunken stomata with round, unthickened guard-cells, and the general structure of the cuticle. The author supports their view that this genus differs in these points from the more complex Bennettitales, but appears to be closely related to recent Cycads. S. G.

CRYPTOGAMS.

Pteridophyta.

Homosporous American Lepidostrobus.—JOHN M. COULTER and W. J. G. LAND (*Bot. Gaz.*, 1921, **72**, 106–8). Though the coalfields of Europe have yielded perfectly preserved strobili of *Lepidodendron*, showing heterospory, the coalfields of America have, with but two exceptions, yielded nothing but casts. A fragment of a strobilus from Iowa was cut and described by Coulton and Land in 1911 (*Bot. Gaz.* 1911, **51**, 449–53). Further fragments of the same cone have since been found, showing the strobilus to have been 22 cm. long and 5 cm. wide. It is well preserved, but the sporangia are nearly all completely empty. The few spores found average 27 μ in diameter. The evidence is strong that this strobilus was homosporous, which is a matter worthy of record and of consideration, since it simplifies the question of the origin of the modern Lycopodiales, a homosporous group. A. GEPP.

Fourth Contribution to our Knowledge of the Anatomy of the Cone and Fertile Stem of Equisetum.—ISABEL M. P. BROWNE (*Annals of Botany*, 1921, **35**, 427–56, 1 plate, 12 figs.). A study of the cones of *Equisetum sylvaticum*, *E. debile* and *E. variegatum*. The results are as follows: (1) The vascular system of the cone of *E. sylvaticum* resembles that of *E. maximum*, but on a smaller scale, and better developed. (2) That of the cone of *E. debile* is much reduced and forms a loose network; and frequently many parenchymatous meshes, originating below the cone, persist far into the cone, some even traversing the whole cone. (3) The stele of the cone of *E. variegatum* is also of reduced type. (4) On grounds of comparative anatomy the separation of protoxylem and metaxylem in the internodes of the cones of certain species of *Equisetum*, a condition most marked in *E. maximum*, is regarded as a derivative character, due chiefly to the reduction of the radial extent of the metaxylem. (5) Parenchymatous meshes of the cone probably first arose, in the phylogeny, at points vertically above the departure of the traces of sporangiophores, and were not true gaps (in Jeffrey's sense); and in cases where meshes arise very close above the departure of the trace, this approximation is probably due to reduction of xylem during the phylogeny. The primitive system was probably siphonostelic. (6) In the anatomy of *E. sylvaticum* the following points support the view that the insertion of the annulus marks the position of a vestigial node: (*a*) the numerous anastomoses of the axial strands at this level; (*b*) indications of anastomosis of the protoxylem at the same level; (*c*) the presence in the axis opposite the annulus of cone B of an abortive trace that never becomes free; (*d*) the presence in this same cone at the level of insertion of the annulus of tracheides somewhat resembling those of the nodal xylem of the vegetative axis; (*e*) the occurrence, according to Milde, of branches below the annulus. (7) In one of the cones of *E. debile* four small groups of vascular cells were observed in the parenchyma of the annulus; though unconnected with cells of the axial bundle, they possibly may represent vestiges of the traces of the annular node. In this species, however, and still more in *E. variegatum*, there are but few indications of the former presence of a node at the insertion of the annulus. (8) In some specimens of *E. debile* the ring of nodal (or supranodal) xylem is not complete at the level of the uppermost whorl of leaves. A. G.

Gametophytes of Equisetum lævigatum.—Elda R. Walker (*Bot. Gaz.*, 1921, **71**, 378–91, 2 plates and figs.). Prothallia of *Equisetum* have rarely been found until recent years, but in August, 1916, large numbers were detected by R. A. Nesbit in Nebraska, associated with *Riccia* on the mud belt of streams and rivers. The investigation of numerous wild specimens gave the following results:—The gametophytes are all of one kind. They consist of a flat circular disc 1–10 mm. in diameter, bearing numerous upright green branches on their upper surface, and surrounded by a band of meristem, which continues the growth of the thallus and produces archegonia and antheridia. They are typically monœcious, bearing some archegonia and many antheridia, which are without order and often within a few cells of each other and of sporophytes, and which may continue to develop until one or more sporophytes have attained considerable size. Antheridia all develop, as is characteristic of eusporangiate ferns, whether in a massive tissue or on a slender branch. Archegonia develop in manner characteristic of the group. Sporophyte development is as described by authors. The leaves of the first shoot are three or four, of the second shoot four or five. Gametophytes grow to maturity under simple methods of culture. The germination of spores and raising of young gametophytes under culture is quite easy; but the spores must be young and quite fresh. A. G.

Eusporangiate Ferns and the Stelar Theory.—D. H. Campbell (*American Journal of Botany*, 1921, **8**, 303–14, figs.). A summary of the evidence which shows that Van Tieghem's stelar theory is not applicable to the eusporangiate ferns, with the addition of further facts derived from a recent study of *Botrychium*. The author's conclusions are as follows :—The presence of a single cauline stele—"protostele," "siphonostele," "dictyostele"—is not borne out by the history of the stelar tissues in the Ophioglossales and Marattiales. In all of these the stelar system begins as a single strand common to the first leaf and root ; the stem apex arises adventitiously in *Ophioglossum moluccanum* and *O. pendulum*, and is very insignificant in *Botrychium* and the Marattiales. No procambium is developed in the stem region in the young sporophyte. In the Ophioglossales the stelar structures of the axis are built up exclusively of leaf-traces to which the bundles of the roots are joined. This condition obtains also for the earlier stages of the Marattiales, but is complicated later by the formation of "commissural" strands, which are of cauline origin. The "dictyostele" of *Ophioglossum* and most Marattiales is in no sense a monostele. The "foliar gaps" are not breaks in a single tubular stele, but are merely spaces between the coalescent leaf-traces, and the pith is part of the ground tissue included within the cylindrical network formed by the united bundles derived from the leaves. In short, the condition found in the axis of the eusporangiate ferns is more in accord with the older theory of "common" bundles traversing a ground tissue, and united to form the woody cylinder of the axis, than with the assumption of a true cauline stele. The condition existing in the eusporangiate ferns by no means implies that the stelar hypothesis must be completely discarded. There seems to be no question of its application to the Lycopods, Conifers, and many Angiosperms ; but in all of these the relative importance of stem and leaf is very different from the condition of the ferns ; and it will not be surprising if, when the different types of the Leptosporangiatæ are subjected to a thorough examination of the origin of the stelar tissues in the young sporophyte, it will be found that in these, as well as in the Eusporangiatæ, the axial stelar tissues are largely, at least, of foliar origin. A. G.

Young Leaves of Angiopteris Teysmanniana.—J. MALKOWSKA (*Rosprawy wydz. mat.-przyr. Akad. umiej. Krakowie*, 1914, sér. 3, **14**, 189–94, pl. and fig. : see also *Bot. Centralbl.*, 1918, **138**, 187). A description of the frond development of plants in the Botanical Garden of Cracow. The young frond (namely, the oldest leaf) is simply pinnate ; the pinnæ are broad and either irregularly incised or entire along the margin. The next frond is dichotomously divided, the following ones are three to four times divided. The course of the vascular bundle is traced by means of transverse sections. E. S. GEPP.

Hymenophyllum tunbridgense (Sm.) in the Jura Sandstone Region in Luxemburg.—E. J. KLEIN (*Naturwiss. Wochenschr. N.F.*, 1916, **15**, 646–8, 4 figs. : see also *Bot. Centralbl.*, 1918, **138**, 361). A record of the occurrence of this fern in several new localities in the so-called "Schlüffe" of the Jura sandstone ; it often grows in cushions in the drip of water associated with mosses and liverworts and the lichen *Sphærophorus coralloïdes* Pers. ; and often in very inaccessible places. Oddly enough the fern does not occur in the Prussian territory on the Luxemburg frontier, which is close to its habitats; the artificial introduction of it failed here. The plant has a rich spore production and flourishes only on porous sandstone (not on the sandy débris from it). The patches are orientated only between S.E. and S.W., most frequently S.E. A diagram shows the frequency of the individuals. The dry N.E. and E. winds are kept off the delicate plant by the walls of the "schlüff": where such a wind reaches it, the plant dries up. Presumably it spread along the Atlantic coast to Luxemburg during the time when Great Britain was connected with the Continent. E. S. G.

Keys to the Ferns of Borneo.—EDWIN BINGHAM COPELAND (*Sarawak Museum Journal*, 1917, **2**, 287–424). An enumeration of the fern flora of Borneo, with the distribution of the species and some critical remarks, and with ample keys for the determination of the families, genera and species. Of the Malay Islands Borneo is the richest in ferns, and yet very few localities in it have been properly investigated. It is to stimulate further research that the author compiled these helpful keys. The number of species already known is about 700: and it is hoped, from experience gained in the Philippine Islands, that 40 p.c. more may be found. In the introduction the question of a natural classification is discussed. A. G.

Bryophyta.

Dissymmetry of Structure of the Leaf of Mnium spinosum.—J. POTTIER (*Berne*: *Buchler & Co.*, 1917, 16 pp. 8vo, 7 pls.; see also *Bot. Centralbl.*, 1918, **138**, 353). The material examined was collected at Kandersteg in the Bernese Oberland. Two leaves of different size of the male plant were studied in great detail, 340 transverse sections being made of one leaf and 230 of the other. Every section was drawn, and 25 were figured. The asymmetry was observed to vary 3–4 times from right to left, and vice versâ, in the same leaf, the change being more marked towards the apex than in the lower portion of the leaf. The asymmetry corresponds with the sinuations of the costa, so that a curve of the costa to the left corresponds with a left-sided asymmetry. The cause of the asymmetry of the midrib is to be sought in the sinuous character of the costa, which is always more marked towards the apex. The cause of the sinuosity of the costa is to be sought in the growth of the two-sided apical cell of the leaf. The greater the intercalary growth, the weaker is the undulation of the midrib, and the less marked is the asymmetry of the costa. E. S. GEPP.

Bryum veronense De Not.—C. MASSALONGO (*Bull. Soc. Bot. Ital.*, 1917, 33–36, figs.). A discussion of the specific rank of *Bryum veronense* discovered by the river bank near Verona in 1834 by De Rainer and described by De Notaris as a new species related to *B. calophyllum*. It is a rare moss, known only in a vegetative state, and its systematic position has been a puzzle to subsequent bryologists, as is shown by the synonymy. It has been recorded also for Bavaria and Styria; and recently it was found again in its original locality. It is now figured. Until fruiting specimens are found there must be doubt as to whether it is a true species, or a state of *B. argenteum* or some other species growing in an abnormal habitat. A. Gepp.

New Species of Aneura.—C. Massalongo (*Bull. Soc. Bot. Ital.*, 1917, 80–82). A description of *Aneura crinita*, a new hepatic found among mosses in a damp wood in the province of Perugia. In habit and size it approaches *A. pinguis*, but differs in its calyptra, which is beset with numerous long radicle-like hairs. A. G.

Taxilejeunea pterogonia and Certain Allied Species.—A. W. Evans (*Bull. Torrey Bot. Club*, 1921, **48**, 107–36, 1 plate and figs.). A detailed and critical description of four tropical American species of *Taxilejeunea*, two of which are new to science. The genus belongs to the section of Lejeuneæ with bifid leaves, and contains large and conspicuous plants; one of its most distinctive features is found in the branches which bear the female inflorescences. These are short and small-leaved, and on one or both sides produce short innovations terminated by a female inflorescence. Thus a complicated branch-system of cymose character is formed. A. G.

Further Additions and Rectifications to the Moss-flora of Switzerland.—J. Amann (*Bull. Soc. Vaud. Sci. Nat.*, 1920, **53**, p. 81–125, figs.). The first series of "additions" was published in *Bull. Soc. Murithienne du Valais*, 1918–19. The present series is founded on collections made in Valais, on the Alps of Saas and Zermatt by the author, on the Great St. Bernard by Bender, in Ticino by Jäggli, near Basle, etc. A careful study of the high Alps has yielded interesting results, and shown that the moss-flora is even yet imperfectly known. The stunted and sterile condition of the plants makes them difficult to study; but they are the more interesting as ecological adaptations to severe conditions. The following species are described as new to science: *Barbula pennina*, *Syntrichia gelida*, *Bryum appendiculatum*, *B. britanniæ*, *Mnium amblystegium*. Nine other species are added to the Swiss flora; and twenty-eight new varieties and forms are described. A critical study is made of the European species of *Mnium*, especially those of the *M. orthorhynchum* group, from the point of view of cellular tissue. The sporophyte of *Ptychodium pallescens* Amann is described. A synoptic table for the determination of European species of *Hygroamblystegium* is provided, as well as a revision of the Swiss species. A. G.

Mosses from the Kanara District.—H. N. Dixon (*Journ. of Indian Botany*, 1921, **2**, 174–8, 1 plate). A list of mosses collected by L. J. Sedgwick in Western Madras, partly in N. Kanara, partly in the drier and more inland district of Dharwar. Ten species and a variety are described as new to science, and figures of them are given. Critical notes are appended to several other species. A. G.

Bahama Mosses.—Elizabeth G. Britton (*Bryologist*, 1921, **24**, 17–9, 1 pl.). A list of thirty-three species of mosses collected in the

Bahama Islands, including a new species, *Hymenostomum flavescens*, a description and figures of which are given. A. G.

Hyophila subcucullata.—R. S. WILLIAMS (*Bryologist*, 1921, **24**, 22, 23, 1 pl.). A description of a new moss species from the San Diego river, Cuba: it is allied to *H. microcarpa*. A. G.

Thallophyta.

Algæ.

Investigations Concerning the Plant and Animal Life of the High Seas.—H. LOHMANN (*Veröff. Inst. Meeresk. Univ. Berlin Geogr. nat. Reihe.*, 1912, **1**, 90 pp., 2 pls., 14 text-figs.; see also *Bot. Centralbl.*, 1918, **138**, 185). A report on the biological work carried out during the voyage of the "Deutschland" from Bremerhaven to Buenos Ayres, May to September, 1911. The average density of organisms for the entire area traversed was for the following depths:—0 m. 9500, 50 m. 5700, 100 m. 1500, 200 m 500, 400 m. 350 individuals per unit. The superficial area is therefore not poorer than the 50 m. stratum, as was also shown later by Schiller. The surface of the cooler regions has a population nine times greater than that of the tropics. The depths from 50–400 m. is at the most twice as thickly populated. The average number of organisms was five times less in the tropics than in the cooler waters, the protophytes predominating. Northern waters were seven times richer than the tropics, and nearly twice as rich as the south. The naked phytoflagellates attained their maximum (2600 individuals) on the surface, as well as all the other protophytes except the Diatoms, Chroococcaceæ, Coccolithophoridæ, Silicoflagellatæ, and Peridinieæ (including Gymnodinieæ). A new genus and four new species are described in Coccolithophoridæ. Tropical water is poor in net- and centrifugal-plankton. E. S. GEPP.

Simple Method of Studying the Nannoplankton of Fresh Water.—E. NAUMANN (*Naturw. Wochenschr.*, N. F., 1916, **15**, 180–3, fig.; see also *Bot. Centralbl.*, 1918, **138**, 375). The author proposes to make careful examinations of the intestines of fresh-water animals, both as a means of obtaining easily nannoplankton, and of adding to our knowledge of the nutrition of zooplankton. The nannoplankton obtained by him in the intestines of *Bosmia* and *Diaphanosoma* would pass through the smallest mesh of any net. Organisms possessing a shell, such as Diatoms, are sufficiently well preserved as to be mounted in Canada balsam, and the gelatinous and other algæ (*Trachelomonas volvocina*, etc.) in glycerine. Both methods supplement each other. He found that *Cyclotella* is a main constituent of the food of Entomostracæ in the lakes of Southern Sweden, and he here records their occurrence for the first time in those waters. Larger Entomostracæ of the plankton feed largely on Diatoms. E. S. G.

Note on a "Blood" Lake.—H. LEDER (*Internat. Rev. ges. Hydrobiol. Hydrogr.*, 1915–16, **7**, 131–3; see also *Bot. Centralbl.*, 1918, **138**, 184). The lake, the Tovelsee, whose waters are coloured a fine red by the peridinian *Glenodinium pulvis-eleas* Stein var. *aculeatus* Larg., lies 1162 m. high, at the foot of the Brenta group. Its greatest depth is 50 m., and it is probably a stagnant lake. *G. pulvis-eleas* occurs in masses, but only in the comparatively warm parts, and only in the warm season. In the morning the lake looked greenish; and the water was clear where it had been red the previous day. In these parts the bottom was covered with a red sediment, formed by close masses of *Glenodinium* in the lowest strata of water. As the lake gradually emerged from the shadow of the mountains, so the organisms rose in thick clouds to the surface and became very closely packed. The cause of this vertical migration is at present unknown. E. S. G.

Polish Fresh-water Peridinieæ.—J. Woloszynska (*Bull. Acad. Sci. Cracovie Cl. sci. math. Sér. B.*, 1915, 260–85, 5 pl.: Cracowie, 1916; see also *Bot. Centralbl.*, 1918, **138**, 171). New genera are described and figured. From a careful study of the fresh-water Peridinieæ the author finds that the plate-shaped structure of the envelope is a far more common character throughout the whole group than has hitherto been allowed. In *Glenodinium polonicum*, one of the new species, the membrane is covered with many regularly arranged small warts, developed more strongly on the hypovalve. Each of these forms a thickening in the middle of a small plate of regular hexagonal outline. This structure of the envelope is the original one. Adaptation of the organisms to different conditions of life brought about a change of the structure of the envelope, the plates combining into larger ones of less regular outline. *Glenodinium* is certainly the original type of many genera of higher Peridiniaceæ. Many of the new species here described are remarkable for their beauty of structure. *Gonyaulax polonica*, a new species, and *G. apiculata* Penard, from the Lakes of Geneva and Balaton, are the only representatives of the genus in Europe. E. S. G.

Phytoplankton of the Dobrostany Ponds.—M. Koczwara (*Kosmos*, 1915, **40**, 231–75, 1 pl. 1 text fig.: Lemberg, 1916: see also *Bot. Centralbl.*, 1918, **138**, 184). The ponds in question are those of Debrostany, Bialogorski, and Wolicki in Galicia. They were under observation between 1912 and July 1914. The results are set forth in tabular form and embrace Flagellates, Peridinieæ, Cyanophyceæ, Chlorophyceæ, Conjugatæ, and Diatomaceæ. The ponds may be designated Flagellate ponds. New species and varieties of Flagellates are described and figured. E. S. G.

Investigations of the Phytoplankton and of the Progressive "Gyttja" and other Mud Formations below the Pelagic Region in certain Archaic Mountain Lakes of South and Central Sweden.—E. Naumann (*K. Svensk. Vetenskap. Handl.*, 1917, **56**, 165 pp., 7 pls., figs. in text: see also *Bot. Centralbl.*, 1918, **138**, 200–3). The lakes in question were situated in the primitive mountains, poor in lime, of South and Central Sweden. The objects of the investigation were:—(1) to use the planktology of these waters as an index of the general lacustrine type, from a geographical and ecological point of view; (2) to see how far the structural peculiarities of the pelagically-formed mud strata were dependent on the sediment-building factors, particularly the plankton production, arising from their environment. The material examined consisted mainly of net-plankton, though nannoplankton was also obtained. The methods employed in the collection and examination of the material are described in detail. The results obtained are fully and clearly set forth, but are too wide in scope and too copious in quantity to be adequately reproduced here. E. S. G.

The Morphology and Physiology of Form-variation (Development, Reproduction, Fertilization and Heredity) of the Phytomonadineæ (Volvocales). II. On the Continuous, purely Asexual, Cultivation of Eudorina elegans and its Significance for the Problem of Fertilization and Death.—M. Hartmann (*Sitz-Ber. kgl. Preuss. Ak. Wiss.*, 1917, 760–76; see also *Bot. Centralbl.*, 1919, **140**, 108). The author puts forward the question whether plants, which in a natural condition exhibit sexual and asexual reproduction, can be permanently reproduced without any sort of cell-disturbances other than those involved in the usual cell and nuclear division. *Eudorina elegans* was chosen for experiment as being convenient for observation with its colony of thirty-two cells. Each of these cells divides five times in the course of a few days (in summer four to seven, in winter twenty days). The author succeeded in rearing 550 individual generations without any sort of interference, and concludes therefore that this experiment, which lasted two and a half years, proves the possibility of permanently cultivating *Eudorina* asexually. Should this be the case, however, the significance of fertilization is not to be found in rejuvenescence. Finally, the author discusses death and immortality in many senses. E. S. G.

Occurrence of Algæ in the Tubes of Utricularia.—E. Lemmermann (*Vortrag Deutsch. Zool. Gesell. auf 23 Jahresvers. Bremen.*, 1913, 261 pp., fig.; see also *Bot. Centralbl.*, 1918, **138**, 184). In the tubes of a *Utricularia* from Brazil the author found three Protococcaceæ, twenty-seven Conjugatæ, two Flagellatæ, one Heterokont. Species which develop swarmspores wandered into the tubes while in a state of activity and continued their development *in situ*. One-celled Desmids behaved in a similar manner. Filament-forming Desmidiaceæ grew in the opening of the tubes and drew other algæ in with them. The phototaxis and the mucilage in the tubes play a part in the phenomenon. One new species, *Derepyxis ellipsoidea*, and several new varieties are described. E. S. G.

Contribution to the Paludine Flora of the Environs of Yverdon.—A. Déglon (*Bull. Soc. Vaud. Sci. Nat.*, 1920, **53**, 23–75, 2 figs.). A description of the algal flora of three ponds, situated 1.8 kilom. S.W. of Yverdon, Canton Vaud. The physical features of the ponds are described, and their connection with former and present waters is shown on a chart. The collections, which were made every fortnight from April 16, 1915, to April 1, 1916, contain sixty-four genera and five hundred and eleven species and varieties. These are all enumerated in a general list, which is followed by a separate discussion on each of the three ponds, with the constituents and periodicity of their respective floras. Each contains a small number of genera and species not observed in the others. Many of the diatoms exist all the year round, a small number showing a maximum development either in cold or in warm water. The other algæ show in general a maximum from August to October. Intermediate forms between several species and varieties of diatoms were observed. Among the seventy-eight samples taken, one form occurs sixteen times. It is here figured as a new variety *minor*, of *Navicula cuspidata* Kütz.

E. S. G.

Study of the Cell-structure of Small Algæ, with Special Reference to Porphyridium cruentum Naeg.—F. BRAND (*Ber. Deutsch. Bot. Ges.*, 1917, **35**, 454–9 : see also *Bot. Centralbl*, 1919, **140**, 107). Although single species of algæ cannot as a rule be determined by cell-structure alone, still it is possible to limit certain groups by means of this character, and then to determine its members by a study of the physiological, biological and functional conditions. Certain important points in a study of cell structure are indicated. Too much value must not be placed on culture and chemical treatment, on account of the great variability of these algæ. In cultivated material pathological deformities frequently arise. The only material suitable for delicate cytological investigation is that in which the majority of the cells, on a preliminary examination under a medium-power objective, appear fresh, absorb a stain in a living healthy manner, and show their homogeneity by the presence of all intermediate forms. These conditions are only to be obtained as soon as possible after collection. The author then proceeds to demonstrate the evil results of an exclusive use of cultivated material, as exemplified by Staehelin's work on *Porphyridium cruentum*, supposed by him to possess a Cyanophyceous nature. The severe criticism of this work of Staehelin is due to a wish to prevent the incorporation of serious errors in literature. The chromatophore of *Porphyridium* differs from the external coloured protoplasm-layer of Cyanophyceæ, which is almost unchangeable in form and position, not only in its Floridean red colour, but also in the variability of its form. Further, it can be displaced by the occasional appearance of sap-vacuoles. Also there is no mistaking the pyrenoid of a normally vegetating living cell of *Porphyridium*. Staehelin's view on the appearance of peripheral grains is also corrected.

E. S. G.

Results of a Study of the Myxophyceæ.—A. BORZI (*Nuov. Giorn. Bot. Ital.*, 1914, **21**, 307–60 : 1916, **23**, 559–88 ; 1917, **24**, 17–30. 65–112, 198–208, 209–14, 5 pls.). This paper embodies the mature views of the author founded on observations made during the last twenty-five years, during which time he has accumulated material for adding to his notes published in the same journal, 1879–1882. The work is divided into two parts. Part I. contains an Introduction in which the gradual advance of the knowledge of Myxophyceæ is described up to the present day, and an indication is given of the problems yet to be solved. This is followed by a discussion on the general characters of the group under the following headings :—Schizophyta and Myxophyceæ (wherein the limitations of the latter are defined), Habitat, Cells, Phycocyanin, Cellular Membrane, Teguments, Cellular Associations, Cellular Scission, Growth and Ramification, Heterocysts, Propagation, Fragmentation, Conidia, Planococci, Hormogonia, Hormocysts, Spores, Polycysts. Then follows a systematic synopsis of the Myxophyceæ, drawn up with full recognition of the unstable value of genera and species owing to their polymorphism under varying conditions. Diagnoses are given of Orders, Sub-orders, Families, etc.

Part II. is devoted to a detailed consideration of Stigonemaceæ, the highest type of Myxophyceæ. This family is divided into Stigonemeæ and Diplonemeæ, according to whether the filaments possess *true* or *spurious* ramification. A conspectus of genera gives diagnoses of fourteen genera for the former and five for the latter, three being new to science. The genera are then treated separately in considerable morphological and structural detail, most attention being paid to those genera which are usually regarded as possessing many species, such as *Stigonema*, *Hapalosiphon*, etc. The extraordinary adaptability of species of Myxophyceæ has formed a special study of the author, and is here discussed. About 200 species of *Scytonema* have been described, of which only seven or eight are valid; 300 species of *Oscillatoria* are reduced to about a dozen; for *Stigonema* only five species are recognized out of fifty. The author states his intention of discussing the remaining families of Myxophyceæ in the same detail in a later publication.

E. S. G.

Chondriome of a Green Alga, Coccomyxa solorinæ Chod. [a Correction].—M. ET MDME. F. MOREAU (*Comptes Rendus Soc. Biol. Paris*, 1916, **79**, 211–2; see also *Bot. Centralbl.*, 1919, **140**, 89). In a previous publication the authors have described, in the cell of *Coccomyxa solorinæ* (a green alga with a special chloroplast), granulose formations which they likened to mitochondria. This opinion was founded on a large number of experiments. In particular, the authors then rejected the hypothesis of metachromatic corpuscles, whose existence they had not been able to reveal in the *Coccomyxa* cell outside the chromatophore. These first researches on metachromatic corpuscles of *Coccomyxa* were carried out on thalli in which most of the gonidia show metachromatic corpuscles limited exclusively to the chromatophore. Recent observations have demonstrated, however, the existence of these same corpuscles distributed generally all through the algal cell, outside the chromatophore. Consequently the authors feel they can no longer affirm the existence of chondriosomes in the protoplasm of the cell of *C. solorinæ* outside the parietal chloroplast which it contains. The granules previously described by the authors as mitochondria seem now to be metachromatic corpuscles. Consequently, *C. solorinæ* does not constitute, as the authors had supposed, an exception to the rule formulated by Guilliermond, according to which green algæ having a special chloroplast lack a chondriome of the usual character. E. S. G.

Chondriomes in Chara.—A. J. RIKER (*Bull. Torrey Bot. Club*, 1921, **48**, 141–7, 1 pl.). An investigation of the origin of the chondriomes or staining granules in the cells of *Chara*. The author states that chromatic granules (prochondriomes) appear on the central plate in the anaphase of *Chara*; these do not disintegrate, but migrate into the cytoplasm and become chondriomes. These prochondriomes have their origin in the nucleolus. Chondriomes are derived by fission from other chondriomes, but they are also produced as nuclear extrusions. No difference in the prochondriome contents has been observed in the actively growing tip between the purely vegetative cells and those which may produce gametes. The extrusion of these prochondriomes is apparently not connected with nuclear degeneration or differentiation of the germ and vegetative cells. A. GEPP.

Homology between the Male and Female Reproductive Organs of Florideæ.—N. SVEDELIUS (*Ber. Deutsch. Bot. Ges.*, 1917, **35**, 225–33: see also *Bot. Centralbl.*, 1919, **140**, 109). An attempt to demonstrate the homology between the spermatium and the carpogonium of Florideæ. In the case of the male and female organs of Phaeophyceæ the homology is very striking. Schmitz's investigations show that the male organs of Florideæ, spermatangia, are always to be regarded as terminal cells in special systems of cell-filaments. The nature of the terminal cells of the carpogonium had already been clearly demonstrated. The author holds that there is now good reason to consider the trichogyne as a metamorphosed cell. In *Batrachospermum*, for instance, forms of trichogyne occur in which the nature of the well-developed trichogyne, as that of a special cell, is quite obvious. Several such forms are figured. Also in *Delesseria* and *Scinaia* the young trichogyne when still in the bi-nuclear stage shows a distinct cell-form. In the Bangiales, on the other hand, the trichogyne is a later papilla-like growth. Possibly the carpogonia of the Bangiales and those of the true Florideæ should be regarded as analogous rather than homologous. The two-celled complex of the carpogonium is regarded as the homologue of the male spermatangium mother-cell with the spermatangium. It is only in primitive Florideæ, such as *Batrachospermum*, that the spermatangium mother-cell shows no difference either in form or contents from the other vegetative cells. In all the higher Florideæ the difference in these two particulars is obvious. The fact that in many cases the spermatangium mother-cell gives rise simultaneously to two or more adjacent spermatangia does not in the author's opinion invalidate the homology. The tendency of organisms to increase the number of the male reproductive bodies on the appearance of heterogamy is pointed out. Cases are recalled of carpogonia with branched trichogynes, which might be regarded as carpogonia with several trichogynes. E. S. G.

Life-history of Corallina officinalis var. mediterranea.—S. YAMANOUCHI (*Bot. Gaz.*, 1921, **72**, 90–6). *Corallina* should be placed near the summit of the Cryptonemiales group of Red Algæ. The author, in studying its life-history, has used material from the Bay of Naples. He summarizes his results as follows:—1. The male and female plants possess 24 chromosomes, while tetrasporic plants have 48. 2. During tetraspore formation the 48 chromosomes become reduced to 24. The tetraspores on germination show 24 chromosomes: and, since 24 chromosomes appear in the vegetative mitoses of the sexual plants, the inference is that the latter arise from tetraspores. 3. The nuclei of the reproductive cells (spermatia and carpogonia) of the sexual plants possess 24 chromosomes. The sporophytic or fusion nucleus, as a result of fertilization, has 48 chromosomes. The sporophytic nuclei give rise by division to the carpospores, which also possess 48 chromosomes. The carpospores on germination show 48 chromosomes: and, since 48 chromosomes appear in the vegetative mitoses of the tetrasporic plants, it is inferred that the tetrasporic plants originate from carpospores. 4. The male and female plants are gametophytic, while the tetrasporic plants are sporophytic. The sporophytic generation begins with the formation of the sporophytic or fusion nuclei, extends through the formation of the cystocarp and carpospores, and finally terminates with the formation of tetraspores on the tetrasporic plant. With the formation of the tetraspores, the gametophytic generation commences. 5. Thus *Corallina* is another clear example of the alternation of a sexual plant (gametophyte) with a tetrasporic plant (sporophyte), the cystocarp existing as an early phase of the sporophytic generation. (The paper has been translated from the original Japanese in *Tokyo Bot. Mag.*, 1913, **27**, 279–85, 8 figs.) A. G.

Spiral Arrangement of the Branches in Some Callithamnieæ.—L. K. Rosenvinge (*Kgl. Dansk. Videnskab. Selskab. Biolog. Meddelelser*, 1920, **2**, 70). The results of a detailed examination of five species of Callithamnieæ, *Callithamnion tetragonum*, *C. corymbosum*, *C. roseum*, *C. furcellariæ*, and *Seirospora Griffithsiana*: with a view to explaining the discrepancies between the conclusions of Nägeli and Kylin on the subject of spiral branching. This paper shows these discrepancies are due to variation of the ramification. Each of the five species examined is discussed in considerable detail, and the variations of ramification are shown in diagrams. A spiral arrangement occurs in all of them, but with varying frequency and direction. The angle of divergence is less constant than in the higher plants, and varies even in the same shoot. In *C. roseum* and *S. Griffithsiana* the spiral was sometimes interrupted by a shorter or longer stretch with irregularly arranged branches. Change in the direction of the spiral was found in all the five species, and usually takes place suddenly. The spiral arrangement of the branches never begins at the very base either of the primary shoots or, except very rarely, of the lateral shoots. In *C. tetragonum* and *C. corymbosum* the first step in the spiral takes place, with very few exceptions, on the outer side of the shoot: this is due to a factor seated in or emanating from the mother axis. This is called by the author "ectoblastesis." A correlation between the direction of the spiral and the position of the first branch of the second order on the members of the spiral was found, and is here discussed. This correlation was present from the beginning of the spiral, though with somewhat diminished constancy. It is probably a result of the asymmetry of the young axial segments. A detailed study of the division of the apical cell and the shape and division of the young segments will throw light upon the factors determining the spiral arrangement of the branches, and the position of the first branches of the second order. E. S. G.

Developmental History and the Systematic Position of the Tilopterideæ.—H. Kylin (*Ber. Deutsch. Bot. Ges.*, 1917, **35**, 298–310; see also *Bot. Centralbl.*, 1919, **140**, 123). A critical review of the literature on this subject, in which the light of modern research on alternation of generations is brought to bear on past work. The more important features in the developmental history of Tilopterideæ are summarized for the following species: *Haplospora globosa*, *Scaphospora speciosa*, *Tilopteris Mertensii*, *Heterospora Vidovichii*, *Acinetospora pusilla*, and *Christocarpus tenellus*. The author recognizes only *Tilopteris* and *Haplospora* as true Tilopterideæ, and regards the Acinetosporeæ (*Heterospora* and *Acinetospora*) as not closely related to Tilopterideæ. The Acinetosporeæ are for the present best ranged under Ectocarpaceæ. Tilopterideæ have developed, according to the author, from Ectocarpaceæ, probably from such forms as *Pylaiella*. The great differences in the conditions of reproduction justify the conclusion that Tilopterideæ is separated off from the Ectocarpaceæ, and therefore also from the Phæosporeæ. Further, he believes that the monospore of Tilopterideæ is homologous with the four tetraspores of Dictyotaceæ. The relationships of the Orders of Phæophyceæ are shown in a diagram.

E. S. G.

Cystoseiras of Banyuls and of Guéthary: Supplement (1).—C. Sauvageau (*Bull. Stat. Biol. d'Arcachon.*, 1920, **17**, 52 pp.). A study of the Mediterranean species of *Cystoseira*, and a comparison with those of the Atlantic. In an Introduction, the author discusses the various localities visited, with their idiosyncrasies of shore, tide, etc., both on the European and African coasts of the Mediterranean. As the result of his investigations he gives his views on the phylogenetic history of some of the Mediterranean species. *C. ericoides*, after penetrating into the Mediterranean, gave rise to a series of species, *C. mediterranea*, *C. stricta*, *C. amentacea*, which differ but slightly from it, and possibly also to *C. cæspitosa*, which differs more markedly. The Mediterranean species, *C. selaginoides*, is probably derived from *C. granulata* of the Atlantic. No line of descent was discovered for *C. discors*, nor for *C. abrotanifolia*. Their nearest oceanic allies are respectively *C. fœniculacea* and *C. myriophylloides*; and the history of the four species seems to be the following:—*C. fœniculacea* and *C. myriophylloides* entered the Mediterranean by the Straits of Gibraltar, formed respectively *C. discors* and *C. abrotanifolia*, and disappeared; while their two representatives invaded the entire Mediterranean. Later on the two latter emerged into the ocean, and are both found at the Canaries. *C. barbata*, a widely spread Mediterranean species, has emerged and reached Cadiz, but no further. Of the five littoral species of the temperate Atlantic, *C. fibrosa*, *C. ericoides*, *C. granulata*, *C. fœniculacea* and *C. myriophylloides*, only *C. fibrosa* has taken no part in the peopling of the Mediterranean with species. *C. ericoides* itself occurs in the western part of that sea. The number of species increases from west to east, but the differences between them are less than between the oceanic species, and are sometimes very small. The new species *C. selaginoides* and a new variety are described; and twenty-three species are discussed at varying length, the matter being additional to that previously published in the memoir on the subject.

E. S. G.

Heterogamic Sexuality of a Laminaria (Alaria esculenta).—C. SAUVAGEAU (*Comptes Rendus Acad. Sci. Paris*, 1916, **162**, 840–2; see also *Bot. Centralbl.*, 1919, **140**, 74). The genus *Alaria* belongs to the tribe Costatæ, which is mainly distributed in the Arctic and North Pacific; and one species alone, out of about a score, descends as far as the coast of Northern France, where it grows at Roscoff on exposed rocks only accessible in a calm sea. The author has succeeded in growing cultures of *A. esculenta*, and has studied the development of the prothallus from the embryospore to the young plantlet. The male and female prothalli differ from those of *Laminaria flexicaulis* and *L. saccharina* by the persistence and the eventual rôle of the embryospore. Also, the female prothallia differ in the form of the oogonium, and by the non-transformation of all the cells into oogonia. Thus the number of plantlets formed is less than in the two species named. The demonstration of an alternation of generations, sexual and asexual, in *A. esculenta* is particularly interesting as occurring in the only representative of Costatæ, which grows on the French coast. Yendo and Okamura regretted that the absence of sexuality of Laminariæ forbade the explanation by hybridization of intermediate characters in *Undaria undarioides*, a Japanese species of the same tribe, Costatæ. This explanation, now made possible, will doubtless apply to other cases and throw light on certain obscurities in the specific distinction of Laminariæ. E. S. G.

Researches on the Exploitation and Industrial Utilization of the Principal Laminarias of the Brittany Coast.—P. FREUNDLER and Y. MÉNAGER (*Office Sci. et Technique d. Pêches Marit. Notes et Mémoires*, No. 5, Angers, 1921, 31 pp.). The object of this research was: (1) to study *in situ* the conditions of the re-growth and reproduction of *Laminaria*, in order to ascertain how far the present method of exploitation is compatible with the preservation of the algal beds. (2) The investigation, in the laboratory, of a practical and industrial process by which to extract simultaneously iodine and tangic acid (algine). (3) The distribution of the iodine and of the tangic acid in the *Laminarias*, according to the region, season, species, age, and the different parts of the alga. As regards the first point, the authors describe the three methods of collecting *Laminaria* for use in the factory of Plouescat: (1) gathering up of jetsam; (2) cutting by hand at low tide; (3) cutting with long-handled knives from boats, down to 3 m. from the surface. The last of these causes most waste and destruction. As regards the possible injury to plants by cutting, it is found that if the stipes be cut through it dies off. If the *Laminaria* be cut at the base of the frond, the plant survives and continues to grow. The rate of growth depends on the emersion or immersion, the species, the region and the season. Details of a series of experiments are given. As regards the second point, two methods are described of determining the proportion of iodine in fresh or dried algæ, and also of iodine in extracts of algæ. The necessity is insisted on of an immediate partial desiccation (40–50 p.c.) before packing and despatching to the laboratory. As regards the third point, preliminary experiments of a favourable character have been made in the simultaneous extraction of iodine and of tangates. The proportion of tangates and the metabolism of iodine are at present in course of investigation. E. S. G.

Fucosan Bladders of the Phæophyceæ.—H. Kylin (*Ber. Deutsch. Bot. Ges.*, 1918, **36**, 10–19; see also *Bot. Centralbl.*, 1919, **140**, 120). After a review of past work on the subject by other writers and by himself, the author emphasizes his own view that the substance in question is related to tannin. It is not a first product of assimilation, such as carbohydrate, but is probably an insignificant bye-product. It has no connexion with Laminarin. The Fucosan bladders are said to facilitate the escape of assimilation products from the chromatophores.
E. S. G.

Temperature Interval in the Geographical Distribution of Marine Algæ.—W. A. Setchell (*Science, N.S.*, 1920, **52**, 187–90). A short preliminary account of the work described in stenothermy and zone-invasion (see below). An instance is given of sharp division in the distribution between the northern and southern species. At the entrance to Vineyard Sound the surface temperatures in the summer are slightly above, and the bottom temperatures are slightly below 20° C.; and the southern species are found in the surface waters, while the northern ones inhabit the depths. The isotherms, both isotheres and isochrymes, of 10°, 15°, 20°, and 25° C. definitely limit the extension of particular floras of marine algæ. The author suggests possible lines of research for determining the explanation, such as the varying viscosities of the sea water, or its power to dissolve gases such as oxygen or carbon dioxide: or again, the activities of some particular enzyme or group of enzymes which act effectively only within narrow limits of temperature. E. S. G.

Stenothermy and Zone-invasion.—W. A. Setchell (*American Naturalist*, 1920, **54**, 385–97). An account of further investigations by the author on the zonal distribution of marine algæ. After a brief summary of the work of former botanists, and of the papers by himself on this subject, the author discusses the distribution of algæ on the coast of New England. He finds that the species may be readily arranged in two categories—one, of the colder waters (20° C. or less), and the other of the warmer waters (20° C. or over); and while some species are found only north of Cape Cod and others only south of it, the majority are found on both sides of the Cape, which is the natural dividing point, and approximates closely to the position of the 20° C. isothere. The temperatures for normal persistence of any particular species of marine plant lie within narrow limits, and the favourable interval is very little, if any, over 10° C. This leads to a discussion of the terms "stenothermal" and "eurythermal" hitherto used mostly by zoologists—the former indicating species having a limited range, the latter a wide range. Eurythermal species are: *Ascophyllum nodosum*, *Rhodocorton Rothii*, *Monostroma Grevillei*, *Polysiphonia urceolata*, *and Grinnellia americana*. Stenothermal species are particularly characteristic of the Tropical zone. The nature of the fundamental differences between the eurythermal and the stenothermal species are considered under "zone-invasion." Each species of marine plant is normal to only one zone, and if the species invades any other zone it is because it finds there the proper temperature conditions for its continuous existence. The proper temperature seems certainly to be that which is most intimately connected with reproduction. Thus species of warmer zones may exist spotwise in a warm spot or area in the midst of cooler waters, or vice versa: the extent of such invasions depending naturally upon the intensity and duration of the unusual temperature. Details are given of the respective ranges of the five species of marine algæ mentioned above, and also of *Zostera marina*, as instances of zone-invasion. In conclusion, the author states that stenothermy is the rule both from the point of view of distribution and of physiology, at least so far as effective reproduction is concerned: eurythermy is largely, if not entirely, a matter of endurance of a wide range of temperature, much of which endurance is due to the power to enter into a condition of rigor after certain extremes of temperature of either direction are passed. A study of the various reasons for zone-invasion assists greatly in making these facts apparent. E. S. G.

Fungi.

Ocellus Function of the Subsporangial Swelling of Pilobolus.—A. H. R. Buller (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 61–4). The writer describes the mechanism of spore discharge in *Pilobolus*. Under the influence of light—i.e. the sun striking on the swelling below the sporangium—the stipe immediately below reacts by growing in length most rapidly on the side nearest the spot of light, and thus bending as a whole: the swollen portion moves about its base, till finally the sporangium is directed towards the source of brightest light. Discharge is secured by the rupturing of the wall below the sporangium, and the cell-sap is squirted out at the top, carrying with it the sporangium to a considerable distance towards the open—on to grass, etc., where cattle feed. A. Lorrain Smith.

Isoachlya, a New Genus of the Saprolegniaceæ.—C. H. Kauffman (*Amer. Journ. Bot.*, 1921, **8**, 231–7, 2 pls.). The genus is characterized and distinguished in the main by the presence of the cymose (or *Achlya*) mode of formation of secondary sporangia, coupled with diplanetic zoospores. The author lists three species that exhibit these characters:—(1) *Isoachlya toruloides* Kauffm. & Coker sp. n.: (2) *I. paradoxa* (Coker) comb. nov.: and (3) *I. monilifera* (De Bary) comb. nov. The new species was collected in a shallow pool over peat-like organic remains and cultivated on the house-fly. Full details of the cultures are given. A. L. S.

Cordyceps in New Zealand.—G. H. Cunningham (*Trans. New Zealand Inst.*, 1921, **53**, 372–82, 4 pls., 8 figs.). The author gives a historical sketch of the genus, species of which are popularly known as vegetable caterpillars, vegetable wasps, etc., the old idea being that the genus represented the transformation of insects into plants. The distribution of *Cordyceps* is world-wide: not much is known of the life-history of the various species, but the author has hunted out the facts already published, and has added his own experience of cultures. Five species are known in New Zealand—four of them being endemic—and they attain to considerable size. The author gives the figures of these species, with figures of the larvæ and insects which are parasitized by the fungus. A. L. S.

Notes on a New Lophiostomaceæ.—GONSALEZ FRAGOSO (*Bull. Soc. Mycol. France*, 1920, **36**, 103–6, 2 figs.). Fragoso places his new fungus provisionally under *Lophiostrema*. It grew on withered fronds of *Pteris aquilina*. A description is given of the development of the species. A. L. S.

Two Species of Pestalozzia.—MARTINO SAVELLI (*Bull. Soc. Bot. Ital.*, 1917, 6–7, 62–8, 3 figs.). Savelli describes two new species—one, *Pestalozzia Lucæ*, grew on the living leaves of an oak: the other, *P. Feijoæ*, was found covering with mycelium and conidia the fruits of *Feijoa Sellowiana*. The new species are compared with others, and their development and spore-germination are described. A. L. S.

New or Rare British Discomycetæ.—CARLETON REA (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 58–61). Here are described seven Discomycetes, mostly new to the British flora. One species, *Ascocorticium anomalum*, represents a genus new to the country. It was collected by A. A. Pearson on bark of *Pinus* at Weybridge. Another new species, *Niptera Taxi*, was also collected by Pearson. Several of the species were found by Menzies in the neighbourhood of Perth. A. L. S.

Studies in the Physiology of Parasitism: VI. Infection by Sclerotinia libertiana.—C. BOYLE (*Ann. Bot.*, 1921, **35**, 337–47, 1 pl.). The author studied the early stages of infection of bean leaves by hyphæ of the fungus. From the top of each hypha there arises a special infection hypha, usually very narrow, which under appropriate conditions penetrates the host. The rupture of the cuticle by this hypha appears to be due solely to mechanical action. After penetration the host tissue beneath rapidly becomes disorganized. A. L. S.

Geoglossaceæ.—C. G. LLOYD (*Cincinnati, Ohio*, May, 1916, 1 pl., figs. 782–807). Lloyd commends Durand's work on this group, though he himself prefers to follow an older grouping with six genera. Durand has distinguished eleven genera in the family. Lloyd gives figures of most of the species, and gives descriptions with habitats and localities. A. L. S.

New Species of Yeast, Debaryomyces Klockerii.—A. GUILLIERMOND and PÉJU (*Bull. Soc. Mycol. France*, 1920, **36**, 164–71, 8 pls.). The yeast was isolated from the throat of a patient. It was cultivated on various media, and giant cells, mycelium and asci were produced. The authors discuss the affinity of the new yeast, and note the close relationship to the Endomycetaceæ. They place it in *Debaryomyces* on account of the *Torula* form of the budding cells, the heterogamic copulation and the characteristic form of the ascospores; the latter have a fairly thick verrucose epispore. A. L. S.

Zygosaccharomyces pastori: New Species of Yeasts with Heterogamic Copulation.—A. GUILLIERMOND (*Bull. Soc. Mycol. France*, 1920, **36**, 203–11, 3 pls., 1 fig.). The new yeasts occurred in a mucilaginous exudation from a chestnut tree near to Lyons. The cultivation of the yeast in all its stages is described. The ascospores resemble those of the genus *Willia*. A. L. S.

New Thermophile Stocks of Aspergillus glaucus. — PAUL VUILLEMIN (*Bull. Soc. Mycol. France*, 1920, **36**, 127–36, 3 figs.). The writer recalls the work on this fungus of Louis Mangin, who had isolated twenty-three different stocks, all of which formed perithecia. Mangin designated fourteen of these stocks as *Eurotium herbariorum*, seven as *E. repens*, with two new species *E. amstelodami* and *E. Chevalieri*, the latter having been brought from Chari-Tchad on the equator. Vuillemin has taken up the study of four thermophile stocks isolated from parasitic maladies of man in Europe. One of them belongs to *Eurotium repens*, the other three approach *E. amstelodami*. He gives an account of his cultures of these fungi, their morphology and the thermal conditions that affect their development. He discusses the affinities of the various stocks. A. L. S.

Effect of Salt Proportions and Concentration on the Growth of Aspergillus niger.—C. M. HAENSELER (*Amer. Journ. Bot.*, 1921, **8**, 147–63, 6 figs.). The fungus was grown on three different salt solutions. Details of methods and results are given. Yield in dry weight of the fungus was approximately proportional to the amount of NO_3 present in the culture: with varying sugar concentrations, the dry weights of the fungus were very nearly proportional to the sugar concentrations of the culture-media. A. L. S.

Aspergillus flavus, A. Oryzæ, and Associated Species.—CHARLES THORN and MARGARET B. CHURCH (*Amer. Journ. Bot.*, 1921, **8**, 103–26, 1 fig.). These species of *Aspergillus* are closely associated with the fermentation of food products in the East, but are really cosmopolitan fungi. The several species concerned in the fermentation process have been carefully contrasted and described by the authors, who have cultivated most of them. A. L. S.

Septosporium Ferrari sp. n.—MARTINO SAVELLI (*Bull. Soc. Bot. Ital.*, 1916, 6–7, 92–4, 4 figs.). The fungus grew on living leaves of *Ficus ferruginea*, where it formed spots on the upper surface. A. L. S.

Three Fungi Imperfecti.—JESSIE S. BAYLISS ELLIOTT and HELENA C. CHANCE (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 47–9, 1 fig.). The fungi described were found on dead twigs of *Pinus sylvestris* at Oxshott, Surrey. The first is distinguished by the spores and has been named *Cytotriplospora Pini* g. et sp. n. The spores are at first oval, but on maturing they become elongate and curve over so as to become obliquely attached to the sporophore, which continues to adhere to the spore somewhat like a cilium. Another fungus, *Næmospora Strobi* Allescher, is a new record for the British Isles. The third fungus, *Fusicoccum bacillare*, grows on the bark, while the slightly different variety *acuum* occurs on leaves. A. L. S.

New Species of Dematiæ.—A. DUVERNOY and R. MAIRE (*Bull. Soc. Mycol. France*, 1920, **36**, 86–9, 1 fig.). The new fungus *Endophragmia mirabilis* is distinguished by large pseudo-endogenous conidia 30–35 $\mu \times$ 15–19 μ; they are three-septate and brown, with the top cell somewhat paler. The genus recalls *Sporochisma*, but the collar round the conidiophore is of late development. It grew on dead branches of *Carpinus Betulus*, in the Jura. The brown mycelium penetrates the wood, and along with the spreading hyphæ are numerous black stromata which may be connected with it. A. L. S.

New Genus of Adelomycetes.—L. MANGIN and P. VINCENS (*Bull. Soc. Mycol. France*, 1920, **36**, 89–97, 7 figs.). The writers have adopted the term Adelomycetes to replace Fungi Imperfecti (*adelos*, uncertain). The new fungus *Spirospora Castaneæ* grew on decaying chestnuts. It is allied to *Mycogone*. In all the cultures there was no formation of ascosporus fruits. The conidia are formed from a terminal spiral. There are also accessory forms of conidia of *Mycogone* and *Torula* form. A. L. S.

Interesting Tilletia on Aira capillaris.—A. TROTTER (*Bull. Soc. Bot. Ital.*, 1915, **7**, 74–9, 4 figs.). The author gives an account of the fungus which had attacked all the flowers on three heads of *Aira*, all that were collected. He discusses the systematic positions of the fungus, and decides that it is identical with *Tilletia separata* J. Kunze. A. L. S.

Ustilagineæ of Etruria.—MARTINO SAVELLI (*Bull. Soc. Bot. Ital.*, 1916, **2**, 35–41). Savelli has listed thirty-one species belonging to Ustilagineæ and Tilletieæ. He appends habitat and locality, with occasional notes. A. L. S.

Life-history and Morphology of Urocystis cepulæ.—T. WHITEHEAD (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 65–71, 1 pl.). This fungus is the cause of a destructive smut disease of onions which has recently appeared in this country. Chlamydospores are formed in masses, each one consisting of one, rarely two, fertile cells surrounded by sterile vesicles. The spores give rise to promycelia which develop sporidia laterally. The sporidia do not conjugate; they may bud repeatedly. Infection takes place probably by the root hairs in the collar region of the host. The fungus within the host is mostly confined to the mesophyll between the vascular bundles. A. L. S.

Cytology of Tilletia Tritici.—JEHANGIR FARDONJI DASTUR (*Ann. Bot.*, 1921, **35**, 399–407, 1 pl., 9 figs.). The author has traced the behaviour of the nucleus through all the stages of germination. The nucleus of the spore passes unchanged into the promycelium: there it divides until eight nuclei are formed. The sporidia also are usually eight, though they vary from four to sixteen. Conjugation takes place between the sporidia either while they are still attached to the promycelium or after they fall off. Secondary sporidia are formed, after the fusion, and these germinate and may develop tertiary uninucleate sporidia. The hyphæ in the early stages of infection of wheat seedlings are uninucleate or multinucleate. A. L. S.

Contribution to the Knowledge of Tuscan Uredineæ.—MARTINO SAVELLI (*Nuovo Giorn. Bot. Ital.*, 1916, **23**, 236–59). The author of the list collected most of the plants himself, but he has also availed himself of collections existing in herbaria. Localities and hosts of the various life stages are given, and, in many instances, biological notes are added. A. L. S.

Cultural Study of Puccinia Opizii.—EUG. MAYOR (*Bull. Soc. Mycol. France*, 1920, **36**, 97–100). Inoculation experiments to determine the members of the Compositæ that could function as host to *Puccinia Opizii.* The writer obtained æcidia on four genera and thirteen species. A list is given of species in which no infection took place. A. L. S.

Genus Kunkelia.—FERNAND MOREAU (*Bull. Soc. Mycol. France*, 1920, **36**, 101–3). The genus was based by Arthur on a Uredine which forms æcidia on *Rubus*, and the spores of which produce directly a promycelium and sporidia. Kunkel had considered this short life-cycle as characteristic of southern forms of Uredines. Moreau takes up the question and discusses whether it may not be merely a "shortened" form of *Gymnoconia interstitialis* on the same host. Moreau along with Madame Moreau have argued that Uredines with similar shortened cycles (such as *Endophyllum*) are derived from those of normal development, and that shortened cycle forms may be found in other genera in southern regions. A. L. S.

Experimental Study of Melampsora abieti-caprearum.—EUG. MAYOR (*Bull. Soc. Mycol. France*, 1920, **36**, 191–203, 5 figs.). The study was undertaken to determine the hosts of this species. Mayor found by inoculations, etc., that pycnidia and cæomata grew on *Abies pectinata*, *A. Pinsapo* and var. *glauca*, *A. normanniana* and *A. cephalonica*. Uredospores and teleutospores grew naturally on *Salix Caprea*, but he was able to infect also *S. aurita*, *S. cinerea*, *S. incana*, *S. purpurea* and *S. viminalis*. A. L. S.

Investigations of Cronartium ribicola in 1920.—L. H. PENNINGTON, W. H. SNELL, H. H. YORK and PERLEY SPAULDING (*Phytopathologist*, 1921, **11**, 170–2). Investigations in the field were carried out by the authors of the note. Two points were brought out which are specially important. *Ribes* are often entirely killed out in a district, and breaking of the quarantine has resulted in outbreaks of the rust. Previous conclusions that æciospores may be blown an indefinite number of miles and cause infection are borne out by the present investigation. A. L. S.

Notes on the Uromyces of Astragalus and Cytisus.—F. KOBEL (*Ann. Mycol.*, 1921, **19**, 1–16, 3 figs.). The author made a series of inoculation experiments with three species on *Astragalus*, native to

Switzerland. He has embodied the results in a series of tables. He considers that there are a number of different forms or "lines" within the limits of these species. On *Cytisus* he experimented with *Uromyces Genistæ-tinctoriæ*, and was able to determine the æcidium form on *Euphorbia Cyparissias*. A. L. S.

Observations on Puccinia Pruni-spinosæ Parasitic on Apple and Uromyces Terebenthi on Pistacia Vera.—Ali Riza (*Bull. Soc. Mycol. France*, 1920, **36**, 125–7, 1 fig.). The author noted the disease of apple-trees at Halkali, and was able to identify the fungus as *Puccinia Pruni-spinosæ*. He also gives a new host for *Uromyces Terebenthi*; he gives a figure of the teleutospore. A. L. S.

Experimental Study of Puccinia Actaeæ-Elymi.—Eugene Mayor (*Bull Soc. Mycol. France*, 1920, **36**, 137–61). The author by numerous inoculation experiments has proved that two species, both forming æcidia on the *Helleborus* group of Ranunculaceæ, are included under the above. The second he designates as *P. Actaeæ-Argopyri*.
A. L. S.

Uromyces Airæ-flexuosæ.—C. Ferdinandsen and O. Winge (*Bull. Soc. Mycol France*, 1920, **36**, 162–4, 2 figs.). The writers have identified the form-rust *Uredo Airæ-flexuosæ* as a stage of *Uromyces Airæ-flexuosæ* sp. n. The latter was found in autumn at Copenhagen growing along with the uredo. A. L. S.

New Lepiota from Brazil.—N. Patouillard (*Bull. Soc. Mycol. France*, 1921, **37**, 81–3). The new species *Lepiota Puttemansii* is distinguished from allied forms by the large size of the pileus (15 cm.), and by the brown-black colour. A. L. S.

French Hymenomycetes (VII. Stereum).—H. Bourdot and A. Galzin (*Bull. Soc. Mycol. France*, 1921, **37**, 103–12). The authors give a synoptic key of *Stereum* species based on macroscopic characters. They publish a first instalment of descriptions of the species. A. L. S.

New Species of Polyporaceæ and some Polypores New to Bengal.—S. R. Bose (*Ann. Mycol.*, 1921, **37**, 129–31, 3 pls.). The new species *Fomes rufolaccatus* was collected in the Simla Hills, India. It is closely related to *Fomes pinicola*, but differs in the large elongated pores and the soft tissue of the pileus. A. L. S.

Two New Basidiomycetes.—H. Bourdot (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 50–4, 2 figs.). The fungi were collected by A. A. Pearson at Weybridge, and submitted to the author for determination. The paper opens with valuable notes on the early forms of resupinales, so different in appearance from the mature stages. *Corticium Pearsonii* occurs as a ceraceous-pruinose efflorescence on a pine log. The second species is also a delicate plant like a loose thin crystalline film of ice. Bourdot places it in a new sub-genus of *Heterochæte* as *Heterochætella crystallina*; it also grows on pine wood, always in an advanced stage of decay. The distinctive characters of these fungi are described and figured. A. L. S.

New British Hymenomycetes.—A. A. Pearson (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 55–8). Species of *Exidia*, *Sebacina*, *Corticium*, *Peniophora*, *Hypochnus* and *Mucronella* new to this country are listed and described. A new variety of *Hypochnus roseo-griseus* var. *lavanduluceus* has been established on account of the colour, "without trace of pink." A. L. S.

Critical Notes on New or Little-known Hymenocytes.—H. Bourdot and L. Maire (*Bull. Soc. Mycol. France*, 1920, **36**, 69–85, 1 fig.). The authors' notes range over a large number of species and over many points—on form, colour, development, type of spores, etc. The species discussed are resupinates. A. L. S.

Cortinarius suaveolens Bataille et Joachim.—Frederic Bataille (*Bull. Soc. Mycol. France*, 1920, **36**, 85–6). A beautiful species collected at Fontainebleau and distinguished from closely allied species by a penetrating odour of orange flower. A. L. S.

Chlamydospores of Fomes officinalis in Nature.—W. H. Snell (*Phytopathology*, 1921, **11**, 173–5, 1 fig.). These secondary spores, colourless, globoid or ellipsoid, and rather small, are constantly formed in cultures. They have now been found on a piece of timber rotted by the fungus. Attempts to germinate these spores were unsuccessful. A. L. S.

Fungi from Tonkin.—N. Patouillard (*Bull. Soc. Mycol. France*, 1920, **36**, 174–7). The fungi are mostly minute forms: several species and varieties are new to science. Patouillard takes occasion to criticize Atkinson's *Eocronartium typhuloides*. He considers it a member of the genus *Helicobasidium*. A. L. S.

List of Micromycetes from Spain.—G. B. Traverso (*Bull. Soc. Bot. Ital.*, 1915, **3**, 22–6). The species were collected by Gonzales Fragoso and submitted to Traverso for determination. There are twelve in all, most of them new to science, and chiefly Sphæropsidales. A. L. S.

Polyporaceæ of Bengal, Part IV.—S. R. Bose (*Bull. H. Carmichael Med. Coll. Belgachia*, 1921, **11**, 1–5, 13 pls.). Bose has written clear descriptions of fifteen species which he has found in Bengal—with one exception. They are finely illustrated by photographic plates showing both surfaces. A. L. S.

Fungi Parasitic on Scale Insects.—T. Petch (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 18–40). The paper was given by T. Petch as his Presidential Address to the members of the British Mycological Society. The earliest fungus recorded on a scale insect was by Desmazières in 1848, who instituted for it a new genus *Microcera*. It was the conidial stage of a *Sphærostilbe*, several of which have been found on scale insects. The writer describes these and the history of their occurrence. He also gives an account of the fungi on the same insects—species of *Cordyceps*, *Aschersonia*, *Hypocrella*, *Myriangium*, *Septobasidium*, *Fusarium* and other Hyphomycetes. When the fungi attack the insects they destroy them quickly and completely, and attempts have been made with some success to use them in combating insect ravages. The majority of scale insect fungi are tropical, but there are a few in this country which ought to be studied more thoroughly. Search should be made for them during the winter. A. L. S.

Mycological Notes.—C. G. Lloyd (*Cincinnati*, 1920, 1029–1101, 16 pls.). The first plate in this publication is a photograph of O. Mattirolo, a prominent mycologist in Italy, who has done important work on hypogæal fungi. A photograph is also printed of the Rev. — Theiszen, who died from an accident in the mountains in 1919. Lloyd then discusses a very numerous and varied series of fungi that have been sent to him; most of them are photographed and reproduced on the plates. Lloyd publishes some critical notes on the Myxomycetes, with an expression of his views as to nomenclature. Several of the larger forms of the group are constantly sent to him as fungi. He also criticizes a paper by Mary E. Currie on Slime-moulds. A. L. S.

Obituary Notice of Emile Boudier.—L. Mangin (*Bull. Soc. Mycol. France*, 1920, **36**, 181–8, portrait). Emile Boudier was born in 1828, and died in 1920; he was a Doctor of Pharmacy and lived most of his life at Montmorency. He was an indefatigable and exceedingly careful mycologist. One of his last and best known works is the *Icones mycologici*, which are greatly admired on account of the fine scientific descriptions and the beautiful reproductions of his drawings of fungi. His publications were begun in 1866; the last, called by him *Dernières étincelles mycologiques*, was published in 1917. He founded, along with Quélet and Mougeot, the Mycological Society of France in 1884. He was an honorary member of the British Society. The list of his published works occupies five closely printed pages. A. L. S.

Fungi from the Island of Malta.—P. A. Saccardo (*Nuovo Giorn. Bot. Ital.* 1915, **22**, 24–76). The fungi were collected by A. Caruana-Gatto and G. Borg during the years 1913–14, and were determined and listed by the late Professor Saccardo in 1914. He enumerated three hundred and two species or varieties, of which eighty-eight species and eleven sub-species and varieties are new to science. Very little was known previously of the fungus flora of the island, and the number of forms collected was surprising when the xerophytic conditions that prevailed and the absence of natural woods are considered. Saccardo notes the great abundance of *Pleospora herbarium* on many plants, and the large number of Sphæropsideæ without the corresponding perfect forms. As an example of the latter case species of *Phomopsis* are fairly numerous, but only one *Diaporthe*, the perfect stage, was collected. Many of the new species belong to the Sphæropsideæ. A. L. S.

Ecological Character and Survey of the Mycological Flora of Libya.—Prof. A. Trotter (*Nuovo Giorn. Bot. Ital.*, 1915, **22**, 500–17: 1916, **23**, 5–33, 10 figs.). The mycological flora of Tripoli, Trotter informs us, is undoubtedly a poor one, due to the relative physical and biological uniformity of the territory and by unfavourable climatic conditions. The lack of species is specially manifest in the fungi that are more particularly humicolous and hygrophilous, such as Hymenomycetes, Phycomycetes, Myxomycetes, etc. The prolonged aridity of the climate favours the existence of species with a short life-cycle and with a rapid development. Parasitic fungi are prevalent. About two hundred species are recorded. A. L. S.

Notæ Mycologicæ.—P. A. SACCARDO (*Nuovo Giorn. Bot. Ital.*, 1916, **23**, 185–234). The author has enumerated 248 fungi submitted to him for determination, of which 76 are new species, 13 new varieties. The collections were made in New York State, the Philippines and Erythræa, while yet another list includes specimens from various regions —Italy, France, Asia, Africa, Australia, etc. A. L. S.

Second List of Fungi from Val S. Martino, or Valle della Germanasca.—B. PEYRONEL (*Nuovo Giorn. Bot. Ital.*, 1918, **25**, 146–92). The list of fungi includes three orders, Hymeniales, Uredinales and Ustiliginales. The species, numbering 128, were collected by the author; 73 are new for the district; one, *Boletus laricinus*, is new for Italy. Localities are given with biological notes. There is appended an index of the genera, and a second index indicating the habitat or the matrix of the fungi. A. L. S.

Micromycetes of Val Germanasca.—B. PEYRONEL (*Nuovo Giorn. Bot. Ital.*, 1918, **25**, 405–68, 76 figs.). The fungi of this list belong to various groups. Many of them are parasites on the plants, and an index of these is appended. The author does not claim that his list is complete. He collected and determined 145 species, 67 of which are new to the district, and 12 new to science. He has described three new genera, *Meringosphæria* (Sphæriaceæ), *Cladographium* (Stilbaceæ), and *Helicodendrum* (Mucedinaceæ). He also places in a new genus *Eriomenella*, the species recorded as *Menispora Libertiana* Sacc. A. L. S.

Fungi from Val d' Aosta.—P. A. SACCARDO (*Nuovo Giorn. Bot. Ital.*, 1921, **24**, 31–43). A list of 97 species, most of them Micromycetes; 60 of the species determined are new to the district, and eight are new to science, with one new genus, *Nothodiscus* (Phacidiaceæ), found on living leaves of *Veronica*. Two species of Mycetozoa are included. A. L. S.

Micromycetes from Piedmont.—ALBERTO NOELLI (*Nuovo Giorn. Bot. Ital.*, 1921, **24**, 183–97). The list is the third contribution by the author to the fungi of Piedmont. He describes four new species, parasites of the higher plants. One of these, *Cladosporium acerinum*, is akin to *C. epiphyllum*. The list also includes ten Mycetozoa. A. L. S.

Fungi of our Common Nuts and Pits.—CHARLES E. FAIRMAN (*Proc. Roch. Acad. Sci.*, 1921, **6**, 73–115, 6 pls.). The author describes the fungi that he has found growing on chestnuts, various nuts, acorns, and on "cherry pits" (stones) and "peach-pits." He has listed and described 102 different forms, not all of them injurious and some of them on involucres of the nuts, etc. A number of species are new to science; all of them have been carefully described, and the less known species figured. A. L. S.

Mycological Notes.—MARTINO SAVELLI (*Bull. Soc. Bot. Ital.*, 1917, **1**, 15–19). The author discusses first the systematic position of a *Puccinia* collected in the Caucasus on *Iris flavescens*, and determined at the time as *P. Iridis*. Careful examination of the specimen and of allied species have induced him to make a new species, *P. caucasica*.

In a second paper he gives an account of the Cystopodaceæ and Peronosporaceæ of Tuscany. Most of the species belonged to the genus *Peronospora*. A number of the species recorded are new to the district. A. L. S.

Californian Bees.—J. RAMSBOTTOM (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 86–8). This name and other designations, such as Palestine Bees, Wine Bees, etc., are given to the organism which forms the ginger-beer plant. It consists of solid white lumps about the size of a pea. The lumps are composed of a yeast, *Saccharomyces pyriformis*, and a bacterium, *Bacterium vermiforme*, which live in symbiotic unison and together cause the fermentation of ginger beer. A. L. S.

Inheritance of Disease-resistance in Plants.—F. T. BROOKS (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 71–8). Brooks discusses the inheritance of disease according to Mendel's Law. He gives the results of workers as regards plants, and he gives various theories as to the means whereby plants secure immunity from the attacks of parasites. The problem has been worked out most completely in the case of yellow rust of wheat, the resistance of the wheat being a Mendelian recessive character. A. L. S.

Audibility of the Spore Discharge in Otidea leporina.—R. B. JOHNSTONE (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 86). The spores were found to be ejected from the asci with a hissing sound which was distinctly heard 6 ft. away. The plants had been collected and placed in a box. When the box was opened twenty-four hours later the discharge became audible. A. L. S.

British Mycology.—J. RAMSBOTTOM (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 1–12). An account is given of the annual foray for 1920 which took place at Minehead. During the meeting various matters were discussed. The President, Mr. T. Petch, gave an account of work done by S. R. Bose on Indian Polyporaceæ. J. Ramsbottom described the occurrence of mycorhiza in orchids; he also exhibited pieces of canvas attacked by fungi. The various outings are described and the more important finds are noted. Finally, a list is printed of all the fungi collected. A. L. S.

Notes on New or Rare British Fungi.—MALCOLM WILSON (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 79–85). Most of the species of micro-fungi here described are new to Britain. A number of Uredineæ are included in the list. The fungi are all from Scotland. A. L. S.

Poisoning by Fungi.—E. Chauvin (*Bull. Soc. Mycol. France*, 1920, **36**, 212–3). A severe case of poisoning was reported from Nancy. The fungi had been freshly gathered and cooked. Trouble arose about seven hours after the meal. Nine persons partook of the repast and seven of them died after great suffering. The symptoms suggested *Amanita phalloides* as the cause, and that it had been probably mistaken for a green *Russula*. A. L. S.

Coronilla nivea Crouan and Cunninghamella echinulata Thaxter.—George Safford Torrey (*Bull. Soc. Mycol. France*, 1921, **37**, 81–99, 1 pl.). The author has made exact studies of these two fungi. He was unable to induce a culture of the former, and concludes that he was dealing with a race differing in some degree from the plants so easily cultivated by other workers. He discusses fully the systematic position of *Cunninghamella*, which has been considered as a reduced member of the Mucorini. A. L. S.

Mycotheca germanica.—Sydow (*Ann. Mycol.*, 1921, **19**, 132–44). A list is given of the fungi of seven fascicles (Nos. 1401–1800). A number are new to science and have been described by the author. A. L. S.

Mycological Research in Veterinary Medicine.—Brocq-Rousseau (*Bull. Soc. Mycol. France*, 1921, **37**, 99–103). The author desires to draw attention to the importance of studying the lower genera of fungi, *Microsporon*, *Sporotrichum*, *Streptothrix*, etc., which cause disease in animals. A. L. S.

Mycological Notes, II.—F. Petrak (*Ann. Mycol.*, 1921, **19**, 17–128). The notes are concerned with a large number of species of microfungi (Nos. 31–115). Many of them are new to science. Others already recorded have been found by Petrak and have been subjected to critical examination and discussion. He has established as new the following genera: *Scolecosporiella*, *Neobulgaria*, *Phæocytostroma*, *Cryptoceuthospora*, *Amphicytostroma*, *Neosphæropsis*, *Neoplacosphæria*, *Podoplaconema* and *Cryptodiaporthe*. A. L. S.

Attack of Poplar Canker following Fire Injury.—Alfred H. W. Povah (*Phytopathology*, 1921, **11**, 157–65, 3 figs.). A disease of poplars had been already diagnosed as due to *Cytospora chrysosperma*. The same disease was found attacking and killing many trees in an area more or less damaged by fire. The trees were not so seriously burned but that they might otherwise have recovered. The surrounding trees were not attacked. *Valsa sordida* was found on the trees, and is presumably the perfect fruiting form. A. L. S.

Note on Cenangium Abietis on Pinus ponderosa.—James R. Weir (*Phytopathology*, 1921, **11**, 166–70, 1 fig.). This fungus has been recognized as a parasite in Europe, but only recently has it been found causing damage to the host tree. The specimen dealt with grew on *Pinus ponderosa*: it caused a reddening of the needles and shrinking of the bark during the winter months (December to February). Inoculations were made, and the parasitic nature of the fungus was established.

A. L. S.

Method of Attack and Parasitic Contamination of Ivy (Hedera Helix) Conditioned by Rain.—P. Bugnon (*Bull. Soc. Mycol. France*, 1920, **36**, 172–4, 1 fig.). The author discovered a fungus, later diagnosed to be *Phyllosticta hedericola*, that formed pycnidia on linear patches along the edge of the ivy leaves. The position was due to the washing down of dusts and spores to the lower region of the leaves by rain. He found *Cladosporium herbarum* on the same area. A. L. S.

New Disease of the Almond.—Ali Riza (*Bull. Soc. Mycol. France*, 1920, **36**, 189–91, 1 fig.). The disease attacks the branches, and is caused by the fungus *Cercospora Amygdali* sp. n. A description of the fungus is given. A. L. S.

Common Scab of Potatoes.—W. A. Millard (*Journ. Agric.*, 1921, **28**, 49–53, 2 pls.). The author gives an account of work done on scab disease at Leeds. It has been proved that American and English scab are alike, and due to a fungus, *Actinomyces scabies*. It was found that manuring with green herbage lessened the attack, and it is suggested that in such a case the fungus lives on the organic matter supplied, and the potato escapes. A. L. S.

Leaf-spots on the Elm.—L. E. Miles (*Bot. Gaz.*, 1921, **71**, 161–96, 3 pls., 1 fig.). The principal American elm, *Ulmus americana*, is often severely attacked by the fungus *Gnomonia ulmea*, which causes spots on the leaves: it is apt to cause considerable damage to seedlings and young trees in nurseries. The first growth of the fungus is found in the living leaf early in spring: the young perithecium develops in the palisade tissue beneath a sub-cuticular stroma. Germination of the ascospores took place readily on living elm leaves, but was never induced on culture media. A conidial stage was found constantly associated with the *Gnomonia*, and has been determined as *Glœosporium ulmeum* sp. n. The connexion between the two forms was proved by artificial cultures. Other leaf-spots on the elm were examined and described. An extensive bibliography is appended. A. L. S.

Lichens.

Lichens of the Minehead District.—H. H. Knight (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 16–18). Minehead proved a profitable gathering ground for lichens. Arboreal species are abundant in Horner's Wood; at Selworthy and Porlock saxicolous forms were more prominent. A very considerable number were found, and have been listed by the author of the paper. A. Lorrain Smith.

Sporulation of Gonidia in the Thallus of Evernia prunastri.—R. Paulson (*Trans. Brit. Mycol. Soc.*, 1921, **7**, 41–7, 1 pl.). Paulson gives an account of gonidial multiplication in *Evernia*, but the same type of sporulation has been found by him in a large number of lichens. He gives the date of collection and the methods of examination employed in his research. He describes the mature gonidium, the breaking up of the contents into two, four, eight, sixteen or more daughter gonidia. He concludes that the gonidium of these lichens is a species of *Chlorella*.

A. L. S.

Review of Publications on Lichens.—G. Bioret (*Rev. Gén. Bot.*, 1921, **33**, 63–76, 146–60, 214–20, 264–72, 328–36, etc.). The author has discussed the many publications on the nature and development of lichens that have been published since 1910. An account of each paper arranged under different subjects is given, with the criticisms of the various works, and the author's own considered views. Finally, Bioret has listed all recently published works under a series of subjects, and geographically under the different countries where the papers have been published. His work shows at a glance the wide interest in lichens and the importance attached to the study of the group. A. L. S.

Lichens.—A. Lorrain Smith (*Cambridge Botanical Handbooks*, 1921, xxii and 464 pp., 135 figs.). The writer gives a connected account of lichens from their earliest mention up to the present day. Special stress is laid on the symbiotic nature of the lichen thallus, and on the interaction of the symbionts, alga and fungus, and on the structure formed by them. Other subjects dealt with are their reproduction, physiology, bionomics, ecology, and the economical value of the plants. There is also a survey of classification, largely drawn from the work of A. Zahlbruckner, the leading exponent of lichens, whose work on systematy has been followed, as it is likely to hold the field for some considerable time. Glossary, bibliography and index complete the book. The illustrations are, many of them, photographs of the living plants.

A. L. S.

Ten Years' Progress in Lichenology in the British Isles.—R. Paulson (*Essex Naturalist*, 1921, **19**, 273–86, 4 pls.). The author reviews recent work on British lichens, which he arranges under four heads: Records, Ecology, Morphology, and Physiology and Symbiosis. The largest number of papers deal with Records of Species. Considerable attention has been given to ecology, and symbiosis is treated from different points of view. Connected with the latter subject is the behaviour of the algæ that form the gonidia of the thallus. The author gives results of his own discoveries of the healthy sporulation of the lichen algæ within the thallus. Dr. Church's views on the origin of lichens are also discussed. A very full bibliography is appended.

A. L. S.

MICROSCOPY.

A. Instruments, Accessories, etc.

W. Watson and Sons, Ltd., 313 High Holborn, London. W.C., have recently issued a new edition of their Catalogue of Microscopes, and in it are contained some new instruments, and modifications of others.

Among the improvements we note they have abandoned the system of suspending the substage or condenser carrier from the under side of the stage of the microscope, the undesirability of which was urged nearly forty years ago by Mr. John Mayall, Jun., and by successive microscopists since.

The practice of extending the limb sufficiently far below the stage for the frame of the substage or condenser carrier to be attached to it

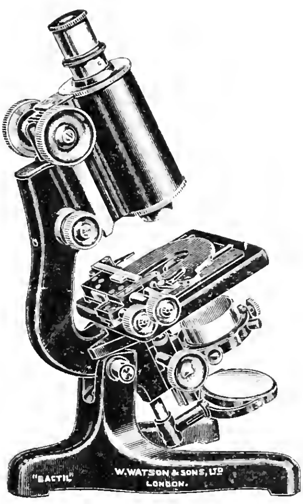


FIG. 1.—"Bactil."

seems to have been followed in all the Watson microscopes, and it is certainly a move in the right direction.

A new microscope under the name of "Bactil" appears for the first time in this catalogue. In the main its lines are those of the "Service" microscope previously described in this Journal, but it is designed especially for research work, and is fitted with a large body, 2 in. diameter. The fine adjustment, which is worked by milled heads from either side of the limb, has a drum with divisions upon it. The mechanical stage, which is shown in position in fig. 1, and which is known as the "Service" pattern, gives a range of 60 mm. horizontally and 35 mm. vertically. As an alternation, the interchangeable Long Range Mechanical Stage (fig. 2) may be fitted. It is claimed for this type of stage that it is fully equal to the stage which is built as part of

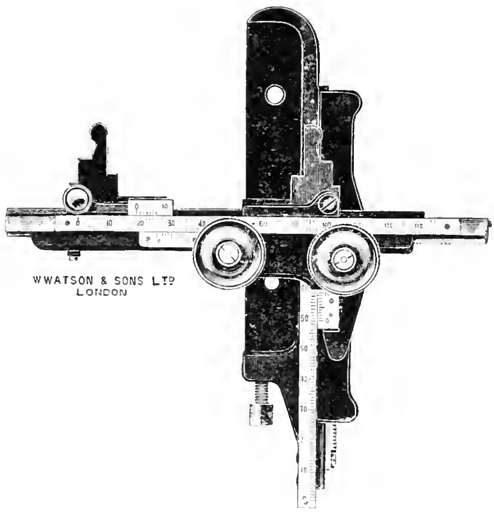


Fig. 2.—Murray's Long Range Attachable Stage.

the microscope. The method of attachment is a simple one, consisting of two pins which pass through the holes usually occupied by the butts of the object springs. These steel pins have screwed ends, and the stage is secured by nuts which fit on these screws. The substage turns

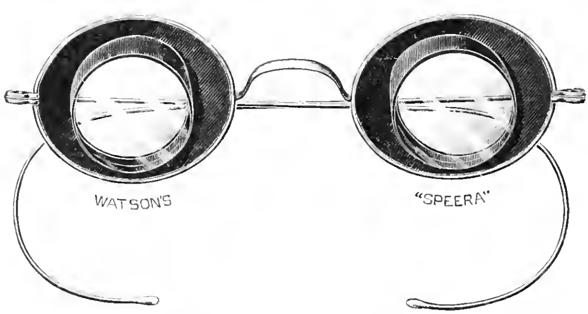


Fig. 3.—Watson's "Speera" Magnifiers.

aside from the optical axis, which has centring screws and rackwork to focus. It is altogether a massive and imposing instrument, and of a design that finds favour in the laboratories of to-day.

The Long Range mechanical stage (fig. 2) referred to in connexion with the "Bactil" microscope is a new pattern of attachable mechanical stage, designed by Dr. Murray for the examination of serial sections, blood films, etc., and gives mechanical movements over 115 mm. by 85 mm.

The method of attachment to the stage is a new one. The design is simple, but mechanically good.

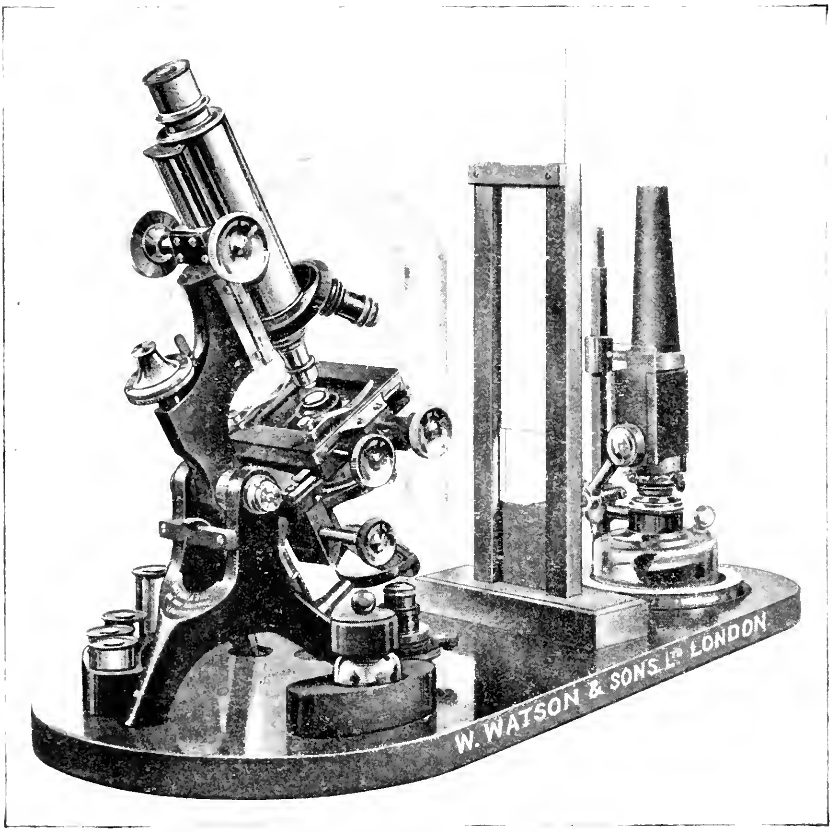


FIG. 4.—"Physician's Outfit."

Special attention is called to the series of apochromatic objectives. They are four in number, as follows: 16 mm., 8 mm., 4 mm., 2 mm. (oil immersion); and there is a new $\frac{1}{7}$ in. oil-immersion objective of 0·9 N.A.

The majority of workers on metal specimens with vertical illumination are in the habit of using both the prism and cover-glass patterns of illuminator. A carrier has been designed into which the prism or the cover-glass holder can be placed and revolved freely. It obviates the continual removal of one piece of apparatus with its objective, and the screwing in of another in its place, and apparatus of this description should simplify working, and is to be commended.

The "Speera" binocular magnifiers should be of interest to most microscopists on account of the many occasions when a low magnifying power is required. The lenses are mounted at slightly convergent angles, so that one image only is seen at the focal point. The lenses are achromatic and give a stereoscopic effect. The focal lengths of the pairs of lenses are made 5 in., 7 in. and 10 in., giving magnifications of about 3·5, 2·5 and 1·75 diameters respectively. The great advantage lies in the freedom which is given to both hands for dissecting or working when these spectacles are worn.

In "Critical Microscopy," by A. C. Coles, an illustration is given of that writer's arrangement of instrument, lamp and accessories, which is always available for reference in its working position. This has been reproduced for commercial purposes as the "Physician's Outfit," and is shown in fig. 4. To the busy worker an arrangement of this description will readily appeal. If interrupted, it is only necessary to cover the microscope with the glass shade and extinguish the lamp; everything is then left ready for continuing investigations when time allows.

B. Technique.

Adjustable Dark Ground Immersion Illuminator.—The outstanding characteristic common to all high power dark ground illuminators is that if they are not accurately focused the object to be examined is not illuminated at all. The light passes through a point and does not enter the microscope unless the object is at that position to reflect this light.

This peculiarity necessitates the use of selected slips of the exact thickness suitable to the focus of the illuminator. Apart from the trouble involved in selecting the slips, this does not present any special difficulty where living specimens are being studied in leisurely fashion, but in a laboratory liable to "rush" periods, it frequently happens that the additional information afforded by dark ground illumination is lost owing to the specimens having been mounted upon an unselected slide of unsuitable thickness; and, moreover, this form of illumination can seldom be used for mounted specimens. We therefore welcome the novel high power dark ground illuminatory introduced by Messrs. R. & J. Beck, which is so made that, by moving the lower lens while the upper lens remains in immersion contact with the slip, any focus of from $\frac{1}{2}$ mm. to $1\frac{1}{2}$ mm. can be obtained – a variation of sufficient range to accommodate any ordinary slip; moreover the focusing adjustment will be found valuable even with slips of selected thickness, as a slight variation of the focus gives somewhat different effects.

The method of adjustment is readily followed from reference to fig. 6. When the movable lens of the illuminator is raised or lowered by means of the projecting lever handle (*c*), a ring outside the mount also moves up and down, thus making a gap (*b*) that appears in the upper part of the mount larger or smaller. The slide on which the object to be examined is mounted may be inserted in this gap and the focusing handle rotated until it just closes on the slide. The illuminator is now set at the correct focus for the particular thickness of the slide.

As the gap is just above the level of the substage this small operation may easily be carried out while the dark ground illuminator is in place on the microscope, or, if necessary, the substage can be swung out for the purpose and then replaced.

A Simple Method for Handling Small Objects in Making Microscopic Preparations.—CHAS. W. METZ (*The Anatomical Record*, **21**, 1921). The following method of handling flies, especially *Drosophila* and other small forms, has been worked out by the author and proved satisfactory.

It resembles the well-known method of wrapping the objects in some flat, transparent membrane like *Cryptobranchus* epidermis, but utilizes the thin transparent bag-like skin which surrounds the abdomen of the *Drosophila* (fruit-fly, vinegar-fly, banana-fly) pupa under the

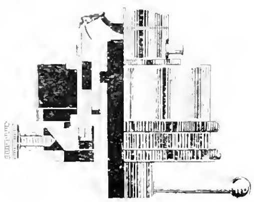


FIG. 5.

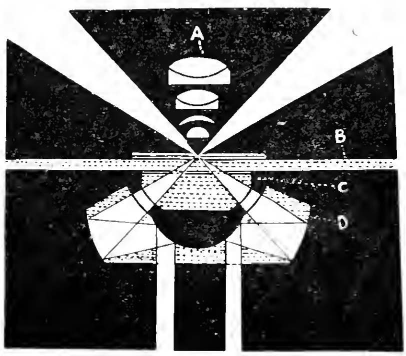


FIG. 6.

chitinous pupa case—at about the middle of the pupal stage. This skin is obtained intact by puncturing the pupa with a needle about a third of the way back from the anterior end (end with the long "horns"), then transferring to water and tearing it in two with dissecting needles, after which the abdomen and the attached portion of the thorax may easily be pulled or pressed from the pupa case and the contents removed by gentle pressure with one needle while the apex of the abdomen is held down with the point of another: there then remains an oval, transparent bag with a constricted opening at the anterior end representing the connexion between the abdomen and the thorax. The small objects to be treated are passed through this orifice into the pouch until the latter is nearly full and then the opening closed by pressing or twisting the edges together with needles or forceps and immersion in the fixative or alcohol. Objects are usually fixed, washed, and run up to 50 p.c. alcohol before packing into the pupa-skins. This avoids any long stay in the dissecting fluid during dissecting and packing into the pouch. But with some objects such as small eggs, etc., not injured by exposure to the dissecting fluid, packing may be done before fixation.

Once a packet is made and the membrane has hardened in the fixative or alcohol it may be handled readily without fear of losing the contents. Reagents, including paraffin, penetrate the membrane readily, so that dehydration and embedding may be done rapidly. It is easy to secure species of *Drosophila* of various sizes around garbage, decaying fruit, etc., and so obtain pupa-skins of sizes adaptable to individual needs. By putting a few flies in a cotton-plugged bottle with ripe banana (or something similar) and a little paper, practically any desired number of pupæ may soon be obtained.

A supply of pupa-skins sufficient for months or years may be made up at one time and kept in 30 p.c. or 50 p.c. alcohol until needed.

This method may seem tedious, but with practice it proves rapid and efficient, and ensures—

1. Standardization of size of packets.
2. Convenience of size of packets.
3. Minimum amount of enclosing tissue together with close aggregation of objects themselves, making it unnecessary to section a packet much larger than the mass of objects themselves.
4. Transparency of the enclosing membrane at all stages, permitting orientation or examination of the contents.
5. Cleanliness of membrane and freedom from dirt and grit such as is often encountered in amphibian epidermis.
6. Relative freedom from extraneous tissue or material in the sections.

METALLOGRAPHY, Etc.

Crystal Growth and Re-crystallization in Metals.—Prof. H. C. H. Carpenter and Miss C. F. Elam (Institute of Metals Meeting, Sept., 1920). The facts ascertained as the result of experiments are :—1. The largest crystals are formed after the minimum amount of stress sufficient to produce growth. 2. The lower the temperature, the greater the stress required to produce large crystals. 3. The increase in size is not gradual.

F. I. G. R.

Monel Metal.—Paul D. Merica (*Chemical and Metallurgical Engineering*, February 16, 1921, **24**, No. 7). A brief statement of the physical properties of this natural alloy, and the commercial uses to which it has been adapted. Its resistance to corrosion and strength at high temperatures are perhaps the most useful properties.

Nickel Brasses.—(*Chemical and Metallurgical Engineering*, Feb. 9, 1921, **24**, No. 6). A summary of the work of Guillet, published in "Revue de Metallurgie" of 1913 and 1920, on the important rôle played by nickel in the manufacture of low-copper ternary brasses.

Chemical Properties and Metallography of Nickel.—Paul D. Merica (*Chemical and Metallurgical Engineering*, February 2, 1921, **24**, No. 5). Data on solubility and magnetic transformation of pure nickel. Notes are also given on the effect of the common impurities such as carbon, oxygen, manganese, sulphur, cobalt, iron and silicon upon various physical properties.

Arc-fused Steel.—Henry S. Rawdon, Ed. C. Groesbeck and Louis Jordan (*Chemical and Metallurgical Engineering*, October 6, 1920, **23**, No. 14). Tests cut from blocks of arc-fused metal gave mechanical properties like an inferior, porous casting, notably deficient in ductility, and determined entirely by unsoundness in the structure. Carbon, silicon and other elements are lost from the welding pencil during deposition.

Effect of Nitrogen on Steel.—O. A. Knight and H. B. Northrup (*Chemical and Metallurgical Engineering*, December 8, 1920, **23**, No. 23). Work showing that at least five definite layers are produced on the surface of low-carbon steel when it is exposed to ammonia at 650° C. Excessive brittleness in the outer zones responsible in part for gun erosion.

Plastic Crystals of Ammonium Nitrate.—W. N. Bond (*Phil. Mag.*, **41**, No. 241). Part II. of this communication should be of interest to microscopists, for it is shown that in bent crystals, ground and mounted, the extinction lines seen when the specimen is examined

between crossed nicols are not normal to the curved crystal. The author considers the probability of a local rational atomic adjustment, which, although the crystal has been distorted, causes it to remain in equilibrium.
F. I. G. R.

Progress Report of Research Sub-committee on Bearing Metals.—(American Society of Mechanical Engineers, December, 1920). By means of an instrument described as the micro-character, a tentative scale of micro-hardness has been drawn up. Photo-micrographs of alloys, ferrous and non-ferrous, are given, showing how the micro-hardness of the constituents can be determined with great accuracy by this instrument.
F. I. G. R.

"Slip-lines" and Twinning in Electro-deposited Iron.—W. E. HUGHES (Iron and Steel Institute Meeting, May, 1921). Photomicrographs of etched sections, deposited under various conditions, are shown which exhibit peculiar lines or markings. It is suggested that these lines may be "slip-lines" produced in the grains of which the deposit is composed by the forces of contraction which act in it during its formation.
F. I. G. R.

Solid Solution of Oxygen in Iron.—J. E. STEAD (Iron and Steel Institute Meeting, May, 1921). With the introduction of cupric re-agents, evidence is accumulating that many solid solutions of iron and every other element are electro-positive to pure iron. When iron is heated in air or oxidizing gases, it appears that the surface layers absorb oxygen which passes into solid solution, but when supersaturated the oxide falls out of solution, forming separate globules of free oxide. Photomicrographs accompany the paper.
F. I. G. R.

Röntgen Spectrographic Investigations of Iron and Steel.—A. WESTGREN (Iron and Steel Institute Meeting, May, 1921). This most remarkable paper confirms, by means of a method analogous to that used by the Braggs in their work on crystal structure, the cubic habit of alpha and gamma iron, and also that beta iron contains crystals oriented in the same way as alpha. Hence the beta-iron theory is opened anew. In martensite, iron is in the alpha form, which is also the case for high-speed steel of ordinary composition hardened at 1275° C.
F. I. G. R.

Cupric Etching Effects Produced by Phosphorus and Oxygen in Iron.—J. H. WHITELEY (Iron and Steel Institute Meeting, May, 1921). The author continues the work of Stead and others, and finds that differences of less than 0·02 p.c. in adjacent layers of otherwise pure iron can be readily detected by means of cupric etching re-agents; as the difference is increased up to about 0·15 p.c. the contrast becomes more marked. Attempts to produce an unequal distribution of oxygen to which cupric methods could be applied have failed. When oxygen is present, white resist-lines are formed only at the weld-junctions, but these resist-lines are not found when unoxidized iron is welded in dry hydrogen. A number of photomicrographs accompany the paper, and bring out very clearly these points in examining microscopically surfaces etched with various cupric re-agents. F. I. G. R.

Constitution of Chromium-tungsten Steels. — (*Chemical and Metallurgical Engineering*, May 4, 1921, **24**, No. 18). Recent Japanese work throwing light upon the complex reactions giving self-hardening and red-hardness properties to modern high speed steels. Edwards' views on like subjects are also briefly given.

Structure of Tungsten Steels.—(*Chemical and Metallurgical Engineering*, April 27, 1921, **24**, No. 17). Review of Honda and Murakami's work, presenting their principal conclusions as to the structure and constitution of tungsten-iron-carbon alloys. Reactions between iron-tungstide and iron and tungsten carbides are responsible for great complexity.

Crystalline Structure of Metals.—Zay Jeffries and R. S. Archer (*Chemical and Metallurgical Engineering*, May 4, 1921, **24**, No. 18). A brief definition of crystallinity: a discussion of the methods used in X-ray analysis of atomic spacing; and a statement of the results of such studies made up to the present time.

PROCEEDINGS OF THE SOCIETY.

A CONVERSAZIONE

was held at the Mortimer Halls, Mortimer Street, London, W.1, on Wednesday, October 5th, 1921.

A Reception was held by the **President,** Professor John Eyre, in the Upper Hall from 7.45 to 8.15.

General Exhibits were shown by—

F. Addey, B.Sc.—Transverse Section of Leaf of *Fittonia*, showing ocelli on Epidermis.

C. Baker.—Greenhough Binocular Microscope. New Model D.P.H., Student and other Microscopes.

R. & J. Beck, Ltd.—Binocular, Standard and Petrological Microscopes. Rowley Metallurgical Attachment, etc. Rock Sections and other Specimens.

The Cambridge & Paul Instrument Co., Ltd.—The Cambridge Rocking and Universal Microtomes and Accessories.

A. Earland, F.R.M.S.—Feather of Goldfinch, showing the orange-coloured plates of Keratin.

G. T. Gurr.—Microscopical Stains and other New Preparations.

Hawksley & Sons.—Spencer Lens Microscopes and Microtomes.

C. E. Heath, F.R.M.S.—Diatom *Arachnoidiscus*, showing abnormal drum-like development.

R. W. Higginson, F.R.M.S.—*E. histolytica* in Section from Intestine. Amytrophic lateral and deseminated Sclerosis.

A. Gandolfi Hornyold, D.Sc., F.R.M.S.—Otolith of an Eel, showing annual zones of growth.

A. Morley Jones.—Diatomaceæ, showing some illustrations of methods of growth.

Rev. A. F. Jones.—Saws of the Saw-fly (*Trichiosoma betuleti*).

Kodak Limited (Wratten Division).—Light Filters, Lamps, etc.

E. R. Martin.—Radula of Whelk.

Martin Melesi & Co.—Koristka Laboratory, Bacteriological, Medical and Student Microscopes and Accessories.

Ogilvy & Co.—Leitz New High-Power Binocular Microscope with Interchangeable Monocular Body. Akehurst Condenser Changers. Silverman Illuminator for Opaque Objects.

RHEINBERG & Co.—Framed Specimens of Graticules, Micrometers, etc., illustrating Processes of Grainless and of Filmless Photography.

RUDOLPH & BEESLEY.—Latest Patterns of Reichert Microscopes and Accessories.

T. J. SMITH.—Sulphur Crystals, Isatine, Menthol, Tetramethyl and Naphthaline under polarized light.

JAMES SWIFT & SON, LTD.—Standard, Portable and Petrological Microscopes and Accessories.

C. TIERNEY, M.S., D.Sc., F.R.M.S.—*Amœba proteus.*

H. TINSON.—Diatoms (various).

W. WATSON & SONS, LTD.—Metallurgical, Petrological, and other Microscopes.

J. T. R. WILDMAN, F.R.M.S.—Type Slide of Diatoms.

Dr. J. A. Murray gave Lantern Demonstrations on the Cellular Structure of the Body.

Pond Life Exhibits were shown by the following FELLOWS OF THE SOCIETY and Members of the QUEKETT MICROSCOPICAL CLUB—

C. H. BESTOW, F.R.M.S.—Rotifers (various).

D. BRYCE.—*Philodina erythrophthalma* from the river Lea.

A. J. BOWTELL, F.R.M.S.—Living diatoms (various).

C. C. CAMPBELL.—*Chlamydomonas* sp.

F. W. CHIPPS.—*Lophopus crystallinus.*

F. E. COCKS.—Free swimming rotifers (*Notops brachionus*).

R. F. G. COLE.—Heliozoa (*Actinospherium eichhornii*).

T. N. COX.—*Spirogyra* in conjugation.

B. S. CURWEN.—*Simocephalus serrulatus.*

E. CUZNER, F.R.M.S.—*Plumatella repens.*

MISS A. DIXON, F.R.M.S.—*Actinospherium eichhornii* digesting water fleas.

F. B. GIBBARD.—Water mites (various).

H. GOULLEE.—Infusoria (various) from a flower-vase.

H. F. GREEN.—*Cyclops* sp. and *Diaptomus castor.*

H. JEWELL.—Cyclosis in *Vallisneria.*

H. J. LAWRENCE.—Desmid (*Cosmarium crenatum*).

R. J. LUDFORD, B.Sc., F.R.M.S.—Early stages in development of *Limnæa stagnalis* (common Pond Snail).

E. MAURICE.—*Hydra vulgaris.*

E. K. MAXWELL.—*Conochiloides dossuarius*, a free-swimming tube-building rotifer.

H. H. MORTIMER, F.R.M.S.—*Hydra viridis* and diatoms (various).

DR. J. A. MURRAY, F.R.M.S.—*Spirostomum* and *Paramæcium bursaria.*

J. C. MYLES.—Eye of *Dytiscus marginalis.*

E. R. Newmarch, F.R.M.S.—*Cristatella mucedo*; also *Daphnia longispina* with polarized light.

C. H. Oakden, F.R.M.S.—Water mites—*Diplodontus despiciens, Limnesia koenikei* and *L. maculata*.

R. Paulson, F.R.M.S.—*Stentor igneus*, showing zoochlorellæ, green algal cells, living symbiotically in the body of the *Stentor*.

F. J. W. Plaskitt, F.R.M.S.—*Chara vulgaris*, showing oogonia and cyclosis.

J. Pollard, F.R.M.S.—*Volvox globator*.

J. Richardson, F.R.M.S.—Alga (*Calothrix epiphytica* on stems of Anacharis).

W. Russell.—Infusoria (various)

H. A. St. George.—

D. J. Scourfield, F.R.M.S.—*Simocephalus vetulus*, stained while alive with neutral red and methylene-blue.

E. J. Summers.—*Leydigia acanthocercoides* from Richmond Park. (A rare water flea.)

B. J. Thomas.—Caddis and Pond Snail.

G. Tilling, F.R.M.S.—Polyzoa, *Plumatella repens* with model; also *Lophopus crystallinus*.

L. H. Tinson.—*Volvox globator*.

G. R. Titchener.—Rotifers (various).

C. Todd.—Hydrozoa, *Cordylophora lacustris*.

J. Wilson, F.R.M.S.—Desmid, *Cosmarium quadrifarium*: and *Lophopus crystallinus*.

Photomicrographic Exhibits were shown by the following Members of the Photomicrographic Society—

W. R. Biss.—Photomicrographic and other Apparatus.

J. G. Bradbury and W. H. Baddeley.—Photomicrographic Transparencies in Monochrome and Colour.

C. H. Caffyn, F.R.M.S.—Rock Sections and Photomicrographs of same.

E. Cuzner, F.R.M.S.—Photomicrographic Transparencies illustrating the Life History and Genera of the Hydroida.

E. A. Pinchin, F.R.M.S.—Photomicrographic Transparencies of Diatoms.

A. E. Smith, F.R.P.S.—Microscopic Specimens and Photomicrographs.

The Nickolds Quartette, under the direction of Mr. A. H. Nickolds, gave Selections in the Upper Hall during the evening.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W., ON WEDNESDAY, OCTOBER 19TH, 1921, PROFESSOR JOHN EYRE, PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the President.

The nomination papers were read of twenty-seven Candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows of the Society :—

Mr. Alexander James Bowtell.
Mr. John S. Dunkerly, B.Sc., Ph.D.
Mr. Richard William Higginson.
Mr. W. O. Humphery, M.I.M.E., P.A.S.I., M.R.San.I.
Mr. Reginald J. H. Hunt.

The President reported that three Fellows had died since the last Meeting of the Society :—

Mr. B. L. Mestayer, who was elected in 1884.
Mr. C. F. Rousselet, who was elected in 1888 and had taken a keen and active interest in the affairs of the Society until failing health prevented him from attending the meetings. His knowledge of early microscopes was unique, and he had served the Society as Curator for many years.
Dr. Henry Woodward, who was elected in 1880, and who held office as President during the years 1902 and 1903.

Donations were reported from :—

Professor De Toni—
Collection of Autograph Letters.
British Optical Instrument Manufacturers' Association, Ltd.—
Dictionary of British Scientific Instruments.
Longmans, Green & Co.—
"Physical Properties of Colloidal Bodies."
Dr. E. Penard—
"Infusiores d'Eau Douce."
Dr. M. Langeron—
"Précis de Microscopie."
Clarendon Press—
"History and Method of Science." (Dr. C. Singer.)
Compte Rendu—
"Faune de France." Vol. II. (Oiseaux).
Professor W. W. Watts—
"Geological Work of Charles Lapworth."

On the motion of the **President**, hearty votes of thanks were accorded to the donors.

Mr. Conrad Beck exhibited and described a Standard Petrological Microscope, and was thanked for his exhibit.

Dr. Lancelot T. Hogben, M.A., D.Sc., F.R.M.S. (Imperial College of Science and Technology), read a paper: "Preliminary Account of the Spermatogenesis of Sphenodon."

The President, Dr. Murray. Mr. Ludford, Mr. E. J. Sheppard and **Mr. Barnard** took part in the discussion which followed.

Instructor-Commander M. A. Ainslie, R.N., F.R.M.S., read a paper by **Mr. Dan M. Stump, B.S.** (State Microscopical Society of Illinois), on "An Application of Polarized Light to Resolution with the Compound Microscope."

The President, Mr. Conrad Beck, Mr. Capell and **Mr. Rheinberg** took part in the discussion on the paper.

On the motion of the **President**, a hearty vote of thanks was accorded to the authors of the above papers and to Commander Ainslie.

The business proceedings then terminated.

AN ORDINARY MEETING

OF THE SOCIETY WAS HELD AT 20 HANOVER SQUARE, W., on WEDNESDAY, NOVEMBER 17TH, 1921, MR. D. J. SCOURFIELD, VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the preceding Meeting were read, confirmed, and signed by the Chairman.

The nomination papers were read of four Candidates for Fellowship.

New Fellows.—The following were elected Ordinary Fellows of the Society:—

Mr. W. H. Baddeley.
Mr. A. J. Batchelor.
Mr. John George Bradbury.
Mr. Francis Joseph Brislee, D.Sc., F.I.C.
Mr. Harold D. B. Cooke, B.Sc.
Mr. Cole Willard Weeton Crowther, A.C.I.C.
Mr. Ganson Depew.
Mr. Herbert John Falkner.
Mr. Holly George Foster.
Professor P. N. Ghosh, M.A., Ph.D.

Mr. Horace Clifford Gillings.
Mr. John Thomas Hall, L.D.S., R.C.S.
Rev. G. H. Hewison.
Mr. William Horton.
Mr. Leslie Ernest Le Souëf.
Mr. John Drummond Pryde McLatchie, M.B., C.M.
Mr. Edmund Maurice.
Mr. A. Subba Rau, B.A.
Mr. William James David Roberts.
Mr. Thomas E. Robertson, F.C.I.P.A., A.F.R.Ae.S., A.M.I.E.E.
Mr. Edmund Arthur Robins.
Mr. H. W. Reginald Room.
Mr. Leonard Sachs, M.P.S.
Mr. Lolitmohan Sen, M.B., D.P.H., D.T.M.
Mr. Dan M. Stump, B.S., M.E.
Mr. Willie Thomas Watkin-Brown, J.P.
Mr. Harold Wrighton, B.Met.

The Donation of "Le Parasitisme et la Symbiose" by the Librairie Octave Doin was reported, and the donors thanked.

Exhibits were shown by Mr. Conrad Beck (a Metallurgical Microscope), and by Mr. E. J. Sheppard (Preparations showing Chromosomes, etc.). These gentlemen were thanked for their exhibits.

Mr. Barnard drew attention to the fact that the Society had issued a programme of Meetings covering the whole Session. The present state of industrial affairs had been responsible for the more or less formal programme that had been submitted. The microscope was taking a much more important place in industrial development than heretofore, and the Royal Microscopical Society would hardly have been fulfilling its purpose had it not done something to forward that development. The Directors of the Industrial Research Associations were written to and asked if they would be willing to communicate to the Society some of the results of their work and experiences. The replies were encouraging and the provisional programme was drawn up. It was not complete, and further papers would be added. The two opening papers dealing with the "Practical Use of the Microscope in Industrial Research" to be read that evening would be devoted to the consideration of the manufacture of glass and to a special branch of Metallurgy. He felt sure that the series of papers to be submitted would help the Fellows of the Society to realize that the microscope had now become the universal tool of Science and Industry.

Mr. George Patchin, A.R.S.M. (Sir John Cass Technical Institute), read a paper :—"The Micro-Examination of Metals with Special Reference to Silver, Gold and the Platinum Metals," illustrated by a number of lantern slides.

The Chairman, Mr. Webb and **Mr. Gardner** took part in the discussion which followed.

Mr. W. C. Crawley, B.A., F.E.S., F.R.M.S., and **Dr. H. A. Baylis, M.A., D.Sc., F.Z.S.,** read a paper :—" Mermis parasitic on Ants of the genus *Lasius*."

Mr. Robert L. Frink (Director of Research, Glass Research Association) read a paper :—" The Practical Value of the Microscope in Glass Manufacture," illustrated by a number of autochrome projections.

Mr. Wrighton and **Mr. Caffyn** took part in the discussion which followed.

On the motion of the **Chairman**, a hearty vote of thanks was accorded to the authors of the above papers.

The Chairman announced that the Biological Section would meet on Wednesday, December 7, when Mr. Ludford would make a communication on " Recent Researches on the Golgi Apparatus."

The business proceedings then terminated.

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