JOURNAL AND PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

NEW SOUTH WALES

FOR

1918.

VOL. LII.

EDITED BY

THE HONORARY SECRETARIES.

THE AUTHORS OF PAPERS ARE ALONE RESPONSIBLE FOR THE STATEMENTS MADE AND THE OPINIONS EXPRESSED THEREIN.

SYDNEY
PUBLISHED BY THE SOCIETY, 5 ELIZABETH STREET, SYDNEY.
LONDON AGENTS:
GEORGE ROBERTSON & Co., PROPRIETARY LIMITED,
17 WARWICK SQUARE, PATERNOSTER ROW, LONDON, E.C.

1919.

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NOTICE.

The Royal Society of New South Wales originated in 1821 as the "Philosophical Society of Australasia"; after an interval of inactivity, it was resuscitated in 1850, under the name of the "Australian Philosophical Society," by which title it was known until 1856, when the name was changed to the "Philosophical Society of New South Wales"; in 1866, by the sanction of Her Most Gracious Majesty Queen Victoria, it assumed its present title, and was incorporated by Act of the Parliament of New South Wales in 1881.

TO AUTHORS.

Authors of papers desiring illustrations, are advised to consult the editors (Honorary Secretaries) before preparing their drawings. Unless otherwise specially permitted, such drawings should be carefully executed to a large scale on smooth white Bristol board in intensely black Indian ink, so as to admit of the blocks being prepared directly therefrom, in a form suitable for photographic "process." The size of a full page plate in the Journal is $4\frac{1}{4}$ in. $\times 6\frac{3}{4}$ in. The cost of all original drawings, and of colouring plates must be borne by Authors.

PUBLICATIONS.

The following publications of the Society, if in print, can be obtained at the Society's House in Elizabeth-street:—

Transactions of the Philosophical Society, N.S.W., 1862-5, pp. 374, out of print.

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Royal Society of New South Wales.

OFFICERS FOR 1918-1919.

Patron:

HIS EXCELLENCY THE RIGHT HONOURABLE SIR RONALD CRAUFURD MUNRO FERGUSON, P.C., G.C.M.G.

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Vice-Patron:

HIS EXCELLENCY SIR WALTER EDWARD DAVIDSON, K.C.M.G.

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C. A. SUSSMILCH, F.G.S.
H. D. WALSH, B.A.I., M. INST. C.E.
Prof. W. H. WARREN, LL.D., Wh. Sc.

FORM OF BEQUEST.

I bequeath the sum of £ to the ROYAL SOCIETY OF NEW SOUTH WALES, Incorporated by Act of the Parliament of New South Wales in 1881, and I declare that the receipt of the Treasurer for the time being of the said Corporation shall be an effectual discharge for the said Bequest, which I direct to be paid within calendar months after my decease, without any reduction whatsoever, whether on account of Legacy Duty thereon or otherwise, out of such part of my estate as may be lawfully applied for that purpose.

[*Those persons who feel disposed to benefit the Royal Society of New South Wales by Legacies, are recommended to instruct their Solicitors to adopt the above Form of Bequest.*]

LIST OF THE MEMBERS

OF THE

Royal Society of New South Wales.

P Members who have contributed papers which have been published in the Society's Transactions or Journal. The numerals indicate the number of such contributions.

‡ Life Members.

Elected.		
1908		Abbott, George Henry, B.A., M.B., Ch.M., Macquarie-street; p.r. 'Cooringa,' 252 Liverpool Road, Summer Hill.
1877	P 5	Abbott, W. E., 'Abbotsford,' Wingen.
1918		Adam, George Hyslop, Chemist, 'Lintrose,' Warren Road, Marrickville.
1904		Adams, William John, M. I. MECH. E , 175 Clarence-street.
1916		Allen, William John, "Oriel," The Boulevard, Strathfield.
1898		Alexander, Frank Lee, c/o Messrs. Goodlet and Smith Ltd., Cement Works, Granville.
1905	P 2	Anderson, Charles, M.A., D.Sc. *Edin.*, Australian Museum, College-street.
1909	P 8	Andrews, Ernest C., B.A., F.G.S., Geological Surveyor, Department of Mines, Sydney.
1915		Armit, Henry William, M.R.C.S. *Eng.*, L.R.C.P. *Lond.*, 30 - 34 Elizabeth-street.
1878		Backhouse, His Honour Judge A. P., M.A., 'Melita,' Elizabeth Bay.
1894	P 26	Baker, Richard Thomas, F.L.S., Curator, Technological Museum.
1894		‡Balsille, George, 'Lauderdale,' N.E. Valley, Dunedin, N.Z.
1896		Barff, H. E., M.A., Warden of the University of Sydney.
1908	P 1	Barling, John, L.S., 'St. Adrians,' Raglan-street, Mosman.
1918		Barr, Robert Hamilton, Mechanical Engineer, Australasia Chambers, 2 Martin Place.
1895	P 9	Barraclough, S. Henry, B.E., M.M.E., ASSOC. M. INST. C.E., M. I. MECH. E., Memb. Soc. Promotion Eng. Education ; Memb. Internat. Assoc. Testing Materials; Professor of Mechanical Engineering in the University of Sydney; p.r. 'Marmion,' Victoria-street, Lewisham.
1894		Baxter, William Howe, L.S., Chief Surveyor, Existing Lines Office, Railway Department, Bridge-street.
1877		Belfield, Algernon H., 'Eversleigh,' Dumaresq.
1909	P 2	Benson, William Noel, D.Sc. *Syd.*, B.A. *Cantab.*, F.G.S., Professor of Geology, The University of Otago, Dunedin, N.Z.
1916		Birrell, Septimus, "Florella," Dunslaffnace-st., Hurlstone Park.
1915		Bishop, John, 24 Bond-street.
1913		Bishop, Joseph Eldred, Killarney-street, Mosman.
1905		Blakemore, George Henry, 4 Bridge-street.

Elected		
1888		‡Blaxland, Walter, F.R.C.S. *Eng.*, L.R.C.P. *Lond.*, No. 4 A. G. Hospital, Randwick.
1893		Blomfield, Charles E., B.C.E. *Melb.*, 'Woombi,' Kangaroo Camp, Guyra.
1898		Blunno, Michele, Licentiate in Science (Rome), 'Havilah,' No. 1, Darlinghurst Road, Darlinghurst.
1907		Bogenrieder, Charles, M.A., No. 2 Little's Avenue, Balmain.
1879		‡Bond, Albert, Wentworth Court, Elizabeth-street.
1917		Bond, Robert Henry, 'Tiro-Tiro,' Middleton-street, Stanmore.
1910		Bradley, Clement Henry Burton, M.B., Ch.M., D.P.H., 'Mebra,' Little-street, Longueville.
1876		Brady, Andrew John, L.K. and Q.C.P. *Irel.*, L.R.C.S. *Irel.*, 175 Macquarie-street, Sydney.
1916		Bragg, James Wood, B.A., c/o Gibson, Battle &Co. Ltd.,Kent-st.
1917		Breakwell, Ernest, B.A., B.Sc., Government Agrostologist, Botanic Gardens, Sydney.
1891		Brennand, Henry J. W., B.A., M.B., Ch.M. *Syd.*, c/o H.M.A. Naval Establishments, Garden Island, Sydney; p.r. 'Wobun,' 310 Miller-st., North Sydney.
1914		Broad, Edmund F., 'Cobbam,' Woolwich Road, Hunter's Hill.
1913		Browne, William Rowan, B.Sc., Assistant Lecturer and Demonstrator in Geology in the University, Sydney.
1906	P 1	Brown, James B., Resident Master, Technical School, Granville; p.r. 'Aberdour,' Daniel-street, Granville.
1898		‡Burfitt, W. Fitzmaurice, B.A., B.Sc., M.B., Ch.M. *Syd.*, 'Wyoming,' 175 Macquarie-street, Sydney.
1890		Burne, Alfred, D.D.S., Buckland Chambers, 183 Liverpool-st.
1907		Burrows, Thomas Edward, M. INST. C.E., L.S., Metropolitan Engineer, Public Works Department; p.r. 'Balboa,' Fern-street, Randwick.
1909		Calvert, Thomas Copley, ASSOC. M. INST. C.E., Department of Public Works, Sydney.
1904	P 13	Cambage, Richard Hind, L.S., F.L.S., Under Secretary for Mines, Department of Mines, Sydney; p.r. Park Road, Burwood. (President 1912). *Hon. Secretary.*
1907		Campbell, Alfred W., M.D., Ch.M. *Edin.*, 183 Macquarie-street.
1876		Cape, Alfred J., M.A. *Syd.*, 'Karoola,' Edgecliff Road, Edgecliff.
1897	P 4	Cardew, John Haydon, M. INST. C.E., L.S., Commercial Bank of Australia Chambers, George and Margaret-streets.
1891		Carment, David, F.I.A. *Grt. Brit. & Irel.* F.F.A., *Scot.*, 4 Whaling Road, North Sydney.
1909		Carne, Joseph Edmund, F.G.S., Government Geologist, Department of Mines, Sydney.
1917		Carpenter, Frederick Wm., M.A., Senior Science Master, Sydney Grammar School, College-street.
1903	P 3	Carslaw, Horatio S., M.A., Sc. D., Professor of Mathematics in the University of Sydney.
1913	P 3	Challinor, Richard Westman, F.I.C., F.C.S., Lecturer in Chemistry, Sydney Technical College.
1909	P 2	Chapman, Henry G., M.D., B.S., Professor of Pharmacology in the University of Sydney. *Hon. Treasurer.*
1913	P 8	Cheel, Edwin, Botanical Assistant, Botanic Gardens, Sydney.

Elected		
1909	P 20	Cleland, John Burton, M.D., Ch.M., Principal Assistant Microbiologist, Department of Public Health, 93 Macquarie-st. (President 1917) *Vice-President.*
1896	P 2	Cook, W. E., M.C.E. *Melb.*, M. INST. C.E., Water and Sewerage Board, North Sydney.
1913	P 1	Cooke, William Ernest, M.A., F.R.A.S., Government Astronomer and Professor of Astronomy in the University of Sydney, The Observatory, Sydney.
1904	P 2	Cooksey, Thomas, Ph.D., B.Sc. *Lond.*, F.I.C., Government Analyst; p.r. 'Clissold,' Calypso Avenue, Mosman.
1913		Coombs, F. A., F.C.S., Instructor of Leather Dressing and Tanning, Sydney Technical College; p.r. 55 Willoughby Road, North Sydney.
1876		Codrington, John Frederick, M.R.C.S. *Eng.*, L.R.C.P. *Lond.* and *Edin.*, 'Roseneath,' 8 Wallis-street, Woollahra.
1906		Colley, David John K., 'Culwalla,' Abbey-street, Leura.
1882		Cornwell, Samuel, J.P., Brunswick Road, Tyagarah.
1909	P 2	Cotton, Leo Arthur, M.A., B.Sc., Assistant Lecturer and Demonstrator in Geology (Acting Professor) in the University of Sydney.
1892	P 1	Cowdery, George R., ASSOC. M. INST. C.E., Blashki Buildings, Hunter-st.; p.r. 'Glencoe,' Torrington Road, Strathfield.
1886		Crago, W. H., M.R.C.S. *Eng.*, L.R.C.P. *Lond.*, 185 Macquarie-st.
1912		Curtis, Louis Albert, L.S., 'Redlands,' Union-street, Mosman.
1875		Dangar, Fred. H., c/o W. G. Deuchar, 12 and 14 Loftus-street.
1890		Dare, Henry Harvey, M.E., M. INST. C.E., Commissioner, Water Conservation and Irrigation Commission, Perpetual Trustee Chambers, Hunter-street, Sydney.
1876	P 3	Darley, Cecil West, M. INST. C.E., Australian Club, Sydney, 'Longheath,' Little Bookham, Surrey, England.
1910	P 1	Darnell-Smith, George Percy, D.Sc., F.I.C., F.C.S., Department of Agriculture, Sydney.
1886	P 21	David, T. W. Edgeworth, C.M.G., D.S.O., B.A., D.Sc., F.R.S., F.G.S., Professor of Geology and Physical Geography in the University of Sydney. (President 1895, 1910.)
1885	P 3	Deane, Henry, M.A., M. INST. C.E., F.L.S., F.R. MET. SOC., F.R.H.S., 'Campsie,' 14 Mercer Road, Malvern, Victoria. (President 1897, 1907.)
1894		Dick, James Adam, C.M.G., B.A. *Syd.*, M.D., Ch.M., F.R.C.S. *Edin.*, 'Catfoss,' Belmore Road, Randwick.
1915	P 1	Dick, Thomas, J.P., Port Macquarie.
1916		Dixon, Jacob Robert L., M.R.C.S., L.R.C.P., The University, Syd.
1906		Dixson, William, 'Merridong,' Gordon Road, Killara.
1876		Docker, His Honour Judge E. B., M.A., 'Mostyn,' Billyard Avenue, Elizabeth Bay.
1913		Dodd, Sydney, D.V.Sc., F.R.C.V.S., Lecturer in Veterinary Pathology in the University of Sydney.
1913	P 2	Doherty, William M., Analyst, Department of Public Health, Sydney.
1908	P 3	Dun, William S., Palæontologist, Department of Mines, Sydney. *President.*

Elected		
1918		Elliott, Edward, Chemical Engineer, c/o Reckitts' (Oversea) Ltd., Bourke-street, Redfern.
1916	P 2	Enright, Walter J., B.A., High-street, West Maitland, N.S.W.
1908		Esdaile, Edward William, 54 Hunter-street.
1879	P 4	Etheridge, Robert, Junr., J.P., Curator, Australian Museum; p.r. 'Inglewood,' Colo Vale, N.S.W.
1896		Fairfax, Geoffrey E., *S. M. Herald* Office, Hunter-street.
1887		Faithfull, R. L., M.D., *New York*, L.R.C.P., L.S.A. *Lond.*, 'Wilga,' 18 Wylde-street, Potts Point.
1902		Faithfull, William Percy, Australian Club.
1910		Farrell, John, 68½ Pitt-st.; p.r. 26 Bayswater-rd., Darlinghurst.
1909	P 3	Fawsitt, Charles Edward, D.Sc, Ph.D., Professor of Chemistry in the University of Sydney.
1881		Fiaschi, Thos., M.D., M.Ch. *Pisa*, 'Beanbah,' 235 Macquarie-st.
1888		Fitzhardinge, His Honour Judge G. H., M.A., 'Red Hill,' Beecroft.
1879		‡Foreman, Joseph, M.R.C.S. *Eng.* L.R.C.P. *Edin.*, 'Wyoming,' Macquarie-street.
1905		Foy, Mark, Elizabeth and Liverpool-streets.
1904		Fraser, James, C.M.G., M. INST. C.E., Chief Commissioner for Railways, Bridge-street; p.r. 'Arnprior,' Neutral Bay.
1907		Freeman, William, 'Clodagh,' Beresford Road, Rose Bay.
1899		French, Sir J. Russell, K.B.E., General Manager, Bank of New South Wales, George-street.
1881		Furber, T. F., F.R.A.S., c/o Dr. R. I. Furber, 'Sunnyside,' Stanmore Road, Stanmore.
1917		Galbraith, Augustus Wm., Civil Engineer, Broken Hill, Proprietory Co. Ltd., Box 196 P.O., Newcastle, N.S.W.
1918		Gallagher, James Laurence, Chemist, c/o Lever Bros. Ltd., Balmain.
1918	P 2	Gillies, C. D., M.Sc., Assistant Lecturer in Biology, The University of Queensland, Brisbane.
1897		Gould, Senator The Hon. Sir Albert John, K.B., V.D., 'Eynesbury,' Edgecliff.
1916		Granger, James Darnell, Ph. D., Manager of Chiswick Polish Co. of Australia, Mitchell Road, Alexandria.
1916		Green, Victor Herbert, 7 O'Connell-street, Sydney.
1899	P 1	Greig-Smith, R., D.Sc. *Edin.*, M.Sc. *Dun.*, Macleay Bacteriologist, Linnean Society's House, Ithaca Road, Elizabeth Bay. (President 1915.) *Vice-President.*
1912		Grieve, Robert Henry, B.A., 'Langtoft,' Llandaff-st., Waverley.
1912		Griffiths, F. Guy, B.A., M.D., Ch M., 135 Macquarie-st., Sydney.
1891	P 16	Guthrie, Frederick B., F.I.C., F.C.S., Chemist, Department of Agriculture, 137 George-street, Sydney. (President 1903).
1880	P 4	Halligan, Gerald H., L.S., F.G.S., 'Riversleigh,' Hunter's Hill.
1912		Hallmann, E. F., B.Sc., Fort Street Boy's High School, Petersham; p.r. 75 Hereford-street, Forest Lodge.

Elected		
1892		Halloran, Henry Ferdinand, L.S., 82 Pitt-street.
1909		Hammond, Walter L., B.Sc., Public High School, Newcastle.
1916	P 1	Hamilton, Arthur Andrew, Botanical Assistant, Botanic Gardens, Sydney.
1912		Hamilton, Alexrnder G., Lecturer on Nature Study, Teachers' College, Blackfriars.
1887	P 8	Hamlet, William M., F.I.C., F.C.S., Member of the Society of Public Analysts; 'Glendowan,' Glenbrook, Blue Mountains. (President 1899, 1908).
1916		Hardy, Victor Lawson, 'The Laurel,' 43 Toxteth Rd., Glebe Pt.
1912		Hare, Arthur J., Under Secretary for Lands, 'Booloorool,' Monte Christo-street, Woolwich.
1905	P 2	Harker, George, D.Sc., Assistant Lecturer and Demonstrator in Organic Chemistry in the University of Sydney.
1913	P 1	Harper, Leslie F., F.G.S., Geological Surveyor, Department of Mines, Sydney.
1918		Hassan, Alex. Richard Roby, 'Sunnymount,' Gordon Road, Roseville.
1884	P 1	Haswell, William Aitcheson, M.A., D.Sc., F.R.S., Emeritus Professor of Zoology and Comparative Anatomy in the University of Sydney; p.r. 'Mimihau,' Woollahra Point.
1916		Hay Dalrymple-, Richard T., L.S., Chief Commissioner of Forests, N. S. Wales; p.r. Goodchap Road, Chatswood.
1914		Hector, Alex. Burnet, 481 Kent-street.
1891	P 3	Hedley, Charles, F.L.S., Assistant Curator, Australian Museum, Sydney. (President 1914.) *Vice-President.*
1899		Henderson, J., F.R.E.S., 'Wahnfried,' Drummoyne.
1916		Henderson, James, 'Dunsfold,' Clanalpine-street, Mosman.
1884	P 1	Henson, Joshua B., ASSOC. M. INST. C.E., Hunter District Water Supply and Sewerage Board, Newcastle.
1918		Hindmarsh, Percival, M.A., 'Linden Park,' Revesby, viâ Bankstown.
1916		Hoggan, Henry James, Consulting Engineer, 'Lincluden,' Frederick-street, Rockdale.
1901		Holt, Thomas S., 'Amalfi,' Appian Way, Burwood.
1905	P 3	Hooper, George, Assistant Superintendent, Sydney Technical College; p.r. 'Branksome,' Henson-street, Summer Hill.
1891		Houghton, Thos. Harry, M. INST. C.E., M. I. MECH. E., 63 Pitt-st. (President 1916), *Vice-President.*
1906		Howle, Walter Cresswell, L.S.A. *Lond.*, Bradley's Head Road, Mosman.
1913		Hudson, G. Inglis, J.P., 'Gudvangen,' Arden-street, Coogee.
1917		Hurse, Alfred Edward, A.M.I.C.E., 'Llanfair,' Robert-street, Strathfield.
1904		Jaquet, John Blockley, A.R.S.M., F.G.S., Chief Inspector of Mines, Department of Mines, Sydney.
1905	P 8	Jensen, Harold Ingemann, D.Sc., Treasury Chambers, George-street, Brisbane.
1917		Jenkins, Richard Ford, Engineer for Boring, Irrigation Commission, 6 Union-street, Mosman.
1918		Johns, Morgan Jones, M.A.M.E., Civil Engineer, Mount Morgan Co., Mount Morgan, Queensland.
1916	P 1	Johnston, Stephen Jason, B.A., D.Sc., Professor of Zoology in the University of Sydney.

Elected		
1909	P 15	Johnston, Thomas Harvey, M.A., D.Sc., F.L.S., C.M.Z.S., Professor in Biology in the University of Queensland, Brisbane.
1911		Julius, George A., B.Sc., M.E., M. I. MECH. E., Culwulla Chambers, Castlereagh-street, Sydney.
1883		Kater, The Hon. H. E., J.P., M.L.C., Australian Club.
1873	P 4	Keele, Thomas William, L.S., M. INST. C.E., Commissioner, Sydney Harbour Trust, Circular Quay; p.r. Llandaff-st., Waverley.
1914		Kemp, William E., A.M. INST. C.E., Public Works Department, Coff's Harbour Jetty.
1887		Kent, Harry C., M.A., F.R.I.B.A., Dibbs' Chambers, 58 Pitt-st.
1901		Kidd, Hector, M. INST. C.E., M. I. MECH. E., Cremorne Road, Cremorne.
1896		King, Kelso, 120 Pitt-street.
1878		Knaggs, Samuel T., M.D. *Aberdeen*, F.R.C.S. *Irel.*, 'Northcote,' Sir Thomas Mitchell Road, Bondi.
1881	P 23	Knibbs, G. H., C.M.G., F.S.S., F.R.A.S., L.S., Member Internat. Assoc. Testing Materials; Memb. Brit. Sc. Guild; Commonwealth Statistician, Melbourne; p.r. 'Normanhurst,' Denmark-st., Kew, Victoria. (President 1898.)
1877		Knox, Edward W., 'Rona,' Bellevue Hill, Double Bay.
1911	P 3	Laseron, Charles Francis, Technological Museum.
1913		Lawson, A. Anstruther, D.Sc., F.R.S.E., F.L.S., Professor of Botany in the University of Sydney.
1916		L'Estrange, Walter William, 55 Albert Road, Homebush.
1906		Lee, Alfred, 'Glen Roona,' Penkivil-street, Bondi.
1909		Leverrier, Frank, B.A., B.Sc., K.C., 182 Phillip-street.
1883		Lingen, J. T., M.A. *Cantab.*, University Chambers, 167 Phillip-street, Sydney.
1906		Loney, Charles Augustus Luxton, M. AM. SOC. REFR. E., Equitable Building, George-street.
1884		MacCormick, Sir Alexander, M.D., C.M. *Edin.*, M.R.C.S. *Eng.*, 185 Macquarie-street.
1887		MacCulloch, Stanhope H., M.B., Ch.M. *Edin.*, 24 College-street.
1878		MacDonald, Ebenezer, J.P., c/o Perpetual Trustee Co., Ld., Hunter-street, Sydney.
1876		Mackellar, The Hon. Sir Charles Kinnaird, K.C.M.G., M.L.C., M.B., C.M. *Glas.*, 183 Liverpool-street, Hyde Park, Sydney.
1903		McDonald, Robert, J.P., L.S., Pastoral Chambers, O'Connell-st.; p.r. 'Lowlands,' William-street, Double Bay.
1891		McDouall, Herbert Crichton, M.R.C.S. *Eng.*, L.R.C.S. *Lond.*, D.P.H. *Cantab.*, Hospital for the Insane, Gladesville.
1906		McIntosh, Arthur Marshall, 'Glenbourne,' Hill-st., Roseville.
1891	P 2	McKay, R. T., L.S., ASSOC. M. INST. C.E., Geelong Waterworks and Sewerage Trusts Office, Geelong, Victoria.
1880	P 9	McKinney, Hugh Giffin, M.E., Roy. Univ. *Irel.*, M. INST. C.E., Sydney Safe Deposit, Paling's Buildings, Ash-street.
1917		McLean, Archibald Lang, M.D., Ch. M., B.A., c/o Bank of New South Wales, 29 Threadneedle-street, London, E.C.
1901	P 1	McMaster, Colin J., L.S., Chief Commissioner of Western Lands; p.r. Flat 14, Kelburn Hall, Elizabeth Bay Road, Elizabeth Bay.

Elected		
1894		McMillan, Sir William, K.C.M.G., 'Althorne,' Edgecliff Road, Woollahra; 79 York-street.
1916		McQuiggin, Harold G., B.Sc., Lecturer and Demonstrator in Physiology in the University of Sydney; p.r. 'Berolyn,' Beaufort-street, Croydon.
1909		Madsen, John Percival Vissing, D.Sc., B.E., P. N. Russell Lecturer in Electrical Engineering in the University of Sydney.
1883	P 34	Maiden, J. Henry, J.P., I.S.O., F.R.S., F.L.S., F.R.H.S., Hon. Fellow Roy. Soc. S.A.; Hon. Memb. Roy. Soc, W.A.; Netherlands Soc.for Promotion of Industry; Philadelphia College Pharm. Southern Californian Academy of Sciences; Pharm. Soc. N.S.W.; Brit. Pharm. Conf.; Corr. Fellow Therapeutical Soc., Lond.; Corr. Memb. Pharm. Society Great Britain; Bot. Soc. Edin.; Soc. Nat. de Agricultura (Chile); Soc. d'Horticulture d'Alger; Union Agricole Calédonienne; Soc. Nat. etc., de Chérbourg; Roy. Soc. Tas.; Roy. Soc. Queensl.; Inst. Nat. Genévois; Hon. Vice-Pres. of the Forestry Society of California; Diplomé of the Société Nationale d'Acclimatation de France; Linnean Medallist, Linnean Society; N.S.W. Govt. Rep. of the "Commission Consultative pour la Protection Internat. de la Nature"; Government Botanist and Director, Botanic Gardens, Sydney. *Hon. Secretary.* (President 1896, 1911.)
1880	P 1	Manfred, Edmund C., Montague-street, Goulburn.
1897		Marden, John, M.A., LL.D., Principal, Presbyterian Ladies' College, Croydon, Sydney.
1908		Marshall, Frank, C.M.G., B.D.S., 'Beanbah,' 235 Macquarie-st.
1914		Martin, A. H., 'Ruthven,' Eric-street, Artarmon.
1903		Meggitt, Loxley, c/o James Barnes Ltd., Alexandria, Sydney.
1912		Meldrum, Henry John, p.r. 'Craig Roy,' Sydney Rd., Manly.
1905		Miller, James Edward, Albury, New South Wales.
1889	P 8	Mingaye John C. H., F.I.C., F.C.S., Assayer and Analyst to the Department of Mines; p.r. Campbell-street, Parramatta.
1879		Moore, Frederick H., Union Club, Sydney, c/o Dalgety's Ltd., London.
1879		Mullins, John Francis Lane, M.A. *Syd.*, M.L.C., 'Killountan,' Darling Point.
1915		Murphy, R. K., Dr. Ing., Chem. Eng., Consulting Chemical Engineer and Lecturer in Chemistry, Technical College, Sydney.
1893	P 3	Nangle, James, F.R.A.S., Superintendent of Technical Education, The Technical College, Sydney; p.r. 'St. Elmo,' Tupper-street, Marrickville.
1917		Nash, Norman C., Analytical Chemist, 'Treleaven,' Darling-street, Balmain East.
1891		‡Noble, Edward George, L.S., 8 Louisa Road, Balmain.
1893		Noyes, Edward, ASSOC. INST. C.E., ASSOC. I. MECH. E., c/o Messrs. Noyes Bros., 115 Clarence-street, Sydney.
1903		‡Old, Richard, 'Waverton,' Bay Road, North Sydney.
1913		Ollé, A. D., F.C.S., 'Kareema,' Charlotte-street, Ashfield.
1896		Onslow, Col. James William Macarthur, 'Gilbulla,' Menangle.

Elected		
1875		O'Reilly, W. W. J., M.D., Ch.M. Q. Univ. *Irel.*, M.R.C.S. *Eng.*, 183 Liverpool-street, Hyde Park.
1917		Ormsby, Irwin, 'Caleula,' Allison Road, Randwick.
1891		Osborn, A. F., ASSOC. M. INST. C.E., Water Supply Branch, Sydney, 'Uplands,' Meadow Bank, N.S.W.
1880		Palmer, Joseph, 96 Pitt-st.; p.r. Kenneth-st., Willoughby.
1901		Peake, Algernon, M. INST. C.E., L.S., Prospect Rd., Summer Hill.
1899		Peterson, T. Tyndall, F.C.P.A., E.S.&A. Bank, King & George-sts.
1918		Petrie, James Matthew, D.Sc., F.I.C., Research Fellow of the Linnean Society in Biochemistry, The University, Sydney.
1909	P 2	Pigot, Rev. Edward F., S.J., B.A., M.B. *Dub.*, Director of the Seismological Observatory, St. Ignatius' College, Riverview.
1879	P 8	Pittman, Edward F., ASSOC. R.S.M., L.S., 'The Oaks,' 65 Park-street, South Yarra, Victoria.
1881		Poate, Frederick, L.S., 'Clanfield,' 50 Penkivil-street, Bondi.
1887	P 10	Pollock, J. A., D.Sc., F.R.S., Corr. Memb. Roy. Soc. Tasmania; Roy. Soc. Queensland; Professor of Physics in the University of Sydney.
1917		Poole, William, B.E., A.M. INST. C.E., L.S., 906 Culwulla Chambers, Castlereagh-street.
1896		Pope, Roland James, B.A., *Syd.*, M.D., C.M., F.R.C.S., *Edin.*, 183 Macquarie-street.
1910		Potts, Henry William, F.L.S., F.C.S., Principal, Hawkesbury Agricultural College, Richmond, N.S.W.
1918		Powell, John, 170-2 Palmer-street.
1918		Priestley, Henry, B.Sc., M.D., Ch. M., Physiology Department, The University, Sydney.
1914		Purdy, John Smith, D.S.O., M.D., C.M. *Aberd.*, D.P.H. *Camb.*, Metropolitan Medical Officer of Health, Town Hall, Sydney.
1893		Purser, Cecil, B.A., M.B., Ch.M. *Syd.*, 193 Macquarie-street.
1876	P 1	Quaife, F. H., M.A., M.D., M.S., 'Yirrimbirri,' Stanhope Road, Killara.
1912	P 2	Radcliff, Sidney, F.C.S., B.M.A. Building, 30 Elizabeth-street.
1916	P 1	Read, John, M.A., Ph.D., B.Sc., Professor of Organic Chemistry in the University of Sydney.
1914		Rhodes, Thomas, Civil Engineer, Box 109, Post Office, Broken Hill.
1909		Reid, David, 'Holmsdale,' Pymble.
1915		Ross, A. Clunies, B.Sc., C. of E. Grammar School, North Sydney.
1884		Ross, Chisholm, M.D. *Syd.*, M.B., C.M. *Edin.*, 155 Macquarie-st.
1895	P 1	Ross, Herbert E., Equitable Building, George-street.
1897		Russell, Harry Ambrose, B.A., c/o Messrs. Sly and Russell, 369 George-street; p.r. 'Mahuru,' Fairfax Road, Bellevue Hill.

Elected		
1893		Rygate, Philip W., M.A., B.E. *Syd.*, ASSOC. M. INST. C.E., L.S., City Bank Chambers, Pitt-street, Sydney.
1915		Sach, A. J., F.C.S., 'Kelvedon,' North Road, Ryde.
1917		Sawkins, Dansie T., M.A., "Brymedura,' Kissing Point Road, Turramurra.
1913		Scammell, W. J., Mem. Pharm. Soc. *Grt. Brit.*, 18 Middle Head Road, Mosman.
1892	P 1	Schofield, James Alexander, F.C.S., A.R.S.M., Assistant Professor of Chemistry in the University of Sydney.
1904	P 1	Sellors, Richard P., B.A. *Syd.*, 'Mayfield,' Wentworthville.
1918		Sevier, Harry Brown. Manager, Lewis Berger and Sons (Aust.) Ltd., 16 Young-street.
1883	P 4	Shellshear, Walter, M. INST. C.E., Consulting Engineer for N. S. Wales, 64 Victoria-street, Westminster, London.
1917		Sibley, Samuel Edward, Chemist, 'Garnella,' Blenheim-street, Randwick.
1900		Simpson, R. C., Technical College, Sydney.
1910		Simpson, William Walker, 'Abbotsford,' Leichhardt-street, Waverley.
1882		Sinclair, Eric, M.D., C.M. *Glas.*, Inspector-General of Insane, 9 Richmond Terrace, Domain; p.r. 'Broomage,' Kangaroo-street, Manly.
1912		Smart, Bertram James, B.Sc., Public Works Department, Sydney
1893	P 55	Smith, Henry G., F.C.S., Assistant Curator, Technological Museum, Sydney. (President 1913.)
1916		Smith, Stephen Henry, Department of Education, Sydney.
1917		Spruson, Wilfred Joseph, Consulting Engineer and Patent Attorney, Daily Telegraph Building, King-street.
1892	P 2	Statham, Edwyn Joseph, ASSOC. M. INST. C.E., Cumberland Heights, Parramatta.
1918		Steel, Frederick William, Chemical Works Manager, c/o General Chemical Co. Ltd., Parramatta Rd., Auburn.
1916		Stephen, Alfred Ernest, Culwulla Chambers, 67 Castlereagh-street, Sydney.
1914		Stephens, Frederick G. N., F.R.C.S., M.B., Ch.M., 'Gleneugie,' New South Head Road, Rose Bay.
1913		Stewart, Alex. Hay, B.E., Metallurgist, Technical College, Sydney.
1900		Stewart, J. Douglas, B.V.Sc., M.R.C.V.S., Professor of Veterinary Science in the University of Sydney; 'Berelle,' Homebush Road, Strathfield.
1903		Stoddart, Rev. A. G., The Rectory, Manly.
1909		Stokes, Edward Sutherland, M.B. *Syd.*, F.R.C.P. *Irel.*, Medical Officer, Metropolitan Board of Water Supply and Sewerage, 341 Pitt-street.
1916	P 1	Stone, W. G., Assistant Analyst, Department of Mines, Sydney.
1883	P 4	Stuart, Sir Thomas P. Anderson, M.D., Ch.M., LL.D. *Edin.*, D.Sc., Professor of Physiology in the University of Sydney; p.r. 'Lincluden,' Fairfax Road, Double Bay. (President 1893, 1906.)
1918		Sullivan, Herbert Jay, c/o Lewis Berger and Sons (Aust.) Ltd., Rhodes.

Elected

1918 | | Sundstrom, Carl Gustaf, Manager Federal Match Co. Ltd., 6 Arcadia Road, Glebe Point.
1901 | P 7 | Süssmilch, C. A., F.G.S., Technical College, Newcastle, N.S.W.
1912 | | Swain, E. H. F., Director, Forestry Department, Brisbane.

1917 | | Tate, Herbert, Bridge Road, Stanmore.
1915 | P 1 | Taylor, Harold B., B.Sc., Kenneth-street, Longueville.
1905 | | Taylor, John M., M.A., LL.B. *Syd.*, 'Woonona,' 43 East Crescent-street, McMahon's Point, North Sydney.
1893 | | ‡Taylor, James, B.Sc, A.R.S.M. 'Cartref,' Brierly-st., Mosman.
1899 | | Teece, R., F.I.A., F.F.A., Wolseley Road, Point Piper.
1878 | | Thomas, F. J., 'Lovat,' Nelson-street, Woollahra.
1879 | | Thomson, The Hon. Dugald, Carabella-st., North Sydney.
1913 | | Thompson, Joseph, M.A., LL.B., Vickery's Chambers, 82 Pitt-street, Sydney.
1913 | | Tietkens, William Harry, 'Upna,' Eastwood.
1916 | | Tilley, Cecil E., Demonstrator in Geology, The University, Sydney.
1916 | | Tillyard, Robin John, M.A., D.Sc., F.L.S., F.E.S., 'Kuranda,' Mount Errington. Hornsby, N.S.W.
1879 | | Trebeck, P. C., Orange, N.S.W.
1900 | | Turner, Basil W., A.R.S.M., F.C.S., Victoria Chambers, 83 Pitt-st.

1916 | | Valder, George, J.P., Under Secretary and Director, Department of Agriculture, Sydney.
1883 | | Vause, Arthur John, M.B., C.M. *Edin.*, 'Bay View House,' Tempe.
1890 | | Vicars, James, M.E., Memb. Intern. Assoc. Testing Materials; Memb. B. S. Guild; Challis House, Martin Place.
1892 | | Vickery, George B., 78 Pitt-street.
1903 | P 3 | Vonwiller, Oscar U., B.Sc., Assistant Professor of Physics in the University of Sydney. (Acting Professor.)

1879 | | Walker, H. O., Commercial Union Assurance Co., Pitt-street.
1899 | | ‡Walker, The Hon. J. T., F.R.C.I., Fellow of Institute of Bankers *Eng.*, 'Wallaroy,' Edgecliff Road, Woollahra.
1910 | | Walker, Charles, 'Lynwood,' Terry Road, Ryde.
1910 | | Walker, Harold Hutchison, Major, C.M.F., Vickery's Chambers, 82 Pitt-street.
1917 | | Wallas, Thomas Irwin, Bacteriologist, 175 Macquarie-street.
1891 | P 2 | Walsh, Henry Deane, B.A.I. *Dub.*, M. INST. C.E., Commissioner and Engineer-in-Chief, Harbour Trust, Circular Quay. (President 1909.)
1903 | | Walsh, Fred., J.P., Capt. C.M.F., Consul-General for Honduras in Australia and New Zealand; For. Memb. Inst. Patent Agents, London; Patent Attorney Regd. U.S.A.; Memb. Patent Law Assoc., Washington; Regd. Patent Attorn. Comm. of Aust; Memb. Patent Attorney Exam. Board Aust.; George and Wynyard-streets; p.r. 'Walsholme,' Centennial Park, Sydney.
1901 | | Walton, R. H., F C.S., 'Flinders,' Martin's Avenue, Bondi.

Elected		
1918		Ward, Edward Naunton, Superintendent of the Botanic Gardens, Sydney.
1916		Warden, Robert Alexander, President, Government Savings Bank, N.S.W., Moore-street, Sydney.
1913	P 4	Wardlaw, Hy. Sloane Halcro, D.Sc. *Syd.*, 87 Macpherson-street, Waverley.
1883	P 17	Warren, W. H., LL.D., WH. SC., M. INST. C.E., M. AM. SOC. C.E., Member of Council of the International Assoc. for Testing Materials, Professor of Engineering in the University of Sydney. (President 1892, 1902.)
1876		Watkins, John Leo, B.A. *Cantab.*, M.A. *Syd.*, Parliamentary Draftsman, Attorney General's Department, Macquarie-st.
1910		Watson, James Frederick, M.B., Ch.M., Australian Club, Sydney, p.r. 'Midhurst,' Woollahra.
1911		Watt, Robert Dickie, M.A., B.Sc., Professor of Agriculture in the University of Sydney.
1915	P 4	Watts, Rev. W. Walter, 'The Manse,' Wycheproof, Victoria.
1910	P 1	Wearne, Richard Arthur, B.A., Principal, Central Technical College, Brisbane.
1897		Webb, Frederick William, C.M.G., J.P., 'Livadia,' Manly.
1907		Welch, William, F.R.G.S., 'Roto-iti,' Boyle-street, Mosman.
1881		‡Wesley, W. H., London.
1918		White, Edmond Aunger, M.A.I.M.E., Manager of Electrolytic Refining and Smelting Co. of Australia Ltd., Port Kembla, New South Wales.
1909		White, Charles Josiah, B.Sc., 'Kooringa,' Robinson-street, Chatswood.
1892		White, Harold Pogson, F.C.S., Assistant Assayer and Analyst, Department of Mines; p.r. 'Quantox,' Park Road, Auburn.
1877		‡White, Rev. W. Moore, A.M., LL.D. *Dub.*
1917		Willington, William Thos., O.B.E., King-street, Arncliffe.
1908	P 1	Willis, Charles Savill, M.B., Ch.M. *Syd.*, M.R.C.S. *Eng.*, L.R.C.P. *Lond.*, D.P.H., *Lond.*, Department of Public Instruction, Bridge-street.
1890		Wilson, James T., M.B., Ch.M. *Edin.*, F.R.S., Professor of Anatomy in the University of Sydney.
1891		Wood, Percy Moore, L.R.C.P. *Lond.*, M.R.C.S. *Eng.*, 'Redcliffe,' Liverpool Road, Ashfield.
1906	P 7	Woolnough, Walter George, D.Sc., F.G.S., Professor of Geology in the University of Western Australia, Perth.
1916		Wright, Gilbert, Lecturer and Demonstrator in Agricultural Chemistry, Department of Agriculture, The University, Sydney.
1917		Wright, George, c/o Farmer & Company, Pitt-street.
1916		Youll, John Gibson, Perpetual Trustee Chambers, Hunter-st.
1918		Young, John Anthony, Director, Lewis Berger and Sons (Aust.) Ltd., 16 Young-street.

Elected		
		Honorary Members.
		Limited to Twenty.
		M.—Recipients of the Clarke Medal.
1914		Bateson, W. H., M.A., F.R.S., Director of the John Innes Horticultural Institution, England, The Manor House, Merton, Surrey, England.
1918		Chilton, Charles, M.A., D.Sc., M.B.C.M. etc., Professor of Biology at Canterbury College, Christchurch, N.Z.
1911		Hemsley, W. Botting, LL.D. (*Aberdeen*), F.R.S., F.L.S., V.M.H., Formerly Keeper of the Herbarium, Royal Gardens, Kew; Korresp. Mitgl. der Deutschen Bot. Gesellschaft; Hon. Memb. Sociedad Mexicana de Historia Natural; New Zealand Institute; Roy. Hort. Soc., London; Kew Lodge, St. Peter's Road, Broadstairs, Kent, England.
1914		Hill, James P., D.Sc., F.R.S., Professor of Zoology, University College, London.
1908		Kennedy, Sir Alex. B. W., Kt., LL.D., D. ENG., F.R.S., Emeritus Professor of Engineering in University College, London, 17 Victoria-street, Westminster, London S.W.
1908	P 57	*Liversidge, Archibald, M.A., LL.D., F.R.S., Emeritus Professor of Chemistry in the University of Sydney, 'Fieldhead,' George Road, Coombe Warren, Kingston, Surrey, England. (President 1889, 1900.)
1915		Maitland, Andrew Gibb, F.G.S., Government Geologist of Western Australia.
1912		Martin, C. J., D.Sc., C.M.G., F.R.S., Director of the Lister Institute of Preventive Medicine, Chelsea Gardens, Chelsea Bridge Road, London.
1894		Spencer, Sir W. Baldwin, K.C.M.G., M.A., D.Sc., F.R.S., Professor of Biology in the University of Melbourne.
1900	M	Thiselton-Dyer, Sir William Turner, K.C.M.G., C.I.E., M.A., LL.D., Sc.D., F.R.S., The Ferns, Witcombe, Gloucester, England.
1915		Thomson, Sir J. J., O.M., D.Sc., F.R.S., Nobel Laureate, Cavendish Professor of Experimental Physics in the University Cambridge, Trinity College, Cambridge, England.

* Retains the rights of ordinary membership. Elected 1872.

Obituary 1918-19.

Honorary Member.

1900	Crookes, Sir William.

Ordinary Members.

1878	Brooks, J.
1868	Fairfax, Sir James R.
1867	Jones, Sir P. Sydney.
1875	Mathews, R. H.
1876	Myles, C. H.
1878	Paterson, Hugh.
1877	Pedley, P. R.
1879	Pockley, T. F. G.
1913	Roseby, Rev. T.
1874	Smith, J. McGarvie.
1906	Taylor, H.

AWARDS OF THE CLARKE MEDAL.

Established in memory of

THE REVD. W. B. CLARKE, M.A., F.R.S., F.G.S., etc.,

Vice-President from 1866 *to* 1878.

To be awarded from time to time for meritorious contributions to the Geology, Mineralogy, or Natural History of Australia. The prefix * indicates the decease of the recipient.

Awarded

1878 *Professor Sir Richard Owen, K.C.B., F.R.S.

1879 *George Bentham, C.M.G., F.R.S.

1880 *Professor Thos. Huxley, F.R.S.

1881 *Professor F. M'Coy, F.R.S., F.G.S.

1882 *Professor James Dwight Dana, LL.D.

1883 *Baron Ferdinand von Mueller, K.C.M.G., M.D., Ph.D., F.R.S., F.L.S.

1884 *Alfred R. C. Selwyn, LL.D., F.R.S., F.G.S.

1885 *Sir Joseph Dalton Hooker, O.M., G.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.

1886 *Professor L. G. De Koninck, M.D., University of Liège.

1887 *Sir James Hector, K.C.M.G., M.D., F.R.S.

1888 *Rev. Julian E. Tenison-Woods, F.G.S., F.L.S.

1889 *Robert Lewis John Ellery, F.R.S., F.R.A.S.

1890 *George Bennett, M.D., F.R.C.S. *Eng.*, F.L.S., F.Z.S.

1891 *Captain Frederick Wollaston Hutton, F.R.S., F.G.S.

1892 Sir William Turner Thiselton Dyer, K.C.M.G., C.I.E., M.A., LL.D., Sc. D., F.R.S., F.L.S., late Director, Royal Gardens, Kew.

1893 *Professor Ralph Tate, F.L.S., F.G.S.

1895 Robert Logan Jack, F.G.S., F.R.G.S., late Government Geologist, Brisbane, Queensland.

1895 Robert Etheridge, Jnr., Curator of the Australian Museum, Sydney.

1896 *The Hon. Augustus Charles Gregory, C.M.G., F.R.G.S.

1900 *Sir John Murray, K.C.B., LL.D., Sc. D., F.R.S.

1901 *Edward John Eyre.

1902 *F. Manson Bailey, C.M.G., F.L.S.

1903 *Alfred William Howitt, D.Sc., F.G.S.

1907 Walter Howchin, F.G.S., University of Adelaide.

1909 Dr. Walter E. Roth, B.A., Pomeroon River, British Guiana, South America.

1912 W. H. Twelvetrees, F.G.S., Government Geologist. Launceston, Tasmania.

1914 A. Smith Woodward, LL.D., F.R.S., Keeper of Geology, British Museum (Natural History) London.

1915 Professor W. A. Haswell, M.A., D.Sc., F.R.S., The University, Sydney.

1917 Professor T. W. E. David, C.M.G., B.A., D.Sc., F.R.S., F.G.S., The University, Sydney.

1918 Leonard Rodway, C.M.G., Honorary Government Botanist, Hobart, Tasmania.

AWARDS OF THE SOCIETY'S MEDAL AND MONEY PRIZE.

Money Prize of £25.

Awarded.

1882 John Fraser, B.A., West Maitland, for paper entitled 'The Aborigines of New South Wales.'

1882 Andrew Ross, M.D., Molong, for paper entitled 'Influence of the Australian climate and pastures upon the growth of wool.'

The Society's Bronze Medal and £25.

1884 W. E. Abbott, Wingen, for paper entitled 'Water supply in the Interior of New South Wales.'

1886 S. H. Cox, F.G.S., F.C.S., Sydney, for paper entitled 'The Tin deposits of New South Wales.'

1887 Jonathan Seaver, F.G.S., Sydney, for paper entitled 'Origin and mode of occurrence of gold-bearing veins and of the associated Minerals.'

1888 Rev. J. E. Tenison-Woods, F.G.S., F.L.S., Sydney, for paper entitled 'The Anatomy and Life-history of Mollusca peculiar to Australia.'

1889 Thomas Whitelegge, F.R.M.S., Sydney, for paper entitled 'List of the Marine and Fresh-water Invertebrate Fauna of Port Jackson and Neighbourhood.'

1889 Rev. John Mathew, M.A., Coburg, Victoria, for paper entitled 'The Australian Aborigines.'

1891 Rev. J. Milne Curran, F.G.S., Sydney, for paper entitled 'The Microscopic Structure of Australian Rocks.'

1892 Alexander G. Hamilton, Public School, Mount Kembla, for paper entitled 'The effect which settlement in Australia has produced upon Indigenous Vegetation.'

1894 J. V. De Coque, Sydney, for paper entitled the 'Timbers of New South Wales.'

1894 R. H. Mathews, L.S., Parramatta, for paper entitled 'The Aboriginal Rock Carvings and Paintings in New South Wales.'

1895 C. J. Martin, D.Sc., M.B., F.R.S., Sydney, for paper entitled 'The physiological action of the venom of the Australian black snake (*Pseudechis porphyriacus*).'

1896 Rev. J. Milne Curran, Sydney, for paper entitled 'The occurrence of Precious Stones in New South Wales, with a description of the Deposits in which they are found.'

PRESIDENTIAL ADDRESS.

By J. B. CLELAND, M.D., Ch.M.

Delivered to the Royal Society of N. S. Wales, May 1, 1918.

Introduction.

During another year the titanic conflict of the Great War has overshadowed every aspect of the life of our community. The part that scientific knowledge is playing in its progress, the part that it will take in the strenuous times of the peace to come, indicate the important effect the war must exert on the activities of this Society. It is a national duty at all times, and much more so during the present world-crisis, for every member of the community to add all he can to the sum total of general knowledge. Thus shall we, as a nation, be made fitter for our present task and more capable of holding our own in the future.

That in this respect members of the Society have recognized the duty imposed on them is shown by the number and nature of the communications submitted during the year and published in our journal. Still more important is the fact that some of our members are engaged in service abroad, in many cases placing at the disposal of the military or other authorities the special knowledge at their command. Prof. T. W. E. David, Prof. J. A. Pollock, Dr. J. A. Dick, Dr. J. S. Purdy, A. Clunies Ross, W. G. Stone, C. E. Tilley, A. M. McIntosh, H. B. Taylor, and F. Marshall, are thus still in Europe, whilst Dr. F. Guy Griffiths and Dr. Archie Lang McLean have left us for this purpose during the year, and Professor S. H. Barraclough is in America. Dr. H. J. W. Brennand, Sir Alexander MacCormick (for the second time) Dr. T. Fiaschi and Rev. A. G. Stoddart have returned from service abroad during my term of office, and we have great pleasure in welcoming them home again.

Our membership now totals 318, and it is gratifying to note that there has been a slight increase during the year. 17 new members have joined, whilst we have lost 10 members by resignation and 4 by death.

The Sections of Industry and Agriculture have fully justified their establishment in the nature and number of the meetings held. Both owe much to Dr. Greig-Smith, who continues as Honorary Secretary of the former. Messrs. Wright and Breakwell have proved themselves energetic Honorary Secretaries of the latter and have spared no trouble in making its meetings a success. The Geological Section has held meetings as usual, but owing to the departure for the Front of Dr. Guy Griffiths, Honorary Secretary of the Section of Public Health and Kindred Sciences, this Section did not hold its ordinary number of meetings, though the earlier ones were important and well attended.

I would like to express my warmest thanks to the Honorary Secretaries, Mr. R. H. Cambage and Mr. J. H. Maiden, F.R.S., and to the Honorary Treasurer, Professor H. G. Chapman, for kindly assistance, advice and guidance on many occasions. Let me add that these gentlemen spare neither trouble nor time in their several capacities, and that the affairs of the Society could not be in better hands. To the members of Council I am indebted for courteous consideration on all occasions, and I wish to thank them cordially for their support and goodwill.

Necrology.

William Adam Dixon, whose death at the age of 76 years occurred at North Sydney on November 6th, 1917, was one of the oldest members of the Society, having been elected in 1875. He held office as a Vice-President in 1883 and 1884, and in 1890 and 1891, and in addition was a member of the Council from 1879-1882, and in 1888 and 1889. He contributed twelve papers to the Society. He retired from active practice as an analytical chemist some 16 years ago. When the Sydney School of Arts was opened in 1878 he was appointed instructor in chemistry, a position he continued to fill for some years after the establishment of the Technical College at Ultimo. He was for some years an examiner in chemistry at the University of Sydney, and was one of the foundation directors of the North Shore Gas Company, being chairman from its initiation until about five years ago.

SAMUEL LEVY BENSUSAN died in London in November at the age of 90 years. For many years he was a member of this Society, having been elected in 1869 and having resigned in 1905. He arrived in Australia in 1850 and was specially identified with mining operations, opening the first copper mine and tin smelting works in Australia. He discovered the Sunny Corner silver mines, and was instrumental in the finding of nickel in New Caledonia.

EDMUND MILNE, Deputy Chief Commissioner of Railways for New South Wales, was elected a member of the Society in 1916, and, though in ill-health for some time, died suddenly, amidst universal regret, on August 23rd, 1917, at the age of 55 years. His early school days were spent at Ulladulla, and he entered the Railway service in 1876, and, by sheer ability, progressed to his final high position as one of the Commissioners. I am indebted to Mr. R. Etheridge, Director and Curator of the Australian Museum, for the following generous appreciation of his work and personality: "The late Edmund Milne was an observer, and not a writer, and a very earnest and close observer at that. The only articles written by him, so far as my knowledge extends, are the following:—

"1. 'An Echo of Bogan River History,' *Town and Country Journal,* 1913 (May 14th), p. 22.

"2. 'Aboriginal Arborglyphs,' *Scientific Australian,* xx., No. 2, 1914, pp. 29-31, text figs.

"3. 'The Passing of the Lithic People. A Story of the Coming of White Wings to Australia,' *Life,* xxv., No. 4, 1916, pp. 300-304, text figs.

"I know of no other direct publications of Milne's, but the following article was unquestionably inspired by him:

" 'Relics of Past History—Aboriginal Arborglyphs. The Chief that Oxley exhumed.' *Daily Telegraph,* 1913 (July 30th), text figs. This is the history of the Oxley tree, as told by Milne.

"His first hobby was the collection and study of the aboriginal stone implements, and of these he amassed a very considerable collection, more particularly from the western districts of this State. He next turned his attention to the 'carved trees,' or, as he called them, 'Arborglyphs,' a subject of absorbing interest—the second of the above references refers to these. On finding that I had been for some years engaged in collecting data about these same 'carved trees,' which I termed 'Dendroglyphs,' as a more appropriate name, Milne, in the most unselfish and kind manner, placed the whole of his photo-prints and notes at my disposal. The account of these remarkable objects by myself is now in the printer's hands, and will be issued as one of the publications of the Department of Mines, when the large share taken in the work by my deceased friend will be manifest to the most casual reader."

John McLaughlin, who was elected as one of our members in 1903, died in Sydney on February 4th, 1918, at the age of 67 years. He was born in Westmeath, Ireland, in 1850, and came to New South Wales with his parents whilst still an infant. He was a well-known man in public life and, for eleven years in all, sat as a member of the Legislative Assembly. As a legislator, he took an active interest in bird protection, as well as in law reform and land legislation. He was admitted as a solicitor in 1874, and for three or four years was chairman of directors of the Insurance Office of Australia.

Honours Conferred For War Services.

It is with great pride that we are able to refer to high honours conferred on two of our members for services rendered on the Western Front in France.

Lieutenant-Colonel (now Colonel) JOHN SMITH PURDY, Army Medical Corps, was announced in the Commonwealth of Australia Gazette, No. 219, of December 20, 1917 (London Gazette, August, 1917), as being the recipient of the Distinguished Service Order "for conspicuous gallantry and devotion to duty. Although continually under shell fire for seven days, he exercised close personal supervision over the evacuation of the wounded, and by his own example of courage and disregard of danger he animated all ranks with a similar attitude of mind. His work during preliminary preparations displayed the same untiring energy and devotion to duty."

Major T. W. EDGEWORTH DAVID, as announced in the daily press of January 2nd, 1918, has also been awarded the Distinguished Service Order. So far it has not been possible to obtain the record of the specially distinguished service of which this honour was the recognition.

It is very pleasing to note that in the first list of Knights Commander of the Order of the British Empire, appointed in August last, appears the name of Professor RICHARD THRELFALL. Sir Richard was for many years a member of this Society, having been elected in 1886. He also occupied a seat at the Council table.

The Chairs of Pharmacology and Zoology in the University of Sydney.

It is a great pleasure to be able to congratulate two members of our Society on their appointments to Professorial Chairs in the University of Sydney. Our Honorary Treasurer, Dr. Henry G. Chapman, is the first occupant of the newly-established Chair of Pharmacology. His researches in physiological chemistry and the advances he has made in our knowledge of these obscure processes show his eminent fitness for such a position. Dr. Stephen Jason Johnston has been chosen to succeed Professor W. A. Haswell, F.R.S., in the Chair of Zoology. That he is likewise an eminently suitable occupant of such a high and honorable position is shown by his published zoological works, and especially by his contributions to Australian helminthology. In wishing them all success and many years of fruitful labour in the provinces of knowledge they have made their own, it is an additional gratification to know that Australian citizens have been appointed to lead Australian thought.

It seems not out of place here, and before this Society, one of whose objects is the advancement of natural knowledge in Australia, to refer with gratification to the manner of the appointment to the new Chair of Pharmacology. A really suitable candidate being available in Australia, and, in fact, being actually at work in the University of Sydney, the chair was offered directly to him instead of the vacancy being advertised in Britain as well as in Australia. The latter procedure, however commendable in theory, is fraught with many difficulties, may be unfair to Australian applicants, and is ill-calculated to encourage young Australians to take up scientific careers. We want as many of our able young men as possible to be induced to take up science as a life-work, or to undergo at least a scientific training. At present pure science commands too frequently but a pittance. A few high Government and University appointments furnish salaries approximating more to the merits of the positions, though sadly deficient when compared with those paid to business men. If our own graduates on low salaries, after fitting themselves by years of study and research, are to see from time to time the higher positions they have understudied pass from their grasp to men, however capable, from overseas, what inducement is there for them to continue along unprofitable financial paths? How can we expect parents to consent to their sons thus, from the public point of view, throwing themselves away by adopting such careers? If a really suitable man is available in Australia for one of these higher positions, then let him be directly appointed, after adequate investigation by really competent persons, to such position, be it in the Public Service or at the University. Let the vacancy be advertised, if necessary, in Australia, preference being given to a candidate, if really suitable, already in the employ of the body concerned. Failing such a suitable applicant here, then let us advertise abroad. It should always be remembered that a committee selecting applicants in Britain may be little aware of the personality, ability and work of the Australians applying, whilst they have probably been in personal touch with the applicants from Britain. Naturally, therefore, they select a good man whom they know, in preference to someone whom they do not know, and with whose particular field of work they have perhaps had little to do. It is to be hoped, therefore, that the precedent now established in the University of Sydney by this appointment will be followed in all cases by the Public Services and other Universities of Australia. Thereby encouragement would be given to young men to follow scientific careers. They would know that if they "made good," such positions, as they fell due, or were created, would be fully open to them, and that they would have first claim on them. Public announcement of such a policy would go far to hearten those already embarked on such careers, would encourage able young men to pursue with diligence their scientific work, and would tend to promote the advancement of natural knowledge in Australia.

The Representation of Science in Parliament.

As under our present State and Commonwealth Constitutions, it is almost impossible for direct representatives of science or in fact of knowledge in general—as, for instance, persons elected by members of our Universities—to occupy seats in Parliament, it seems necessary in the public interest to devise some other means by which legislators may be guided to right decisions on these aspects. That such a course is necessary is shown by a recent Weights and Measures Bill. No provision was made in this for the use of the metric system as a legal alternative. The necessity for such inclusion was not even hinted at till the Bill was launched. Yet the importance of the metric system in international commerce and in science, and the clear indication that its adoption throughout the British Empire is merely a matter of a few years, should have been recognised, especially by those members conversant with business requirements. There seems one way by which candid and unfettered scientific advice can be rendered to members of Parliament. This would be by the appointment of one or two Royal Commissioners of Science in each Parliament. These Commissioners should have, by Act of Parliament, the right to be heard at the Bar of the House on any matter in which scientific knowledge plays a part. In other words, they would be to all intents and purposes members of Parliament, but would not be allowed to express any political views or to vote. Their duties would consist in ascertaining, from authoritative sources, and in assessing the scientific aspects, from all sides, of any question submitted or that should be submitted to Parliament, and of expressing these views to members. By their patents they would have all reasonable access to public and private sources of information and, in placing the truth before the House, would be untrammelled by political or other considerations. It is clear that especially able and capable men, with real scientific training, must be chosen, and must be paid suitably high salaries. Their whole time would be devoted to this work. By an appointment for five years, and beyond that, by two years' notice of intended removal, endorsed by both Houses under two consecutive Parliaments, adequate protection would be given them in fulfilling their duties. The appointment of such commissioners would, I feel certain, result in great advantage, whilst the Parliaments adopting the measure would lead in an advance in our methods of legislation that would be quickly followed elsewhere. Parliaments that have a nominee Upper House, as that of this State, already have a ready means of obtaining the invaluable advantages to be derived from inclusion amongst their members of men of high scientific attainments.

Science and Its Applications in Australia.

For many years British scientists have been calling attention to the urgent need for more scientific research and a greater utilisation of scientific knowledge throughout all walks of our national life. The British scientist is, on the whole, not a business man, his chief desire being the acquirement of knowledge for its own sake rather than for the purpose, purely and simply, of money-making. The business man, on the other hand, is essentially not scientific. His training has been purely commercial, except in a few instances, and his school work, to a large extent, has been classical rather than scientific. He knows his business, and knows it well from a commercial aspect, but he does not, and cannot be expected to, understand the application of the knowledge of various sciences to his own particular work. We see, therefore, as it were, a great cleft between the two important sections of the community—those engaged in scientific work, and those engaged in industrial, commercial, agricultural, pastoral and other pursuits. We have failed as an Empire—and this is also true of Australia as a part of that Empire—to recognise that an intimate union is necessary between these two sections of the community, so as to make the best possible use of all our national resources and the means for making these available. The present great war has awakened us to the true position of affairs in this respect, and has shown us what tremendous power can be acquired by an almost perfect co-ordination between these two sections of the community, as manifested by our enemy, the German.

We now know that for many years Germany has had one great aim in view—preparation for the war now in progress. To ensure in her eyes certain success, she has not only utilised in her military organisation all possible scientific knowledge which could be applied to the manufacture of weapons and other means of offence and defence, but she has also applied scientific knowledge in every other business or commercial transaction which could in any way increase her prestige and power. Not only were those sciences dealing more directly with war called to her service, but even those which at first sight might seem to be of little practical use to her, have been shown to play a by no means unimportant part. We find, for instance, that the study of meteorology has been of the greatest value to her in deciding when to act in some of her great efforts, and when to make aerial descents upon the British coast. Side by side almost with the advance of her invading armies the meteorological staff progresses so as to render the combatant forces such service as they can.

If Germany, therefore, by this union of scientific knowledge with business ability, has been able to achieve the striking results which she has attained, and which are costing us so many valuable lives and so much money to defeat, it is very obvious that the same means should be adopted by us, when the results, I think it is safe to say, would be still more successful than those obtained by Germany. Not only in the carrying on of the great war must this co-ordination be obtained, but when the fighting is over, and peace reigns once more, our future behaviour must be far different from the past.

From these remarks it will appear that Australia, to be successful in the future, must apply science wherever she can to her national undertakings and her daily work, corporate and individual. When the white man first reached Australia, vast potential resources presented themselves before him, but with the blindness of the newcomer their value was hardly recognised. To-day, the scales are dropping gradually from our eyes, and we see how much we have already lost by this spendthrift existence—feeding on our capital. Our timber has been rapidly cut out, and half a century will see a timber famine unless means are taken to make good the deficiencies. The by-products of many industries, especially those of coal, have received but scanty recognition, and in many other of our occupations we have been content to obtain a satisfactory main objective, overlooking almost entirely the side-products that pay. It is all very well to say that under the circumstances it would not have paid to conserve these various other materials; but what is the good of thinking and talking in this fashion, if a few more years see us nationally bankrupt in some important commodity, merely because it did not seem to pay to conserve that commodity in the earlier years of our life. It is high time, therefore, that science came to play her part in our national work, and we should now move energetically to organise ourselves in this respect so as to meet the final settlement of peace and the succeeding struggle of nations, calm in the knowledge that we are doing the right thing, and resolved to profit in every possible way by scientific research and effort, and their practical application.

Under these circumstances it may be useful briefly to indicate, like Milton's grades of angels, the various types or degrees of scientific workers, and their value and use to the community as a whole.

We have, first of all, the man of general average ability, who has had a general average education, and has an average knowledge of various sciences. I think it may be said with safety that many of our school children, educated in the public and private schools, have now this average scientific education. They are really in the position of knowing enough about various sciences to understand that there is a very great deal more which they do not know. They should also be in the position of knowing, when necessary, where to apply for sound scientific advice in problems that present themselves, and also to be guarded to some extent against the plausible views of the charlatan and the man with scientific obsessions. It probably frequently happens that the individual possessed of this average education is unaware of its limitations, and presumes to act or advise on scientific questions for which he is not competent. These cases must be carefully guarded against, for in science, above all, a little knowledge is a dangerous thing. Obviously, the more broad and the more thorough this basic scientific education is, the better citizens should those who have received it be, provided they are not carried away with the idea of knowing more than they actually do. It is obviously quite impossible for any one now-a-days, even of the utmost ability, to acquire more than a general knowledge of all branches of scientific thought. An individual may specialise in one or two or three separate and narrow fields, but, as regards other lines, like members of the general community, he can be little more than a child in scientific thought, save—and here is the great distinction—that if he has been trained along some particular scientific line, and has followed this to some of its utmost ramifications, this very training itself enables him more easily to understand the principles of other sciences, and to appreciate the value of the work done in these.

Proceeding now to the second degree, we would include here those who have acquired some special scientific training in connection with their own particular pursuit. Such scientific knowledge is necessary to a successful baker or wine-maker or brewer or plumber or pastoralist or wheat grower or accountant, or one may say almost anything. Those who have acquired special knowledge by reading and study, and the attendance of special lectures and demonstrations in connection with their own particular work, must obviously do that work better, more thoroughly, and more intelligently than those who have neglected these important adjuncts. Moreover, the more capable amongst this class may grasp new ideas or suggest new theories which may prove of the utmost value. Further, the more thorough such training has been, the more likely is the individual to grasp the scientific necessities of the case before him, and the possibilities will be added to when on top of his special training he has a broad general scientific education. He may then see difficulties which perhaps can be removed by the application of scientific knowledge in some hitherto unthought-of direction. He will be able to understand the scientific requirements, and he will know through what channel to obtain advice in connection with these. Unfortunately for our national life, many of our number engaged in commercial pursuits are, through lack of initial general or special training in connection with these pursuits, quite unaware of the possible aid that may be given to their work by the application of scientific knowledge. They are, in fact, like the Chinese before, according to Lamb, they discovered, by burning down their houses, the deliciousness of roast pork—they do not know what they are missing. They have no grasp of science themselves, and hence it never occurs to them that if various branches of science were brought to bear upon their work, these might be of the utmost value to them.

The third degree of the scientifically trained mind is that of the person who has had a broad, general and scientific training, as in a university, and then has received special training in some particular branch or branches of higher scientific thought. In this way, along certain narrow channels, he can speak and think with authority, and can apply to the use of the general community, and present needs, the scientific knowledge acquired in many countries during the past centuries.

Still further elaboration of this type consists in the mentally more capable individual, trained along these same lines, who can bring to bear his own particular knowledge of some branch of science on problems that arise, and which at first appear to have no bearing directly upon his own immediate work. As an example of how such an application might arise may be taken, for instance, what is known as "dry-farming." In recent years it has been shown that breaking up the surface soil in dry districts will help to retain moisture in the deeper layers. This is dependent entirely upon physical laws, more especially in connection with capillary attraction. The advantages derived from this method of agriculture might have been achieved many years earlier had the attention of some physicist of ability been directed to the problem besetting the agriculturist in dry countries, and had he set to work then to think out some practical method for conserving the moisture of the soil. There must be very many other pursuits in which the trained mind, if the owner has the ability, may be able to revolutionise our processes, if his attention were only brought to bear upon the requirements. Obviously we need some machinery to enable this to be carried out. We want, in fact, two different types of people—one mental type to go round and see what seems to be required, and another mental type to advise on and tackle the problems presented by the first.

Highest of all the scientific grades, and often combined with the last mentioned, is that which can undertake original research and investigation, materially forwarding scientific knowledge by opening up new fields and making new discoveries. This type differs essentially from the plodder of infinite pains who, after much travail, brings forth in a mass of detail some small item of advance, and is best illustrated by brilliant investigators, such as Lord Kelvin, Lister and Pasteur, who, apparently almost without effort, have been able to grasp and crystallise from the Unknown ideas, thoughts and facts revolutionising the world.

From the foregoing it is clear that men of the last type are born and not made, and are of the greatest value by far to the community. They should be sought after diligently, and, when found, given free scope in whatever direction may seem to them best. The grade below this is also to a great extent born, ability being enhanced by environment and opportunities. They also must be sought after and placed in positions where the best results can be obtained. The next grade, where a scientist by study has acquired a special knowledge of some group, is one that may be attained by almost anyone with ability a little above the average. To a great extent these men can be turned out to meet the demand. They are to some extent the hewers of wood and the drawers of water in the realms of science, and though they cannot be expected to make great advances, yet they are of the utmost value in the application of knowledge already gained.

Part I.—Scientific Aspects of the Year.

The Great War.—It is the custom in Presidential addresses to review any questions of scientific importance that may have cropped up during the year, more especially those affecting this State. The world-war has naturally been uppermost in the minds of all, and it may safely be said that every scientific worker and thinker in our midst has revolved, time and again in his mind, all the knowledge in his possession, of his particular province of science, with regard to its possible application, directly or indirectly, in the national interest. Though our losses in life—of the noble, of the supremely fit, of those who would have been leaders in science and in all the various walks of social life—can never be made up to us, yet the sacrifice has not been in vain. Out of the Spanish-American and South African wars arose a fuller knowledge of the role that flies may play in the spread of typhoid fever. That information has been applied in practice with far-reaching results. Perhaps it is no exaggeration to state that the losses of life in these wars have been made up since by the saving of life resulting from the knowledge gained during their progress. Similarly, in the present war, and as a direct result of it, advances of enormous importance have been made in the treatment of wounds, in the knowledge of the means of spread of such diseases as typhus fever, cerebrospinal fever and bilharziasis, and in other directions. Of equal importance, though less directly connected with the saving of life, have been the discoveries made in chemistry, in engineering, and in many other fields. Though doubtless in the course of years, these various problems would have been solved, their solution has been precipitated, their crystallization from obscurity has been hastened, by the attendant requirements of war. Further, the need of scientific assistance is at last being realised by the community in general, and the closer co-ordination of science and industry in our social life is being slowly brought about.

The Housing Problem and the Public Health.—As a change, especially marked during the last year, has taken place in the housing accommodation of Sydney, a reference to it, as affecting the social welfare of the community, may be allowed from this chair. The matter might well receive fuller consideration at the hands of our Public Health Section. The change to which reference is made consists in the introduction and rapid spread of the flat system. Its popularity may be referred to several causes, chief amongst which are the difficulties in obtaining domestic assistance, the scarcity and high price of dwelling-houses, and the increase in cost of suburban transit. These reasons for its adoption hardly concern us from the scientific aspect, and are quite legitimate, provided they are not counterbalanced by factors operating injuriously on the community as a whole. In this connection I would like to point out an aspect that, it seems to me, may have a very unfavourable effect upon the children of families living in flats. All are agreed, I think, that the family system is that best calculated, in the Anglo-Saxon race at least, to develop children healthy in body, normal in mentality, and original in initiative. Mixing with the parents and in the surroundings of the home, they assimilate the acquired knowledge of their parents, and acquire that touch of individuality that must be lacking to a great extent in the barrack-system. It is recognised that State children develop better and more naturally in the home surroundings of foster-parents than in reformatories. Now the flat system is a half-way house to the barrack-system. Families live, one piled on the other in layers, like the Chinamen in the steerage of an Eastern-going vessel. The seclusiveness of family life is lessened from the intimate proximity of neighbours, whilst the children home from school have no garden to play in nor free scope for their many activities. How the difficulty can be overcome is one for legislators to decide. Attention may also be called to the health value of large gardens round houses, and no municipal legislation should exist which tends to make it unduly costly for homes to be surrounded by adequate air spaces.

The Commonwealth Advisory Council of Science and Industry.—The permanent establishment of the Institute of Science and Industry has not yet been accomplished. The Advisory Council, however, has continued its excellent work of initiation, supervision and direction, and it behoves all science workers to aid, in every possible way, investigations of such national importance now being carried out under its auspices. It seems plainly to be the duty of anyone, with information, ideas or suggestions that may be of value, to place these, even though unsolicited, unreservedly and immediately at the disposal of the Council. The value of team-work, especially in unravelling difficult problems, can hardly be over-emphasised, whilst batteries of workers, in cordial co-operation and representing all branches of knowledge possibly having a bearing on the question at issue, are more likely than single workers to obtain the best and quickest solutions. The part played by our learned societies in the furtherance of scientific investigation in Australia, coupled with the personality and capacity of many individual members, indicate that they are corporate bodies of no small importance, of great public utility, and of very considerable experience in their particular provinces of knowledge. As a consequence, I believe the Advisory Council itself, and the various State Committees, would be considerably strengthened if these societies were directly represented on them. The work now being carried out by the Council is far too little known to the scientific public of Australia, and I would suggest the importance of establishing a regular Journal of Science, under its auspices, which would keep us all informed of the progress made, and which might also contain references to current work published elsewhere in Australia, summaries of previous investigations, and other suitable matter.

Through the kindness of the Secretary, Mr. Gerald Lightfoot, I have been placed in possession of the following information as to the work carried out by the Council during last year. I make no apology for including this in my address, as the matter is not otherwise easily accessible, and members will doubtless, like myself, be surprised at the volume and diversity of the subjects considered. Further, all will see from reading it, the importance of contributing what they can to ensure the success of the Institute of Science and Industry.

Brief Résumé of Work carried out by the Commonwealth Advisory Council of Science and Industry from June, 1917, *to April,* 1918:—

I. *General.*—As indicated in the Report of the Executive Committee for the year 1916-17, the objects for which the temporary Advisory Council was established, pending the organisation of the proposed permanent Institute, had been largely carried out at the date at which that report was issued. A meeting of the whole Advisory Council was held in July, 1917, when a detailed scheme for the organisation and work of the future Institute was discussed and approved. This scheme was brought before the Prime Minister, who indicated that he approved of its general principles. Since the 30th June last, considerable progress has been made with the work, though the Executive Committee has been hampered through having to carry on (under the temporary organisation and with insufficient powers and staff, and with no laboratory accommodation of its own), work which should really be carried out under the permanent Institute. The Executive Committee has dealt with a large number of matters of a very varied nature. The work may be summarised under the headings, firstly, the more systematic investigations conducted by Special and Standing Committees, and by other organisations assisted by the Executive; secondly, matters to which the Executive Committee have given a large amount of attention, but which have not yet reached the stage at which they can be made the subject of systematic investigation; and thirdly, miscellaneous inquiries and investigations. The last class at present fall into no special plan, and consist largely of inquiries for advice made by persons engaged in industry. It is probable that many of them will find their place later, in some co-ordinated scheme of work under the permanent Institute; but with the staff and funds at the disposal of the temporary organisation, it has not been practicable to undertake systematic investigations regarding those of them which the Executive consider require such investigation.

II.—*Investigations conducted by Special Committees.*

1. Ferro Alloys.—The work of this Committee is practically completed. Valuable results have been obtained, and information has been supplied to persons interested.

2. Mode of Occurrence of Gold in Quartz.—A large amount of work has been carried out, and the results are published in Bulletin No. 4. Provisional results of considerable value to the mining industry have been obtained.

3. Alunite.—Methods of treatment of each of the alunite deposits of Australia have been worked out. The results are published in Bulletin No. 3, and large-scale experiments are in progress by the owners of certain of the deposits with a view to the establishment of the potash industry.

4. Yeasts and Breadmaking.—Results which may be of considerable importance with respect to the solution of the day-baking trouble, and which are of considerable scientific value, have been obtained.

5. Damage by Insects to Grain in Store.—A preliminary report has been made by the Committee, and published in Bulletin No. 5. Recommendations for systematic investigations have been made, but the question is still under consideration.

6. Purification of Damaged Wheat by Lime.—The results of these investigations were reported in Bulletin No. 5.

7. Electrical Sterilisation of Milk.—These investigations are still in progress.

8. Tanning Methods in N.S.W.—Investigations in progress.

9. Utilisation of Mangrove Bark for Tanning (Queensland).—The investigations are not completed. Valuable results regarding decolourisation have been obtained.

10. Utilisation of Red Gum for Tanning (W.A.).—Investigations are in progress. Work has been delayed owing to difficulty in obtaining a properly trained leather chemist.

11. Means of Transmission of the Worm Nodule Parasite.—Investigations are in progress.

12. Control of Sparrow Pest.—Steps have been taken with a view to preventing this pest from reaching Western Australia.

13. Alcohol Fuel and Engines.—A large amount of work has been done, and a comprehensive report published as Bulletin No. 6.

14. Posidonia Fibre.—Investigations into the constitution of the fibre with a view to increasing its strength by chemical treatment are practically completed.

15. Grass Tree Resin.—Fundamental research into the composition of the resin is in progress, with a view to the commercial utilisation of the resin. Definite chemical substances have been isolated.

16. Development of Mechanical Cotton Picker.—Investigations are now in progress. Valuable results have been obtained. Arrangements are being made to grow cotton near Brisbane for the purpose of experimental picking by machine.

17. Utilisation of Phosphatic Rock.—Investigations are now in progress.

18. Life History of the Cattle Tick.—Investigations are in progress on the lines of the recommendations given on p. 17 of the Report of the Executive Committee.

19. Substitutes for Tin Plate.—The investigations are nearing completion. Very satisfactory results have been obtained.

20. Commercial Utilisation of Kelp.—Investigations, specially in regard to the extraction of potash and iodine, are in progress at Hobart.

21. Blow-Fly Pest in Queensland.—Investigations are in progress in collaboration with the State Government.

22. Cold Storage Problems.—The Committee is engaged in devising a scheme for systematic investigation, especially in regard to the cold storage of fruits.

23. Tuberculosis in Stock.—Special Committees are at work in each State.

24. Native Grasses and Fodder Plants.—A Special Committee, with headquarters in Sydney, has been established on an Interstate basis.

25. By-products of Wool Scouring Industry.—A Special Committee is investigating this matter, especially with a view to dealing with the recovery of potash.

26. Nitrogen Requirements of Australia.—A Special Committee has been appointed to investigate this matter. The work is in progress.

III. *Work of Standing Committees*:—

1. Chemicals Committee.—This Committee has dealt with a large variety of important matters. Other problems are now under investigation.

2. Marine Biological Economics of Tropical Australia.—This Committee is dealing specially with Trochus and sponges. An expert sponge-fisher is to investigate the sponge beds near Cooktown.

3. Metric System and Decimal Coinage.—Work is in progress.

4. Seed Improvement.—This Committee has been established to undertake the examination, comparison, classification and production of identification keys, to different varieties of cereals.

IV. *Investigations by Organisations other than Special or Standing Committees*:—

1. Society of Chemical Industry of Victoria.—A grant has been made to defray the expenses of work on the standardisation of chemical analysis.

2. N.S.W. Pastoral Committee on the Blow-Fly Pest.—A grant has been made to assist this Committee in its in-

vestigations, and the Executive has appointed a representative on the Committee.

3. Electrical Association of Australia: Committee on Standardisation.—Representatives of the Executive Committee have been appointed both on the N.S.W. and Victorian sections of this Committee.

V. *More Important Matters which have not yet reached the Stage for Systematic Investigation by Committees*:—

1. Paper Pulp.—A large amount of information has been collected, and experiments have been conducted, on the paper making possibilities of a considerable number of indigenous plants, etc. The whole matter is still under consideration.

2. Prickly Pear.—A comprehensive report and recommendations for co-operative action between the Commonwealth and New South Wales and Queensland Governments have been made, but the consent of the New South Wales Government has not yet been obtained.

3. St. John's Wort.—The question of the introduction of a parasitic insect, with a view to the repression of the pest, is under consideration.

4. Destructive Distillation of Hardwoods.—Preliminary experimental work has been completed.

Other Matters of Special Importance dealt with by the Executive:—

1. Repression of Cattle Tick.—At a conference held in Brisbane in January last, at which representatives of the Commonwealth, Queensland, and New South Wales were present, a scheme of action was devised. This is now being considered by the Commonwealth and State Governments.

2. Organisation of Industry.—The Executive is taking action with a view to the establishment of industrial research associations, on the lines of the scheme adopted by

the British Department of Scientific and Industrial Research.

3. Flax Industry.—The Commonwealth Flax Industry Committee has been established under the War Precautions Act, on the recommendation of the Executive Committee, to control and develop the flax industry.

4. Interstate Forestry Conference.—The Executive Committee was represented at this conference, which was held in Perth, and as a result it has been decided that the compilation of data on Australian forest products shall be undertaken by the Executive Committee.

5. Imperial Sugar Research Association.—A proposal for the establishment of research laboratories on a basis of co-operation between the different parts of the Empire concerned, is under consideration.

6. Agricultural Conference.—An important conference of Agricutural Experts was held in Melbourne under the ægis of the Advisory Council. Already valuable results are accruing, e.g., the establishment of the Special Committees on Seed Improvement and Native Grasses, etc. The Report of the Conference will be issued shortly as Bulletin No. 7.

7. Catalogue of Scientific and Technical Periodicals in Australia.—This work is in progress in each State. The final compilation of the results will be carried out in Melbourne under the Executive Committee.

8. Soil Survey of Australia.—Preliminary steps have been taken. The matter is in abeyance through lack of funds.

9. Herb-growing.—Action has been taken for the development of this industry in conjunction with the work of the Victorian Government's Medicinal Plants Board.

10. Ceramics, Enamels and Glazes.—Various aspects of this matter have been considered. The conclusion has been

reached that until a School of Ceramics, with a thoroughly qualified director, is established, research into these matters cannot be usefully undertaken.

11. Miscellaneous.—The following gives some idea of the range of miscellaneous matters dealt with by the Executive Committee:—Manufacture of cylinders for holding compressed gas, manufacture of starch, manufacture of white lead, bleaching of pith cane, botanical and forestry survey of Papua, the training in England of Australian apprentices, recovery of potash from eucalyptus distilleries, production of oxidised linseed oil, remission of duty on alcohol for scientific purposes, the most suitable times for felling timber, brown coal, War Profits taxes and the chemical industry, production of vinegar, transmission of disease through mouse-infested wheat; utilisation of waste fruit, of leather shavings, of waste paper, of wood shavings, of willow bark and of vegetable dyes, sugar from grapes; liability of copra to spontaneous combustion, chemical retting of flax, regulations regarding the use of small stills for laboratory work, patent fodder cakes for stock, manufacture of tinplate in Australia, milling tests for flour, the production of tar oils, remission of duty on alcohol used in the manufacture of rennet, atmospheric nitrogen.

Worm-Nodules in Cattle.—The difficult task of discovering the means of transmission of the larvæ of the nematode worm, *Onchocerca gibsoni* Jnstn. et Cleland, from one bovine to another still awaits solution. As a result of a careful survey of the whole subject, and especially of our experiences on Milson Island, in the Hawkesbury River, it seemed highly probable that the most likely vector of the parasite was a March fly. Previous experiments having been unsuccessful, Dr. (now Professor) S. J. Johnston and I approached the Advisory Council of Science and

Industry for financial assistance to carry out further ones. This was granted, and I have the permission of the Executive Committee and of my colleague to make an announcement which, though far from conclusive, rather strongly supports the view, based on epizoological grounds, incriminating tabanids. With the aid of our assistants, Miss Marguerite Henry, B.Sc., and Miss Chase, B.Sc., on three occasions larvæ, probably those of *O. gibsoni,* have now been found, in the course of dissecting several thousand March flies. Whilst a single worm was found in one of these tabanids, several were present in each of the others. It must be remembered that it is still quite possible that these larvæ were merely accidental infestations, but the fact that in two of the flies the worms had much increased in size is important. It is also further possible that these larvæ are not those of *O. gibsoni.* We have also several calf experiments in progress, one in a fly-proof pen, from which helpful results may follow. A partial worm-nodule survey of the State, carried out chiefly by Miss Somerville, B.Sc., and myself, shows wide dispersion of the parasite even as far as the Victorian border, with an absence, sometimes apparently complete, of nodules in certain highly-situated districts, such as Bathurst and Blayney.

The Experiments Supervision Committee of the Department of Agriculture.—The work done by this Committee, quietly and unostentatiously, is little known to the general public, or even to those interested in agriculture, but outside the Department itself. Most of the experimental work of the Department is controlled by this Committee. Many of the experiments themselves are designed in detail by its members, whilst others are submitted by officers engaged in the subject under consideration. The objects aimed at are a full exploitation of all aspects of the science of agriculture, avoidance of over-lapping, co-ordination of effort with the view of quicker and more final results, accuracy of detail of experiments to avoid possible flaws, and adequate control and check experiments. From time to time the results of this work appear in the *Agricultural Gazette of New South Wales,* covering such wide fields as manuring and variety trials of cereals and other crops, fungicide tests, ploughing experiments, the improvement of pastures, the control of flying-foxes, the prevention of blow-fly in sheep, prickly-pear eradication, etc. One of the most important investigations recently dealt with by the Committee was the use of dry copper carbonate for the prevention of bunt, instead of the pickling of wheat with a solution of copper sulphate, the experiments having been suggested and designed by G. P. Darnell Smith and H. Ross.

Blow-Fly in Sheep.—Mr. John Froggatt, under the direction of the Government Entomologist (Mr. W. W. Froggatt), has been continuing his investigations at Moree into the best baits and traps for attracting and catching the blow-flies, the effect of the heavy seeding of an extensive area with the hymenopteron parasite (*Nasonia brevicornis*) of the pupæ of these flies, and the results of systematic poisoning of carcases for the purpose of destroying the blow-flies. In wishing them every success in their investigations, it should be borne in mind that the control of this pest will probably always be a matter of considerable expense, untiring energy, and meticulous care; that it is unreasonable to expect the discovery by anyone of an easy and rapid means of eradication; and that they will have performed a remarkably useful piece of work when, at the conclusion of their experiments, they have co-ordinated and perfected a scheme to utilise to the fullest advantage the information at their disposal, and backed this by an Act of Parliament to enforce its essentials.

Prickly-Pear.—The seriousness of the prickly-pear problem in Queensland and New South Wales is hardly realised by the community. Day by day the pest is extending, and year by year the millions of acres already infested are being added to by hundreds and thousands. With a problem of this nature, it is highly improbable that any royal road to eradication will be discovered. The Experiments Supervision Committee of the Department of Agriculture is actively engaged in investigating the most effective means of destroying the pear, and has in hand experiments to test the relative costs of the different methods suggested. These comprise mechanical means and spraying with certain preparations of arsenic. All are costly, and in poor country the expenses of eradication will often exceed the value of the land. The fact that *Opuntia monocantha,* a pest pear in parts of Australia, can be destroyed by the cochineal insect, suggests the possibility that a mutant from it may possibly be found which would attack also the common pest pear, *O. inermis.* Provided there is no mechanical reason why these insects cannot feed on the latter, massed feeding experiments might be tried on an area where the two species are growing together. The frequent transmission of millions of coccids from plants of *O. monocantha* to adjacent ones of *O. inermis,* may eventually lead to the appearance of a mutant able to maintain itself on the latter. Considering the issues at stake, it is worth while expending a considerable sum on this matter to test it thoroughly. Meanwhile drastic action is necessary to prevent more land being rendered useless and a nuisance. Lightly infested areas, with easily eradicable pear, on Crown and private lands, must at once be eradicated before the plants have gained a stronger hold. It is folly to delay action longer, and essential that the present limits of "ineradicable" pear should not be extended by further neglect.

Introduced Plant Pests.—In every direction one sees the extension of noxious weeds, and new species are frequently being brought from overseas. No effort to control these seems to be made until they are so firmly established that extinction is impossible. Surely some means could be devised by which a special botanical staff, placed at the disposal of the Government Botanist, could methodically survey likely portions of the State, especially in the neighbourhood of seaports and along railway lines, to detect the early appearance of noxious weeds, and to arrange for their elimination at once. If some such scheme is not adopted millions more will be wasted in vainly endeavouring to remedy what a few hundred pounds expended now could with reasonable certainty accomplish.

I am indebted to others for the following summaries of progress made in Australia in various branches of science during the year under review:—

Work of Australian Mathematicians.—Professor H. S. Carslaw, in the University of Sydney, has published two papers, one (Proc. London Mathem. Soc.) continuing his work on Wave Equation, the other (Amer. J. of Mathem.) on the Gibbs' Phenomenon in Fourier's Series. His (second) paper on Napier's Logarithms (this Journal, L, 1916, p. 130) has appeared also in the *Phil. Mag.*

Professor H. J. Priestley, of the University of Queensland, has also given attention to the mathematical theory of the diffraction of waves, and has contributed a paper on this subject to the London Mathematical Society. He is at present engaged in important research on these lines.

Dr. C. E. Weatherburn, the first Doctor of Science in Mathematics of the University of Sydney, and now lecturer in the University of Melbourne, has made several contributions to the *Phil. Magazine* and the *Quarterly Journal of Mathematics*, continuing the researches which won for him the D.Sc. here.

The large work by Mr. G. H. Knibbs, C.M.G., the Commonwealth Statistician, based on the Census of Australia, has attracted considerable attention.

The staff of the Sydney Observatory, under Professor W. E. Cooke, has devoted much of its time to the preparation for publication of measures of the plates taken at Pennant Hills in connection with the photographic survey of the heavens, and in other circumstances this work would by now have been published.

Physics.—E. M. Wellisch, Lecturer in Applied Mathematics in the University of Sydney, has contributed important papers with regard to the motion of ions and electrons through gases.

The Reverend Father Pigot has carried out valuable work in his seismological laboratory. Early in the year our members were invited to contribute toward a fund to defray the expenses of a research into the nature of earth tides at present being carried out by him at Cobar. Father Pigot was invited, before the outbreak of war, by the International Geodetic Society to install a pendulum of extraordinary precision, in a situation and at a point removed from the influence of ocean tides and solar thermic action. He selected a deep level in one of the mines at Cobar, and received generous facilities at the hands of the Great Cobar Company. This work has not been conducted previously, under such favourable conditions, in many respects in any part of the world. Moreover, no earth-tide records have hitherto been obtained outside of Germany and Russia, save in the neighbourhood of Chicago, where the conditions are far from ideal. After exercising much patience and ingenuity in the accurate installation of the pendulum, Father Pigot has succeeded in overcoming many of the preliminary difficulties, and has now his first tracings of the earth tide—an achievement which will undoubtedly be followed by a series of further, improved curves, from which calculations of eminent scientific importance will be made. The expense of this research, a research of international character, must be borne by those who have learned to appreciate the value of science, and it should not be left to Father Pigot to trouble himself about these sordid matters. The Editor of *The Medical Journal of Australia* has therefore taken upon himself the responsibility of collecting a sum sufficient to cover the cost of the research for two years. Contributions to the fund will be gratefully acknowledged.

Chemistry.—The chemical research done in Australia within the last year, is chiefly that in connection with problems which have been taken up by the Advisory Council of Science and Industry. A Bulletin dealing with the Alunite deposits of Australia and their utilisation, has appeared. The conditions for roasting alunite so as to obtain the potash in a soluble form (potassium sulphate) have now been well investigated. The potassium salts thus made available should be a valuable asset to the country, as potash manures have not been obtainable to any extent since the outbreak of war.

Establishments for the manufacture of electrolytic zinc and calcium carbide are under construction in Tasmania. Messrs. Baker and Smith, of Sydney, have continued their researches on the eucalypts and other native plants, and the importance of their work to chemists becomes increasingly more evident.

Part II.—Rats and Mice.

For the special part of this address, I am taking as a subject "Rats and Mice." My reasons for doing so are several. First of all, the subject is one of general interest, and in a Society such as ours, composed of members whose interests are as diverse as are the paths of natural knowledge, it seems fitting to choose a text that may appeal to all. Secondly, the association of these animals from time immemorial with man, and often under tragic circumstances, opens up by-paths of history and literature that may tend to lighten a scientific discourse, and to introduce that human touch that adds a piquancy to the pursuit of knowledge. Thirdly, my official work in this State, and in Western Australia, has brought me into intimate personal contact with these pests, and it has been necessary to acquire local information concerning them from every possible aspect. Lastly, animals of such social habits may, like ourselves, be afflicted with grievous ailments, and behave and suffer in many ways like the races of man, and so offer headings for discussion, philosophical and otherwise, that, as disjointed units, would partly lose their application and direction. I do not propose to deal with the subject from all its aspects, but to confine my remarks more especially to Australian conditions and experience.

Special attention was first directed in Australia to rats more than 18 years ago, in January, 1900, when cases of plague in man were reported in Sydney, being part of the great pandemic of this disease that originated a few years previously. Before the pandemic died out, outbreaks occurred also in Queensland and Western Australia, with a few cases in Melbourne and Adelaide. As the result of the epidemiological observations of Ashburton Thompson, the bacteriological work of Tidswell, and the investigations of Ham, Australian workers were in the van in elucidating the problems connected with the transmission of the plague bacillus to man. Their work, confirming and supporting that of investigators in other parts of the world, soon incriminated the rat as a dispersing agent. Since that date rats have received the closest attention in this State, as elsewhere. A ceaseless vigil has been kept upon them here, and daily examinations are made for the purpose of anticipating any future recurrence of plague in human beings. Consequently a large amount of data has been collected in my laboratory in connection with them and their habits, parasites and diseases in general.

Though in such a systematic survey of rats, the common house mouse, *Mus musculus,* is included, being also subject to plague, much general attention had not been directed to this small pest till recently, when the enormous havoc amongst our wheat stacks caused by its phenomenal abundance perforce directed attention to it.

With this short introduction, the consideration of our rats and mice divides itself naturally under the following headings:—

The Species of Rodents concerned, and their Habits.

The Damage done by Rats and Mice.

The Distribution and Prevalence of the Common Rats and Mice in Australia.

The Numbers of Rats and Mice per Litter.

The Rats that Travel by Sea.

The Diseases of Rats:

Community Animals and the Origin and Spread of Epizootic Diesease. The True Significance of Disease. The Manifestations of Disease may be Specific. Attributes both of the Parasite and of the Host.

Plague: The Romance of Plague. A summary of the occurrence of Cases of Plague in Australia. The Species of Animals naturally infected with Plague in Australia.

Rat Leprosy. Spirochætosis ictero-hæmorrhagica. Rat-bite Fever.

Malignant Growths in Rats and Mice:

A Theory as to the nature of Cancerous Processes. Cancerous Growths in Rats and Mice. Malignant Growths in Other Animals.

Other Disease Conditions met with.

The Ectoparasites of Rats and Mice:

Fleas.—Fleas caught on Human Beings. Bed Bugs. Pediculids. Acarina.

The Protozoal Parasites of Rats and Mice:

Trypanosoma lewisi. Hæmosporidia. Sarcosporidia. Spirochætes.

The Helminth Parasites of Rats and Mice:

Nematodes: *Trichinella spiralis.* *Gongylonema neoplasticum.* *Hepaticola hepatica.* Larval. Nematodes in subserous nodules on the intestines. Rats as possible dispersers of the eggs of Human Ankylostomes.

Acanthocephala—Cestodes—Trematodes.

Previous Phenomenal Visitations of Rats or Mice in Australia:

The 1869-70 "Gulf Country" Rat Visitation. The 1887 Cooper's Creek and Darling District Rat Visitations. The 1895 Visitation of the Rat *Ascopharynx cervinus* at Charlotte Waters. The 1904 Visitation of Rats at Alice Springs, S.A. The 1903-5 Mouse Visitation. Mice in South Australia in 1911.

The Mouse Plague of 1917:

The Species of Mouse responsible. Summary of the Information available. Official Information. Personal Information. Disease in the Visitation Mice. Disease in Men associated with the Mice. Birds and the Destruction of Mice. Means of combating the Plague of Mice.

The Species of Rodents concerned, and Their Habits.

The species of rats and mice dealt with in this review comprise only the two common rats, *Epimys rattus* and *E. norvegicus,* and the common house mouse, *Mus musculus*—three species usually and more or less universally associated with the habitations of man.

Epimys rattus (L.) (including *E. rattus alexandrinus*). —This is the so-called old English Black Rat. *E. alexandrinus* is considered by Oldfield Thomas (MSS. letter) merely as a color variety, "a white or yellow bellied race," of the black bellied *E. rattus,* being "essentially the same species." The colour of *E. rattus,* in the wider sense, varies therefore considerably. Australian specimens are usually greyish-brown all over, in colour thus resembling *E. norvegicus.* Not infrequently we find them with light or almost white bellies, sometimes with an indistinct fawn edge separating the light under-surface from the brown back. Occasionally they are of a uniform rich glossy blackish colour, then presumably representing the true black rat. Compared with *E. norvegicus,* the chief external specific characters are the larger, thinner ears, and a tail longer than the length of the body (125 per cent.). The skulls are slightly but specifically distinct in the two species. The Black Rat is essentially a house and climbing rat, in contradistinction to the Norway Rat, which has been designated the Sewer Rat. Consequently the former is brought more into intimate contact with man.

Under the title "On the Habits of the Sydney Bush Rat (*Mus arboricola*)," Edgar R. Waite[1] gives an interesting account of the tree-climbing habits and fruit-eating capacity of this species at Mosman and in other parts of Sydney. He found difficulty in trapping it unless fruit was used as a bait. It also ate the seeds of *Tecoma australis*

[1] Waite, Proc. Zool. Soc., 1897, p. 857.

and *Mandevillea suaveolens* and the fruits of Moreton Bay figs. Another unusual article of diet was snails (*Helix aspera*), of which it bit off the apex of the shell to get at the animal inside. It formed nests in trees, and also made its home in the joints of bamboos. Oldfield Thomas points out that these rats, originally described by Macleay as *Hapolotis arboricola*, were evidently a form of *Mus rattus*.

Captain S. A. White[1] gives an interesting description of the habits of Black Rats which had recently appeared in numbers at the Reedbeds, near Adelaide. He caught them easily with flesh baits, and found that they hid in the day-time in holes in the river bank, under floors, and in old sparrows' nests in hedges. It was almost impossible to grow maize, sorghum, sunflowers, or other plants, whilst they ate grapes on the vines, devoured fruit on the trees, and even climbed the stems of zinnias and bit off the flower heads in search of seeds. The device of paper twisted into spools, or bell-shaped, and encircling the stems of maize or zinnias, protected them, the rats fearing a trap. From the alarm calls of birds in the trees at night, he believed the rats were in search of birds at roost, and anticipated much economic harm from destruction of our native birds.

Captain White's notes are illustrated by photographs of rats eating maize cobs, of the damage done to maize and zinnias, and of the paper spools *in situ*. I remember when in Perth, W.A., that considerable damage was occasionally done by Black Rats in a florist's shop, which is interesting in connection with Captain White's observations.

Mus tompsoni Ramsay, and *M. variabilis* H. and P., are apparently synonyms of *E. rattus.*[2]

Epimys norvegicus (Erxl.), (*Mus decumanus* Pallas), the Norway or Brown Rat.—This species has a tail less

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[1] White, "The Observer," Adelaide, April 7th, 1917, pp. 4, 26.
[2] A. R. McCulloch, Rec. Aust. Mus. VI., 1907, p. 312.

than the length of the body (80 per cent.), and shorter and thicker ears. It is also a larger and more robust rat. There seems to be little variation in colour, our specimens being all of a general greyish-brown. Though sometimes called the Sewer Rat, it does not confine itself to such localities. I remember in the early nineties frequently seeing it near Adelaide, climbing up into hedges of the African thorn, probably to eat the fruit.

Mus musculus L., the Common House Mouse.—This almost universal domestic pest varies little in size with us when adult, nor have I personally met with decided variations in colour in wild specimens submitted for examination. *Mus adelaidensis* Gray (1841), and *M. simsoni* (1882) from Tasmania, are both, Mr. H. A. Longman informs me, this species.

The Damage done by Rats and Mice.

I do not propose to deal fully with this aspect. The damage may be direct by eating foodstuffs or gnawing goods and spoiling them, or indirect by causing fires, or flooding by water, or expense in suppressing an outbreak of plague. References to details will be found in many publications dealing with rats. Mr. H. A. Longman,[1] of the Queensland Museum, in his introduction, gives some information, mentioning for instance that in Great Britain the loss has been estimated at £15,000,000 a year. He also refers to a return prepared some years ago in an Australian capital, where a firm dealing in meat products calculated the damage done by rats at a loss of £500 per annum.

A few years ago, Dr. J. S. C. Elkington,[2] then Commissioner of Public Health for Queensland, drew up a schedule of questions on this subject and submitted them to

[1] Longman, Notes on the Classificat. of Common Rodents, C'wealth of Aust., Quar. Serv., Serv. Publ. 8.

[2] Ann. Rep. Comm. of P. Health, Q., to June 30th, 1910, p. 7.

leading business firms in Brisbane. He gives the following examples of losses:—"One firm lost from £50 to £100 per annum from rats until the Departmental Rat Gang came to their aid; another lost £35 in goods damaged by rats during a move; another suffered £10 worth of damage from these animals in a single night; and a fourth found the expenditure of £500 in rat-exclusion measures a profitable investment."

Mr. N. G. Sparks, Chief Officer, N.S.W. Fire Brigades, in answer to an enquiry of mine, has kindly supplied the following information as to the rôle rats and mice may possibly play in causing fires. He states that in this State, for the four years 1914 to 1917 inclusive, 63 fires were attributed to 'rats and mice at matches,' distributed as follows:—City: 1914, 1; 1915, 6; 1916, 7; 1917, 9—total, 23. Country: 1914, 9; 1915, 7; 1916, 7; 1917, 17—total, 40. He adds:—'The damage in each case was not extensive, otherwise there would have been no proof of the supposed cause. There is no record of the breaking down of insulations or short circuit of electric wires caused by the action of rats."

The Distribution and Prevalence of the Common Rats and Mice in Australia.

It is now known that the presence of rats (and possibly, but to a much less extent, of mice), is necessary for the establishment of bubonic and septicæmic plague in man. This statement does not apply to pneumonic plague, which may be directly conveyed from man to man. It is also necessary that infected rats or mice (or perhaps infected material) should be introduced into the area to start the epidemic in the local rodent population. Such an introduced infection cannot lead to an epidemic of the first-mentioned types of plague in man in the absence of local rats (and mice), or if these are so few in numbers as to prevent a reasonably extensive epizootic occurring amongst them. At the utmost, in human beings, an accidental case or so might occur under these circumstances, conveyed by fleas actually leaving the sick introduced rats or by some other fortuitous means.

It is, therefore, of very considerable importance to know the distribution in Australia of these rats and mice. As regards the latter, they are so easily transported in merchandise of various kinds, by rail, team or sea, that they may be considered as practically universally distributed throughout the continent wherever man has his dwelling—even the temporary shelters of camps. Thus I remember in 1907, when investigating Surra in camels in Western Australia, when we were camped for several months 60 miles inland from Port Hedland, and with no town nearer than this port on one side or Marble Bar, equally far away, on the other, that several mice, almost certainly the house mouse, were found to have accompanied us, probably in forage. Yet there was no bush station house within many miles. Spencer and Gillen mention that the common mouse has reached the centre of Australia. The recent rapid extension of the wheat belt also favours its spread by giving it abundant food. Mice, however, though capable of being infected by plague and suffering therefrom when the rat population is suffering from the epizootic, are not considered responsible for the general spread and maintenance of the disease. Doubtless, however, if plague gained access to them when present in such countless hordes as were recently witnessed in this and neighbouring States, an epizootic might be started and human beings infected, provided, as regards the first occurrence, that fleas were on them capable of conveying the plague bacillus from mouse to mouse, and as regards the second occurrence, that such fleas would also bite man. Amongst samples of the mice from

[1] "Across Australia," I., p. 166.

the recent infested wheat areas, the only fleas encountered (all from one sample—they were not looked for in others) were the blind flea *Ctenopsylla musculi,* which does not, apparently, bite man.

The two common species of rat are therefore the chief, in Australia, perhaps, the only, means available for the distribution of the plague bacillus apart from direct infection from man to man in pneumonic plague. A town free from rats will be free from a visitation of ordinary plague; a town that reduces its rats to numbers so small that a plague epizootic cannot establish itself amongst them, if plague rats are introduced, will be free; a town that lets its rats multiply is exposed to a menace that may lead to enormous financial losses and possibly a heavy death roll. It is, of course, an exceedingly difficult task to keep down the rat population. In spite of all efforts, they may still be present in large numbers. When plague has never reached such a town, or its ravages and cost have passed into oblivion, the constant warfare against rats may wane and the authorities cry out at a seemingly needless expense. Days of financial stringency may arise, and the pruning knife lop off more and more of this important public protection. It is the old story again of one of Britain's little wars. The expedition had been a success; the native tribes had made suitable submission; the general in command was submitting his report on the part played by the various units in achieving such desirable results. For the medical work, he wrote, little praise could be bestowed, because, as a matter of fact, the staff had had nothing to do, there had been no sickness at all—but in truth there had been no sickness *because of the very efficiency of that staff in preventing its appearance.* Had typhoid fever decimated the ranks and slain more than the enemy, had dysentery incapacitated the troops, the medical staff could have done tangible work in trying to remedy an evil that might have been prevented—and a warm tribute of praise would have been paid them. Nevertheless, what finer recognition of their services could they have, in the eyes of a right-seeing posterity, than the unconscious compliment paid them in the despatches—there was no sickness. Even so is the attitude to rat control in our midst. The quiet work goes on from year to year, the harbor shores and buildings are rendered rat-proof, systematic trapping and baiting are carried out, nesting sites for the vermin are removed, food to nourish and propagate them is protected from them—and then the cry goes up why all this needless expense, this waste of public and private money—we have no plague! Aye, we have no plague, but why? Shall we open the door to it again? And if we do, as sure as autumn leaves do fall, sooner or later the unwelcome visitor will come in thereat. And even though it be many years before he intrudes again, is not the pecuniary loss to the community from the ravages of rats, estimated at £15,000,000 per annum in Great Britain and Ireland, alone worth while our attention?

Let us now turn to the present known distribution of our rats. In England, the old English Rat, *E. rattus,* is said to be nearly extinct, its place having been taken by the more aggressive Norway Rat, *E. norvegicus,* introduced about 1728 or 1729. Sir Ray Lankester,[1] however, says that the Black Rat is not extinct there, not even very rare. He had seen specimens from a warehouse in London where they were abundant, and they occurred, for instance, in Great Yarmouth and in isolated dwelling houses.

In the United States the Norway Rat[2] is the prevalent one, though *E. rattus* preceded it and is still found in a few

[1] Ray Lankester, Science from an Easy Chair.

[2] Lanz, in "The Rat and its Relation to the Public Health," Washington, 1910, p. 18.

places, whilst the Alexandrine variety of the latter is common near the sea-coasts of the southern parts.

In Sydney, *E. norvegicus* and *E. rattus* (including *E. rattus alexandrinus*), are present in about equal numbers. Thus, between March 1st, 1904, and December 31st, 1916, 89,216 of the former and 104,520 of the latter were examined in the Microbiological Laboratory of the Department of Public Health. In 1904, 1905 and 1906, *E. norvegicus* was more numerous than *E. rattus*, in one year being twice as many. Since 1907, *E. rattus* has been the predominant rat submitted for examination, in some years being nearly twice as numerous as *E. norvegicus*.

In the "Report on a Second Outbreak of Plague at Sydney, 1902," it is stated, in reference to rats examined between 1900 and 1902, that *E. rattus* predominated amongst those taken along the shores and *E. norvegicus* amongst those taken inland.

In the Ulmarra district of our North Coast, in 1905, out of 1,128 rats examined, only three were *E. rattus*. At Grafton, however, 62 out of 234 were of this species. I have received recently a specimen of *E. rattus* from Bathurst, and specimens of both the Alexandrine and of the typical black forms from Goulburn.

Mr. R. H. Cambage informs me that when Stockton and Hetton Collieries were working the former contained numerous rats but no mice, while in Hetton there were multitudes of mice but no rats. He also states from personal experience that, in 1891, when on the Upper Nambucca River, he found, as soon as the lights were extinguished, the miners' huts were invaded every night by bush rats, which ran all over the room and over those lying in bed.

From municipal enquiries I am informed that rats are known at Hay, and have been seen in the goods yard at

Queanbeyan, and that one was seen three years ago at Culcairn, but there are said to be none at Yass, Narrandera, Jerilderie, Berrigan, Corowa and Albury. A. R. McCulloch,[1] in 1907, records having received specimens of rats from Wagga, where they were found about grocers' stores and stables. From these he was able to show that *Mus tompsoni*[1] Ramsay was really *Mus* (*Epimys*) *rattus.* Bennett's account[2] of a visitation of *Mus tompsoni* (*E. rattus*) in western Queensland and western New South Wales (east of the Darling) in 1887, shows a wide distribution of this species. Rats are found deep down in the mines at Broken Hill, where they enter the sanitary pans and eat the fæces, but I do not know which species these are.

As regard Queensland, Ham[3] states that at Brisbane and Rockhampton *E. norvegicus* was four times as common as *E. rattus,* but at Townsville and Cairns, where epidemics and epizootics had frequently occurred, *E. rattus* was the more common.

In Melbourne, Ham (*loc cit.*) states that *E. norvegicus* was practically the only rat found in the city itself, a few *E. rattus* being occasionally found about the wharves and shipping. Through the courtesy of Dr. Robertson and the Secretary of the Public Health Department, Melbourne, I am informed that, of the rats examined between January 1st, 1912, and August 31st, 1916, 86.02 per cent. were *E. norvegicus,* 10.93 per cent. *E. rattus* (and *E. rattus alexandrinus*), and 3.01 per cent. "hybrids."

In Adelaide my recollection of the rats seen as a schoolboy suggests these were *E. norvegicus.* I remember being much struck when at the London School of Tropical Medicine with the beauty of the Alexandrine Rat from a New

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[1] McCulloch, Rec. Aust. Mus., VI., 1907, p. 312.

[2] Bennett, Proc. Linn. Soc., N.S.W. (2), II., 1887, p. 447.

[3] Report on Plague in Queensl., 1900-1907, p. 130.

Zealand vessel, so different from the rats I had previously known. Adelaide specimens seen by me about 1907 were certainly *E. norvegicus*. Dr. Borthwick informs me that when plague was present in Port Adelaide in 1909, both *E. norvegicus* and *E. rattus* were present, the former predominating. Recently the Black Rat has appeared near Adelaide in considerable numbers. Mr. E. R. Waite,[1] of the South Australian Museum, first called attention to its presence and attributed its arrival to escapees from troopships. As this species, as I shall indicate elsewhere, is the principal rat that travels by sea and is present on many vessels, any inter-State or oversea ship, however, might have introduced it.

In Tasmania, Ham states that both species occur.

In Western Australia, when I was there between 1906 and 1909, *E. rattus* was the only rat met with in Perth, except along or adjacent to the water frontage of the Swan River, where *E. norvegicus* was also found. Similarly at Fremantle, this latter species occurred only near the wharves. It seems fairly certain that *E. rattus* had been first introduced, as might have been expected, from its being the species usually found on ships, and that *E. norvegicus* had only recently arrived, but had already established itself in the immediate neighbourhood of shipping and water carriage.

The Number of Rats and Mice per Litter.

The number of rats and mice born per litter is of considerable interest, as showing the potentialities that exist for the rapid increase of these pests in the absence of controlling factors such as dearth of food supplies. It may be taken as a general axiom that the various living beings that inhabit the earth, both plants and animals, are as regards

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[1] Waite, "The Register," Feb. 12th, 1916.

their numbers in a condition of approximate equilibrium, at least so far as their normal habitat is concerned. They have had countless ages in which to multiply. If prolific breeders, their population has reached that degree of magnitude capable of being sustained under normal circumstances. If slow breeders, the species may be on the verge of extinction—and doubtless many species have become actually extinct for this reason—or slowly diminishing, or holding its own, or gradually increasing, according to the losses taking place amongst the young before these are capable of reproducing their kind. Altered conditions, as for instance, those due to the presence of man, may vastly disturb this equilibrium, whilst extension more or less fortuitous to a new habitat may enable a rapid increase to occur from absence of the usual controlling factors. The equilibrium is therefore an unstable one, liable to swing violently in one or other direction as the result of fire or flood, starvation, or an abundance of food, alteration in environment, increase or decrease of disease, and extension to new habitats or encroachments on old ones. The spread of introduced animal and vegetable pests in Australia is a striking example of the swing of the pendulum in the direction of phenomenal increase, due to extension of the species to a new habitat, and that one lacking in many of the controlling factors found in the normal surroundings of the species. The apparent great increase of the Australian blowflies, *Anestellorhina augur* and *Pollenia stygia,* responsible now for so much blowing of living sheep, is probably a similar example due to an altered environment, namely, the presence of the exotic sheep, cattle, and rabbits. The approaching extinction in many parts of Australia of the aborigine, the kangaroo and wallaby, and wombat, shows a swing of the pendulum in the other direction, due to an environment altered by the white man's presence and activity.

In spite of these striking exceptions, the axiom still holds good in a general way. Further, the presence of the various species still existent on the earth shows that these, in contradistinction to species now extinct, have been sufficiently prolific to maintain themselves up to the present in spite of the summation of all adverse conditions. For some species this has been difficult, and in the case of those verging on extinction the death rate has evidently exceeded the birth rate. In others, the maintenance has been easy. But all, rare species and common ones, are at any particular period of time, and under normal conditions, relatively stable in numbers. If this be the case, then it is clear that the number of progeny, potential or actual, produced by the parent, or in the case of diœcious species the parents, during its, or their, lifetime, is a measure of the risks encountered by the young in reaching maturity under average normal conditions. In other words, each parent or pair of parents has the expectation, on the average, of leaving one or two descendants, according to the case, to perpetuate the species. Otherwise, of course, the number of individuals of the species would progressively increase or decrease.

If a large number of progeny, either young animals or seeds, be produced, then it can be assumed that the chances against any one of these reaching maturity are great. If the number is small, then the risks are few. Many orchids produce annually vast numbers of seeds—evidently the likelihood of any one of these finding a suitable habitat and maturing is very small, but the operation repeated from time to time during the life of the plant eventually, on an average, enables it to leave at least one descendant. The spores set free from the cap of one agaric (*Psalliota campestris*—the common mushroom) have been estimated by Buller[1] at 1,800 million; from the fruit-body of another

[1] Buller, Researches on Fungi, 1909, pp. 82-85.

(*Coprinus comatus*) at 5,240 million; and from a bracket fungus (*Polyporus squamosus*) at 11,000 million, and this was only one of ten brackets on the tree from the same mycelium. As, in these fungi, the one mycelium may give rise to several fruit-bodies during the season and maintain itself for years, evidently the likelihood of the germination and establishment of any one of these spores is almost infinitesimal. Woman in a savage state had probably about a dozen children, perhaps more, during her life time, but the risks attendant upon their upbringing must have reduced the average of adults reaching maturity and procreating to little more than two. Amongst the British race, where celibacy is unfortunately far too common, it is considered that four births to a married couple are capable of maintaining the number of the population.

From this it would appear that if we knew the average numbers of litters during the lifetimes of rats and mice, and the average number of young per litter, we should get an indication of the risks attendant on the young rats or mice before they are old enough to reproduce themselves. I have not got personal information of the average number of litters borne by our two common species of rats and the common house mouse during the individuals' lifetimes. It is known that they reach maturity quickly, and that one pregnancy can be followed by another at intervals to be measured by weeks. I have, however, a considerable amount of evidence as to the number per litter, and some interesting points emerge from the consideration of this. My data show clearly that a large number of young must be produced during the average lifetime of these rodents, and that, therefore, the risks normally attendant on their lives, and especially on that of their young—due to starvation, man, beasts of prey, disease, accidents, and perhaps cannibalism—must be considerable; and conversely that, in the absence or diminution of these controlling factors, the rate of increase may be very rapid, in fact, in the absence of all inhibiting circumstances, astounding.

The following table (Table I.) shows the number of rat fœtuses found on examination in the Microbiological Laboratory of the Department of Public Health, in the three species, *E. rattus, E. norvegicus,* and *M. musculus,* during the three years 1915, 1916, 1917. As not infrequently, when pregnancy is well advanced, one or two partly absorbed fœtuses may be found in the horns of the uterus, the number born per litter will be somewhat less. Still, for practical purposes, these figures may be taken as showing the number actually born.

Table I.—*Number of Fœtuses found in Rats and Mice in Sydney during the Years 1915, 1916 and 1917.*

Epimys rattus.			*Epimys norvegicus.*		*Mus musculus.*	
Number of Fœtuses = number born per litter.	Number of such pregnancies	Approximate additions to population	Number of such pregnancies.	Approximate additions to population.	Number of such pregnancies.	Approximate additions to population.
1	4	4	1	1	2	2
2	6	12	0	0	1	2
3	34	102	4	12	5	15
4	43	172	5	20	9	36
5	136	680	35	175	8	40
6	145	870	17	102	5	30
7	160	1120	41	287	5	35
8	77	616	30	240	2	16
9	72	648	49	441	1	9
10	41	410	22	220	0	0
11	14	154	16	176	0	0
12	8	96	9	108	0	0
13	1	13	6	78	0	0
14	3	42	4	56	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	1	17	0	0	0	0
18	0	0	1	18	0	0
Total	745	4966	240	1934	38	185
Average per litter	6·66		8·05		4·87	

A study of the table will show that specific differences exist as regards the number of fœtuses present. Thus the average in 38 pregnancies of *Mus musculus* was 4.87 fœtuses; in 745 pregnancies of *E. rattus,* 6.66; and in 240 pregnancies of *E. norvegicus,* 8.05. The highest number found in the common mouse was 9, whilst that for *E. rattus* was 17, and for *E. norvegicus* 18. I have a recollection of finding, in one or other of these two rats, on one occasion no less than 24. We have other records of 15 (once) in *E. rattus*; of 17 (once) and 15 (twice) in *E. norvegicus*; and of 11 (once), 10 (twice), and 9 (twice) in *M. musculus,* whilst my assistant, Mr. R. Grant, has seen 14.

In *Mus musculus* the usual number of fœtuses is 4, and then 5, followed third in order by 3, 6 and 7. By reference to Table II it will be seen that in 44.7 per cent of the pregnancies (38), 4 or 5 fœtuses were found; in 84.27, 3 to 7.

Table II.—*Showing the Percentage of Pregnancies to the Total Number of Pregnancies for each Number of Fœtuses found in utero.*

No. of Fœtuses	*Epimys rattus.*		*Epimys norvegicus*		*Mus musculus.*		
1	·5		·4		5·2		
2	·8		0		2·6		
3	4·5		1·6		13·1		84·2
4	5·7		2		23·7	44·7	
5	18·2	59	14·5	71·6	21		
6	19·4		7		13·1		
7	21·4		17		13·1		
8	10·3		12·5		5·2		
9	9·6		20·4		2·6		
10	5·5		9·1		0		
11	1·8		6·6		0		
12	1		3·7		0		
13 – 18	·6		4·5		0		

In *E. rattus* 7, followed by 6, and then 5, were the usual numbers. Then comes a big drop to those with 8 fœtuses, followed by 9, and then by 4 and 10. In 59 per cent. of the 45 pregnancies the fœtuses numbered 5, 6 or 7.

In *E. norvegicus,* 9 followed by 7, and then 5 followed by 8, was the order of magnitude in 240 pregnancies. It is rather inexplicable to find that the number for 6 is less than half that for 5; whilst the numbers for 7 and 9 are more than for 5. Also that the number for 8 is slightly less than that for 5; whilst the numbers for 7 and 9 much exceed 8. I can offer no explanation for this difference, but had odd and not even numbers been the lower, this might have suggested that each ovary supplied usually the same number of ova for fertilisation. 71.67 of the 240 pregnancies showed 5 to 9 fœtuses present.

The presence of a small number of fœtuses, say 1 or 2, can be explained by obstacles to fertilisation. An interesting feature in the two rats, one absent in the mouse, is the occasional occurrence of a number of fœtuses much more than double that usually found. Perhaps these may be instances of superfœtation or of the maturing of a double number of ova. Otherwise they must be considered as mutations.

These New South Wales figures for the numbers of fœtuses found in pregnant *E. rattus* compare remarkably closely with some that I have published[1] for Western Australia. In 221 pregnant rats of this species examined in 18 months, 1143 fœtuses were found, giving an average of 6.43 per pregnancy, the figures for New South Wales being 6.66.

Whilst examining the pregnant rats in Perth, I was struck by the fact that occasionally one horn of the bicornuate uterus might contain more fœtuses than the other. This led to making notes, the substance of which was published in the above *Bulletin,* to see how great the divergence might be, and as to whether one side or the other tended on an average to have a greater number of young.

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[1] Bull. of the Dept. of State Med. and Pub. Health, W.A., Nos. 10-12, 1909, p. 16.

The following extremes were noted, the right and left figures referring to the respective cornua:—9-0, 6-1, 1-5, 0-5, 7-2, 1-5, 5-1, 1-5, 3-8. In 101 rats 331 fœtuses were found on the right side, and 326 on the left. It therefore appears that either horn may have a considerable preponderance of fœtuses, and that the average number on each side over a series is approximately equal. In other words, it would appear that when a discrepancy exists, this is due to some accident, either mere chance or some pathological obstructive process, and is not due to any inherent specific factor in the species, by which more ova were liberated into and fertilised in one horn than the other.

From data, compiled by me in Perth between 1906-1908, over a period of $2\frac{3}{4}$ years, as to the percentage of pregnant females (of *E. rattus* almost entirely) to total adult females for each month, a definite variation seems to exist, if the totals of rats examined, which varied from 265 to 684, were sufficiently large to exclude undue error. In March this percentage was 14.7. From April to May, it fell from 10.1 to 9. It rose to 15.7 in July, and 20.3 in August, to fall in September to 13.6. From October to February it ranged between 21.2 and 35.3. The young rats from the October to February pregnancies would reach maturity at about the plague period of the year.

The Rats that Travel by Sea.

As the old English black rat (*Epimys rattus*), including the Alexandrine variety (*E. rattus alexandrinus*), the Norway rat (*Epimys norvegicus* [*decumanus*]), and the common house mouse (*Mus musculus*) are all subject to plague, it is of considerable interest to see which of these species is most prone to travel by sea. The most frequent traveller of the three would naturally be looked on, other factors being equal, as the most likely introducer of the plague bacillus into unaffected parts.

For the purpose of putting this matter beyond dispute, I have had a list prepared of all the rats and mice submitted for examination to the Microbiological Laboratory under my charge, from vessels berthing in the cosmopolitan port of Sydney between April 16th, 1913, and April 14th, 1917.

During the period rats or mice were found on fumigation by the Commonwealth Department of Quarantine on 189 vessels—of which eight are specifically designated barques—after the accomplishment of 325 voyages. I have no information as to the number of instances in which neither rats nor mice were found. The ships belonged to all nationalities, though naturally British vessels much predominated, whilst the voyages they had made included coastal, interstate, and overseas in all directions. On the 325 voyages made by the 189 vessels,

Epimys rattus was present in 293, and absent in 32 instances.

Epimys norvegicus was present in 3, and absent in 322 instances.

Mus musculus was present in 53, and absent in 272 instances.

Epimys rattus was associated with *E. norvegicus* in 1, and with *M. musculus* in 22 instances.

Epimys norvegicus was associated with *E. rattus* in 1, and with *M. musculus* in 1 instance.

Mus musculus was associated with *E. rattus* in 22, and with *E. norvegicus* in 1 instance.

2968 individuals of *E. rattus* were found and submitted, an average per voyage of 9.

7 individuals of *E. norvegicus* were found and submitted, an average per voyage of .02.

487 individuals of *Mus musculus* were found and submitted, an average per voyage of 1.5.

The largest numbers of *E. rattus* found and submitted at the ends of voyages were 90, 71, and 68 (twice) ; in the majority of instances under 10 were submitted. The numbers of *E. norvegicus* were 4, 2 and 1. The largest numbers of house mice submitted were 95, 55 and 37 (twice). The largest numbers of mice were found on vessels trading with the North Coast of New South Wales, and an undue proportion of such vessels yielded mice, probably as a result of the frequent carriage of fodder. Interstate vessels and those plying to New Zealand came next in both respects. Mice were only occasionally found on vessels from overseas, as for instance England.

Of the three vessels on which *Epimys norvegicus* were found, one came from Vancouver, and one from Noumea.

In July, 1915, an unusual rat was submitted to us which had been caught in the S.S. Le Maire, in Sydney, from Java. It was sent to Oldfield Thomas, at the British Museum, for identification. He kindly informed us that the specimen was somewhat deteriorated, but appeared to be an example of *Epimys terræ-reginæ* Alston. This species is a native of Cape York, in Queensland. On a previous trip this steamer had called at Rockhampton, but apparently not further north in Queensland.

Longman[1] states that the Indian Mole Rat, *Gunomys* (*Nesokia*) *bengalensis* Gray and Harden, has occasionally been taken on ships in Australian waters.

The Diseases of Rats.

The diseases of rats are very important from a human point of view, and this for two reasons. In the first place certain of the diseases affecting them may be conveyed directly or indirectly to man, and in this respect the rats

[1] Notes on Classification of Common Rodents, etc., C'wealth of Aust. Quar. Service, Service Public., No. 8, 1916, p. 18.

may be the chief sources of infection, sometimes in large numbers, of human beings. In the second place other diseases are closely allied to, though probably not identical with, similar diseases in man. Conditions may exist for working out the full etiological histories of these latter rat diseases, which may be impossible in the case of the allied diseases in human beings. As instances of the first-named conditions may be given plague, trichinosis, rat bite fever, spirochætal jaundice, and perhaps trench fever. An instance of the latter type is rat leprosy.

Community Animals and the Origin and Spread of Epizootic Disease: the True Significance of Disease.— Both rats and mice are, to a great extent, "community" animals. In other words, their numbers may be considerable within a limited space, and the individuals must come frequently in direct contact with each other, whilst they associate together in the same place over long periods of time. Such circumstances favour the spread of epizootics. It is quite clear that if the members of any particular species of animal live in couples widely separated from their neighbours, there is little chance of noxious organisms passing readily from individual to individual of the species. If the organism be rapidly fatal to its host, the victim dies alone, and the germs with it. If the host be a community animal, if it be a member of a herd, before its death it may have conveyed the germs of its disease, either directly or by contamination of its surroundings, to some of its fellows. Further, we know in bacteriology, that the rapid passage of certain bacteria from one individual to another tends to enhance their virulence. Such rapid passage is easy of achievement in community animals, but more difficult of fulfilment the more solitary-living are the hosts. A community-living animal, therefore, not only gives a pathogenic microbe a better chance to spread, but also tends to increase the pathogenicity of feebly pathogenic types. We are not quite clear as to what this increased pathogenicity really means. It may mean that the tendency of each species to vary round a mean, here gets its opportunity to perpetuate mutants of an aggressive type. Or it may mean that the strain as a whole accommodates itself better to its environment, becomes more acclimatised, with results disadvantageous to the host.

As an offset to the increased virulence of the invader, we have an increase of protective bodies in the host, whilst if the host's response is poor, it may die, and a weakling—from this point of view—be thereby eliminated with advantage to the species. It may be briefly stated here that it is rarely of any advantage to the invader to destroy its host. It is, in fact, seldom of any advantage to it to incapacitate the host, or make it ill, or even to cause any reaction to its presence. Reaction—and these reactions constitute and cause the signs and symptoms of disease—is an effort on the part of the host to nullify the invasion of the parasite and to repair the damage done. In object, if not always in effect, such reaction is purely protective. It may almost be stated as an aphorism that the first sign of getting well is getting ill! The invader's aim is clearly to avoid any reaction at all if possible.

The community animals, rats and mice, therefore, like the community animal man, might be expected to offer better facilities for the development of new races of pathogenic organisms than non-social animals. As a matter of fact, we do find that, just as man has a number of diseases, and is infested by a moderate number of parasitic animals, so are rats and mice affected by a considerable number of animal parasites and several epizootic diseases.

The Manifestations of Disease may be Specific Attributes both of the Parasite and the Host.—In the early days of the attempted differential descriptions of species, a simple exclusive and inclusive definition was considered sufficient. A short description, which included all the necessary individuals and excluded all others, was almost all that was required. Now much more complete morphological data—and the fuller the better—are demanded. As yet, however, there is little tendency to include as specific traits in the descriptions other facts than those of morphology. Baker and Smith, before this Society, have shown the importance of the presence or relative absence of certain chemical bodies in the separation of our species of *Eucalyptus, Melaleuca, Callitris,* etc. Mental characteristics, based as they must be on cellular, molecular, or perhaps chemical differences, should also, I think, receive full consideration. The common Australian Willy-wagtail or Shepherd's Companion (*Rhipidura motacilloides*), has universally the habit of settling on the backs of sheep, cattle and horses whilst these are feeding, and of circling round them from this perch to catch the flies disturbed during grazing. The bird is a friendly one, and little afraid of man. Its cousins, *Rh. albiscapa* and *Rh. rufifrons,* have not, as far as I am aware, the habit of settling on the backs of grazing animals, though they also are relatively tame. This peculiar habit of the Shepherd's Companion is a true specific trait, equally entitled to inclusion in the description as the morphological details of colouring or the character of the pigmentation of the eggs. I would go further and say that if I came across a race of Shepherd's Companions which, in the presence of frequent opportunities, universally failed to manifest this habit, I would be induced to scan the members of this group closely to see whether such a difference in behaviour was not accompanied by some other departure, perhaps morphological, perhaps in the structure of the nest, which would entitle one to distinguish the race as a distinct variety. It may here be noted that closely related species, so close as to be at first sight deemed but one, nearly always show not one slight difference in detail alone, but usually several, apparently unrelated. A striking instance is seen in the case of the two *Bilharzia* trematode worms affecting man in Egypt. For years controversy raged as to whether one species or two were responsible for the lesions found in man. This was due to the fact that, though the adults of each seemed the same, in some cases terminal-spined eggs were found alone, in others lateral-spined. We know now, through Leiper's researches, that there are two species, *Bilharzia hæmatobium* and *B. mansoni,* that the difference in positions of the spines is due to the difference in species, that the intermediate molluscan hosts belong to different genera—*Bullinus* in the former, *Planorbis* in the latter, and that the cercariæ differ in minor morphological details. It would seem as if, in the differentiation of species, not one factor, but several, alter together. Though these factors may not appear to be related to each other, it may be that they all have a common origin in a single mutation in the germ-plasm. In human beings we do not know why certain blue sclerotics of the eye should be associated with fragility of the bones. The two are so constantly found together that their origin from a common factor seems clear. For these reasons, in the case of the Shepherd's Companion, I would scrutinise the bird closely to look for collateral evidences of change, were a race met with departing in mental characteristics from the type—and I am of opinion that I would not look in vain.

We see, therefore, that besides morphological characters, chemical ones and mental traits may all with advantage be considered in drawing up the specific description. Now just as important as these is the way the species, be it animal or plant, reacts in disease. In Western Australia there are two species of Eucalyptus—*E. marginata,* the jarrah, and *E. Todtiana*—rather resembling each other in superficial appearance, and often growing near each other. *E. Todtiana* has frequently very large and peculiar Brachyselid galls; the jarrah is remarkably free from disease of any kind. This gall, specific of the insect causing it, is equally a specific characteristic of its host. Measles and scarlet fever, as manifested by their typical rashes, are specific reactions in *Homo,* as characteristic of the host as of the unknown parasites causing the diseases. Man might be exclusively defined as an animal capable of reacting to the viruses of measles or scarlet fever by diseases characterised by particular rashes. Similarly the manifestations of disease in rats or mice may be in some cases—as for instance rat leprosy—almost or quite specific features.

Plague.

It is now established conclusively that the usual means of dissemination amongst man, of ordinary bubonic and septicæmic plague, is by means of the rat through the intermediation of rat fleas. Pneumonic plague, on the other hand, spreads directly from man to man, owing to the vast numbers of plague bacilli expectorated by the sick and distributed as fomites.

The Romance of Plague.

Of all diseases, plague is perhaps the most dramatic, tragical and historically interesting. Its spectacular clinical symptoms—the so-called ''tokens'' referred to by De Foe, and occurring in some epidemics—its rapidity of onset, its intense mortality, its decimation of populations, its effect on trade and commerce, the part it has played in history, the foundation it has laid for legends, and, in modern times, the stimulus it has given to the cleansing of the foul slums of our great cities—all contribute to these characters, impress the popular mind, instil dread of its ravages, and arrest the attention of the historian, the epidemiologist and the administrator. As the outbreak of cholera in England helped to lay the foundations of modern public health at the hands of Sir Edwin Chadwick and his colleagues, so the outbreak of plague in Sydney, in India, and elsewhere, led to hygienic reforms of great significance to the wellbeing of the community, though aimed primarily at the control of rats.

I do not purpose to deal in full with the many interesting accounts of epidemics of plague in the days of old. By various writers these have been more or less fully condensed and digested. I would like, however, to indicate some of the more important accounts, and refer those interested to the actual descriptions themselves.

Drs. Tidswell and Dick, in 1899, before the then Medical Section of this Society,[1] called attention to the account, in the 5th and 6th chapters of the 1st Book of Samuel, of what appears to be the earliest, and one of the clearest historical references to plague. The Ark of God had been carried away by the Philistines. Placed in the house of Dagon, the image of Dagon fell on its face before the Ark. "The hand of the Lord was heavy upon them of Ashdod, and He destroyed them and smote them with emerods." So they carried the Ark to Gath. "And it was so, that, after they had carried it about, the hand of the Lord was against the city with a very great destruction; and He smote the men of the city, both small and great, and they had emerods in their secret parts." Then the Philistines called the priests and diviners together, who advised the return of the Ark of God with a trespass offering, and for the trespass offering "ye shall make images of your emerods and images of your mice that mar the land." Then the Ark was placed on a cart, and the kine that drew it, brought it, undriven, to

[1] Aust. Med. Gaz., Oct. 20th, 1899.

Beth-Shemesh. Now here the men of Beth-Shemesh rejoiced to see the Ark, and they "clave the wood of the cart and offered the kine a burnt offering unto the Lord. And the Lord smote the men of Beth-Shemesh because they had looked into the Ark of the Lord, even He smote of the people fifty thousand and three score and ten men." In this account we see references to the buboes in the groins of those afflicted, to the mice (or rats) that marred the land, to the disease breaking out wherever the Ark journeyed with its freight of plague-infected mice—the vengeance of the God of Israel, to the special attack of the men of Beth-Shemesh who came into such intimate contact with the Ark in breaking up the wood-work of the cart, and doubtless disturbing the mice in the Ark, and to the image of Dagon falling down, perhaps from the gnawing through of its supports. The picture seems complete in all its details.

Gibbon,[1] in masterly language, described in full the great plague of Justinian that started in 542 A.D. and lasted for 52 years. After describing the typical signs and symptoms, the effects on the population, and the question of contagion, he adds that "No facts have been preserved to sustain an account, or even a conjecture, of the numbers that perished in this extraordinary mortality. I only find that during three months, five, and at length ten, thousand persons died each day at Constantinople; that many cities of the East were left vacant; and that in several districts of Italy the harvest and the vintage withered on the ground."

Gibbon, at the end of this chapter, has an interesting footnote. He quotes Procobius (Anecdot. C. 18) as saying that 'μυριάδας μυριάδων μυριάς' "had been exterminated under the reign of the Imperial dæmon. The expression is obscure in grammar and arithmetic, and a literal interpretation would produce several millions of millions. . . .

[1] "Decline and Fall of the Roman Empire," Ch. XLIII.

If we drop the μυριάδας the remaining μυριάδων μυριάς, a myriad of myriads, would furnish one hundred millions, a number not wholly inadmissible.'' Now the Greek for a mouse or rat is μῦς, μυός, whilst the Latin is *mus, muris.* It occurred to me that the redundant μυριάδας, with its stem *mur,* might be a punning reference—a failing to which I believe some of these old authors were inclined—to rats and mice having also succumbed. On referring the matter to Professor Darnley Naylor, of Adelaide, he suggested that, if any manuscript showed μυρίων (for μυριάς), then it would be quite conceivable that μυρίων was a corruption of μυῶν, i.e., ten thousand times ten thousand rats. He added, however, that this was the vainest guess-work without the original to which to refer, and this he was unable at the time to do, as he was away on a holiday.

The story of the Pied Piper of Hamelin, so graphically embodied in verse by Robert Browning, is, I am inclined to think, a legendary reference to an outbreak of plague. ''The Pyed Piper''[1] was promised a reward if he would drive the rats and mice out of Hamelin (Westphalia). This he did, for he gathered them together by his pipe, and then drowned them in the river. As the people refused to pay him, he next led the children to Koppelberg Hill, where 130 of them perished (July 22nd, 1376). Does not this suggest that the rats and mice, which were evidently numerous, contracted plague, which nearly or quite exterminated them? Metaphorically they were piped together and drowned in the river. Following on the disappearance of the rats, there was a heavy mortality in human beings, in this case in children, due to their contracting the plague from the rats, and they, likewise, metaphorically followed the Piper as the rats had done, and passed to eternity ''through the wondrous portal that opened wide in the

[1]Rev. Dr. Brewer, Dict. of Phrase and Fable.

mountain's side." And is it not a significant coincidence that this calamity befel the children because the Piper had not been paid his dues?—which we now know were cleanliness and better sanitation. That this view of the story of the Pied Piper has indirect evidence to support it, it may be mentioned that Payne[1] states that after some 800 years, during which plague cannot be clearly traced, it broke out afresh in the fourteenth century. The "Black Death" appeared in Southern Italy in 1346-47, and spread over the whole of Europe. A second epidemic occurred in 1361, and a third in 1368. "It has been calculated that 25 million persons, one-fourth of the population of Europe, died of the disease." The date of the story of the Pied Piper is 1376, eight years after the last of these great outbreaks, and it is not unreasonable to assume that at this period there were still many local outbreaks of the disease. It may further be pointed out that, if this legend does not refer to an outbreak of plague, to what does it refer? It may be pure imagination, but nearly all such tales, however distorted, have a basis in fact. Even our familiar Punch and Judy has a deeper origin than fun and fancy.

One of the most graphic and picturesque descriptions is that of the plague in Florence in 1348, given by Boccaccio in the Introduction to the Decameron. "Despite all that human wisdom and forethought could devise to avert it, as the clearing of the city from many impurities by officials appointed for the purpose, the refusal of entrance to all sick folk, and the adoption of many precautions for the preservation of health . . . between March and the ensuing July upwards of a hundred thousand human beings lost their lives within the walls of the city of Florence, which before the deadly visitation would not have been supposed to contain so many people." Boccaccio refers to other animals

1 Allbutt's Syst. of Med., 1st Edit., I., p. 917.

contracting the disease. His account, however, of two hogs "trifling with their snouts" amongst the rags of a poor man who had died of the disease, and almost immediately dying themselves, cannot be taken as an instance to support his statement.

De Foe's "History of the Plague in London, 1665," is doubtless well-known to you all, and is well worthy of perusal. Hirsch[1] gives a full historical summary of the recognised occurrences of epidemics of plague.

A Summary of the Occurrence of Cases of Plague in Australia.

In Australia, from 1900 to 1909 inclusive, at least 1214 indigenous cases of plague occurred, with 470 deaths, a mortality of about 39 per cent. There were in addition a few extra cases which had been infected on board ship. These either developed the disease at sea or, if after arrival at an Australian port, under circumstances showing that the infection had not been contracted ashore in Australia. A few deaths, probably not more than a dozen altogether, occurred amongst these exotic cases.

New South Wales.—Between 1900 and 1909 there were 617 cases and 210 deaths in this State.

1900.—The first case of plague in New South Wales, and also in Australia, occurred in Sydney on January 19th, 1900. A second case appeared five weeks later, and during the first outbreak, between January 19th and August 9th, 303 cases and 103 deaths were recorded.

1901-1902.—Single cases of plague occurred on November 4th and December 8th, 1901, whilst the main second outbreak lasted from January 10th or 11th to June 8th, 1902. There were 139 cases, 39 of which were fatal. The last plague rat was found on July 14th, 1902. An indigenous fatal case

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[1] Hirsch, Handk. of Geograph. and Hist. Path., Vol. I, p. 494,

occurred at Newcastle on August 6th, 1902. During the outbreak a number of animals died in the Zoological Gardens, Moore Park, and amongst these plague was detected in four wallabies (*Macropus sp.*), one wallaroo (*M. robustus* Gould), one pademelon (*M. thetidis* Lesson), one tree kangaroo, an Indian antelope (*Antilope cennacapra* L.) and three guinea-pigs (*Cavia cutleri* Bennett). Infected rats, all *E. norvegicus,* were found on the s.s. *"Antillian,"* from Capetown. Dr. Tidswell did not find plague in any specimens of *E. rattus,* though these were readily infected in the laboratory.

1903.—Two human cases occurred, one on June 17th, the other on July 2nd—both recovered. Plague rats were found between May 12th and August 15th. Plague rats were found between July 29th and August 3rd on the barque "Alterschwan," from Buenos Ayres, etc.

1904.—Twelve human cases, of which six died, occurred between March 9th and September 10th. Between March 1st and December 3rd, 108 *E. norvegicus,* 73 *E. rattus,* 62 *M. musculus* and 1 cat were found plague infected.

1905.—In this year plague occurred not only in Sydney, but also on the North Coast. In the former locality there were 18 cases, five fatal, between March 11th and July 12th. Plague rats were found between January 18th and December 5th. Altogether 78 *E. norvegicus,* 45 *E. rattus* and 18 *M. musculus* were found infected. The outbreak began on the North Coast wharf with infected *E. rattus* and later *E. norvegicus.*

In the Ulmarra district of the North Coast there were 13 cases of human plague, eight fatal, between December 14th, 1904, and May 6th, 1905. 101 infected *E. norvegicus* and 2 infected mice were found at Ulmarra, and five of the same species of rat and 1 mouse infected at Woodford Island; 2 cats also had plague. At Ballina, on the Richmond River, 4 human cases, 3 fatal, occurred between February 3rd and May 28th; 4 plague rats were found on February 14th, and in all 28 rats, 3 mice and 1 cat. At South Woodburn plague rats alone were found between March 18th and April 19th.

At Lismore there were 8 cases and 3 deaths between May 1st and May 30th, though there were possibly an additional case in March and 2 in April. Eleven rats and 8 mice were found infected between May 12th and June 13th.

Plague also appeared at Newcastle, which had hitherto remained comparatively free, having had only two cases, both in 1902, one indigenous and one from Sydney. Between March 25th and July 3rd there were 14 human cases, 3 fatal. Between March 28th and July 6th, 171 *E. norvegicus,* 13 *E. rattus* and 22 *M. musculus*—a total of 206—were found infected.

1906.—In Sydney, 20 human cases, 8 being fatal, occurred between March 12th and December 22nd. One of these was a case of primary plague pneumonia. Between January 25th and December 29th 46 *E. norvegicus,* 89 *E. rattus* and 39 *M. musculus* were found with plague.

1907.—There were 47 cases, 16 fatal, in Sydney, between January 7th and December 29th. Two were due to primary plague pneumonia. Between January 10th and September 21st, 57 *E. norvegicus,* 143 *E. rattus* and 19 *M. musculus* were found infected. At Kempsey, in the North Coast district, 4 cases, all fatal, occurred between January 23rd and February 6th. Two or three of these, including the matron of the hospital, had primary plague pneumonia. Twelve plague infected rats were found here.

1908.—An infected rat was found in the metropolis on January 2nd. In Sydney during the first six months of the year, there were 7 cases, with 3 deaths, and 160 infected rats, and 15 infected mice, were found. In addition, a fatal case occurred at Kempsey, in February.

1909.—In Sydney there were 11 cases of plague in March, 9 in April, and 4 in May, giving a total of 24, with 7 deaths. Between January and June, 178 infected rodents were found.

1910.—No human cases occurred, but 5 infected rats were found in Sydney in April.

New South Wales has been free from plague since 1910.

Table III.—*Cases of Plague in New South Wales.*

Year.	Town.	Human Cases.	Deaths.	*E. norvegicus*	*E. rattus*	*M. musculus.*	Cats.	Zool. Gardens various animals.
1900	Sydney ...	303	103					
1901	,, ...	2	1					
1902	,, ...	137	38	...	...	...	...	11
	Newcastle ..	1	1					
1903	Sydney ...	2	0	111		50		
1904	,, ...	12	6	108	73	62	1	
1905	,, ...	18	5	78	45	18		
	Ulmarra ...	13[1]	8	101	...	2	1	
	Woodford I.	0	0	5	...	1	1	
	Ballina ...	4	3	28		3	1	
	S. Woodburn	0	0	rats				
	Lismore ...	8 (?11)	3	11		8		
	Newcastle ...	14	3	171	13	22		
1906	Sydney ...	20	8	46	89	39		
1907	,, ...	47	16	57	143	19		
	Kempsey ...	4	4	12				
1908	Sydney ...	7	3	82	78	15		
	Kempsey ...	1	1					
1909	Sydney ..	24	7	22	138	18		
1910	,, ...	...	...	4	1			
Total	...	617 (?620)	210	674 162 580		257	4	11
				1416				

[1] Beginning in December, 1904.

Queensland.—Between 1900 and 1909 there were 499 cases of plague and 219 deaths in this State.

1900.—136 cases, with 57 deaths, occurred between April 15th and December 13th, distributed as follows:—

Brisbane, between April 27th and December 13th, 56 cases and 25 deaths.

Rockhampton, between April 15th and August 17th, 36 cases and 21 deaths.

Townsville, between April 28th and September 16th, 37 cases and 9 deaths.

Cairns, between May 10th and July 26th, 5 cases and 2 deaths.

Ipswich, on May 21st, 1 case and no death.

Charters Towers, on September 30th, 1 case and no death.

Ninety infected rats were found in Brisbane between March 5th and October 24th.

1901.—36 cases, with 12 deaths, occurred in the Brisbane area only between February 28th and December 9th.

101 infected rats were found between April 4th and November 22nd.

1902.—91 cases, with 33 deaths, occurred between January 27th and November 26th, distributed as follows:—

Brisbane, between January 27th and August 4th, 82 cases and 26 deaths.

Townsville, between August 20th and November 26th, 7 cases and 5 deaths.

Bundaberg, on October 13th, 1 case and 1 death.

Gladstone, on August 25th, 1 case and 1 death.

106 infected rats were found in the Brisbane area between January and August.

1903.—29 cases, with 17 deaths, occurred between February 8th and September 11th, distributed as follows:—

Brisbane, between February 8th and September 11th, 21 cases and 11 deaths.

Bundaberg, 2 cases and 1 death.

Rockhampton, between February 11th and February 21st, 2 cases and 2 deaths.

Townsville, 3 cases and 2 deaths.

Cairns, 1 case and 1 death.

84 infected rats and 4 infected mice were found in the Brisbane area between January and September 28th. Infected rats were discovered at all the other towns infected.

1904.—35 cases, with 12 deaths, occurred between February 9th and September 14th, distributed as follows:—

Brisbane, between February 9th and September 14th, 30 cases and 8 deaths.

Ipswich, on July 10th, 1 case and 1 death.

Maryborough, between June 3rd and June 13th, 2 cases and 1 death.

Cairns, between February 16th and March 22nd, 2 cases and 2 deaths.

401 rats and 3 mice were found infected in the Brisbane area between January 8th and December 15th. 309 of these rats were identified as *E. norvegicus* and 63 as *E. rattus.*

1905.—56 cases, with 33 deaths, occurred between January 1st and October, distributed as follows:—

Brisbane, between January 1st and June 14th, 28 cases and 15 deaths.

Bundaberg, on February 3rd, 1 case and 1 death.

Ipswich, between May 15th and July 14th, 8 cases and 2 deaths.

Childers, on May 16th, 1 case and 1 death.

Maryborough, between May 19th and June 16th, 10 cases and 8 deaths.

Cairns, on June 24th, 2 cases and no deaths.

Townsville, between August 4th and October, 6 cases and 6 deaths.

Infected rodents were found at all the places attacked. 129 were detected in the Brisbane area between January 4th and November 29th, of which 87 were *E. norvegicus*, 41 *E. rattus* (*alexandrinus*) and 1 *Mus musculus*.

1906.—32 cases, with 12 deaths, occurred between March 6th and December 18th, distributed as follows:—

Brisbane, between March 6th and December 18th, 11 cases and 7 deaths.

Rockhampton, between April 3rd and May, 11 cases and 4 deaths.

Cairns, in July, September and October, 10 cases and 1 death.

48 infected rodents were found in the metropolitan area between January 12th and December 28th, comprising 32 *E. rattus* and 16 *E. norvegicus*.

1907.—53 cases, with 25 deaths, occurred between January 3rd and September, distributed as follows:—

Brisbane, between January 3rd and September, 40 cases and 20 deaths.

Ipswich, on February 12th and May 23rd, 2 cases and 2 deaths.

Port Douglas,[1] between January and May, 10 cases and 2 deaths.

Townsville, on March 17th, 1 case and 1 death.

45 infected rodents were found in the metropolitan district between January 2nd and December 20th.

1908.—29 cases, with 16 deaths, occurred between January 3rd and November, distributed as follows:—

Brisbane, between January 3rd and April, and in June, August and November, 14 cases and 8 deaths.

Cairns, 14 cases and 7 deaths.

Mackay, on April 29th, 1 case and 1 death.

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[1] In the ten cases from Port Douglas, bacilli morphologically like those of plague were detected. In addition, in this Mossman district there were about sixty other cases with glandular swellings, provisionally diagnosed as 'pestis minor.'

71 infected rodents were found in the Brisbane area between January 22nd and September 15th.

1909.—2 cases, with 2 deaths, occurred at Mackay in January and June. Five infected rats were found in July, August and September.

Since 1909, there have been no further cases detected in man or rats in Queensland.

Table IV.[1]—*Showing the Incidence of Plague on Human Beings in the State of Queensland for whole Period 1900 to 1909.*

Area.	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	Total Cases	Total Deaths
Brisbane (Metropolitan area)												
Attacks ..	56	36	82	21	30	28	11	40	14	0	318	
Deaths ...	25	12	26	11	8	15	7	20	8	0	...	132
Ipswich—												
Attacks ..	1	0	0	0	1	8	0	2	0	0	12	
Deaths ..	0	0	0	0	1	2	0	2	0	0	...	5
Maryborough—												
Attacks ...	0	0	0	0	2	10	0	0	0	0	12	
Deaths ...	0	0	0	0	1	8	0	0	0	0	...	9
Childers—												
Attacks ..	0	0	0	0	0	1	0	0	0	0	1	
Deaths ...	0	0	0	0	0	1	0	0	0	0	...	1
Bundaberg—												
Attacks ...	0	0	1	2	0	1	0	0	0	0	4	
Deaths ...	0	0	1	1	0	1	0	0	0	0	...	3
Gladstone—												
Attacks ...	0	0	1	0	0	0	0	0	0	0	1	
Deaths ...	0	0	1	0	0	0	0	0	0	0	...	1
Rockhampton												
Attacks ...	36	0	0	2	0	0	11	0	0	0	49	
Deaths ...	21	0	0	2	0	0	4	0	0	0	...	27
Townsville—												
Attacks ..	37	0	7	3	0	6	0	1	0	0	54	
Deaths ...	9	0	5	2	0	6	0	1	0	0	...	23
Cairns—												
Attacks ..	5	0	0	1	2	2	10	0	14	0	34	
Deaths ...	2	0	0	1	2	0	1	0	7	0	...	13
Port Douglas—												
Attacks ...	0	0	0	0	0	0	0	10	0	0	10	
Deaths ..	0	0	0	0	0	0	0	2	0	0	...	2
Charters Towers												
Attacks ..	1	0	0	0	0	0	0	0	0	0	1	
Deaths ..	0	0	0	0	0	0	0	0	0	0	...	0
Mackay—												
Attacks ..	0	0	0	0	0	0	0	0	1	2	3	
Deaths ..	0	0	0	0	0	0	0	0	1	2	...	3
Totals { Attacks	136	36	91	29	35	56	32	53	29	2	499	
Totals { Deaths	57	12	33	17	12	33	12	25	16	2	..	219

[1] Adapted from Ham, *loc. cit.*

Victoria—1900.—There was an imported case of plague in April, and 10 indigenous cases in May and June. The vital statistics show 2 deaths.

1902.—An indigenous case occurred in March.

1907.—An imported case, which was fatal, occurred in May.

No plague infected rats were discovered in these outbreaks.

South Australia—1900.—Considerable controversy took place at the time as to the real nature of certain cases which occurred in South Australia in January. In the light of experience gained later as regards the plague bacillus and the epidemiology of plague, it can only be said that on reading the reports, even were the cases this disease, the records do not carry conviction. The following are the cases referred to:—Case 1, a man from Gawler, who was admitted to the Adelaide Hospital on January 1st and died on January 12th; case 2, a boy from Gawler, admitted to the same hospital on January 5th; and case 3, a boy from Adelaide, admitted to the hospital on January 18th. Later, an undoubted case of plague occurred in a man at Port Adelaide, who had been working on a steamer which had recently arrived from Sydney.

1909.—There were four fatal cases of plague at Port Adelaide.

Western Australia.—In this State, between 1900 and 1906, there were 80 indigenous cases of plague and 34 deaths. There were four additional cases landed from a French mail steamer. Two fatal cases in 1905 and a fatal case in 1901 were not indigenous. The Vital Statistics give 36 deaths in all up to the present.

1900.—Between April 6th and June 18th there were 6 cases, with 3 deaths, all at Fremantle.

1901.—Between March 2nd and May 18th there were 23 cases, with 5 deaths. Of these 15 cases and 5 deaths were at Perth, 7 cases at Fremantle, and 1 case at Kalgoorlie.

1902.—There were 3 cases at Fremantle between May 22nd and July 8th, all of whom died. The Vital Statistics record 4 deaths.

1903.—13 cases, 8 fatal, at Fremantle between January 25th and November 6th.

1904.—4 cases, 1 fatal, between June 25th and August 25th. Of these, 2 cases and 1 death were at Perth, 2 cases at Fremantle.

1905.—There were no local cases. The Vital Statistics record 2 deaths.

1906.—31 cases, 14 fatal. Of these there were four cases in Perth between January 12th and May 14th, 17 at Fremantle, with 6 deaths, between February 12th and June 2nd, and 10, with 8 deaths, at Geraldton, between February 19th and March 8th.

1909.—A non-indigenous fatal case occurred.

Of the local cases, 6 occurred in January, 22 in February, 24 in March, 2 in April, 7 in May, 5 in June, 2 in July, 1 in August, 1 in September, 1 in October, 2 in November, and none in December.

The Species of Animals Naturally Infected with Plague in Australia.

In the earlier years of plague, differentiation between infected *E. norvegicus* and *E. rattus* was not carried out. From 1904, however, some information is available for New South Wales, Queensland and South Australia.

E. norvegicus.—In New South Wales, from 1900 to 1902, all the infected rats were considered to be *E. norvegicus*.

From 1904 to 1910, 674 infected individuals of this species were recognised, located at Sydney, Newcastle, Ulmarra and Woodford Island. In Queensland, in 1904, 1905 and 1906 (*vide* Ham's Report, p. 131)—the only years apparently in which the requisite data have been published—there were 412 infected *E. norvegicus.* Dr. Borthwick informs me that in Port Adelaide in 1909 all the rats found infected, 6 in number, were of this species. Total, 1092.

E. rattus.—In New South Wales, for the period mentioned, 580 *E. rattus* were found infected, all being from Newcastle or Sydney. In Queensland the number for the three years 1904 to 1906 was 136. Total, 716.

Mus musculus.—Whilst 257 infected mice in New South Wales were found at Sydney, Newcastle, Ulmarra, Woodford Island, Ballina and Lismore, only 4 altogether were found in Queensland. Total, 261.

Other Animals.—4 cats were found infected in New South Wales, at Sydney, Woodford Island and Ballina. A list already given shows that in Sydney, in 1902, 4 wallabies, 1 wallaroo, 1 pademelon, 1 tree kangaroo, 1 Indian antelope and 3 guinea-pigs contracted plague naturally in the Zoological Gardens.

Rat Leprosy.

What is known as rat leprosy has been recorded from various parts of the world, including Australia (Sydney, Melbourne, Adelaide). A severely affected rat loses the hair on the back and adjacent parts of the limbs, and this is accompanied with much thickening of the skin and subcutaneous tissues, and frequently with small areas of superficial ulceration. When sections are made of these tissues they are found to contain countless millions of the acid-fast bacilli of rat leprosy. Sections stained as for tubercle bacilli may appear deep red from their abundance—in fact, in some specimens examined by us it is safe to say that in the affected areas the weight of these leprosy bacilli was greater than that of the tissue they were invading. This condition in rats meets its parallel in certain cases of nodular leprosy of human beings; in these lepromata the leprosy bacilli may be present in enormous numbers. The first leprous rat recorded for Australia was found in Sydney on 20th April, 1904.[1] In May, 1910,[2] another infected rat (*Epimys norvegicus*) was found at Ultimo. Further leprous rats were found in Sydney on 4th December, 1911, 11th January, 1912, and 22nd August, 1912.[3] From two of these rats successful inoculations were made into white rats. Up to the period when the last of these rats was found by us about 560,000 rats and mice had been examined during the previous 14 years, and five of the rats were found severely affected with this disease. From this it might be inferred that one diseased rat might be expected in Sydney in about 100,000 examined.

In 1913 Dr. Priestley (*Australasian Medical Gazette*, Nov., 1913, p. 405) recorded the presence of these acid-fast bacilli in rats (*E. norvegicus*) in the Townsville district. Of 220 rats examined, 6 had the lymphatic form of the infection, 6 the musculo-cutaneous type found in the above-mentioned Sydney rats. The incidence amongst these North Queensland rats is much higher than in the New South Wales ones. In 1907, Dr. R. J. Bull[4] recorded a case from Collingwood, Melbourne. L. B. Bull reported the occurrence of a case in South Australia to the chairman of the Adelaide Local Board of Health a few years ago.

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[1] Report of the Board of Health on Leprosy in New South Wales, 1904 p. 13.

[2] Second Report of the Government Bureau of Microbiology, 1910–1911, p. 49.

[3] Fourth Report of the Microbiological Laboratory, Dept. of Public Health, 1913, p. 186.

[4] Intercol. Med. J. of Austr., May, 1907.

From the above short resumé of the occurrence of rat leprosy in Australia it will be seen that this disease is fairly widely distributed, though of relatively rare occurrence. Its incidence amongst the rat population is much about the same as the incidence of leprosy amongst the human population. Annually in New South Wales several cases of leprosy are as a rule notified, and the same probably occurs in Queensland, whilst occasional instances are found in the Northern Territory and in North-west Australia. For the whole of Australia, during the nine years 1907 to 1915 inclusive, about 16 new cases were on an average reported annually. Indigenous cases of human leprosy are not known in South Australia, and seem very rare in Victoria. On January 1st, 1915, there were 22 human lepers in New South Wales, in a population of 1,868,000. This is, approximately, 1 leper to 80,000 inhabitants. Though in some of the instances of human leprosy in Australia, infection may have occurred outside Australia, in quite a number of instances there is no doubt the patients were infected naturally in Australia, as for instance in the case of persons who were born in Australia and have never been outside it. Whilst in some of these cases association, more or less direct, can be traced to previous lepers, in other instances no such association can be found. It may be roughly stated that whilst about one in 80,000 of the inhabitants of New South Wales examined at any particular time will be found to be leprous, about one in a hundred thousand of rats examined in this State may be expected to have rat leprosy. Is there any possible connection between the two diseases? Are they due to the same organism? Is there any reason to think that if the method of spread of rat leprosy could be discovered, the key would be found to the solution of the means of spread of human leprosy?

In answer to the second question, it may be stated that it is possible, if not absolutely certain, that the two diseases are due to different organisms.

In answer to the third question, it is quite possible that if the etiology of rat leprosy were thoroughly worked out we would find the solution of the human leprosy problem.

This leads to a very interesting, and possibly very important, speculation. There are several diseases known, affecting man and animals, due to acid-fast bacilli, probably really species of *Streptothrix,* and quite a number of diseases due to other streptotriches and allied organisms. Tuberculosis in human beings, bovines and other animals, is due to the various varieties or species of tubercle bacilli which by some are called *Streptothrix tuberculosis.* The disease affecting the intestines of cattle, causing thickening of the rugæ, and known as Johne's disease, is also due to an acid-fast bacillus. Dr. Bull met with a case of this disease in an imported cow in Melbourne in 1911. Then we have human leprosy and rat leprosy, all of these diseases being due to acid-fast bacilli of the *Streptothrix* group.

In addition we have, as a common disease in cattle and an occasional disease in man, actinomycosis, which in cattle may be responsible for "lumpy jaw" and "wooden tongue." This disease is due to the growth of various species of *Streptothrix* or allied fungi, and there seems no doubt at all but that the infection is conveyed to the animals from their surroundings (herbage, etc.). This is indicated by the frequency with which awns of grass or similar material are found in cases of the disease whether in animals or human beings. From this it would appear that infection in actinomycosis occurs from the surroundings of the animals or human beings, where presumably the fungi responsible are living saprophytic existences, rather than by direct contamination from previous cases.

As regards tuberculosis, however, the infection of both animals and man is unquestionably more or less direct by contamination from the surroundings of previous cases, the tubercle bacilli not leading a saprophytic multiplicative existence in the interval.

In this group of diseases, then, we see two different types of infection, one, illustrated by tuberculosis, showing more or less direct infection from one victim to another; the other being apparently due to the establishment of an organism which usually leads a saprophytic existence, but which, given the opportunity, can multiply and produce disease in higher animals. Under which of these two categories do leprosy in rats and leprosy in man come?

It is recognised that leprosy in human beings is rarely conveyed to those in contact with lepers. Occasionally, after long and intimate association, such cases occur. The danger of a leper to others is greatly less than that of a tubercular person to his associates. Cases occur in families, but here it is hard to say whether one had been infected from another or whether all had had a common origin. Leprosy is a relatively rare disease, both the human form and the rat one. Actinomycosis, a disease apparently not spread by direct association with previous cases, is common in our cattle, and even in man not rarer than leprosy. It seems to me quite possible, therefore, that leprosy, both in rats and men, is due to the accidental establishment in the tissues of an organism which is normally a saprophyte of their surroundings. Undoubtedly the phylogenetic history of the tubercle bacillus would show that it was originally such a saprophyte purely confined to growth in our surroundings, as for instance the acid-fast Timothy-grass bacillus is still; that its next stage was its accidental introduction by the alimentary canal or through wounds into the tissues of vertebrates, where it found itself capable of living and multiplying, even though in such an unusual environment; finally, being given frequent opportunities of escape from its host through ulceration in the lungs and of introduction consequently to fresh individuals, its pathogenicity increased and its saprophytic qualities were diminished or lost. If the leprosy bacillus has reached only the second of these stages it may eventually be found in the natural surroundings of cases of leprosy. The chief objection to this point of view is the difficulty or impossibility of growing the organism artificially. If this supposition be correct, it may modify considerably our methods of control of leprosy.

Spirochætosis icterohæmorrhagica.

For many years occasional outbreaks of an acute infective disease with jaundice have been known in man. Special attention was drawn to the disease in 1886 by a paper by Professor Weil, of Heidelberg, and the complaint has until recently been commonly associated with his name under the designation "Weil's Disease." Now a more suitable name, indicative of its etiology, has been found for it. Recently this form of jaundice has been noticed in Japan to be unduly prevalent amongst coal miners working in certain galleries, especially liable to be flooded, and amongst sewermen. A spirochæte, which Inada and Ino have called *Spirochæta icterohæmorrhagica,* has been found in these cases, and seems clearly to be responsible for the condition. The disease has also appeared on the western battlefront in Europe —its appearance during campaigns has been noted before, an infective jaundice having appeared, for instance, amongst Napoleon's troops in Egypt—and the same organisation has been found in some of the patients. Further, following on carefully reasoned epidemiological data, the Japanese searched for and found the *Sp. icterohæmorrha-*

gica in sewer rats. Supplementing this discovery, Martin and Pettit found it in a Norway rat in Europe coming from an army area in which there had been a case of the spirochætosis, whilst Courmont and Durand[1] found it in 4 out of 50 sewer rats (*E. norvegicus*) in areas in France in which the disease was not known in man. The conclusion seems justifiable, therefore, that this organism is a parasite of the sewer-rat in various parts of the world, and it seems probable that this rat is its chief distributing agent.

During 1917 we carried out some experimental inoculations to see whether this spirochæte could be detected in rats in this State. For this purpose, on October 5th, six kidneys from six *E. norvegicus* were ground up in normal saline solution and injected into the subcutaneous tissues of the groins of two guinea-pigs; on October 8th, three kidneys from three *E. rattus* were similarly employed; on October 9th, four kidneys from four *E. norvegicus*, and on October 11th, three kidneys from three *E. rattus* were likewise injected into other pairs of guinea-pigs. Of the eight guinea-pigs used, one of the first pair died of sepsis within three days. The other seven remained unaffected, from which may be inferred the absence of the *Spirochœta icterohœmorrhagica* in the 10 *E. norvegicus* and the 6 *E. rattus* used for the experiments.

The occurrence of occasional cases of fatal jaundice (?) in monkeys in Taronga Zoological Park led to a careful examination of them for the spirochætes of this disease. These were not found either in suitably treated sections of the tissues, or by inoculations of emulsions of the spleens and kidneys into the susceptible guinea-pig. Equally unsuccessful in conveying the disease was the injection of another monkey with such an emulsion. Further, on Novem-

[1] Bull. et Mém. de la Soc. Méd. des Hôpitaux de Paris, 1917. p, 115; quoted in Rev. of Bact., etc., VII, 1917, No. 50.

ber 13th, the injections of emulsions of the kidneys and spleens of four specimens of *E. norvegicus,* caught in proximity to the monkey cages, into four guinea-pigs, were likewise without results. Thus there is no evidence that our local rats harbour this parasite.

Rat-bite Fever.

For some years a peculiar disease in man, following on bites by rats, has been known under this designation. Blake[1] has given a full description of the disease on which the remaining part of this paragraph is based. In Japan, which has furnished most of the cases, it is known as "Sokodu." The original wound having healed, after an incubation period of a few days to a month, the part becomes again inflamed. Systemic symptoms follow, and the patient's condition may become grave. A characteristic rash may be present. If the patient recover from the first bout of fever, the disease may assume a relapsing form, and be prolonged for months and even, it is said, for years.

The disease may be conveyed to guinea-pigs by making rats bite them. Recently Japanese workers have found spirochætes in healthy rats, in human beings bitten by rats and suffering from the disease, and in monkeys and guinea-pigs infected in the laboratory. Futaki, Takaki, Tangiguchi and Osumi[2] have designated this organism as *Spirochœta morsus muris*—but as trinominals are inadmissible, except to indicate a variety of a species, i.e., a sub-species, *Sp. morsus-muris* should be adopted.

No cases of this disease have as yet been recorded for Australia. I have, however, heard of a child in Sydney who recently was bitten by a cat, a prolonged illness re-

[1] Blake, J. of Exp. Med., XXIII., I, p. 39, quoted in C'wealth of Aust., Quart. Service Public, No. 8, p. 26.
[2] Journ. of Exp. Med., 1917, XXV, pp. 33–44.

sulting. From the account, it is possible that this was a case of rat-bite fever, the cat having been infected with the spirochætes from catching rats.

A Theory as to the Nature of Cancerous Processes.

During recent years great progress has been made in unravelling the principles governing phylogeny, ontogeny and heredity. In one direction, the discovery of the chromosomes of cells and of the differences between those of somatic and those of gametogenic cells, and in another direction the Mendelian theory of heredity, have both led to far-reaching advances in our knowledge of life-processes. Having been engaged some years ago in cancer investigations as Cancer Research Scholar at the London Hospital, and this at a time when, through the researches of Farmer, Moore and Walker, particular attention was being directed to the types of mitoses found in cancer cells, my attention was naturally especially focussed on this aspect of the question. Since then opportunities for further practical work on this subject have not presented themselves to me, but nevertheless my interest in this and allied questions has naturally not flagged, and has been stimulated from time to time by new views and ideas that have suggested themselves, often as a result of collateral work by various investigators. The present seems a fitting occasion to present these ideas, partly because some of them may be of interest to educated people in general, partly because they may help in the solution of problems still unsolved.

A cancer is a new growth or neoplasm. Neoplasms may be roughly divided into two groups, innocent and malignant. Innocent growths form tumours, whose cells grow independently, or relatively so, of the needs of the rest of the body. Their cells do not invade the adjacent tissues, and injury or death to their host results merely from their position and size, which may interfere with vital functions.

Encapsuled fatty tumours or lipomata are typical instances of innocent tumours. Their relative independence of control by the rest of the body may be well seen in starvation or in emaciation from cachexia,[1] when the normal fatty tissues may be absorbed to supply the needs of the moment, but those of the growth are unaffected. Here an interesting speculation may be hazarded. The fat manufactured in a fat cell is set free for use elsewhere by means of fat-splitting ferments, lipases. This action is reversible, the same ferment having originally synthesised the fat from the materials furnished by the surrounding nutritive fluids. A condition of equilibrium is considered to exist between the pro-fat constituents on the outside of the cell-wall of the fat cell and the neutral fat stored within it, the lipase being the agent by which this equilibrium is maintained. An increase in the former constituents leads to storage of fat till equilibrium is again restored, whilst a diminution leads to splitting up of the stored fat with the same object in view. The accounts are transferred from side to side of the ledger according to requirements, so that, like an ideally-conducted business, with a perpetual audit, income and expenditure always balance. Now from this it will appear that in the absence of lipase or of means to set it working, the fat must remain where it is. The loaded fat cell will remain loaded if there is no percussion cap or ferment to initiate its discharge, or no finger to pull the trigger and so explode the percussion cap. It seems to me possible that lipomata may arise either through the disappearance of the lipase required to discharge the fat, or owing to failure of the required stimulus to make it split up the fat. The lipase may fail because the cells lose the capacity to make it, or an antilipase neutralises it as made—the stimulus (a

[1] Vide Paget, Lects. on Surg. Path., Turner, 3rd Edit., 1870, p. 378. —case of intense emaciation from tuberculosis with fatty tumours in the mesentery.

deficiency of the fat-forming constituents) may be unable to reach the cells because the vascular and lymphatic channels, the roads by which it comes, are blocked or inefficient, or because the concentration of the pro-fat materials surrounding the fat cells is, for some reason, still too high in spite of a deficiency elsewhere. The fat cell is then in the position of the carpet-snake that has swallowed a china nest-egg—unable to split up the body distending it, and equally unable to disgorge it. Neighbouring pro-fat cells similarly form fat, store it up, and then find it cannot be dealt with. Finally the summation of these cells forms a tumour. Enzymes probably play a similar part in the production and absorption of fibrous and even bony material —witness, for instance, the absorption of callus after an injury to bone. A little imagination will show how this view can be applied to fibromata and osteotomata as well as lipomata.

Malignant growths are similarly formed of cells growing independently of the bodily needs. They differ from innocent growths in that their cells, to a greater or less extent, tend to invade the surrounding tissues and replace them, and even to be dislodged from the situation in which they grow, to be distributed by the vascular or lymphatic tissues to other parts of the body. When thus seeded they begin to grow in the new situation, forming fresh deposits of the new growth or metastases. The faculty of invasion may give rise to a loss in size of the invaded tissues by a process of erosion—when we have the anomaly of a malignant "tumour" which shows a shrinkage in size from the normal, and not an increased "swelling," as the name implies—or to an increase in size from the number and size of the malignant cells more than making up for the loss of the normal cells. Death may result either from interference, by replacement, with vital tissues from the original growth or its deposits, or by the pressure effects of the tumour masses.

What is the essential basis of the malignant process? Is it due to changes inherent in the cells or the tissues, or to a reaction to parasites of external origin? Is the process intrinsic or extrinsic? If the latter, we must seek to exclude the causal factor or factors; if the former, to ascertain and control the means by which the departure from normal is brought about.

The great body of cancer investigators hold the view, based on a reasonable assessment of all the known data, that an external parasite—protozoal or otherwise—is not an essential in the development of true malignant neoplasms. It is true that reactions of the body cells to foreign parasites, some bacterial, some animal, may ape in various ways malignant neoplasms, and that such parasites may aid in the starting of a cancer. But the balance of evidence is strongly against the view that such foreign living bodies are the essential cause, though this view cannot be considered as conclusively discounted.

To my mind, the nature of cancer is intimately bound up with the development of the body cells. I believe it to be the expression, by nearly effete somatic cells, of an attempt by them to prevent extinction by the formation of gametoid tissue—that, in fact, they are trying to form gametes or sex cells with the object of these uniting to form individuals of a new and rejuvenated generation. That under the circumstances they lamentably fail is only to be expected from their prentice hands. Their gametoid tissue, though bearing some of the marks of normal gametogenic tissue, is produced in a bed unprepared for it, and in surroundings not in keeping with its needs. The gametes formed are clumsy, unwieldy cells, and not the perfect mechanical and physiological units represented by the spermatozoa and ova of normal development.

What support is there to such a view? To my mind a thoroughly rational argument, with important data to support it, can be brought forward. I know of no definite facts and no reasonable hypothesis to render it unlikely. And beyond these I may say that, considering the biological possibilities, a cancer is, after all, only what might be expected to happen under certain circumstances.

To explain this view, it is necessary to consider the beginning of the life of a multicellular organism such as man. The fertilised ovum, the union of the male and female gametes, is a pluripotential cell. Its descendants comprise all the cells of the body, whether somatic cells or germinal cells. As evidenced by experiments in various animals, of its early progeny some are likewise pluripotential, inasmuch as separation into two component parts may lead to the development of two individuals from one fertilised ovum. In man homologous twins, who are practically identical in appearance and characteristics—were in fact once identical—are examples of two individuals thus developed. Sometimes we see a most remarkable further stage in which, after two individuals have started to form from one ovum, they have amalgamated again, the right of one twin and the left of the other being almost entirely suppressed. One individual is formed, but the suppressed limbs of the other halves may be recognised in abortive excrescences.

For how long does this pluripotentiality continue? Authorities differ, but many biologists consider that at a very early stage the forerunners of the sex cells are set aside for their specific purpose. Some, in fact, consider that this germ-plasm is directly continuous from individual to individual, and that it is, so to speak, the immortal element in us, our bodies as we see them being merely temporary tabernacles erected round the germ-plasm to protect and nourish it. With the transmission of the sacred germ-plasm to the custody of a new generation, this domicile returns to dust and ashes again. Whilst admitting the relatively early differentiation of the germ-cells in the higher animals, I do not agree with the view that the germ-plasm is set aside so early that it is correct to say that there is direct continuity of it from generation to generation. An analogy with the protozoa will make my meaning clear. The malarial organism, introduced into man, multiplies. Brood after brood of asexual forms are developed, giving rise during their evolution to the symptoms and signs of the disease. These asexual forms are the representatives of the somatic cells of the body. If, instead of being separate units, like the cells in our blood, they were all brought together and made dependent one on the other, we would have a soma. Eventually, arising from these forms after various generations, gametes appear. These are the sex cells, incapable apparently of further development in the vertebrate host, incapable of causing in such the signs of disease, capable only of multiplying again after sexual conjugation in the mosquito. If, in the so-called lowly protozoon, we have a long series of *X* somatic generations, on which eventually are superadded *Y* gametogenic generations leading to the evolution of the gametes, why should we not have in man, for instance, a similar series of *X* somatic generations, followed by *Y* gametogenic generations, amongst that group of cells set aside for the purpose of reproduction? In my opinion, such a series of somatic generations does precede the gametogenic ones, and these somatic generations are no more a direct continuance of the germ-plasm than are the somatic generations of other tissues of the body. I further believe that in these other cells, that is those not originally set aside for reproductive purposes, the capacity to form gametoid tissue is latent, and not absent or eliminated. Under ordinary circumstances, such capacity cannot manifest itself, because other factors inhibit it in the interests of the organism as a whole. The character is recessive, and so dormant, because other factors are dominant, and so assert themselves. In other words, I look on every cell still capable of mitosing as possessing the latent recessive character of producing gametoid tissue, and even perhaps of being pluripotential. I will admit that some cells may possibly have discarded, by accident or design, such potentialities. By virtue of the work required of them, by reason of specialisation, they may have sacrificed their birthright, just as the red cell of the blood has discarded its nucleus. The majority of multiplying cells, I believe, retain such latent potentialities.

I therefore put forward this view. Somatic cells are such because in them the somatic factor is dominant. Specialised cells are such because the factors bringing about specialisation are dominant in them, or because the co-ordinating mechanism of the individual stimulates these factors and inhibits others. These cells, however, also possess gametoid factors, which are recessive except in the case of the tissues set aside for reproduction. Remove the dominant somatic factors, suppress the stimuli giving them domination, and the gametoid factor will, of necessity, appear and exercise its functions. The gametoid tissue thus produced, under circumstances not provided for in ontogeny and in places unsuited for the purpose of the procreation of a new individual, seems, so to speak, to run riot. Like the early gametogenic tissue of the germinal epithelium, it tends to invade the tissues surrounding it. From its unusual position and circumstances of origin, the factors that should keep this invasion in bounds and should modify the potential gametes into spermatozoa or ova according to circumstances, fail to reach or govern the cells. We have, in fact, an incoordinate mass of tissue, partly gametoid, partly somatically differentiated. Now the gametoid aspect predominates, and the cells invade and eat into the tissues, undergo reducing or irregular divisions, and form clumsy gametes incapable of fertilising each other; now the somatic side preponderates and the cells differentiate more or less, forming, for instance, in certain cases, keratin and cell-nests. This uncontrolled and uncontrollable, unbridled, incoordinate and chaotic cell-mass is cancer. Its occurrence I believe to be thus due to the recessive gametoid factors in a group of cells becoming able to exert their influence through failure of the dominant somatic factors to maintain fully their dominance.

Two questions require answering. One is, is there any evidence that recessive factors may in the progeny of somatic cells eventually manifest themselves through failure of the dominant factors? The other question is, is there any evidence that the changes found in cancer are of a gametoid nature?

As answer to the first question, may I mention a curious phenomenon in the case of my wife's hair. This is dark brown, but occasionally she has noticed, and I have secured, an odd hair of much coarser texture and bright reddish colour. Being of Scotch extraction, it is clear that these are hairs of an individual with the vivid colouring well-known amongst that race. But how came they to appear on my wife's head? The hairs of the head are derived from down-growths of the surface epithelium. This latter is derived from the epiblast. The epiblast is descended from the original fertilised ovum. The cells of the hair follicles, before producing a hair, have gone through an enormous number of generations since the epiblast first appeared. They all must at one time have possessed attributes in common. How, then, does it come about that an occasional hair follicle produces a hair unlike its fellows? The answer, I think, is clear. The cells, in this case, are not pure cells, but hybrids—hybrids with brown and relatively fine as dominant factors, coarse and red as recessive factors. As long as the factor or factors for brown and fineness exist in the cells, the hair formed is of this texture. If by any accident—and who can guess its nature?—the dominant factor drops out or is inhibited, then the cells must, and do, produce a hair of the recessive type. This seems to me a reasonable and sound explanation of the circumstances and, to my mind, shows that a dominant factor may disappear or be inhibited in a group of somatic cells, and that then the antithetic recessive one will appear.

Now are the changes in cancer those characteristic of gametoid tissue? Columns of cells invade a subjacent tissue—so does the primitive germinal epithelium. Reducing divisions eventually occur in normal gametogenic tissues, preparatory to the formation of the highly differentiated gametes—reducing divisions, both heterotype and homotype, are of common occurrence in cancerous processes, but there is no formation of specialised gametes, only clumsy potential gametes appearing. Such reducing divisions are the chief characteristic of gametogenic tissue, and occur thus also in cancer.

Reversing the view here put forward, may I ask what changes one would expect if the somatic cells were considered as possessing recessive gametoid potentialities, and the dominant somatic factors were suppressed or inhibited? One would expect an attempt at the formation of a bizarre ovary or testis, or at least of a tissue comprised of the noble elements of these organs. The cells affected would invade the surrounding tissues, and would sooner or later undergo reducing divisions preparatory to the formation of gametes. All this occurs, and the cancerous process is exactly what one would expect under these circumstances.

What are the causes at work in stimulating this latent gametoid capacity of the cells? I believe that many forms of chronic irritation and conditions leading to stress and strain in the normal functioning of somatic cells may be responsible. The cells multiply unduly rapidly, and do so exposed to noxious influences. They have probably normally a limit to the number of somatic divisions they can undergo. This limit is reduced under these circumstances. They therefore become old before their time, whilst the previously dominant somatic factors are handicapped. Extinction or rejuvenation of the group of cells concerned are the only alternatives. Sometimes the former occurs, and we get necrosis of tissues. Sometimes the latter, and a cancer results.

If this view is correct, then one of the main objects of cancer research should be to ascertain the factors, often obscure, that set up such chronic irritations. We know them fairly well in the cases of the lip and tongue. If we could discover them and remove them early in the cases of the mammary gland, the uterus and stomach, numbers of lives might be saved. If cancer research is to be conducted in Australia, I would most strongly advocate attention in this direction as being by far the most promising field for productive results. This aspect is referred to again in the next section.

Cancerous Growths in Rats and Mice.

Rats and mice, like a number of other vertebrates, are subject to malignant growths, both carcinomata and sarcomata. The recognition of these tumours in any species, whether the various races of man or a lower animal, is probably dependent in great part on the number of individuals of the species (or race) available for examination, the average span of life of these individuals as compared with the natural length of life, and the degree to which members are exposed to certain forms of chronic irritation. These three factors require a little further explanation. As regards the *number of individuals,* since cancer only appears in a small percentage, instances of the disease would be more likely to be encountered when the species was abundant in members and these easily accessible to intelligent observation. Thus many cases are recognised amongst the millions of civilized man, but fewer proportionately amongst savage races, partly because the latter are less closely under medical observation, though also because they have, on an average, a shorter life, and are less exposed to certain forms of chronic irritation. With Dr. Bancroft[1] I have reported a case of carcinoma of the liver in an Australian aboriginal. Rats and mice are very abundant in numbers, though being elusive and small, they are not very closely under human observation. When examined systematically one would expect to find, and actually does find, cases of cancer amongst wild rats and mice. As large numbers of tame rats and mice are bred, amongst these also, from time to time, cases of cancer are found, and, in fact, such spontaneous tumours have yielded important experimental data at the hands of cancer workers. Lions and tigers are relatively fewer in numbers—nevertheless I have met with a case of carcinoma of the mammary gland in an old lioness in the Zoological Gardens in Perth, W.A. This case, however, is probably unique. It is only to be expected, therefore, that the more abundant the individuals of a species, the more likely are we to meet with cases of malignant growths.

The average span of life of the individuals as compared with the natural length of life might be better put as *the number of individuals who reach old age.* By the natural length of life is meant that age at which senescence de-

[1] Aust. Med. Gaz., May, 1913, p. 465.

velops to such an extent as to lead to extinction of life. In most individuals of a species, accident or disease leads to death before senescence can play its part. Thus, in man, the average expectation of life at any age falls far short of the expectation of life if mere senescence had alone to be considered. The natural length of life varies, of course, markedly in different species, being probably a year or so in wild rats and mice, and about 70 years in man. But not only does it vary in extent according to the species, but it varies, though to a much less extent, according to the family, and even, probably, according to the individual. Long-lived human stocks and short-lived ones are well-known. I have seen a man of about 70 with the aspect of one of 40, and probably with his expectation of life, whilst the son of 40 looked like a lad of 20. Thus the natural length of life of the individual, or the age at which the animal machine will go to pieces from natural wear and tear, apart from being cut short by accident or disease, varies markedly with the species, decidedly with the family and somewhat with the individual. The greater the number of individuals of the species who reach old age, and thus approximate to the tether of their natural existence, the greater will be the average span of life of the individuals of the species. Now cancer is essentially a disease of old age. Even in those forms that occur in early life, it is noteworthy that they especially arise in cells which may be looked on as approaching senescence, or as having undergone approximately the number of mitotic divisions that would naturally be expected of them. Cancer of the liver and certain sarcomata in young children are instances in point. In such young persons, one never sees epithelioma of the lip or tongue, or carcinoma of the breast tissues, in which the cells will continue mitosing for many years to come. Hence one finds that, be it man or lower vertebrates, the greater the number of individuals who reach old age, the greater, *ceteris paribus,* will be the occurrence of cancer amongst them. Probably this very fact, that more people through increased medical skill and better public health protection reach old age than formerly, and thereby increase the average span of life of the population, accounts in some measure for the apparent increase of cancer.

The third factor, *exposure to certain forms of chronic irritation,* is an important one. In man we know that such factors may consist in irritation of the lip from a clay or other pipe, injury to the tongue from a jagged tooth, unwise exposure of the operator to X-rays, irritation of the scrotum from soot in chimney sweeps, frequent burns on the chest from braziers containing hot charcoal in certain inhabitants of India, etc. In *Epimys norvegicus* we have the irritation of the stomach caused by a round worm, *Gongylonema neoplasticum.* In cattle in Australia we have squamous epithelioma of the orbital region, probably due to the chronic irritation of grass seeds or other foreign bodies, and the same condition occurring round brand marks on the rump. It is safe to say that in these instances removal of such causes of chronic irritation would eliminate, or at least vastly reduce, the occurrence of the cancerous process in the situations indicated. In fact, I would go so far as to say that, given a dictator's authority in Australia, and the power to enforce effectively that authority, I could diminish materially the number of cases of cancer in males by stopping all smoking, and preventing the occurrence of syphilis! There would still, in males, remain a number of cases of cancer of the intestinal canal, and in women of the uterus and mammary gland. It is almost certain that these also owe their origin to some form of chronic irritation. If this could be ascertained and removed, how great would be the boon to humanity! I am firmly of the opinion that if cancer research is to be taken up in Australia the most fertile field to investigate is that of the nature of these, at present unknown, causes of chronic irritation. Such chronic irritation is so clearly a factor in so many forms of malignant growth that I feel it must play an equally important part in the majority of cancerous conditions. In this continent the money would be much better spent along these lines than in attempts to fathom the deeper meaning of the cancerous process—which, to my mind, is already solved. Of course this view carries with it the reservation that the researcher has not conceived some entirely new line of investigation that, to expert minds, carries with it the possibility of material advance in our knowledge of the condition.

Applying the above three factors to the case of rats and mice, we find that, as regards numbers, they are very abundant, and that for certain purposes (plague to wit) very many have come under close human scrutiny; that there is reason to think that a considerable number, in the absence of epizootic disease and exposure to danger, reach an age that may be called old for them; and that, in one instance at least, a form of chronic irritation is known that is specially apt to lead to cancer. We would therefore expect to find cases of malignant growths amongst them during a systematic examination of a large number. In those coming under my notice in Australia, the following cases have been met with, viz.:—Amongst *Epimys norvegicus,* 11 cases; amongst *E. rattus,* 12 cases, and amongst *Mus musculus,* 3 cases.

The following indicate the forms found:—

In *Epimys norvegicus*: *Squamous-celled epithelioma of the stomach.*—August 30th, 1912. Associated with the presence of a round worm, at the time thought to be *Protospirura muris* (*Spiroptera obtusa*), but perhaps *Gongylonema neoplasticum* (which see for further details).

Double renal carcinomata.—March 31st, 1915. A growth the size of a walnut in one kidney, and two small growths in the other.

Renal carcinoma with metastases.—March 2nd, 1909. A female rat with a large lobulated mass in the position of the left kidney, numerous small nodules scattered over the peritoneum, and several minute white areas in the liver.

Renal carcinoma.—November 11th, 1913. A growth in the lower end of the kidney.

Malignant Hypernephromata in both Kidneys.—May 6th, 1910. A growth about the size of a large pea in the left kidney and several smaller growths scattered through the right one. Sections showed cubical cells in columns, and the growths were considered as having arisen in remnants of the suprarenal capsules.

Carcinoma of the Thyroid.—July 7th, 1910. There was a growth the size of a walnut behind one shoulder, showing cystic spaces and the presence of colloid material.

Fibro-adenoma of the Mammary Gland becoming Adeno-carcinomatous.—March 9th, 1909. A growth the size of a bantam's egg. The lymphatic glands were not noticed as being enlarged.

Fibro-sarcoma of Mammary Area.—May 31st, 1909. A tumour the size of a pigeon's egg.

Spindle-celled Sarcoma of the Liver.—August 30th, 1911. This was associated with the presence of *Cysticercus fasciolaris,* under which cestode further reference is made to it.

Spindle-celled Sarcoma of the Stomach.—December 4th, 1908. A tumour the size of a walnut dependent from the pyloric end of the stomach, the peritoneal cavity being studded with a large number of secondary deposits up to the size of peas.

Large-celled Sarcoma.—November 18th, 1910.—Soft growths over the right chest and in both thighs, showing very large irregular cells closely packed together.

In *E. norvegicus* var. *albina* (Tame white rat):

Ossifying sarcoma (?).—There were small irregular cartilaginous to calcified nodules in both lungs, in the thymus, over the pleuræ and ribs, in the pectoral muscles and the inner muscles of the thighs, attached to one femur, and near the vertebral column in the neighbourhood of the kidneys and invading these.

In *Epimys rattus*: *Carcinoma of Kidney.*—June, 1910.

In *Mus musculus*: *Carcinoma of the Mammary Gland.*—April 5th, 1911, Narrabri (Dr. Barton). Extensive irregular nodular growths of the right mammary gland and adjacent part of the neck.

Carcinoma of the Mammary Gland.—June 8th, 1911, Inverell. Irregular growths the size of half-walnuts in front of the left shoulder, on the right side of the chest, and in the left groin.

Carcinoma of a Salivary Gland or perhaps a Mammary Gland.—October 23rd, 1916. Carcinomatous deposits, suggestive of a possible origin in a salivary gland, were found between the right ear and shoulder (size of a small marble), in the left side in the same situation, and in both groins.

The following innocent cyst has been met with in *Epimys rattus*:—*Multilocular Ovarian Cyst.*—September 14th, 1909. Size of a walnut.

Malignant Growths in Other Animals.

It may be of interest, for comparison with the preceding, to record here the various malignant growths I have met with in other animals in this State from 1909 up to the present. The occurrence of such growths in so many species suggests that no vertebrates are exempt from them. The protection afforded to animals by man's care, either as regards his domestic animals or living zoological collections, probably adds to their span of life, so that more reach the "cancer age" than in a wild state, and hence more cases are met with under such conditions.

Cattle.—Squamous epithelioma of the orbital region (six cases, one with tuberculosis elsewhere); squamous epithelioma of the rump developing on a brand mark (brand cancer); squamous epithelioma infiltrating the parotid gland; squamous epithelioma of the anus; columnar epithelioma of the epiglottis; columnar epithelioma of the gall bladder; carcinoma near the liver; squamous epithelioma of the urinary bladder, apparently following on the irritation of the papillomata and angiomata, that give rise to endemic hæmaturia in the Illawarra district; colloid carcinoma invading the peritoneal cavity; epitheliomatous or sarcomatous cyst of the cervical region; large irregular-celled sarcoma of the mediastinum. Total, 16 cases.

Horses.—Squamous epithelioma of the lip; squamous epithelioma of the eyelid. Total, 2 cases.

Sheep.—Carcinoma, probably derived from the skin glands, of the face of a ram (Deniliquin); columnar epithelioma invading the pleura and lung; columnar epithelioma invading the peritoneum; colloid carcinoma of the intestine; round-celled sarcoma invading the diaphragm and peritoneum. Total, 5 cases.

Cat.—Columnar epithelioma arising in the gall bladder (?).

Dog.—Squamous epithelioma of the anus.

Deer.—Carcinoma of the stomach.

Raccoon.—Carcinoma or sarcoma of the abdominal cavity.

Peccary.—Spindle-celled sarcoma.

Domestic Fowls.—Squamous epithelioma of the rump; squamous epithelioma of the head; colloid carcinoma (?) of the peritoneal cavity.

Muscovy Duck.—Large-celled sarcoma forming subcutaneous nodules.

Other Disease Conditions Met With.

Enlargement of the Spleen.—I have previously[1] called attention to an enlargement of the spleen, sometimes up to eight or nine times the normal size of the organ, in many of the rats on the wharves at Fremantle. Though the species affected was not recorded at the time, this was probably *E. norvegicus*. Since then, in this species, a similar enlargement of the spleen has been noted in New South Wales. I am not prepared to say whether this hypertrophy is due to some chronic pathological process, or is a specific feature of the species concerned.

Other disease conditions of our rats to which I have referred[2] are the following:—Ulceration of the feet with death in caged rats; dark pigmentation of the lymphatic glands; chronic abscesses in the groin, near the stomach, in the left side of the thorax, the neck, and the axilla; curdy pus in a uterine horn; pus round the sheath of the penis; the spleen studded with small white granules and the liver pale; peritoneal adhesions; calcified areas in the liver (3 cases); infarct in the liver; subcutaneous dark-coloured areas on the abdomen; inversion of the uterus (2 cases); and cystic kidney.

The following have occurred in New South Wales:—

Fatty Infiltration of the Liver.—A very fat *E. norvegicus* had a large friable liver mottled with bright yellow

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1 Aust. Assoc. Adv. Sci., Adelaide, 1907.

2 Loc. cit.; Bull. Dept. of State Med. and P. Health, W.A., 1909, Nos. 10-12, p. 17.

and maroon (due to blood). The cells contained numerous large and small fat globules.

Necrotic Tubercles in the Lungs, due to a Diphtheroid Organism.—In a specimen of *E. rattus* the lungs were speckled with numerous small white nodules the size of pins' heads. There was a small abscess with thick pus near the base of the penis. Smears from the areas in the lungs showed numerous long, somewhat irregular, thin Gram positive diphtheroid bacilli, which were isolated in pure culture and gave acid in glucose, lactose and saccharose, and no reaction in mannite and dulcite. A guinea-pig inoculated with the culture died in three weeks—no lesions were found in it. A rabbit similarly inoculated was killed 2½ months later, and found to be normal.

Microcystic Kidneys.—I have an impression that the kidneys of *E. norvegicus* are more subject to small cysts than those of *E. rattus.* I have a record of microcystic kidneys in *E. rattus,* in which many of the ducts were dilated to various degrees, with round-celled infiltration and blood pigment between the tubules.

Cystic Spaces in the Lung.—The animal affected was a tame white rat (*E. norvegicus* var. *albina*). The lower half of one lung was occupied by cystic spaces filled with thick glutinous contents. Microscopically, the spaces were lined by one to several layers of somewhat flattened cells.

"Elephantiasis."—Both hind legs of an *E. norvegicus* were enormously thickened and fibrosed from the "ankle-joints" downwards. Apparently the animal had been walking on its tarsus, as one side of this was ulcerated. The condition was apparently due to chronic inflammatory changes.

Lobulated Liver of a Mouse, showing Cystic Spaces the size of Wheat Grains.—This case is very interesting, as the microscopic appearances suggest that the condition was due to a developmental anomaly, the outgrowths from the primitive intestine intended to form the solid liver having failed to do so completely, leaving cystic spaces resembling intestinal tissue. This view is supported by the presence of a narrow *muscularis mucosæ* in the walls of the cysts, which are lined by very tall, narrow, degenerated cells in places. Villous-like projections, one into each of several cysts, were also noted, perhaps representing the intestinal villi.

Chronic Abscess of the Spleen.—In a specimen of *E. norvegicus* examined on July 6th, 1910, the spleen was greatly enlarged (17 grms., the whole rat weighing 381 grms.), and contained a large chronic cheesy abscess at one point, and a few smaller ones scattered throughout the rest of the organ.

Cheesy Abscesses of the Liver.—These were present in a common mouse submitted on May 26th, 1909.

Decomposing Fœtuses in Uterine Cornua.—A Norway rat, examined on April 8th, 1909, had one horn of the uterus distended with a foul-smelling fluid containing two macerating fœtuses. A specimen of *E. rattus,* submitted on July 9th, 1909, had a mass, the size of a marble and attached to one uterine cornu, distended with a foul-smelling mass, probably due to a retained fœtus.

Abscesses of Both Ovaries.—In a Norway rat, on March 28th, 1912, abscesses, one the size of a small mandarin orange, were present in both ovaries.

Extra-Uterine Fœtation (?).—In a specimen of *E. rattus,* on February 2nd, 1910, a mass the size of a walnut was found behind the uterus at the junction of one horn. It contained fœtal remains, and was due either to an extra-uterine fœtation or the rupture of one horn.

Miliary Nodules in the Peritoneum and Abdominal Muscles.—In these situations, in a specimen of *E. norvegicus* submitted on February 11th, 1911, were a number of small, round, firm, yellowish-white nodules the size of wheat grains or larger.

The Ecto-Parasites of Rats and Mice.

The ecto-parasites of these rodents met with in Australia comprise fleas, bed-bugs, lice and species of acarina.

FLEAS: Ham[1] gives a list of fleas associated with rats and mice. Twenty-eight specific names are given of fleas found associated with individuals of the genus *Mus, sensu lato.* As probably three of these at least are synonyms, the total number of fleas recorded from *Epimys rattus, E. norvegicus* and *Mus musculus* is reduced to eleven, two of which are fowl fleas occasionally occurring on rats and mice. He gives the following as the flea species met with in association with *E. rattus* and *E. norvegicus*:—

1. *Pulex irritans* Linn.
2. *Pulex cheopis* Rothschild.
3. *Ctenocephalus canis* Curtis (=*C. felis* Rothsch., and *C. serraticeps*).
4. *Ceratophyllus fasciatus* Bosc.
5. *Ceratophyllus londoniensis* Rothsch.
6. *Ceratophyllus italicus* Tiraboschi.
7. *Neopsylla bidentatiformis* Wagner.
8. *Ctenopsyllus musculi* Duges.
9. *Ctenopsyllus taschenbergi* Wagner.

Of the above list, Nos. 1, 2, 3, 4, and 8 have been found on rats or mice in Australia.

In the routine examination of rats for plague as carried out by the Microbiological Laboratory at the Department of Public Health, Sydney, the number of fleas collected weekly from the rats have been tabulated from the beginning of 1909 to 1917. During this period the total number of fleas identified comprises the following:—*Lœmopsylla*

[1] Report on Plague in Queensland, 1900-1907, p. 144.

(*Xenopsylla, Pulex*) *cheopis,* 4863; *Ctenopsylla* (*Typhlopsylla*) *musculi,* 3370; *Ceratophyllus fasciatus,* 1380; *Ctenocephalus canis* or *felis,* 61; *Pulex irritans,* 3.

Ham (loc. cit., p. 147) gives a table of the information available at the time of writing his report (1907), as to the relative prevalence of the species of rat-fleas in the various Australian States. In Queensland, *L. cheopis* comprised 90.8 to 100 per cent. of the fleas on rats; in New South Wales in 1902, 81 per cent.; in Sydney in 1904, 69 per cent.; in Newcastle in 1904, 20.5 per cent.; and in Perth, from December to July, 78 per cent.—but from July to December, 17 per cent. *L. cheopis* also occurs in Victoria and Tasmania. *C. musculi* composed 23 per cent. of the rat-fleas in Sydney in 1904, 70 per cent. in Newcastle in the same year, and 22 and 82.6 per cent. in Perth for the months respectively mentioned above.

Of 60 rat-fleas found by me in Perth in 1906, 32 were *L. cheopis,* 27 *C. musculi,* and 1 *C. fasciatus.*

It is now universally recognised that *L. cheopis* is *par excellence* the plague flea, that is to say, that it is through its intermediation that the plague bacillus generally reaches man in bubonic and septicæmic plague. As plague shows a pronounced seasonal prevalence, the object of this flea census was to ascertain not only the relative yearly prevalence of fleas, but also their variations in numbers from week to week in order to ascertain whether there was any correlation between their number and the incidence of cases of plague in man. The accompanying table (Table V) will show the monthly prevalence of the various species of fleas on rats as met with in Sydney from 1909 to 1917.

As regards *L. cheopis,* this flea is most abundant in February (962) and March (946), followed by April (691) and January (479). It will be seen, on referring to the summary of cases of plague in New South Wales, that these

Table V.—*Showing the Incidence of Various Species of Fleas on Rats in Sydney during the Years 1909 – 1917.*

Year.	Jan.	Feb.	Mch.	April	May	Jne.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Lœmopsylla cheopis.													
1909	108	120	331	314	108	55	42	9	76	16	3	9	1191
1910	14	88	80	139	43	54	44	67	121	20	11	20	701
1911	97	316	191	103	47	17	122	55	27	26	43	61	1105
1912	44	129	128	66	59	62	42	30	14	17	11	39	641
1913	30	77	29	11	28	62	1	...	...	...	5	...	243
1914	25	...	29	33	..	...	12	21	14	55	8	36	233
1915	88	8	77	14	1	18	13	15	5	5	5	3	252
1916	73	120	43	9	16	3	26	...	7	...	3	...	300
1917	...	104	38	2	5	...	...	...	22	21	4	1	197
Total	479	962	946	691	307	271	302	197	286	160	93	169	4863
Ctenopsylla musculi.													
1909	81	60	77	42	28	25	20	16	62	50	15	28	514
1910	41	34	33	48	37	56	57	46	88	87	6	8	541
1911	46	106	59	37	57	28	121	124	205	97	106	79	1065
1912	23	14	25	45	12	32	15	67	40	75	34	60	442
1913	7	24	3	4	17	27	4	...			27	...	113
1914	5	...	2	3	...	2	2	44	48	234	24	7	371
1915	4	1	7	26	6	8	33	27	27	6	...	11	156
1916	11	12	17	10	13	...	10	...	11	...	19	5	108
1917	...	13	3	4	4	...	...	...	10	3	23	...	60
Total	218	264	226	219	184	178	262	324	491	552	254	198	3370
Ceratophyllus fasciatus.													
1909	52	11	35	8	5	4	10	1	5	47	6	26	210
1910	36	19	23	11	5	13	24	28	48	33	9	17	266
1911	53	20	12	13	11	3	16	38	66	54	38	51	375
1912	24	7	18	9	2	11	17	14	9	31	29	48	219
1913	11	5	...	...	2	4	...	...	..	..	9	...	31
1914	2	.	...	...	...	...	1	6	27	37	14	7	94
1915	7	1	5	2	...	...	3	2	12	23	6	10	72
1916	4	30	13	9	...	...	8	...	6	...	6	...	76
1917	...	...	5	...	5	...	...	..	1	16	10	...	37
Total	189	93	111	52	30	35	79	90	174	241	127	159	1380
Ctenocephalus canis and *felis.*													
1909	1	1	1	...	...	3	...	...	...	...	...	4	10
1910	1	2	2	...	1	...	...	2	...	...	...	...	8
1911	1	3	2	...	...	...	...	..	...	2	3	..	11
1912	...	.	6	...	1	...	...	...	...	...	...	7	14
1913	...	3	...	...	...	...	...	...	...	...	...	...	3
1914	...	...	...	...	...	...	...	...	...	1	1	...	2
1915	...	...	3	...	...	...	1	...	...	...	...	...	4
1916	4	3	...	...	...	...	...	...	1	...	...	...	8
1917	...	1	...	...	...	...	...	...	...	...	...	...	1
Total	7	13	14	...	2	3	1	2	1	3	4	11	61

Pulex irritans.

1909	...	...	1	...	...	...	...	...	...	...	...	...	1
1910	...	...	...	...	1	...	...	...	...	...	...	...	1
1911	...	1	...	...	...	...	...	...	...	...	...	...	1
1912	...	...	...	...	...	...	...	...	...	...	...	...	...
1913	...	...	...	...	...	...	...	...	...	...	...	...	...
1914	...	...	...	...	...	...	...	...	...	...	...	...	...
1915	...	...	...	...	...	...		...	...	...	...	...	...
1916	...	...	...	...	...	...	...	...	...	...	...	...	...
1917	...	...	...	...	...	...	...	...	...	...	...		
Total	...	1	1	...	1	...	...	...	...			...	3

are the months in which epidemics have most frequently originated and in which the majority of cases have occurred. Yet these figures have been obtained when, except for the years 1909 and 1910, no instances of plague in man or rats were known. The figures for the other months, though irregularly variable, are much lower.

The monthly numbers of the blind flea, *Ctenopsylla* (*Typhlopsylla*) *musculi*, are less variable. Considerable increases occur in September and October, and next to these in August.

The figures for *Ceratophyllus fasciatus* are smaller and very variable. There is a distinct increase in September and October, and another in December and January.

Ctenocephalus canis or *felis*, of which few specimens were obtained, shows a preference for the warmer months.

A further table (Table VI) shows the numbers and species of fleas found in Sydney in each of the three rodents concerned during the non-plague period 1911 to 1917. In *E. rattus*, somewhat less than half of 3221 fleas were *L. cheopis*, between one-third and one-half were *C. musculi*, about one-seventh *C. fasciatus*, a few were *C. canis* or *felis*, and 1 *P. irritans*. Five fleas found on this species from Goulburn, in April, 1918, all belonged to *C. musculi*. In *E. norvegicus* more than one-half of 2137 fleas were *P. cheopis*, nearly one-third *C. musculi*, and about one-eighth *C.*

fasciatus, whilst there were a few *C. canis* or *felis*. Only 30 fleas from *Mus musculus* were identified, amongst which *C. musculi* were nearly twice as common as *L. cheopis*, the remaining few fleas being *C. fasciatus*. Six fleas, found in mice from Temora, in November, 1917, were all *C. musculi*.

Table VI.—*Showing the Total Number of Fleas taken from each Species of Rodent in Sydney from 1911 to 1917*,

Species of Rat.	*L. cheopis*	*C. musculi*	*C. fasciatus*	*C. canis* and *felis*	*P. irritans*	Total
E. rattus	1,530	1,209	457	24	1	3,221
E. norvegicus	1,161	688	274	14	...	2,137
M. musculus	9	17	4	...	...	30
Total ..	2,700	1,914	735	38	1	5,388

Besides one of these species of fleas (*L. cheopis*) acting as a nursery for the plague bacillus, this and other species are also true intermediate hosts for other parasites of rats. Thus *Ceratophyllus fasciatus* transmits *Trypanosoma lewisi* from one rat to another, and Harvey Johnston[1] has recorded the finding of the Cysticercoids of the tapeworms *Hymenolepis diminuta* and *H. murina* in Sydney in both *Læmopsylla cheopis* and *Ceratophyllus fasciatus*, and in a Melbourne specimen of *C. fasciatus* the Cysticercoid of *H. diminuta*. He has also recorded (p. 81) the presence of larval nematodes, *Agamonema* sp., in *L. cheopis* and once in *C. fasciatus* in Sydney. He considers the larva in all probability to be the young of a Spiroptera *sensu lato*, and suggests especially *S. obtusa*.

Fleas Caught on Human Beings.—It may be of interest to mention here the species of fleas that I have found infesting man in Australia. In Sydney and at Narrabeen, out of 19 fleas caught at varying times, 18 were *Pulex irritans* and 1 *Ctenocephalus canis*. A batch of 27 fleas from

[1] Johnston, Proc. Roy. Soc., Queensl., June, 1912, p. 69.

Hamilton, near Newcastle, received in October, 1916, all proved to be *Ct. canis*—specimens were determined by the Hon. N. Charles Rothschild. They occurred in sandy surroundings, and constituted a veritable plague. Narrabri had a similar experience in April, 1917, these fleas being also identified for us by Mr. Rothschild. In the sandy suburbs of Perth fleas are also very abundant at times, and belong to the same species. The closely allied *Ct. felis,* distinguished chiefly by a slight difference in the shape of the head, I have so far not found on man, but only on dogs. As already indicated, *Ct. canis* or *felis* (the separation of the two species was not made) is occasionally found on our rats, as is also *P. irritans.* So far, I have not found *L. cheopis* on man, but the occurrence of plague in human beings indicates that on occasion this flea does bite man in Australia.

Dr. F. Tidswell[1] found, out of 97 fleas caught on man in Sydney, that 81 were *P. irritans* and 16 *Ct. canis.* He (*loc cit.,* p. 72) has been able to get *Ceratophyllus fasciatus* to bite man experimentally.

Bed-bugs, *Clinocoris* (*Cimex*) *lectularius* L.—In the 1902 epidemic of plague in Sydney, bed-bugs in all stages of development were found on the rats submitted for examination, and also occasionally by Dr. T. Harvey Johnston in 1909, 1910 and 1911. Similarly Ham mentions that they were present on rats during the outbreak of plague in Brisbane in 1900, and in some instances in subsequent ones. If bed-bugs attach themselves to living rats, and can be transported by them, there is naturally the possibility that they may be themselves transferred by rats from one building to another, and thus introduce the bugs to fresh quarters. As the rats submitted for examination in Sydney have been in nearly all instances dead trapped rats or

[1] Rep. Second Outbr. of Plague, Syd., 1902, p. 74.

poisoned rats, I think it is quite possible that the bugs found had merely taken advantage of the cover offered by the dead carcase to hide themselves. The bug, I presume, after having fed, will at once seek cover. It will not remain on or near the host that it has bitten if any movement is made by such host. In the case of trapped rats, however, the bugs might come out and perhaps feed on the body when warm, and then, finding no movement, hide themselves in its neighbourhood or between the flexures of the joints, and thus be removed with the rats when found by the rat-catchers later; or, having fed elsewhere, the bugs may merely take shelter on the dead or cold carcase as they might in any other suitable situation. I think, therefore, that it still remains to be proved that rats can be responsible for the transference of bed bugs from one house to another.

PEDICULIDS.—Harvey Johnston[1] has recorded *Polyplax spinulosus* Burm. for *E. rattus* and *E. norvegicus* from Sydney, Melbourne and Brisbane. Neumann[2] has described another species, *Hæmatopinus* (*Polyplax*) *bidentatus,* as from *Mus rattus*, "au lac Torrens, dans l'Australie sud." (Rothschild Collection). This reference to the introduced *E. rattus,* suggesting its occurrence in the neighbourhood of the depression, sometimes containing salt-water, known as "Lake Torrens," and situated to the north of Port Augusta in the interior of South Australia, aroused my interest. The arid nature of the country, far from the haunts of man, suggested some mistake. I made enquiries through Dr. Borthwick, Medical Officer of Health for Adelaide, which seem to show an error, by translation, in locality and an error in the host. Through Professor Stirling, then Director of the South Australian Museum, Dr. Borthwick

[1] Johnston, Rep. Govt. Bur. of Microbiology, N.S.W., 1909 (1910), p. 80.

[2] Neumann, Arch. de Parasitologie, XIII., 1909, p. 497.

had forwarded a collection of ecto-parasites from rats to the Hon. N. Charles Rothschild. The host animals were caught near the banks of the R. Torrens, which runs through Adelaide, its water being dammed back to form an artificial lake called "Torrens Lake." Amongst these external parasites were fleas from common rats and lice from a water-rat, *Hydromys leucogaster*. Presumably this was the source of the specimens described by Neumann, the host having been wrongly noted, and Torrens "Lake" being referred to as "lac Torrens." As further support to this view, Dr. Johnston later examined a pediculid found by us on *H. leucogaster* caught in Sydney Harbour. The insect was mutilated, but its appearance suggested that it was the species described by Neumann.

Acarina: *Leiognathus bacoti* Hirst.—On several occasions in Sydney complaints have been received of small mites attacking workers in factories and shops. A similar complaint was received from Fremantle, in Western Australia, in 1908, in the case of men working on the wharves at night. These mites cause a good deal of irritation and skin-scratching. Enquiries showed the association with their presence of rats, some of which were caught, infested with the mites, in a shop in Sydney, next door to one of these factories. The mites were sent for identification to Mr. S. Hirst, of the British Museum, who identified them as *Leiognathus bacoti* Hirst, a species originally described by him from *Mus norvegicus*, and found in Egypt, Abyssinia, Australia and South America. The irritation caused by these mites is very similar to that caused by *Leiognathus bursa* Perlese = *L. morsitans* Hirst, which has been identified for us also by Mr. Hirst, and is usually conveyed in Sydney by starlings nesting in premises. This other mite is normally a parasite of domestic poultry in the more tropical parts of the world.

GAMASIDS AND TICKS.—On Sydney rats, during 1909, 1910 and 1911, Harvey Johnson found 287 gamasids (*Lælaps*)—260 of them in 1909; 12 ticks (*Ixodidæ*); and 6 very small acarids, mites, probably the above *L. bacoti.*

NOCTÆDRES ALEPIS Raillet et Lucet (*Sarcoptes muris*).—This causes a warty scabies, affecting the ears and genital organs. Such warty ears are not uncommon in Sydney rats. Johnston[1] has recorded the mite for *E. norvegicus* in New South Wales and *E. rattus* (*alexandrinus*) in Western Australia.

The Protozoal Parasites of Rats and Mice.

TRYPANOSOMA LEWISI (Kent).—Though trypanosomes were first observed in the blood of the trout in 1841, and various observations had later been made on species found in mammals, frogs and fishes, they received little attention until 1878. In this year, Lewis, in India, described the species found in *Mus decumanus* (*Epimys norvegicus*) and in *Mus rufescens.* In 1881, Saville Kent named this parasite *Herpetomonas lewisi.* The name of Lewis is especially associated with the beginning of the enormous amount of work dealing with all aspects of trypanosomiasis, because his discovery of the trypanosome of the rat was soon followed, in 1880, by that of the first definitely pathogenic species, the trypanosome of surra found by Evans in horses and camels in India. Some 20 years later, in 1901 and 1902, trypanosomes were found in cases of sleeping sickness in man. This discovery, followed later by proof of these trypanosomes being responsible for the disease, led to attempts, by means of arsenic compounds and synthetic dyes, to kill the parasites without injuring their host. From these partially successful results emerged eventually the discovery by Ehrlich of salvarsan, and the employment of this

[1] Johnston, Rep. Govt. Bur. Microbiol., Sydney, 1909 (1910), p. 81.

drug and allied compounds in the alleviation and sometimes cure of syphilis in man. Such treatment forms the essential basis in the present campaign to diminish and, if possible, to eliminate this scourge of mankind. Thus the study of a parasite of a common domestic pest has played a part, indirect yet by no means unimportant, in the diminution of human suffering.

Tryon[1] in Queensland was apparently the first to see this trypanosome in Australian rats.

Harvey Johnston and I have found *T. lewisi* in *E. rattus* and *E. norvegicus* in Sydney, whilst I have found them also in the former species in Perth, and C. J. Pound in rats in Brisbane.[2]

The flea *Ceratophyllus fasciatus*[3] is an intermediate host of *T. lewisi*. The flea *Ctenophthalmus agyrtes* and the louse, *Hæmatopinus spinulosus*, can also apparently transmit the parasites.

HÆMOSPORIDIA.—The following species have been recorded[4] in the three rodents under consideration:—*Hepatozoon muris* (Balfour), 1905 (1906?), in *E. norvegicus* (Africa, Oceania, Portugal, India); *H. ratti* (Adie), 1907, in *E. rattus* (Azores, India, Oceania); *H. perniciosum* Miller, 1908, in *E. norvegicus* var. *albina* (America); *H. musculi* (Porter), 1908, in *M. musculus* var. *albina* (England); *Piroplasma muris* Fantham, 1905, in *E. rattus* var. *albina* (England; *Nuttallia decumani* Macfie, 1915, in *E. norvegicus* (Africa); *Toxoplasma musculi* Sangiorgi, 1913, in *M. musculus* (Italy); and *T. ratti* Sangiorgi, 1915, in *E. rattus* var. *albina* (Italy).

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1 Tryon, this Journal, XXII., 1888, p. 374.

2 Vide Rep. Govt. Bur. of Microbiol. for 1909, N.S.W. (1910), p. 37.

3 Vide Nuttall, Parasitol, I., 1908, p. 296; Strickland, Brit. Med. J., May, 1911, p. 1049; and Minchin and Thomson, Brit. Med. J., June, 1911, p. 1309.

4 Vide Franca, Sur. la Classificat. des Hæmosporidies, J. de Sciencias, Matematicas, Fisicas e Naturais, 3d Serie, No. 1, 1917.

Harvey Johnston and myself[1] have found Hepatozoa in Australian rats. In 1906, whilst in Perth, Western Australia, I first met with a Hepatozoon in the local rats. This was on the day after reading Balfour's article[2] on a new hæmogregarine of mammals, in the gerboa, *Jaculus jaculus* (*gordoni*), which he designated *Hæmogregarina jaculi,* but added in a footnote that Laveran had called it *Hæmogregarina balfouri.* In this article he mentions having found apparently the same parasite in the leucocytes of *Mus decumanus* (*E. norvegicus*) at Khartoum. Consequently I recorded this finding as that of *H. balfouri* in the host *E. norvegicus* (*Mus decumanus*). Subsequent identifications of these rats by Mr. Oldfield Thomas, of the British Museum, showed they were *E. rattus* (*alexandrinus*). Balfour[3] later separated the rat parasite as *Leucocytozoon muris* (now *Hepatozoon muris*). It will be seen, from the list given above, that França considers as separate species the Hepatozoa of *E. norvegicus* and of *E. rattus,* named *H. muris* and *H. ratti* respectively. As we later in Sydney found a Hepatozoon also in *E. norvegicus,* it is possible that only one species really exists, for which the name *H. muris* (Balfour) would take precedence. If there are two species, then the one in Perth in *E. rattus* would be *Hepatozoon ratti;*[4] that in Sydney in *E. norvegicus, H. muris.*

SARCOSPORIDIA.—The exact position of the Sarcosporidia in the Sporozoa is still a matter of doubt. Minchin[5] classifies them as an order under the Neosporidia. Recently Crawley[6] has produced reasons for considering them as

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1 Cleland, J. of Trop. Med. and Hyg., IX., 1906, p. 196; Aust. Assoc. Adv. Sc., 1907, p. 516; Johnston and Cleland, Proc. Linn. Soc., N.S.W., 1909, p. 501.

2 Balfour, J. of Trop. Med. and Hyg., March, 1906, p. 82 (same article, August 15th, 1905, p. 242).

3 Balfour, Sec. Rep. Wellcome Research Labs., Khartoum, 1906, p. 111.

4 As suggested by me, Aust. Assoc. Adv. Science., Adel., 1907.

5 Minchin, An Introduction to the Study of the Protozoa, 1912.

6 Crawley, Proc. Acad. Nat. Scien., Phil., June, 1916.

forming a sub-order of the Order Coccidiomorpha under the Telosporidia. He[1] has worked out the evolution of *Sarcocystis muris* in the intestinal cells of the mouse. Johnston and I[2] have recorded *S. muris* in the muscles of *E. rattus* and *E. norvegicus* in Sydney.

SPIROCHÆTES.—The proper classificatory position of the spirochætes and allied organisms is a matter of much controversy. Some workers consider they are Schizomycetes or closely allied to the bacteria, basing their opinion chiefly on the occurrence of transverse division. Others consider them as protozoa, and complicated life-phases agreeing therewith have even been described. The group is of vast human interest, inasmuch as one of the direst of human diseases—syphilis—is due to *Treponema pallidum* (*Spirochaeta pallida*), whilst several other fatal human complaints, in two of which rats probably play the part of normal hosts for the parasites, are due to other spirochætes. A digression as regards these organisms may therefore be allowed.

First of all it may be mentioned that spirochæte-like forms are found in many situations in man and animals, living usually a more or less saprophytic existence. Thus in man they are common in the mouth round the teeth, especially decayed ones, whilst *Sp. refringens* is found under the prepuce. Johnston and myself (*loc. cit.*) have recorded as *Sp. ratti*, spirochætes found in the cæca of *E. norvegicus* and *E. rattus* in Sydney. I have recorded[3] abundant spirochætes in the centres of castration tumours in pigs in Western Australia, possibly dwelling in this situation as imprisoned saprophytes. Sydney Dodd[4] has found them in ulcers of the skin in pigs in the Transvaal, and I

[1] Crawley, loc. cit., May, 1914, p. 432.
[2] Johnston and Cleland, Proc. Linn. Soc., N.S.W., 1909, p. 510.
[3] Cleland, Parasitology, I., Oct., 1908.
[4] Dodd, J. of Comp. Path., XIX., 1906, p. 216.

have also seen them in the same situation in a N.S.W. pig (October, 1911), and also in a growth of a pig's foot. They are also found in intestinal lesions in these animals. They may be found in several species of our white ants (Termites) and in mollusca.

From the above it will appear that Spirochætes, in the broad sense, are widely distributed organisms found in many situations in association with various animals. In the above instances they seem, for the most part, to be simple saprophytes, living on mucous and allied surfaces, and deriving nourishment, presumably, from the broken down organic material there found in abundance. In some of the cases mentioned above, however, it is possible that they may also exert some pathogenic action—that is to say, they may feed upon the living tissue or may utilise foodstuffs in course of passage to the host's cells. As a result of such damage or interference, or as a result of the production of toxins, they may cause a reaction to their presence by the cells of the host. The skin ulcers of pigs and perhaps the castration tumours may be such instances. We also find from time to time in man that certain spirochætes of the mouth may be present in large numbers in particular ulcerations and infections of that region and the neck, constituting Vincent's angina.

Some of these saprophytic-living spirochætes, then, appear to possess potentialities for pathogenic activity, if given the opportunity. The opportunity may be perhaps a wound or other infection. In such spirochætes, in fact, we see the beginning of the evolution of true parasites with pathogenic powers. To my mind it is unquestionable that the organism of syphilis, the dreaded *Sp. pallida,* has evolved from a saprophyte inhabiting originally only the mucous surfaces of the vagina and prepuce. Promiscuous sexual intercourse gave such saprophyte its chance to establish and develop pathogenic properties. It is well-known that repeated transmission of an organism from one host to another tends frequently to accentuate its pathogenic properties, latent perhaps at first. Amongst the saprophytic spirochætes inhabiting the generative mucous membranes of man, one would expect that a mutant, possessing more than its fellows the capacity to invade living tissues, would have this property increased by repeated conveyance from one warm moist human mucous surface to another. Promiscuous sexual intercourse gave it this opportunity. The result we see to-day.

A still further evolution in complexity of life-processes is seen in certain spirochætes. This consists in the conveyance of infection by intermediate hosts, ticks and bedbugs for instance. How this has come about from saprophytic types is questionable. That these forms have arisen from such types in ages long ago is undoubted. The course of events was presumably one of two. The saprophyte, having become an invasive parasite, eventually reached the blood-stream, as it does now in syphilis. The arthropod, drawing this blood, ingested the spirochætes, which found themselves capable of multiplying in their new surroundings. Thence they entered the tissues of a fresh vertebrate host when the arthropod fed again. The second alternative is that the pathogenic spirochætes were primarily arthropod dwellers (we have seen that they are found in termites). The arthropod, in feeding on its host, either injected its spirochætes or fouled the wound it made with fæcal matter containing these. In the new environment, the spirochætes were able to grow and multiply, and were not destroyed, whilst the vertebrate host reacted, in the shape of illness, to their presence. Bitten by further arthropods, the spirochætes entered again their original hosts. In either case, in the course of time, the spirochætes became more selective in their behaviour, no longer being merely facultative parasites of the two types of hosts, but obligatory parasites of both, with perhaps complicated life-histories in each.

I have mentioned *Sp. ratti* as a probable saprophyte of the intestinal canal of rats. The spirochætes (*Sp. icterohæmorrhagica* Inada and Ino) of a form of infective jaundice (Weil's Disease) in man and those (*Sp. morsus-muris* Futaki, Takaki, Taniguchi et Osumi) found in rat-bite fever in man and other animals, appear to be normally parasites of rats, occasionally conveyed to man with severe, even fatal, results. These diseases are dealt with elsewhere.

The Helminth Parasites of Rats and Mice.

NEMATODES.—Hall[1] gives the recorded numbers of species of nematodes in *Epimys norvegicus* as 11, in E. rattus (if *E. alexandrinus* is included) as 12, and in *Mus musculus* as 12. Of the species found in *E. norvegicus* and *E. rattus,* five are common to both. *M. musculus* shares three species with *E. norvegicus* and four with *E. rattus,* whilst two species are common to all three rodents.

Harvey Johnston[2] records the various species of helminths found in rats and mice in Australia. Six nematode species have been found in *E. norvegicus,* 5 in *E. rattus,* and 5 in *M. musculus.* Consideration of this paper requires the addition to Hall's list, to make it complete, of *Hepaticola hepatica* and *Heterakis spumosa* for *Mus musculus,* and of *Oxyuris obvelata* for *Epimys norvegicus.* Johnston also records *Œsophagostomum sp.*[3] for *E. norvegicus,* whilst in

[1] Maurice Hall, Nematode Parasites of Mammals of the Orders Rodentia, Lagomorpha and Hyracoidea, Proc. U.S. Nat. Mus., 1916, p. 227.

[2] Johnston, Rep. Bur. Microbiol., Syd., 1909 (1910), and Proc. Roy. Soc., Q., 1912, p. 107, and 1918, p. 53, in the press.

[3] Since identified by Johnston as *Heligmosomum braziliense* Trav. Proc. Roy. Soc., Q., xxx, in the press.

this species I have found larval nematodes, *Spiroptera* (?) *sp.*

The known nematodes of *E. norvegicus* (Australian records[1]) are therefore:—*Strongyloides papillosus, Capillaria annulosa, C. schmidti, Hepaticola hepatica*[1], *Trichosomoides crassicauda*[1], *Trichinella spiralis, Heterakis spumosa*[1], *Oxyuris obvelata*[1], *Heligmosomum braziliense*[1], *Strongylus sp., Gongylonema neoplasticum, Protospirura muris*[1] *and Spiroptera ?..sp.*[1]

Of *E. rattus* (including *E. rattus alexandrinus*):—*Capillaria annulosa, C. papillosa, Hepaticola hepatica*[1], *Trichuris muris*[1], *Trichosomoides crassicauda, Heterakis spumosa*[1], *Oxyuris obvelata*[1], *Gongylonema neoplasticum, Protospirura muris*[1], *Physaloptera circularis, Spiroptera ratti*, and *Filaria sp.*

Of *Mus musculus*:—*Capillaria bacillata, Hepaticola hepatica*[1], *Trichuris muris*[1], *Trichosoma muris-musculi, Trichinella spiralis, Heterakis spumosa*[1], *Oxyuris obvelata*[1], *O. tetraptera*[1], *Strongylus lemnii* (?), *Ollulanus tricuspis, Gongylonema musculi, G. neoplasticum, Protospirura muris*[1], and *Spiroptera quadrialata.* Johnston records *Gongylonema sp.* for Australia.

These lists give 13 species for *E. norvegicus*, 12 for *E. rattus* (and *E. alexandrinus*), and 14 for *Mus musculus.* Seven species are common to *E. norvegicus* and *E. rattus. M. musculus* shares 5 species with *E. norvegicus* and 6 with *E. rattus,* whilst 5 are common to all three rodents.

In Australia, *E. rattus* and *M. musculus* have five species of nematodes in common, and share four of these with *E. norvegicus.*

Of these nematode parasites of rats, two for different reasons are of world-wide interest, a third is of some particular interest to members of this Society, whilst a fourth is hitherto unrecorded, at least for Australia. These are the following:—

Trichinella spiralis Owen.—The ingested larvæ of this species mature in the intestines of suitable hosts. The embryos of the new generation find their way to the voluntary muscles. Here they encyst and develop to the infective larval stage. Numerous mammals may act as such hosts, and these include man, the pig, the Norway rat, and the house mouse. In man, the muscular invasion causes a severe typhoid-like disease, with tenderness in the affected muscles, which may be fatal. The presence of eosinophilia in the blood, due to the worm infestation, is of assistance in diagnosing the illness from other similar ones. Indigenous cases of the disease are unknown in Australia, but Johnston and Cleland[1] have collected the records, up to 1912, of Australian cases in which the infection has been derived from elsewhere; whilst Palmer, Cleland and Ferguson[2] have recorded a later similar case. Man is usually, perhaps always, infected by eating raw or under-done pork containing viable larvæ. The fact that both *Epimys norvegicus* and *Mus musculus* are liable to infestation opens a possible door for the introduction of the disease eventually to Australia. The former, and probably the latter also, are at times cannibalistic. Hence the infestation of one or more of their number may thus spread widely to others. Their original infestation may be derived from eating raw pig's flesh. Rats or mice may therefore be the vehicle for the worm's introduction into Australia. As white people do not eat either of these rodents, it might be thought that here, as regards man, the matter ended. Unfortunately, the omnivorous pig is a factor to be considered. Given the opportunity, he would certainly eat rats or mice, either

[1] Johnston and Cleland, Proc. Aust. Assoc. Adv. Sc., 1912, p. 305.
[2] Palmer, Cleland and Ferguson, Aust. Med. Gaz., June, 20th, 1914, p. 456.

sick ones infesting his sty, or dead ones disposed of by being given to him to eat by keepers too lazy to destroy them otherwise. Whilst the possibility exists in Australia of the infection of man by such a route, the likelihood of this happening is remote, partly because skilled meat inspection would probably detect the small lesions in the muscles of the hog, and partly because Australians are very particular as to cooking their supplies of meat. Some years ago in Perth I examined the diaphragms and other muscles of a small series of rats for *Trichinella spiralis,* but, as might have been expected, with negative results.

Gongylonema neoplasticum Fibiger et Oitlusen.—This worm is of interest for quite another reason. Its presence in the squamous celled anterior part of the digestive tract is associated with hypertrophy of the mucosa, which may lead to a papillomatous condition, and even finally to carcinoma (cancer), with metastatic growths in other parts. It is well worthy of consideration, therefore, in elucidating the various etiological factors that, directly or indirectly, lead to the onset of the cancerous process. In this case, and with our present knowledge, competent cancer investigators can come to but one conclusion, viz., that the presence of this worm sets up a form of chronic irritation which, like many other forms of chronic irritation—from a jagged tooth to the injuries from repeated burns and the subtle chemical bodies present in chimney soot—may eventually lead to the cell dyscrasia which is the basal change in the cancerous process. The intermediate hosts, from which the Black Rat, Norway Rat or house mouse may be infected, are the cockroaches, *Periplaneta americana, P. orientalis* and *Blatta* (*Ectobia*) *germanica,* and the Mealworm (*Tenebrio molitor*).

These neoplastic changes due to *Gongylonema* were first described by Fibiger[1] in 1913. It is interesting to note that

[1] Fibiger, quoted by Hall, Nematode Parasites of Mammals of Order Rodentia, etc., p. 235.

in August, 1912, I had the opportunity of examining a specimen of *E. norvegicus,* submitted for routine plague examination, in which the stomach was much enlarged, its wall thickened, the serous coat corrugated and the mucous membrane papillated. The stomach was full of nematodes, at the time presumed to be the common *Protospirura muris* (*Spiroptera obtusa*), but in the light of Fibiger's findings perhaps really *Gongylonema neoplasticum.* Sections of the affected parts showed portions of the worms embedded in the squamous epithelium, which was much thickened, and showed numerous marked cell-nests. This apparent cancerous process, a squamous-celled epithelioma, appeared to be invading the deeper parts, but had not yet reached the muscular coat. Strange to say, the stomach of another rat, taken as a normal control, showed also, embedded in the keratinized squamous epithelium, portions of a nematode.

Mention may be made here to an adenomatous condition of the stomach of a fowl, examined by us in 1910, in which we thought that the round worm, *Dispharagus nasutus* Rud., might have been a contributory cause of the lesion.

Heptaticola hepatica Bancroft.—In Australia the livers of our two common rats, and sometimes that of the house mouse, show irregular whitish or yellowish spots or streaks. In these areas are found numerous ova with opercular plugs at each end. During examinations for the presence of plague, these pathological lesions may give rise to some suspicion of the presence of this disease. In 1893, in the Journal of this Society,[1] Dr. T. L. Bancroft, under the title "On the Whip-worm of the Rat's Liver," described the worm responsible for these eggs as *Trichocephalus hepaticus,* and also dealt with the lesions present. As this nematode has been found in France, Italy, England (?) and the United States, as well as Australia, it is of special in-

[1] Bancroft, This Journal, Vol. XXVII., pp. 86-90, plates 7 and 8.

terest to us to find that such a widely distributed species was described and named by a member of our Society a quarter of a century ago. Hall (*loc. cit.*) states that the parasite had been previously observed by Chaussot (1850), Colin (1862), Davaine (1877), and Leidy (1891).

Larval Nematodes in Subserous Nodules on the Intestines.—On March 14th, 1912, two fresh rats (*E. norvegicus*) and a decomposing one, caught on the same premises off Oxford-street, Sydney, were found to have minute whitish nodules scattered over the serous coats of the intestines. On dissecting these, they were found to be occupied by larval nematodes, each about .4mm. long and 38 μ broad. So far the species has not been determined. Maurice Hall (*loc. cit.*, p. 223) refers to *Spiroptera* sp. Gerstaecker found encysted in the walls of the digestive tract of *Epimys* sp. These larvæ were 1.4 mm. long and 100 to 110 μ thick. Our larvæ are smaller, and do not show the morphological details given for Gerstaecker's forms. We sent specimens from these rats to Dr. Hall last year, and he thinks they may possibly be an earlier stage of the species found by Gerstaecker.

Rats as Possible Dispersers of the Eggs of Human Ankylostomes.—Whilst visiting Broken Hill last year, I was much interested in finding that rats were present in the mines, even at deep levels. Sanitary pans, placed in recesses, were entered by them and the fæces eaten. If at any time a carrier of ankylostomes from elsewhere, employed in the mine, should use one of these pans and rats ingest the ova, it is possible that infection might be spread to the workings, as the eggs may pass through the rat's alimentary tract unharmed. A lid to each pan is, of course, the solution of the matter.

ACANTHOCEPHALA.—The large *Gigantorhynchus moniliformis* has been recorded by Johnston (*loc. cit.*) in the intestines of *Epimys rattus* and *E. norvegicus* in Australia. It is often present in numbers.

CESTODES.—Harvey Johnston (*loc. cit.*) has recorded the tape worms *Hymenolepis diminuta* and *H. murina,* and *Cysticercus fasciolaris,* of which the adult stage is *Tænia crassicollis* of the cat, as parasites in Australia of *E. rattus* (*alexandrinus*), *E. norvegicus* and *Mus musculus.* He has just recorded also *Davainea sp.* from *E. norvegicus* in Brisbane.

In connection with the Cysticercus (*C. fasciolaris*), in August, 1911, I received from Dr. R. Dick, of Newcastle, two paraffin blocks containing portion of a large tumour with a small outgrowing nodule which had been attached to the liver of a specimen of *E. norvegicus.* In the centre of the mass he had found a cestode parasite several inches in length, which, from the description, was undoubtedly *C. fasciolaris,* which often matures to this stage in our rats. Sections revealed, in addition to much necrotic tissue and leucocytic infiltration, masses of mitosing spindle-shaped cells. I came to the conclusion that the growth was a spindle-celled sarcoma, which had arisen as the result of the chronic irritation of the parasite. This malignant growth, though of different nature to the carcinomatous process resulting from the presence of *Gongylonema neoplasticum* in another situation, may be considered as a parallel instance of the chronic irritative effects of helminth parasites.

Bridre and Conseil discuss the relation of hepatic sarcomata to the presence of *Cysticercus fasciolaris.*[1] Five out of 2,000 wild rats had these growths in the liver, and in four of these a *Cysticercus* was present in the growth. In three of the four cases it was the only one in the organ.

As mentioned more fully in discussing the rat fleas, Harvey Johnston has found the Cysticercoids of *H. diminuta*

[1] Vide Vet. Rec., XXII., 1910, No. 1126, p. 526.

and *H. murina* in the fleas *Lœmopsylla cheopis* and *Ceratophyllus fasciatus.*

In the rats found in a ship trading to Sydney in 1915, and identified by Oldfield Thomas as *Epimys terra-reginœ,* cestodes were present. These were forwarded to Harvey Johnston, who informs me that the species is apparently *Hymenolepis diminuta.* "It is rather broader, but I have not so far been able to find any difference justifying its separation from *H. diminuta.*"

TREMATODES.—No trematodes have been met with in any of these three rodents in Australia.

Previous Phenomenal Visitations of Rats or Mice in Australia.

"Plagues" of rats or mice in other parts of the world are well known. I do not propose to dwell on them, so will merely indicate several. There are two legends of the Rhine district concerning great hordes of mice invading stores of grain after years of famine. One mentions Hatto, Archbishop of Mayence, who in 970 was devoured by mice—he had previously assembled the poor in a barn and burnt them to death to save for the rich the corn the former would have consumed. The other is that a wicked Count Graaf was similarly treated by mice attracted to his tower by the grain collected there. Lantz[1] records instances of vast numbers of rats invading Astrakan in 1737, the Bermudas (*E. rattus*) in 1615, various parts of the United States in 1877, 1903 and 1904, and parts of South America. Various American bulletins deal with the economic losses from species of mice other than *Mus musculus.*

Longman's list[2] shows that the following numbers of indigenous species of rats and mice occur in Australia pro-

[1]Lantz. The Brown Rat in the United States, U.S. Dept. of Agric., Biol. Survey, Bull. 33, 1909.
[2] Longman, List of Australasian and Austro-Pacific Muridae. Mem. Q. Mus., V., 1916.

per, viz.:—*Hydromys*, 2 species; *Xeromys*, 1; *Epimys*, 13; *Pseudomys*, 18; *Leporillus*, 1; *Notomys*, 3; *Ascopharynx*, 1; *Conilurus*, 2; *Mesembriomys*, 2; *Zyzomys*, 2; *Laomys*, 2; *Mastacomys*, 1, and *Uromys*, 4. Total, 13 genera and 52 species. In addition, we have *Epimys norvegicus, E. rattus* and *Mus musculus* as introductions, presumably since colonization began, a period of only about 130 years. The damage done by these alien pests far outweighs any produced by our native species. Though some of the following references to mouse or rat visitations concern Australian species, it is certain that the most grievous of them has been caused by an introduced one.

The first reference, of which I am aware, to an unusual abundance of a murine rodent in any part of Australia is that in a footnote to the paper by Mr. E. Palmer to be shortly quoted. In this he states that "it is reported that Cooper's Creek, and the far western country (of Queensland) were visited many years ago by multitudes of mice." K. H. Bennett (see later) refers to an invasion of rats in the Darling country in 1864.

The 1869-70 *"Gulf Country" Rat Visitation.*—Under the heading of "Notes on a Great Visitation of Rats in the North and North-Western Plain Country of Queensland, in 1869 and 1870," E. Palmer, M.L.A.[1], describes the occurrence of an "extraordinary and sudden increase in numbers of an indigenous rat" at the period mentioned, from the heads of the Flinders and Cloncurry northwards. They were first noticed about the middle and towards the end of 1869. January and February, 1870, were months of continuous rains and extensive floods, resulting in an exuberance of vegetation. When the waters had subsided, in the words of Mr. Palmer, "the plague of rats increased to an extent that would scarcely be credible. They covered

[1]Palmer, Proc. Roy. Soc., Q., II., 1885, p. 193.

the plains in every direction; when riding at night they could be heard squeaking everywhere, fighting with each other; they swarmed into the huts and gnawed everything they could get at. Flour, meat, and leather articles had to be stored in galvanised iron rooms or safes, built expressly for the purpose. When camping out, every article had to be hung in a tree, and the hobbles, made of green hide, have been known to be gnawed off the horses' feet during the night. . . . If a hundred were killed round the hut at night there appeared no diminution of the number of visitors on the following night; and for months in succession the same slaughter could be kept up. It would be impossible to estimate numbers; for hundreds of miles along the Flinders and its tributaries, traces of these rats were to be seen; the grass looked as if it had been cut down, or flocks of sheep had been over it. . . . Fifty thousand square miles occupied by these animals, and one rat to every ten square yards in each mile would not represent anything like their numbers. The large open plains appeared to be their favourite resort, and, strange as it may appear, very seldom were any young ones discovered, although their nests were occasionally found, showing that they bred in the country. Towards the end of 1870 they decreased in numbers, and in the following year disappeared." Mr. Palmer states that this rat, which appeared to be indigenous to Australia, as it was known to the blacks, seemed most nearly to approach the brown rat (*Mus decumanus*), and was similar to it in its burrowing habits. It was of a greyish-brown colour, not much more than six or seven inches long in the body, with a short, thick bare tail three inches long; the fur was close and short, the body thick and strong, the ears short and stiff. The increase of rats was accompanied by an "almost corresponding increase in their natural enemies —native dogs, snakes, hawks and owls."

Evidence existed that this same district had been subjected to a similar visitation years before, inasmuch as the settlers who first occupied it, five years before the visitation mentioned above, found great heaps of the skeletons of rats at the bases of old hollow trees, previously occupied presumably by owls.

The sudden and remarkable increase seems rightly attributed to congenial surroundings and abundant food, coupled with the absence of enemies, whilst their disappearance is capable of explanation by a reversal of these conditions, aided by their own cannibalism.

The 1887 *Cooper's Creek and Darling Rat Visitations.*—The following description is from a communication made to me in January, 1916, by Mr. John M. Bagot, and, in its nature, it closely resembles that of Mr. Palmer, though floods and abundant herbage were not apparently associated with the increase. Doubtless the same, or a closely allied, species of rat was responsible. As the species met with by Mr. Bennett in the Darling district was identified as *Epimys rattus* (*Mus tompsoni*) presumably the Cooper's Creek rats were the same. Mr. Heber A. Longman, of the Queensland Museum, suggests, from the term "river rats," *E. norvegicus,* but adds that a long snout and rather thin body point more to *E. rattus.* Determinations from descriptions are, however, as he states, unsatisfactory.

"In the year 1887 I was witness to an enormous migration of rats, thousands of millions, I should say. In that year we were building the railway (of which I was one of the engineers) round the south shore of Lake Eyre. We were camped in tents a mile or two from the dry lake-bed, with one or two iron buildings for the protection of stores. Suddenly, before precautions could be taken, a plague of rats was upon us, and in a very brief space £1000 worth of provisions, tents, and other commodities were destroyed.

The rats had come from the north, from the great dried-up river beds of the Finke, the Alberga and the Macumba, and smaller rivers which, in times of extraordinary rain, pour their floods into the north-west area of Lake Eyre. At any rate, the blacks and old bushmen told me that the rats came from these usually dry river beds, which, of course, contain many (so-called) permanent water holes. I heard also that this was not the only rat migration known in these parts.'' Mr. Bagot attributed the fact that the rats travelled southward and not northward to their keeping ''to the area where are the artesian springs, and where also temporary surface waters are more frequent than in the drier districts divided from the Lake country by faults.'' He adds: ''But the line of artesian waters breaks away from Maree (Hergott Springs) towards Lake Blanche, where it finally ends, and the cretaceous and oolitic formations butt up against the older strata extending eastward. This stretch is sandy and stony, there are but few springs in it, and the rats did not make in that direction. They turned southwards at Maree, following approximately the course of the railway through better country intersected at first by creeks coming from a range to the westwards, and after passing Mt. Deception they followed the plain between the Flinders Range and Lake Torrens, passing through that range where the railway passes, and finishing up their journey at Quorn, some 240 miles from Adelaide, where they appear to have succumbed to nature or the hardships of their march. They appear to have spread 30 to 40 miles wide, always keeping the line of country where food and water was least problematical. I might here mention that no rats came from the Cooper River to Maree, the reason being, I surmise, that they would have had to cross 90 miles of stony desert, where no surface water is (or was), and where bores struck the secondary formation at 1200 feet without penetrating a water-bearing bed. During the invasion I and others used to sink a hole in the centre of the tent, in which was placed a kerosene can with its top flush with the ground. The upper square of tin was cut out and pivoted on a pin of wood, and the can half filled with water. The rats, walking on this trap, fell into the water and were drowned, more than a dozen being sometimes taken out in the morning. These river rats were grey, with a long snout and rather thin body.''

I am indebted to Mr. J. C. B. Moncrieff, of Adelaide, for the following note from Mr. J. G. Stewart, in reference to this same visitation. He says: ''I was engaged about this time upon the survey of the railway from Hergott to Oodnadatta, and afterwards on the trial survey from Oodnadatta to the McDonnell Ranges. These rats came down in enormous numbers about 1886, and it was understood that they travelled from the south-west of Queensland. They were smaller than the ordinary rat and, I think, entirely herbivorous, and were greatly relished as food by the natives. They appeared to pass through the country in a south-westerly direction, and eventually died out; but I cannot say how far they reached. I remember hearing at the time that there had been similar visitations before, always in good seasons, but have not been able to get any information of such having occurred in later years.''

Mr. J. C. Moncrieff's brother, Mr. A. B. Moncrieff, also personally witnessed their numbers, and remarked on the sudden way in which they came, and then disappeared without any apparent cause. An Adelaide newspaper cutting also mentions that Mr. D. J. Beck had seen large numbers of rats which had come from the Diamantina country, South-west Queensland, and had extended down as far south as Bulloo Downs. The rats were smaller than ordinary rats, and lived in warrens.

K. H. Bennett[1], under the specific name of *Mus tompsonii,* Ramsay, which A. R. McCulloch[2] has shown to be a synonym of *Epimys rattus,* gives a note on rats then infesting the western portion of New South Wales. They had first appeared as stragglers in the Ivanhoe district in February, 1887. By the middle of April, the country west of Booligal to Wilcannia was swarming with them, all travelling southwards. So numerous were they, that their countless footprints obliterated overnight on the roads all marks of vehicles, or even of flocks of sheep. They moved about at night, hiding by day in rabbit-warrens, etc. As food they consumed seeds, pigweed and probably young rabbits. About the middle of May, the main body had passed Ivanhoe. At the end of May, they were tolerably numerous along the river at Tilpa in the middle Darling. Near Cobar they were unknown. Previous to reaching Ivanhoe, they had been reported in Western Queensland. Floods in the Darling and other rivers, which occurred this year, did not stop their progress.

Mr. Bennett remembered a similar invasion of rats in 1864, a year when the Darling was also in flood. He was doubtful whether they were the same species as, in addition to living in burrows, they built large heaps of sticks, underneath which were nests of soft grasses. They were accompanied by large numbers of hawks (*Elanus scriptus*) and owls, which preyed on them, but which were not numerous in 1887. In 1874, in the Barrier Ranges, he had seen rats inhabiting similar nests and also accompanied by *E. scriptus* and owls.

The 1895 *Visitation of the Rat Ascopharynx cervinus at Charlotte Waters.*—Spencer and Gillen[3] refer to these migratory hordes of rats in Central Australia and mention

1 Bennett, Proc. Linn. Soc. N.S.W. (2), II., 1887, p. 447.
2 McCulloch, Rec. Aust. Mus., VI., 1907, p. 212.
3 Spencer and Gillen, Across Australia, I., p. 166.

specifically that those responsible in 1895 belonged to an Australian species, *Ascopharynx* (*Notomys*) *cervinus* Gould. They say:—"Periodically, one species will appear in enormous numbers, forming migratory hordes. In 1895, for example, Mr. Byrne, writing from Charlotte Waters, said 'the Jerboa-like rats are coming from the eastwards, and they almost amount to a plague here.' These periodic migrations of rats are well known in many parts of the dry interior of Australia. They march on and on, along a definite course, as the Lemmings do in Europe, appearing and disappearing almost suddenly. Those which escape the birds of prey that follow them, probably perish finally from lack of food and water, for impelled by some instinct, they march straight ahead, utterly regardless of whether there is food or not."

The 1904 *Visitation of Rats at Alice Springs, S.A.*—I am idebted to Mr. E. A. Allchurch, of Hergott Springs, through Mr. J. C. B. Moncrieff, of Adelaide, for the following account of a migratory horde of rats at Alice Springs in 1904. As far as Mr. Allchurch remembered, the pest first appeared in September. He says:—"First there were just one or two stragglers. Then we noticed that they appeared everywhere. The first few we were able to destroy. Then we tried to check them with poison, and all sorts of devices, but these were of no avail. After a few days, everything green, or growing, of any description was eaten clean out. Our small vegetable garden disappeared in quick time. They then started on any kind of leather, such as harness and saddles, and on clothing, and were particularly keen on anything with a little grease on it. Eventually they were so bad that we could hardly use our beds, and I remember trying to place pieces of zinc around the legs of my wooden stretcher, but they took no notice of these. Eventually, we found, by placing high pieces of zinc (from old zinc cases) right across the doorway, that they would run right round the verandah and we were allowed to sleep in peace. This lasted for some four weeks. By this time everything they could possibly devour had gone. We then noticed a slight falling off in their numbers, and they gradually got less and less, until not one remained. They appeared to work from due north to south, clearing up everything as they went. In describing them, I may say they were not more than half the size of the ordinary everyday rat, and they had a very sharp, quick, active way with them, and were very cunning. They were also very savage, and could bite very hard. The head appeared more like that of a fox on a small scale. The tail stood straight up in the air and at the tip was distinctly bushy, but the bushiness did not extend far down the tail, and only appeared to sprout out from the tip. During the rest of my term (11 years) at the Alice, they never appeared again, and did not seem to have left any progeny behind. Some time after, we certainly had a mild mice plague, and also in a dry season we had an extraordinary large number of water-hens. I should say there were thousands, passing for some days. They travelled in an opposite direction altogether, going from east to west, and were very destructive during their stay. Considering the scarcity of water that particular year, it was quite a unique occurrence.''

The 1903-1905 *Mouse Visitation.*—Lucas and Le Souef in ''The Animals of Australia'' (p. 21), mention that ''sudden hordes of rats and mice also appear in the interior. Collecting in multitudes, they migrate over great distances, are alarmingly destructive to the crops and stores of the settlers, wherever these lie in their course, and are followed by pursuers, which may be nearly as troublesome as the rodents themselves.'' They then give an extract from the Sydney *Daily Telegraph* of Oct. 9th, 1905, from which it appears that towards the end of 1904 and in the early months of 1905 millions of mice swept over the western plains of Queensland and invaded the central districts of South Australia. The Sydney paper quotes a correspondent of the Adelaide *Advertiser,* for an interesting account of this wave of mice as it reached Goyder's Lagoon. They ate the pack bags, worried sleepers and gnawed their ears, and took possession of nearly everything in the homestead. Three hundred mice were poisoned in one kitchen in a night and 2000 in a few days. When this correspondent wrote, the mice had disappeared, the disappearance having been aided by a marsupial mouse-catcher.

Mr. C. J. Cameron, J.P., of Roseville, Sydney, has kindly supplied me with the following personal recollection of a mouse visitation in 1903, which is evidently part of the same "plague" referred to by Lucas and Le Souef. He says:—

"Some few months after the drought broke up mice appeared in small numbers, and in a few weeks' time were to be seen in myriads, not only in the inhabited parts, but through the bush, even in districts that were purely pastoral and a considerable distance from any agricultural country. This plague increased very rapidly for a time, and disappeared as suddenly as it had come. The mice ranged in size from that of an ordinary mouse to almost the size of a full-grown rat; and varied in colour, some being that of an ordinary mouse, but in the majority of instances they were varied colours of yellow, black, and piebald with all kinds of stripes.

"In the pastoral area where I saw them, viz., the Western District of this State, they naturally did not do the same amount of damage as in the agricultural areas, where, of course, they destroyed stacks and grain. In the pastoral areas the damage was confined to the homesteads, where furniture, floorcoverings, and the woodwork of the buildings were greatly damaged by them."

Poisoning and trapping had little effect on them, so great were their numbers, but in a few weeks' time they had completely disappeared.

Mr. F. W. Gavel, Inspector of Stock at Dubbo, has kindly given me the following information as to his experiences of this mouse-pest as it affected the north-west of New South Wales and the adjacent parts of Queensland:—

"In 1904 the plague of mice was particularly bad to my knowledge in that part of Queensland embracing the towns of St. George, Goondiwindi, Surat, Mungindi, Dirrinbandi, Hebel and Bolon. Also in the north-western part of New South Wales, embracing the towns of Boggabilla, Boomi, Mungindi, Collarenebri, Mogil Mogil, Walgett, Angledool, Garah and Moree. The plague made its appearance at Mungindi about the month of May, travelling from Queensland in a southerly direction into New South Wales. After it had abated at St. George, in Queensland, it was at its worst at Mungindi, about 90 miles south from St. George; and again when it had abated at Mungindi it was at its height at Moree, 74 miles further south. The Barwon River was at the time running a fair stream, but it did not seem to have much effect in checking the progress of the march south. The duration of the plague was not more than about four months, but while it lasted it was particularly bad. The pest was distributed right throughout the fields, and mice could be found under almost any tuft of grass, piece of bark, or anything affording cover. Their little pads could be noticed anywhere out in the fields. The breeding nests and numbers of young mice were a most noticeable feature. The season had been unusually good during the summer months, and there was at the start any amount of food, but as the mice became more numerous, they devoured everything capable of giving them nourishment. Any provisions not protected from them were soon destroyed by them. Any stacks of hay were soon rendered quite unfit for use. As the mice became more numerous they became more ravenous, and attacked, killed and ate pigeons in their cages, and chickens and even odd confined fowls were said to have been killed and eaten by them. If any mice were trapped or disabled they were soon devoured by other mice. It was quite the usual thing for drovers, or bushmen camping out, to be disturbed at night by mice nibbling their fingers and hair. Trapping, in the ordinary way, was of no avail, though the mice could be poisoned readily. After a fair poisoning I have heard of from two to three fair-sized washing tubs having been gathered up. About July they became miserable and weak, and began to die. Anything giving out warmth attracted them. They could be seen huddled together, looking mean and miserable, under anything affording cover or protection. They seemed to be suffering from some disease. The eyesight often appeared to be affected, and many of them seemed to be quite blind. By the end of August the plague had passed on from Mungindi, and the place seemed to be unusually free of mice. I am of the opinion that starvation largely assisted the disease to eradicate them. At any rate, diseased or poverty-stricken mice could not be seen in the vanguard. Breeding only occurred where the mice were vigorous.''

In answer to an enquiry of mine as to the species of mouse responsible, he added—:

''There is not any doubt but that the mice were the ordinary house mice, taken to the fields. They over-ran both fields and houses. Odd marsupial mice were found at the time, but they were rare, and it seemed were driven out by the ravages of the house mice, which constituted the plague.''

D. Le Souef[1] quotes newspaper extracts showing the presence of an extensive visitation of mice in 1905 in the Merriwa and Mitiama districts, Victoria.

From these accounts, it seems highly probable that the 1903-5 visitation was due, like the 1917 one, to the common house-mouse, *Mus musculus.* I am unaware of any actual accurate determination of the species, but Mr. Gavel states clearly that they resembled in every way the house mouse, and that he had no doubt that they were this species, whilst Mr. Le'Souef, who received Victorian specimens, says they were apparently the ordinary domestic mouse. Their habits conformed with those of *Mus musculus,* and their behaviour was very similar to that of the mice of the recent visitation which have been so identified. Mr. Cameron raises a doubt, however, by referring to a marked variation in size, and to the presence of variation in colour. Amongst large numbers of mice, partial or complete albinism and other colour changes, including melanism, might occasionally be expected, due to developmental deficiencies of the factors responsible for colour production, or perhaps to mutations of a positive nature. Occasional instances of partial albinism have been noted in the recent visitation, but I have not heard of unusual differences in the size of adult mice.

Mice in South Australia in 1911.—In a MSS. letter, Dr. R. H. Pulleine mentions that mice (*M. musculus*) in this year constituted a "severe plague" in Northern South Australia.

The Mouse Plague of 1917.

It appears that the first indication of mice being more numerous than usual was noticed in New South Wales in December, 1916, but in that State the mice had not increased "to an alarming extent" until early in April, 1917, when

[1]Le Souef, Wild Life in Australia, p. 132.

their numbers could be considered as constituting a "mouse plague." In Victoria the increase was first noted in February and March in the North-western districts; whilst in South Australia the "mouse plague" was reported in March. In the latter State they had been noticed to be "bad" in four or five towns, e.g., Port Broughton, Mundoora, and Kybunga, during the previous season, and it was in this district that the increase first occurred. In Tasmania and Western Australia there was no undue prevalence, whilst in Queensland the information available indicates that the Darling Downs district was affected. During the winter, when the plague was at its height, the carcases of destroyed mice were estimated in tons, the amount of grain actually consumed by them was large, whilst the havoc and destruction caused by their depredations were enormous.

The Species of Mouse Responsible.—A considerable number of mice were from time to time submitted to me from various parts of New South Wales, either for the purposes of experimenting with various bacterial and other methods of destroying them, or for examination for disease. All the specimens so submitted were indistinguishable in general appearance from the common house mouse. To make certain as to the identification, examples were forwarded to Mr. Oldfield Thomas, of the British Museum, the world's authority on rodents, for his opinion, and he has identified them as *Mus musculus,* the common house mouse. Mr. Heber A. Longman, of the Queensland Museum, whose work on Australian rodents is well known, has also kindly made detailed examinations of the skins and skulls of samples from four different localities (Temora, Gilgandra and Tocumwal amongst them), and has pronounced the mice all to be typical *Mus musculus,* though their external dimensions showed more variability than usual. He also examined mice from the Darling Downs district in Queensland, and found these to be the same species.

As regards variation in size, Mr. J. B. Clarke, of Victoria, after seeing some hundreds of thousands, says they were almost as equal as peas in a pod. He saw little variation in colour—an occasional piebald one, and only one or two albinos in the season. In reference to one of the mice from Tocumwal, with light colouring on its under surface, Mr. Longman says that this is interesting in view of the fact that Collett's specimen from Coomooboolaroo, N. Queensland, collected in 1884, and identified by Thomas as *Mus musculus,* had the under side nearly white.[1]

Summary of the Information Available.—Before giving in detail the information collected, it may be useful to summarise this, and indicate the salient points of scientific interest. It appears that the common house mouse, which in the mild climate of Australia has taken much to the fields, as well as to houses, outhouses and barns, multiplied prodigiously during the season under review. This was due to the abundance of suitable food, first of all from stacks of wheat left over from the previous year, then from grain shed in the fields as the result of unusual wind and rain storms, and finally from the vast accumulations of fresh grain stored in the neighbourhood of these previous food supplies. These conditions were more or less prevalent over the wheat areas of New South Wales, Victoria and South Australia, leading to a general and almost contemporaneous increase over vast areas. Given an abundant food supply, no natural enemies existed in Australia in sufficient numbers to cope with such prolific breeders. The mice, having exhausted the food in the fields, or being disturbed by ploughing, then sought new stores, and invaded the stacks, gnawing the bags. The wheat escaped, and the

[1] R. Collett, Zool. Jahr., 1887, p. 839.

stability of the stacks was endangered. The grain poured down, and the roofs collapsed, letting in rain. Thousands of tons of wheat were lost, partly through consumption by the mice, partly through damage by rain, partly through being spoilt by mouse droppings and tramped into the mud. The mice did not migrate in the ordinary sense, but followed trails of food to new districts, or were transported unwittingly by man to fresh areas. Ordinary means of trapping and poisoning failed, but by suitable fencing, clean stacks could be efficiently protected, and rebagged wheat stored in these. The transport of grain to uninfested districts was a means of protection of value. With such measures, and the onset of cold weather, the damage done by the pest was diminished. Disease amongst them, probably subcutaneous abscesses and the ringworm favus, is thought to have played some part in decreasing their numbers, but I doubt whether such diminution was appreciable. Ringworms and superficial sores occurred to some extent in persons handling the spoilt wheat, and the former was unduly prevalent in other inhabitants of the affected areas.

Official Information.—For the purpose of obtaining official information as to certain aspects of the mouse visitation, I personally asked Mr. E. Harris, the officer in charge of the Government Wheat Operations in New South Wales, for information on the subject, and wrote to the various Departments in the other Commonwealth States asking for data in connection with the undermentioned eleven points.

As regards Queensland, I received a reply from the Under-Secretary, Department of Agriculture and Stock, stating that it was regretted that the information asked for could not be supplied, the reason being that there was no official enquiry made at the time of the visitation, and consequently no statistics were collected by the Department.

A letter from Mr. J. Sibbald, General Manager of the Wheat Marketing Scheme of the Government of Western Australia, stated that the mice had appeared there only in normal quantities, and no special measures had been taken in that State to combat them.

Mr. L. A. Evans, Acting Director of Agriculture in Tasmania, stated that up to September 24th no plague of mice had occurred.

Through Dr. Cameron, Director of Agriculture, Victoria, a reply was received from Mr. A. Judd, Secretary to the Victorian Wheat Commission, Melbourne; and a communication was also forwarded by Mr. W. L. Summers, Secretary to the Minister for Agriculture, South Australia. These, together with Mr. Harris's observations in New South Wales, are summarised in the following manner:—

(1) *When and where was the Increase first noted?*

New South Wales: Evidence that mice were more prevalent than usual first appeared in December, 1916, but their numbers did not increase to an alarming extent until early in April, 1917, when these could be said to constitute a "Mouse Plague."

Victoria: The increase of the mice was first noted in February and March in the North-western districts of that State.

South Australia: In four or five towns mice were "bad" in stacks during the previous season, e.g., at Port Broughton, Mundoora and Kybunga. It was in this district that the mice plague was first reported in March, 1917.

(2) *Districts affected by the Plague.*

New South Wales: The area of the State chiefly affected by the mice plague was the Southern district, the mice working up into New South Wales from the Victorian border. The West (with the exception of the district from

Parkes to Forbes, and including the branch line from Trundle to Peak Hill and Narromine, and the district from Dubbo to Coonamble) was not affected, and in the North the pest has never assumed more than normal proportions.

One aspect of the matter that might be noted with interest is that Henty—which is situated in the centre of one of the worst affected areas—was practically free from mice, while the stations a few miles on either side suffered considerable damage. The same remark applies to Holbrook, Old Junee, and Wagga. In the case of Wagga, the Murrumbidgee River may have been a protection from the mice journeying here to the south, for, while there is little evidence of mice at Wagga, when they came to the river they seem to have concentrated their attention at Bomen, where they did considerable damage.

Another noticeable fact is that in hilly country the mice did little damage. At Grenfell and Greenthorpe no damage was done, yet within a few miles, where the hilly country merges into the flat Bland country, the damage was exceptionally heavy. This aspect is noticeable right through. Wherever hills bounded the towns or districts, the damage was very light, and where the country was very flat the damage was exceptionally heavy. Molong might be cited as another instance—the country between Molong and Parkes being hilly right through. At none of these stations were the mice above normal, but directly the flat country is reached at Parkes, they were reported as bad. The same thing occurred at Dubbo—no mice; but on the flat country from Dubbo to Coonamble, large quantities of them.

Victoria: The districts affected were the Northern, the North-western, and later the South-western portions of the State.

South Australia: The mouse visitation extended from Hawker in the North, to Millicent in the South-east, and from Fowler's Bay on the West Coast (Eyre's Peninsula) to Pinnaroo in the East.

(3) *Evidence of spread from one district to another.*

New South Wales: The experiences on the Murrumbidgee River mentioned under (2) may suggest migration.

Victoria: The evidence of the mice spreading was shown by their appearance first in North-western and later in Northern and Southern districts.

South Australia: There was no evidence of spread. They were found 400 miles west of Port Augusta on the East-West railway.

(4) *Did the mice multiply in the fields and then invade the stacks, or invade both simultaneously?*

New South Wales: The mice are of migratory habits, and were first noticed in the fields—especially in stubble paddocks. Stacks at stations adjoining stubble paddocks appear to have received first attention. Those further removed were not attacked until later on. The ploughing of the fields seems to have driven them to the wheat stacks.

Victoria: Where the mice multiplied is unknown. They first appeared in the fields, and later in the wheat stacks. The absence of the young in wheat stacks shows that they did not multiply there.

South Australia: So far as we know the mice bred in the fields, and then invaded the stacks.

(5) *Special Breeding Times, (a) in the Fields, (b) in the Stacks.*

New South Wales: In the early stages of the plague, say from April until well on in July, no signs of young mice were found in any of the stacks; but from that date on nests have been found, although not to any great extent.

It has been proved that the mice are cannibalistic in their habits, and this probably accounts for the relative absence of young. Another explanation is that they breed in the fields and in the dunnage, but not in the wheat stacks.

Victoria: The special breeding time in the fields is not known, and breeding in the wheat stacks was not noticeable.

South Australia: We have no knowledge of breeding times. Very few immature mice have been seen in the stacks, and hardly any nests discovered until about two months ago, since when a few only have been seen. During the past month or six weeks (October 9th, 1917), the number of mice in wheat stacks has largely decreased.

(6) *Nature of damage done, e.g., to Wheat, Hay-stacks, Sown Grain, etc.*

New South Wales: The mice seem to have fed only on wheat, great quantities of which they destroyed. The bags, of course, were rendered quite useless by their depredations.

The extent of damage to the wheat stacks has been considerable. When the mice in large numbers attacked the wheat, the stacks collapsed, and loose wheat was thrown out, rendering a great amount of labour necessary to put it in bags and in condition again.

In addition to the loss in wheat, bags and labour, it became necessary to build sheds to re-house the wheat, to make mice-proof fences to keep the mice out, and to destroy those inside the fence. It was also necessary to remove great quantities of the wheat from the plague affected areas to depots out of the danger zone, and until all this wheat is finally removed it is impossible to say to what the damage will amount.

Mr. E. Harris informs me that the 1915-16 grain, which was harder through containing less moisture than the 1916-17 wheat, was hardly touched at all by the mice.

Victoria: The damage to wheat was chiefly due to collapse of the stacks, whilst the hay was rendered unfit for consumption by horses, and sown grain was eaten.

South Australia: As regards the wheat, the grain was chewed, the bags riddled, and the wheat fouled with excreta and urine, and tainted, whilst the roofs collapsed and the wheat was damaged by the weather. In hay stacks the grain was eaten out of the hay and the hay tainted. Sown grain was reported to have been eaten in some districts, and germination of crops was correspondingly thin.

(7) *Rough estimate of financial loss, by percentage of wheat destroyed or value and cost of reducing the pest.*

The Victorian Wheat Commission could give no estimate of the loss, but the South Australian reply gave a rough estimate of 3d. per bushel on the whole crop. The loss on some of the worst individual stacks, including cost of reconditioning bags, labour, and damaged and lost grain was estimated at 8d. per bushel.

(8) *Means of Combating the Plague—(a) By destruction of mice; (b) by protecting Foodstuffs.*

New South Wales: The first action was to protect the wheat from the weather, and to effect this, temporary roofings to replace the collapsed roofs were put on the stacks. A fresh site was then prepared, and around this a mouse-proof fence of galvanised iron was built, and over the site a shed was erected. The wheat was then re-bagged or reconditioned into the mouse-proof area. This method was found to be effective provided that reasonable care was taken to prevent the mice getting inside the mouse-proof fences. Phosphorus paste, applied on bread and cheese, has been found an excellent and safe means of destroying the mice.

Another method to combat the plague has been to board in the stacks to a height of 4 or 5 feet, so that the falling loose wheat would form a wall round the existing bags. This has the effect of driving the mice out of the stack, as they cannot live in the loose wheat. The dunnage and heaps of rubbish left in the station yards have also been fumigated with bisulphide of carbon with excellent results.

Removing the wheat from the infested areas to depots outside the mouse-infected country has been adopted with success, as the mice do not seem to have crossed the Great Dividing Range.

Victoria: The wheat stacks were enclosed with galvanised iron fencing, and the mice were captured in pits.

South Australia: In those stacks which it was found possible to enclose in gas-tight sheets, fumigation with hydrocyanic acid gas proved effective in killing a large proporton of the mice in the stack, wherever the gas penetrated, thus saving the stacks from collapse. This was especially useful at large stacking depots. Enclosing stacks with galvanised iron barriers, and burying kerosene tins outside with the tops one inch above the ground-level, has proved effective in keeping the number of mice down.

(9) *Evidence of Disease in the Mice.*

New South Wales: In the latter part of the period mentioned, say from well towards the end of July, disease is reported to have broken out in a few districts in the South, and also in the West—specimens forwarded were swollen and inflamed in the hind legs and tails; but there is no evidence that this has carried them off to any great extent. One reason advanced for this condition is that the disease has been brought about through wheat-eating, and this is borne out to a great extent by the number of birds losing the use of their legs after eating freely and constantly of the wheat.

Victoria: A kind of paralysis was noticeable in a small percentage of the mice in May, 1917.

South Australia: Skin disease was in evidence at many places most of the year, but apparently had no appreciable effect in decreasing the number of mice. Cold weather and wet weather appear to have been the principal influences leading to a diminution of numbers.

(10) *Disease in Man, e.g., Ringworm, Sores, attributed to the Mice or the Damaged Grain, etc.*

Victoria: In isolated cases, men handling wheat infested by mice contracted an itching on the arms similar to ringworm. The diagnoses of impetigo contagiosa, scabies and favus had apparently been applied to the sores.

South Australia: A few men (relatively) contracted skin disease from mice, apparently through carelessness in not using disinfectants on cuts, etc. Apparently none of the skin troubles were serious, and were cured without difficulty.

(11) *Suggested Cause of the Increase, Seasonal, etc.*

The Secretary to the Victorian Wheat Commission offers no suggestion as to the cause of the increase.

Similarly in South Australia no information was obtainable except that the mice had appeared almost simultaneously in most parts over an area of 600 to 700 miles square, both in and distant from agricultural areas.

Personal Information.—Mr. J. B. Clarke, late of the Victorian Wheat Commission, has very kindly supplied me with the following account of the pest in that State. He says:—

"One of the main features which tended to make the plague so bad during the last season was the fact that immense stacks of old wheat were held at country stations in 1915-16. During the spring of 1916 it was noticed that mice were becoming very plentiful at certain stations in the Wimmera and the North-West Mallee. The Victorian Wheat Commission, in order to minimise the damage as much as possible, shifted a number of the stacks to the seaboard. Sufficient stacks, however, were left to provide a breeding and feeding ground for the mice, which were daily increasing; at this period there were a great number of young ones in the stacks. During the harvest they were observed in the fields, and the old stacks at stations were now suffering severely, and it was apparent that a plague was about to occur. By the middle of February, 1917, the damage to new wheat stacks was becoming serious, and loose wheat was pouring out all round these, and it became apparent that the great majority would collapse.

"The Wheat Commission, during March, determined to shift the whole of the grain to sites selected near Melbourne. The railways were asked to make strenuous efforts, which they did; but in spite of all efforts, a number of stacks were by this time merely heaps of bran on the outside. However, on removing the outer covering, it was found that the lower layers of bags were very little damaged. This fact was due to the loose wheat running down through the stack and filling up the spaces. Incidentally, it proved that mice can do very little damage to loose grain.

"Great damage was at this period caused by the roofs of the stacks collapsing, and allowing the water which fell on them to run in amongst the wheat. As a precaution and preventive, the Commission had erected a single galvanised fence round the stacks, with openings at every sixteen feet. Unfortunately, the manner of erection was a poor one, pegs being driven on each side of the iron. The mice soon learned to run up the pegs and jump on to the top of the iron, and then run down the opposite pegs to the ground. In the openings were placed kerosene tins with the tops cut out. At first these were fairly successful in trapping the rodents, for seeing the opening, they attempted to pass through, and fell into the tins, which contained sufficient water to drown them.

"The Commission had appointed Mr. England (of Messrs. Cuming, Smith & Co.) to experiment at Minyip with bisulphide of carbon fumigations, but he found it impossible to do anything in that respect. When at that centre, his attention was drawn to the fence and trapping device. He subsequently erected what proved to be a most effective device for trapping, as follows:—A double fence of galvanised iron was erected right round the stack, with a space of about 3 feet between the two fences. These were sunk in the ground to a depth of six inches in a trench, which was closely rammed to prevent burrowing. Pegs were driven firmly into the ground, and the iron nailed to these at every corrugation, to ensure a tight joint, as it was found that if the edge of the sheet projected they ran up the lap. Thus the fence was absolutely plain on the inside, and once the mice were between the fences, there were no means of egress. To encourage them to climb over from both the outside and the stack side, strips of bag were attached to the pegs and allowed to reach the ground on the outside, but did not hang lower than 14 inches from the ground on the inside of the race. After watching thousands of mice trying to jump out of the race, it was found that at 13 inches an occasional one could get a grip on the bag, but at 14 inches not one was observed to escape.

"At a later date at some stations the bags were removed, and it was found that the mice ran up the bare pegs better, and hopped over into the race themselves. Bait, in the shape of oil of aniseed and treacle, was laid in the race as an attraction, but as 268,000 were caught in one night at Lascelles without bags on the race or without bait, it was pretty evident that it was not necessary to provide enticement.

"On close observation where the stacks were in very bad condition, it was apparent that the great majority of the mice were living in burrows about the railway yards, as they would be found at night in myriads climbing over the outer fences to get into the stack. Once they had accomplished their purpose, and got into the race, their doom was sealed, as they were driven along to the end of the fences, which here converged into a V-point, where a round pit, encircled on the inner side with galvanised iron, was sunk. As the fences projected through a slit in the iron six inches into the pit, it was impossible for them to escape, and in a good drive they poured in like a stream of water. A cupful of bisulphide of carbon was then thrown into the pit on top of them, and a couple of bags placed over the top. In a few minutes what was previously a seething mass was suffocated. They were then thrown into a cart, taken away, and buried.

"By this means immense catches were made, and 500,000 were caught in three nights at Lascelles, or reckoning 36 to the lb., 8 tons. Subsequently 500,000 were caught in one night at Sheep Hills. These estimates were reckoned at 800 dry mice to a kerosene tin, although up to 960 were counted out of a full tin.

"During June and July it was apparent that disease had broken out. Various ideas were given as to the nature of the complaint that they were suffering from, but it was clearly proved on close examination that they were very badly infected with mange and ringworms, and generally lost the power of their hind legs before death. The men handling the wheat broke out in sores and a species of ringworm. This, however, was easily cured by iodine, especially if treated promptly in the early stages.

"Subsequently Mr. Luley, of the Vermin Destruction Branch, formed eleven pens of mice taken direct from the stacks. Very interesting results have occurred from his observations. He finds that they breed at a month from birth, that nine young ones is a common litter, and that a full grown mouse will eat up to 10 grains of wheat *per diem*.

"A general review of the plague period shows pretty conclusively that the set of circumstances which had arisen through having such a vast stock of food on hand accelerated the breeding of the pest. That, in the later stages, they did travel, was proved fairly well by the immunity for a long time of the new country on the Ouyen to Murrayville line, which was cut off by the desert at Tempy from the infested area. For a long time the mice could be seen following the railway line, and it is an opinion that they followed the wheat dropped from the trucks. Subsequently they reached Austral Gypsum, a station in the centre of the desert, and eventually to Nunga and Ouyen, and along the new line, and also from Pinnaroo in South Australia, to Murrayville, and back to Ouyen. By October disease had practically killed all mice, and by November mice were below normal in the country districts."

I am indebted to Mr. F. G. England, of Melbourne, who was deputed by the Minister of Agriculture of Victoria (Hon. F. W. Hagelthorn) to organise and carry out a campaign of mouse destruction in that State, for the following account of his experiences of the visitation. Mr. England first started the systematic destruction of the vermin at Crystal Brook, in South Australia, where over 4 tons of mice were killed in part of the yard in a week. In North-western Victoria his campaign accounted for 600 tons of mice (approximately 36 million individuals) in about six weeks. After trying various methods of destroying the mice by fumigation with carbon bisulphide, which were successful as far as they went, but which made little impression on the multitudes present, Mr. England hit on his double-fence device, with the results mentioned above, in the following way. One night, when walking round the stacks of wheat near the railway lines, the sleepers and the track being covered with mice, he noticed that the animals could be driven ahead between the rails for a fairly long distance before scattering. This observation, combined with the fact that he had noticed that the mice not only came into the stack from outside to feed, but also went out from the stack for water and *to play,* suggested the idea of surrounding the stacks with a double fence, access to the space between the two fences being rendered easy for the mice inside the stack and for those outside the fences, but egress from the space impossible in either direction. The mice, once inside the outer space, were then periodically driven into pits in the corners, and killed with carbon bisulphide. Mr. England lays considerable stress on the value to his scheme of the habit the mice have of leaving the stacks at night to play. He says: "I have watched the mice chasing each other for hours after they have been feeding, the liveliest time for *playing* being about 3 a.m. One night I put a tin disc (like a rat-stop on a ship's rope) on one of these poles, and in ten minutes the pole was lined with mice, those above the stop looking down, and *vice versa,* all waiting for those in front to move on. When I came up close with my lantern the two armies ran back opposite ways. This was the strongest proof of my theory that the mice were going in and out of the stacks all night. My double fence therefore catches them when they attempt to cross the trapping zone."

Talking of the disappearance of the mice, and other interesting points, Mr. England goes on to say: "The cold weather seemed to stop further multiplication; though, given shelter under bags and wooden dunnage near the sheds, the mice would not die from the cold. I found by careful observation that in summer the majority of the mice were living *outside* and not in the stacks by day, in numerous burrows in the sides of water channels, embankments along railway tracks, etc., and that at nightfall they invaded the stacks, retiring to their burrows again before daybreak. This accounts for their being always thickest at the paddock end of the stacks. At quiet stations they were also much more numerous, better conditions probably favouring the breeding. From a burrow I fumigated I secured 110 mice, packed like sardines. The burrow was Y-shaped, and in less than a square foot of ground. Some mice bred in the stacks, making nests of jute, gnawed or torn from bags, and I found 5, 7 and 9 in three nests. In summer, however, only a small proportion bred in the stacks or lived there during the day. As an example of the latter, I took down a stack of 500 bags, which at night was black with thousands of mice. This was done in daytime, and all the mice there went into the dunnage below as we took the stack down. Covering this with a tarpaulin, and fumigating underneath with carbon bisulphide, the dunnage when removed yielded barely 500 mice (less than half a kerosene tin full, a kerosene tin full = 1100 dry mice and about 800 wet ones, i.e., mice swollen with water from drowning). This experiment showed the folly of trying to cope with the mice by fumigating stacks in the daytime in summer, when most of the mice were safely out of the way in their burrows. In any case, fumigation was not practicable, as the fumes dissipated before a 'death atmosphere' could be produced in such dense masses of wheat."

After making preliminary investigations in March, 1917, Mr. England perfected his scheme early in April, and on May 15th and 16th arranged a demonstration to the Vermin Destruction Officers at Hopetoun. It was therefore the end of May before he was ready for his campaign, and he now found conditions less suitable for his purpose.

"The mice had not to go out for water, but only to play, which they did on fine nights. The cold made them crowd into the stacks amongst the bagging and stacked dunnage, where they kept each other warm. Burrows not drained would, of course, be abandoned, and I noticed that in sandy mallee country the burrows were occupied longer into the winter than those in heavy land. The net result to my scheme of colder weather conditions was that there were fewer mice to catch, and the work took longer, as they could get water easily, and did not run about everywhere at night when the ground was wet, though on clear frosty, though cold, nights, they came out well. Notwithstanding, we caught, as above stated, upwards of 600 tons of mice, mostly in June, 1917. Earlier in the summer we would have more than doubled the catch in the same period. Actual record catches were 42 tons at Ultima, 30 tons at Brim (where 10 tons of this were caught in one night), and numerous stations where the amount was in the vicinity of 20 tons each. At Brim 96 barrow loads, each of about 65,000 mice, were caught the first night."

In answer to enquiries of mine as to the duration and cause of the prevalence of mice, Mr. England says: "The plague in Victoria commenced in the spring of 1916. Some Wimmera stations were recognised as plague stations (so I am informed) at that time. Right through 1916 wheat was stacked continuously, and was still there in many cases when the 1917 wheat came in. The old dunnage had not been cleaned up, and in many cases was infested with mice when the new wheat was put on top of it. The season probably was peculiar in favouring mice breeding, and many mice were also brought in from the farms, with the loads of wheat. From then, I think, it was just a multiplication sum. I do not believe the theory that the mice came from Central Australia—our Ouyen-Pinnaroo line was the least, and last, to be affected, and it should, under these circumstances, have been the first. Also, there was no mice plague where there was no wheat. There are still (February, 1918) mice in Northern Victoria, but at present there is no anxiety.''

As regards the number of mice, Mr. England caught some 36 million in Victoria late in the season, and the Wheat Inspector agreed that twice as many could have been caught earlier. There would be quite as many mice on farms as in the railway wheat stacks. In South Australia the mice seemed to be thicker, and to do more damage, reducing the stacks to heaps, whilst in Victoria they still retained the semblance of stacks. He gathered also that New South Wales was worse affected than Victoria. Some reckoned the damage done in Victoria as £500,000, and more in the other affected States, whilst, in addition, was the damage to farmers' property.

As regards migration, he says: ''I found the mice very local in their habits when once near food. The only migration then appeared to be to and from the stacks, though certainly at night they were all over the roads, and were scattered by motor cars. The mallee scrub was full of them, and they apparently fed on the leaves and bark.''

Mr. England says ''nearly all'' the mice appeared to be the ordinary house mouse, brownish-grey and whitish underneath, in size about 2½ inches long, and the tail upwards of 3 inches. Many young mice no bigger than walnuts were caught, though there was a popular idea that the mice were all adults. The young mice were especially active, and in spite of supposed inexperience very elusive and hard to catch, which might account for this fallacy. Occasional white, yellow and piebald (grey and white) mice were seen. The following approximate table of weights and measures is interesting:—

"One mouse averages in weight slightly over half an ounce.

"1 ton = 60,000 mice.

"1 drayload—15 cwt. = 45,000 mice.

"1 million mice—22 drayloads = about 17 tons.

"Rats were occasionally caught in the pits with the mice."

As Circular No. 1, dated May 12th, 1917, Mr. England issued Directions for Double Fencing Wheat Stacks for Trapping Mice. For this device he had then applied for a patent.

Disease in the Visitation Mice.

During the height of the mouse visitation, newspaper and verbal reports came to hand as to the presence of disease in them, and also of the occurrence of sores in those men brought more or less in touch with the mice. Still later, medical men recognised, in the mouse districts, a remarkable increase of ringworm in human beings, not necessarily in those only who were engaged in handling wheat. As regards disease in the mice themselves, a number of batches of mice said to be affected, were submitted to us from time to time by the State Wheat Office. As some of these, before arrival, had travelled long distances, and so arrived in a decomposed state, examination of them led to little result. Amongst the others two diseases were met with, one consisting of subcutaneous abscesses in the neighbourhood of the joints of the legs, the other of mouse favus. I have not noticed, in the mice I have examined, any other ringworm-like lesions than the heaped-up crusts of favus. It is possible, however, that ringworms causing only small bald patches or partial depilation escaped my notice, but I certainly saw nothing resembling a pustular dermatitis. Later in the year two clinical forms of ringworm appeared in human beings, one consisting of angry, raised, circular, reddish patches of purulent dermatitis, the other the usual form of circular bald patches on hairy parts, or slightly raised circinate reddish areas on the face, etc. The former may possibly represent human infection with the mouse favus, but I have not, perhaps partly through faulty observation on my part, or because such specimens were not caught, seen in the mice patches of ringworm with stunted broken hairs, such as I have seen, in a mouse district, in a baby, dogs and a cat. As the evidence suggests in this latter instance mice as the conveyors of the infection, this form doubtless does occur in them.

Favus.—Mouse favus is not uncommon in Australia. The first case described for this continent is one of my own[1] from Western Australia. We have met with it not infrequently in this State, having received specimens from Lithgow (August, 1910—third mouse found infected), Gilgandra (November, 1910), Cowra (February, 1913—mice suffering from this disease during the last two years; it apparently does not destroy them), and Coonabarabran (May, 1916).

During the mouse visitation we had specimens from Narrabri (September), Tocumwal (November), and Barellan (February, 1918). In connection with the latter, an accompanying letter said that "two or three of this batch were suffering from a skin disease which seemed prevalent amongst them, and seemed to be the same as that which the men contract in handling wheat on affected stacks; we doubt if this disease carries them off."

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[1]Aust. Med. Gazette, April 20th, 1908, p. 280.

Darnell Smith[1] has recorded other recent instances in New South Wales. Mr. England tells me he has seen mice in South Australia with "white, ugly growths on the head"—evidently favus. In December, 1911, we received from Dr. E. Brown, of Adelaide, two favus mice sent to him from the country. He said: "Over here we have been having local plagues of mice, and they get a disease like this, and then almost entirely die out—the plague meantime appears in some other part."

Dr. Herman Lawrence[2] describes cases in Victorian mice, and one of his photographs shews extension of the process from the head down the dorsum to the tail, the lesions in my cases having all been confined to the head area. The head is more or less covered with raised dirty yellow heaped-up crusts, later blocking the orifices and obscuring the eyes. The appearance is very repulsive, and the disease is said to lead to rapid death. It is due to a fungus, one of the Achorions, probably *A. Quinckeanum* Zopf.

Subcutaneous Abscesses.—In several batches of mice, including some from Junee, submitted to us, a number showed swellings in the neighbourhood of the joints, and sometimes on the tail. The chief areas affected were the second joints, not counting the hip or shoulder, of the legs. The animals were much crippled by them. On dissection, the abscesses were found to be deeply subcutaneous, but not arthritic. The common pyogenic and skin organisms, *Staphylococcus aureus* and *S. albus,* were cultivated from the lesions. Healthy mice, fed with the pus or with cultures of the above organisms, remained perfectly well. It did not seem, therefore, that this disease was infectious or easily conveyed to fresh mice by cannibalism. Further, there seemed no means

[1] Darnell Smith, Agric. Gaz. of N.S.W., Feb., 1918, p. 131.
[2] Lawrence, Med. J. of Aust., Feb. 23rd, 1918, p. 146.

for promoting its spread through the mouse population, if the organisms could be eaten with impunity.

Mr. F. E. Place, in the South Australian *Journal of Agriculture* for 1917, attributed paralysis and other symptoms in horses to their having been fed on mousey, and consequently mouldy, chaff. The mouldiness would be due to the access of rain to the damaged stacks, and so only indirectly attributable to mice. Any deteriorated food may be responsible for indisposition in horses, and it seems to me that in this instance undue stress has been laid on the part played by the mice in the direct causation of disease.

Disease in Men Associated with the Mice.—Human skin affections might arise in two ways in this connection. Firstly, the handling of decomposed carcases amongst soiled and destroyed grain might lead to ordinary dirt infections of scratches or cuts. Secondly, the specific infections of certain ringworms might establish themselves in man. Of the former, which is not, of course, confined to the conditions brought about by the mice, but might occur under dirty conditions of any kind, or even apart from such, I have seen several instances. In one case, the back of one hand, and the back of the other near the thumb, shewed red, glazed, echthymatous patches of the size of a threepenny-bit or sixpenny-bit, the edges being slightly raised, and the epithelium grey beyond the edge. There were some smaller similar areas (about seven on each side) on other parts of the backs of the hands and of the fingers, and a single pustule just above the left wrist. The patient attributed the sores to being bitten by mice at night; but he could not give a clear account of having felt the bites at the time. *Staphylococcus aureus* and diphtheroid bacilli were grown from the lesions. As regards ringworm in man, Dr. Herman Lawrence first called attention to its undue prevalence under the title of "Dermatomycosis in Mice and

Men'' in a communication to the Victorian branch of the British Medical Association about six months before his article in the *Medical Journal of Australia,* referred to above. About the same time he also submitted a preliminary report to the Victorian Board of Health, expressing the opinion that the disease was the same in mice and men.

On August 7th, 1917, we had an opportunity of examining a man who had come from West Wyalong, one of the mice-infected districts, where he had been engaged in re-bagging and lumping wheat. He had extensive, rather circular, raised areas of dermatitis with pus formation on the left forearm, the chin and upper lip, and smaller lesions on the right forearm and left thigh. From several of the lesions abundant pure cultures of a ringworm were grown.

About this period, and on till November, reports of the occurrence of ringworm, especially in children, were common in the areas in which the mice were prevalent. Cases were especially brought under our notice at Narrabri and Narromine. Two clinical forms appeared to occur—one in the limbs or face showing intense dermatitis, with pus formation, as in the case mentioned; the other affecting the scalp or face, and producing bald, circinate, somewhat reddish patches. I had an opportunity of seeing an interesting series of cases near Narromine. A baby, under a year old, followed quickly by two dogs and a cat, developed a bald ringworm of the scalp. In the three animals the hairy faces were affected. Later on an adult in the family also became affected. Whilst in the latter case the infection may have been derived from the baby, I came to the conclusion, partly on account of the almost simultaneous appearance of the ringworms in the first four hosts mentioned, partly because the dogs, and probably the cat also, would not be allowed in close proximity to so young a child, that these four had all been infected from a common source. The only likely common source, under the circumstances, was mice, which were abundant.

In December, 1917, Dr. C. N. Paul,[1] of Sydney, referred to the mouse visitation being accompanied by a large number of cases of ringworm in man. He associated the two causally, partly because many of those handling the infected wheat became affected, and partly because many mice were seen "with patches almost denuded of hair." He described one case in particular with photographs. The patient shewed extensive areas on exposed parts of a circinate pustular dermatitis; later these parts presented the appearance of a chronic eczema. The fungus was revealed in the hairs and scales, and was easily grown. It proved to be a microid ecto-endothrix trichophyton of the *Gypseum* group, for which he proposed the name of *Trichophyton rodens.*

Later, Dr. Lawrence, of Melbourne (*loc cit.*), who from his description and a photograph was evidently dealing with the same disease as Dr. Paul, came to the provisional conclusion that the human complaint was due to *Achorion Quinckeanum* Zopf, the cause of a favus disease of mice. With this view, as regards the generality of cases, Dr. Paul (*loc cit.*, March 2nd, 1918, p. 185) does not agree.

Birds and the Destruction of Mice.

Captain S. A. White, of Fulham, South Australia, has informed me that "in the latter part of the invasion, the straw-necked ibis appeared in great numbers, and they devoured millions of mice. White-faced herons and barn owls also accounted for great numbers." The specific names of these birds are respectively *Carphibis spinicollis* James, *Notophoyx novae-hollandiae* Lath., and *Tyto alba delicatula* Gould.

[1] Paul, "A Ringworm Epidemic presenting a New Type of Fungus," Med. J. of Aust., Dec. 15th, 1917, p. 496.

White[1] has recorded the results of an examination of the pellets or casts of two of the last-mentioned species, the Screech or Barn Owl, from the Adelaide district. He says that this species, in common with other owls, lives largely on mice, rats, young rabbits, small birds, and night-flying insects, and also on bats and frogs. The pellets were found under trees where the birds had been roosting. As regards one of the owls dealt with by Captain White, 172 complete or nearly complete pellets, and 109 partly broken up or loose skulls were found in six months under one tree. He estimates, from an examination made of seven pellets that were disintegrated for the purpose (the rest being kept for Museum purposes), and from other data, that during a year this owl would destroy approximately 640 sparrows, 64 starlings, 1600 mice, and 60 young rabbits. In the seven pellets were respectively: Four mice; two mice, four frogs and a jew lizard; two mice and seven frogs; one mouse and one young rabbit; one mouse and two sparrows; three mice and one sparrow; and three mice, one sparrow and one frog. In the case of the second owl, which had roosted a few yards from a house, it was estimated that the pellets, which had accumulated for certainly not more than a year, contained the remains of 465 sparrows, 10 starlings, 80 mice and 5 rats. Three pellets, disintegrated and examined, showed as follows:—Four mice and one sparrow; three mice and one sparrow; and three sparrows.

North[2] mentions definitely field mice or mice, presumably *Mus musculus*, as having been found in the stomachs or as constituting part of the food of the following Australian birds:—*Circus assimilis* Jard. and Selby, Spotted Harrier; *Elanus axillaris* (Lath.), Black-shouldered Kite; *E. scriptus* Gould, Letter-winged Kite; *Hieracidea orientalis* Gray,

[1] White, The South Aust. Ornithologist, II., pt. 4, p. 90.

[2] North, Nests and Eggs of Birds found Breeding in Australia, Vol. III.

Brown Hawk (F. Hislop, N.E. Queensland—"small rats and mice"); *Cerchneis cenchroides* (Vig. and Horsf.), Nankeen Kestrel (G. Savidge, Upper Clarence River—field mice and small birds; G. A. Keartland, Melbourne—mice); *Ninox boobook* (Lath.), Boobook Owl; *Strix delicatula* Gould (=*Tyto alba delicatula*), Delicate Owl; *Eupodotis australis* Gray, the Australian Bustard or Plains Turkey; *Gymnorhina tibicen* (Lath.), Black-backed Magpie; *G. leuconota* Gray, White-backed Magpie; *Cracticus destructor* (Temm.), Butcher Bird; and *Cracticus nigrigularis* (Gould), Black-throated Butcher Bird. He also states (Vol. II, p. 359) that the food of *Dacelo gigas,* the Laughing Jackass or Kookaburra, consists during spring and summer principally of lizards, rats, mice and small birds and insects.

D. Le Souef[1] refers to crowds of Magpies (*Gymnorhina*) following the plough and catching the mice in Victoria during the prevalence of mice in 1905.

In a Bulletin, now in the press, of the Department of Agriculture of New South Wales, dealing with the food of native birds, Mr. C. T. Musson, of the Hawkesbury Agricultural College, gives the following instances of mice remains being found by him in birds' stomachs:—*Elanus axillaris* (Lath.), Black-shouldered Kite (5 birds—2 mice in crop and 3 in stomach; stomach full of mice; 5 mice in stomach; 4 mice in stomach; 2 mice and a lizard); *Cerchneis cenchroides* (V. and H.), Nankeen Kestrel (remains of mice); *Ninox maculata* V. and H., Spotted Owl (remains of mice); *Corvus coronoides* V. and H., Crow (3 birds—bones of mouse (?); scarabs and hair and bones of mice; maize, etc., egg shell, piece of bone, mouse hair); *Corone australis* Gld., Raven (2 birds—larva, pellet of mouse hair, feathers, vegetable matter; thin slices of potato, horse and cow (?) and mouse hairs, small bones).

[1]Le Souef, Wild Life in Australia, p. 132.

MEANS OF COMBATING THE PLAGUE OF MICE.

There are two objects to be achieved in endeavouring to control such a phenomenal increase of mice as that recently experienced. One is to protect from their attacks material likely to be destroyed by them, the other to reduce their numbers so that the remainder are relatively harmless. Some methods achieve to a varying degree both these results, others one only.

From the information available the following deductions may be drawn:—Loose wheat cannot be attacked by mice except at its periphery—they cannot burrow into its depths, as the weight of grain would compress them and they would be deprived of air. Bagged wheat, on the contrary, as long as sufficient bags were intact, would offer a reticulation of crevices and interstices for ingress and egress of the mice.

The most efficient means of overcoming the ravages due to mice is by the removal of the grain to areas relatively mouse-free, and there storing it under adequate protective conditions. In Victoria, the Port of Melbourne offers such facilities, and the aim of the authorities there, ably assisted by the Railway Service, has been to convey clean grain thither as soon as possible. In New South Wales, the problem has been complicated by the ravages of weevils in the neighbourhood of Sydney, and consequently depots had to be opened at suitable country centres instead.

Clean bagged wheat can be efficiently protected from mice by surrounding it with a low, but effectively-constructed, galvanised iron fence. If a double fence, as in Mr. England's device, be adopted, the mice already in the stack can be materially reduced in numbers, and outside mice in large quantities can be trapped and destroyed—thus lessening the general risk to the locality. By the double-fence both objects aimed at, protection of grain and diminution of mice, are achieved.

Any fence system requires, however, constant and minute supervision. A single act of carelessness, as, for instance, leaving a bag hanging over a fence or a pole connecting the stack side with the outside, may lead to a considerable infestation of a clean stack, with all that this entails.

Considering the efficiency of fences for wheat stacks, destruction of the mice by poisoning, as with strychnine or phosphorus, does not commend itself in this connection. There is, in addition, the remote possibility of poisoned grain or bait getting mixed with the good grain, whilst the presence of abundant food would lessen the likelihood of the poison being taken. Doubtless systematic poisoning, combined with domestic and barrel traps, may tend to keep down the numbers of mice in farm-houses and outbuildings. I do not see that it is practicable to control the mice in fields when they are feeding on much shed grain.

The deliberate spread of the organisms of disease amongst the mice does not seem capable of achieving much. The only form of ringworm of an aggressive type that I have seen amongst them is favus. Mice so affected have come from divers localities, but the disease, in spite of such an extensive distribution, does not seem to have done much in checking the pest. Doubtless those affected eventually die from interference with sight and obstruction to the nose. How long this takes I am not aware, but some seem to think the condition progresses rapidly. If the disease were quickly communicable, one would expect to find many more mice affected than is the case. Laboratory cultures do not seem to produce lesions rapidly. The organisms could only be distributed effectively throughout the mouse population by inoculating large numbers of mice, firmly establishing the disease, and then setting them free. This would be laborious and expensive, whilst seed mice would have to be caught in numbers for purposes of propagation.

The success of the fence traps is so great in comparison that the question of favus can be dismissed.

Though, towards the end of the visitation, mice were said to be dying from disease, there is no clear evidence that such was the case, or, if it was so, as to the nature of the disease. The subcutaneous abscesses, though doubtless crippling, and perhaps finally killing, the affected mice, did not seem capable of reaching epizootic proportions.

The various rat-viruses, members of the food-poisoning group of the great coliform family of bacilli, have been suggested from time to time for the purpose of destroying rats and mice. My experience of a number of strains of these is highly disappointing. Though with gross feeding we have been able at times to kill rats or mice under laboratory conditions, at other times we have signally failed. We have not been able to produce an epizootic in caged animals. If such a fatal epizootic as plague makes but a slight diminution in rats, and certainly does not exterminate them, can we expect material help from a less virulent organism such as one of this group? Still every little might help, and it was decided to test the matter as regards the pest mice under field conditions in this State. Four different strains, one recently obtained, were tried by us in a country centre in July, 1917. In spite of liberal baitings with the organisms, which baits the mice were seen eating, no noticeable decrease in their numbers could be recognised. They were, of course, confined within a limited space. I am inclined to think that the good effects reported of these viruses, under collateral but not identical conditions, were coincidences, and not consequences.

The natural enemies of mice in Australia, such as snakes, monitor lizards, cats, dogs, and certain birds, probably play some part in keeping the numbers down under ordinary conditions. These can play little part when abundance of food has facilitated rapid increase and the mice are in countless multitudes. The value of birds should not, however, be underestimated, and proper protection should be afforded to the species particularly useful in this respect.

* * *

In conclusion, may I express my deepest thanks to all those who have facilitated, in ways many and various, the preparation of this address. In every instance my request for information or criticism has been granted unreservedly, immediately and fully. Many gentlemen have gone to a large amount of trouble to furnish me with data. Though already acknowledged in the text, I should like to repeat my appreciation of their assistance, and to mention especially the following:—The Honorary Secretaries (Mr. J. H. Maiden and Mr. R. H. Cambage) and the Honorary Treasurer (Professor Chapman); Professors Carslaw, Fawsitt, and Darnley Naylor; Dr. Armit, Dr. C. N. Paul; Capt. S. A. White; and Messrs. C. Hedley, George Valder (Under-Secretary for Agriculture), Gerald Lightfoot (Secretary Advis. Council of Science and Industry), E. Harris, Heber A. Longman, J. B. Clarke, F. G. England, D. Le Souef, J. C. B. Moncrieff, F. W. Gavel, J. G. Stewart, E. A. Allchurch, and C. J. Cameron.

This, gentlemen, ends a long, somewhat disjointed and discursive discourse. If I have aroused interest in our rats and mice, if I have called attention to aspects of their lives that have much in common with our own, and from which we can perhaps learn somewhat, the labour has not been in vain. May I close with the beautiful idea expressed by Mrs. Browning:—

"Earth's crammed with heaven
And every common bush afire with God:
But only he who sees, takes off his shoes;
The rest sit round it and pluck blackberries,
And daub their natural faces unaware
More and more from the first similitude."

THE SPINE MODE OF *CENTROPYXIS ACULEATA*, STEIN.

By C. D. GILLIES, M.Sc.,

Biology Department, University of Queensland, Brisbane.

With Eight Text Figures.

[*Read before the Royal Society of N. S. Wales, June 5, 1918.*]

Centropyxis aculeata, Stein, is regarded as the most variable of the testaceous freshwater Rhizopoda, and as it is a common form, it lends itself readily to the study of its empirical spine mode. For this purpose material from the following localities in Queensland was investigated:—

Brisbane District—Botanical Gardens, Ironside and Gold Creek.

North Coast—Caloundra, Eumundi and Bajool (near Rockhampton).

The various gatherings were preserved in weak formalin, and in preparing the tables the spines of both inhabited and empty tests were counted.

1. Brisbane Botanical Gardens. (Lagoon near old bird house), Figs. 1 and 2.

Material from this locality was systematically collected about the end of each month from May 1916 to December 1917, and the gatherings were taken from a constant part of the lagoon. Gatherings were also made on 12th May and 6th October, 1916.

(*a*) 12th May, 1916.

No. of spines	1	2	3	4	5	6	7	8	9
Frequency	3	9	9	5	5	0	1	0	1

Total frequency 33 Mode 2 – 3

(*b*) ? June, 1916.

Species too scarce for tabulation.

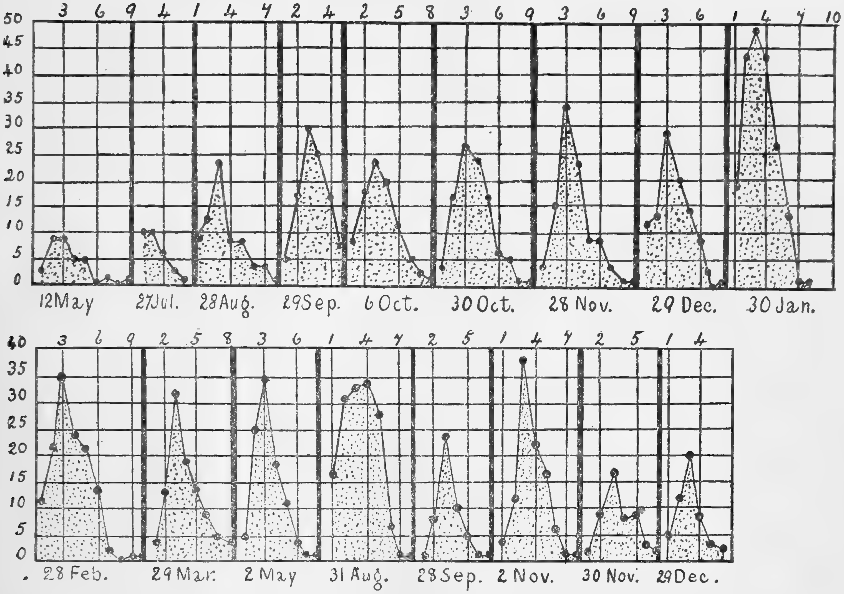

Fig. 1. Spine frequency polygons. Brisbane Botanical Gardens, (see 1) May 1916 to December 1917. The heavy lines divide the graph into a series of seventeen monthly polygons.

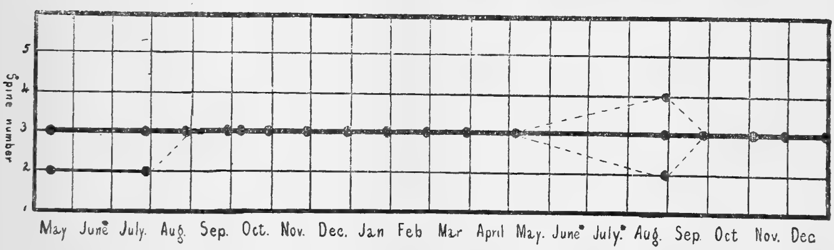

Fig. 2. Graph of Modes. Brisbane Botanical Gardens, (see 1) May 1916 to December 1917. (* No data).

(c) 27th July, 1916.

No. of spines	1	2	3	4	5	6
Frequency	0	10	10	6	3	1

Total frequency 30

Mode 2 – 3

(*d*) 28th August, 1916.

No. of spines	1	2	3	4	5	6	7	8
Frequency	9	12	24	8	8	4	4	1

Total frequency 70 Mode 3

(*e*) 29th September, 1916.

No. of spines	1	2	3	4	5	6
Frequency	5	17	30	25	16	7

Total frequency 100 Mode 3

(*f*) 6th October, 1916.

No. of spines	1	2	3	4	5	6	7	8
Frequency	8	18	24	20	11	5	3	1

Total frequency 90 Mode 3

(*g*) 30th October, 1916.

No. of spines	1	2	3	4	5	6	7	8	9
Frequency	3	17	26	24	17	6	5	1	1

Total frequency 100 Mode 3

(*h*) 28th November, 1916.

No. of spines	1	2	3	4	5	6	7	8	9
Frequency	4	15	34	23	9	9	4	1	1

Total frequency 100 Mode 3

(*i*) 29th December, 1916.

No. of spines	1	2	3	4	5	6	7	8	9
Frequency	12	13	29	20	14	8	3	0	1

Total frequency 100 Mode 3

(*j*) 30th January, 1917.

No. of spines	1	2	3	4	5	6	7	8
Frequency	19	43	49	43	26	13	1	1

Total frequency 195 Mode 3

(*k*) 28th February, 1917.

No. of spines	1	2	3	4	5	6	7	8	9	10
Frequency	11	22	35	24	21	14	2	0	1	1

Total frequency 131 Mode 3

(*l*) 29th March, 1917.

No. of spines	1	2	3	4	5	6	7	8
Frequency	4	13	32	19	14	9	5	4

Total frequency 100 Mode 3

(*m*) 2nd May, 1917.

No. of spines	1	2	3	4	5	6	7	8
Frequency	5	25	35	18	11	4	1	1

Total frequency 100 Mode 3

(*n*) 31st May, 1917.

Species too scarce for tabulation.

(*o*) 28th June, 1917.

Species too scarce for tabulation.

(*p*) 1st August, 1917.

Species too scarce for tabulation.

(*q*) 31st August, 1917.

No. of spines	1	2	3	4	5	6	7	8
Frequency	17	31	33	34	27	7	1	1

Total frequency 151 Mode 2 – 4

(*r*) 28th September, 1917.

No. of spines	1	2	3	4	5	6	7
Frequency	1	8	24	10	5	1	1

Total frequency 50 Mode 3

(*s*) 2nd November, 1917.

No. of spines	1	2	3	4	5	6	7	8
Frequency	4	12	38	22	16	6	1	1

Total frequency 100 Mode 3

(*t*) 30th November, 1917.

No. of spines	1	2	3	4	5	6	7
Frequency	2	9	17	8	9	3	2

Total frequency 50 Mode 3

(*u*) 29th December, 1917.

No. of spines	1	2	3	4	5	6
Frequency	5	12	20	8	3	2

Total frequency 50 Mode 3

Out of the seventeen sets of positive data, fourteen ($d-m$, $r-u$) show a mode of 3, and all of these except (g) exhibit a well defined modal preponderance. (a) 12th May, 1916, total frequency 33, and (c) 27th July, 1916, total frequency 30, show a modal value $2-3$; (q) 31st August, 1917, total frequency 151, has a modal range of $2-4$. As these values include 3, it is believed that this number is the true mode more or less obscured by the temporarily increased frequency of the adjacent values. (g) 30th October, 1916, total frequency 100, is an intermediate case in which 3 is only slightly in excess of the greater of the two adjacent values, *i.e.*, 4. By accepting the above explanation for the discrepancies mentioned, it will be seen for this locality that:

(*a*) 3 is the monthly modal value, hence it is a seasonal constant.

(*b*) (*a*) is not invalidated by the inclusion of empty tests as the mode is a constant.

(*c*) June appears to be a minimum in the seasonal distribution of the species, on account of the difficulty in obtaining data about this period.

2. Brisbane Gardens (Big Lagoon), Fig. 3. 7th Dec., 1915.

No. of spines	1	2	3	4	5	6	7
Frequency	2	4	2	11	4	4	1

Total frequency 28 Mode 4

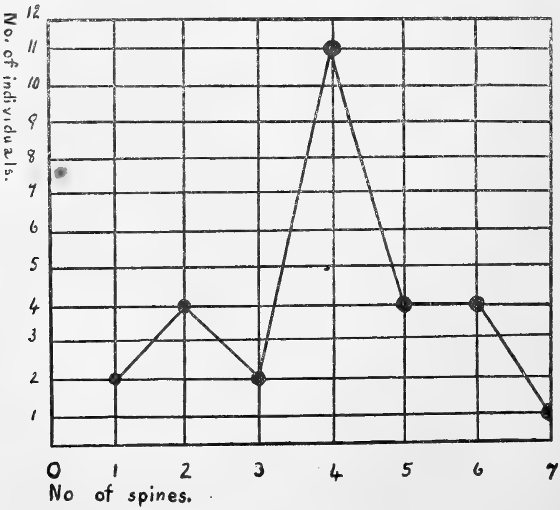

Fig. 3. Spine frequency polygon. Brisbane Botanical Gardens (Big Lagoon), 7th December, 1915.

3. Gold Creek, Fig. 4. June, 1915.

No. of spines	1	2	3	4	5
Frequency	11	7	19	4	1

Total frequency 42 Mode 3

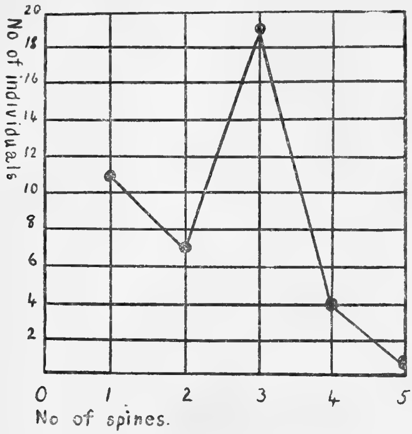

Fig. 4. Spine frequency polygon. Gold Creek, June 1915.

4. Ironside, Fig. 5. 7th October, 1916.

No. of spines	1	2	3	4	5	6	7	8	9	10
Frequency	3	16	29	31	25	9	5	2	0	1

Total frequency 121 Mode 3–4

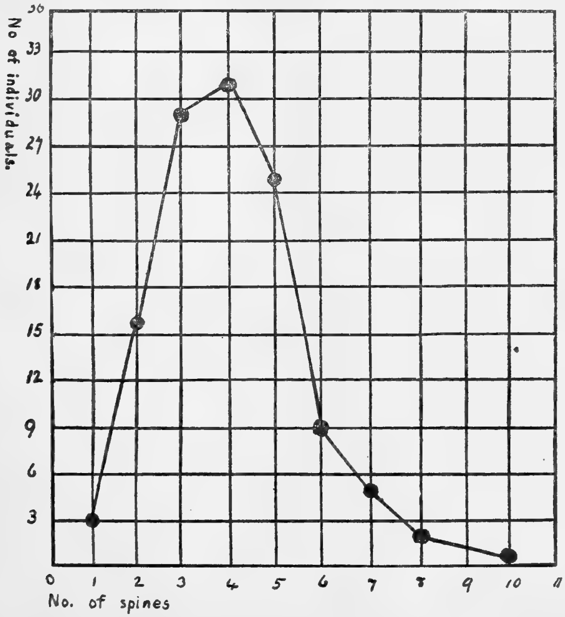

Fig. 5. Spine frequency polygon. Ironside, 7th October, 1916.

5. Caloundra Head, Fig. 6. 19th May, 1917.

No. of spines	1	2	3	4	5	6	7
Frequency	2	6	14	13	6	4	3

Total frequency 48 Mode 3 – 4

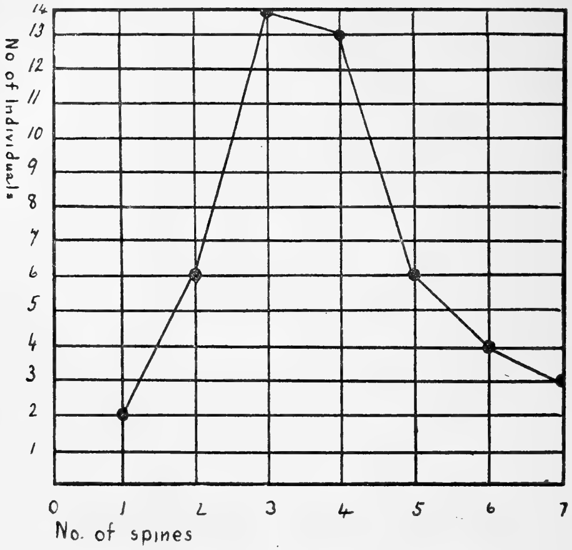

Fig. 6. Spine frequency polygon. Caloundra Head, 19th May, 1917.

6. Eumundi, Fig. 7. June, 1916.

No. of spines	1	2	3	4	5	6	7
Frequency	12	14	19	0	2	2	1

Total frequency 50 Mode 3

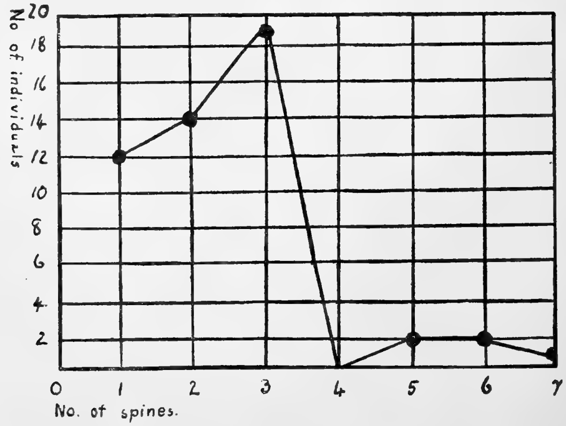

Fig. 7. Spine frequency polygon. Eumundi, June 1916.

7. Bajool, Fig. 8. April, 1915.

No. of spines	1	2	3	4	5	6	7
Frequency	2	5	6	4	10	0	1

Total frequency 28 Mode 5

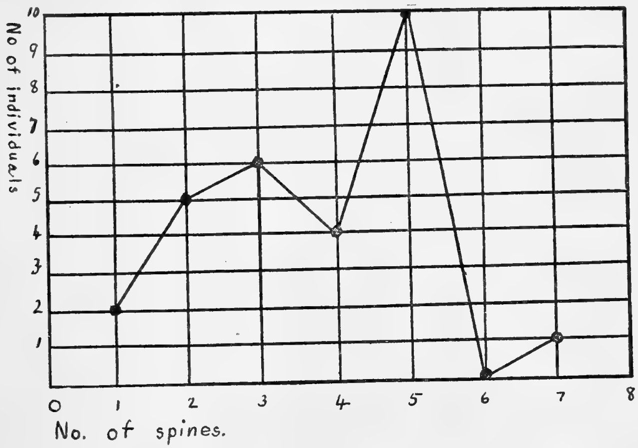

Fig. 8. Spine frequency polygon. Bajool, April 1915.

From tables (2 – 7) it will be seen that the modal value is not a constant for different localities.

Table of Modes.

Modal Value.	Locality.
3	Brisbane Botanical Gardens (1), Gold Creek (3), Eumundi (6).
3 – 4	Caloundra Head (5), Ironside (4),
4	Brisbane Botanical Gardens (2).
5	Bajool (7).

All the polygons (Figs. 1, 3 – 8) are unimodal in spite of the variability of the mode from 3 – 5, and the great range of variation that characterises *Centropyxis aculeata.*

Summary.

1. Spine frequency polygons of *Centropyxis aculeata,* Stein are unimodal.

2. The modal value for *one locality* appears to be a constant.

3. The modal value is not a constant for *different localities*, in the observed cases varying from 3 – 5.

I should like to express my indebtedness to Dr. T. Harvey Johnston, Biology Department, University of Queensland, for his kindness in obtaining the material from Bajool and Eumundi used in this investigation.

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ON A NEW SPECIES OF *LEPTOSPERMUM* AND ITS ESSENTIAL OIL.

By R. W. CHALLINOR, F.I.C., F.C.S., EDWIN CHEEL, and A. R. PENFOLD, F.C.S.

[*Read before the Royal Society of N.S. Wales, June 5, 1918.*]

LEPTOSPERMUM CITRATUM sp. nov.

L. flavescens var. *citratum* Bailey and White, Queensl. Agric. Journ. Vol. v, p. 161, pl. 13 (1916); Bot. Bull. XVIII, p. 8, pl. 2 (1916).

Frutex, nonnunquam ad arborem minorem auctus, 4–20 pedalis, ramis junioribus angulatis mox teretibus. Foliis linearibus vel angustato-lanceolatis, obtusis, glabris, membranaceis obsolete-3-nerviis pellucido-punctatis, 2–4½ c.m. longis, 3–4 mm. latis. Floribus albis, solitariis axillaribus, sessilibus vel brevissime pedicellatis nonnunquam terminalibus in ramis lateralibus. Bracteis 2, caduceis. Calicibus glabris, lobis ovatis marginibus fimbriatis. Petalis spathulatis vel laminis orbicularibus. Ovario glabro; fructibus quinque-locularibus.

A glabrous shrub or small tree, varying in height from 4 to 20 feet, the main stem up to and occasionally exceeding 3 inches in diameter, bark light brown colour and comparatively thin and smooth on the upper branches, more or less fibrous and furrowed on the lower part of the stem. Juvenile branchlets at first somewhat angular, afterwards terete.

Leaves alternate, linear or narrow linear-lanceolate, obtuse, 2 to 4½ cm. long, 3–4 mm. broad.

Flowers white, solitary in the axils of the leaves or occasionally terminal on the lateral branchlets, sessile or very shortly pedicellate. Bracts 2, greenish, enveloping the buds and soon falling off when the flowers reach maturity. Calyx-tube glabrous, sepals 5, ovate, valvate, more or less sprinkled with prominent oil-glands, the margins fimbriate with a woolly fringe. Petals 5, white, orbicular but distinctly clawed, giving them a somewhat spathulate appearance. Style 2 – 3 mm. long, with a capitate stigma. Stamens about 25 to 30. Ovarium glabrous. Capsules 5-celled, the valves slightly domed and usually about the same size as the calyx-tube.

Credit is due to Rev. H. M. R. Rupp for the first discovery of this interesting species. He forwarded some specimens (in fruit only) to the National Herbarium in August 1911, from Copmanhurst, Clarence River, New South Wales.

Additional specimens were obtained from Mr. G. Savidge from the same locality in December 1912, but were not sufficiently perfect for complete investigation.

In September 1916, during a trip to the northern rivers with Dr. T. Guthrie, Mr. A. D. Ollé, and one of us (E.C.) visited Copmanhurst, and made special investigation of this species and secured a fair amount of material, including a quantity of ripe fruits and seeds, for the purpose of studying the plants in different stages of growth to see if they were really distinct from *Leptospermum flavescens* var. *grandiflorum*, which it very closely resembles. As a result of this trip, one of us (E.C.) has been able to raise a large number of seedlings, and has planted them in various localities in different kinds of soil, and finds that the characters, as well as the citron-scented oil contained in the leaves, are constant and identical with the parent plants, and quite distinct from any other species of *Leptospermum*. Some difficulty was encountered during the early stages of growth of the seedlings, as it was found that the plants require careful nursing; this probably accounts for the limited number of plants and restricted areas.

In January 1917, Mr. R. W. Challinor collected some additional fresh material from Copmanhurst, and in November 1917, Mr. Cheel supplemented this, and, as a result of our investigations, we are now able to state that the oil from the leaves of the cultivated plants agrees in every way with that from the original plants. Its nearest ally seems to be *L. flavescens* var. *grandiflorum* Benth., but from this the new species may be distinguished by the more obtuse leaves, which have a distinctly fragrant citron-like odour, and the smaller flowers and different habit of growth. It is interesting to note that *L. flavescens* var. *grandiflorum* is chiefly found in the beds of creeks and rivers, and seems to be confined to Port Jackson and southern localities. The typical form of *L. flavescens* also seems to be absent from the neighbourhood of Copmanhurst.

There is, however, an abundance of *L. flavescens* var. *microphyllum* in the neighbourhood of Copmanhurst; in fact this latter seems to be common in the northern parts of this State and Queensland, but it is quite distinct, and cannot in any way be confused with *L. citratum*.

The distribution is as follows:—New South Wales—Copmanhurst (Rev. H. M. R. Rupp, August 1911; G. Savidge, December, 1912 (in flower); E. Cheel, Dr. T. Guthrie, and A. D. Ollé, September 1916).

Queensland—Springbrook, Macpherson Range (C. T. White).

The Essential Oil.

The oil obtained from this species of Leptospermum is of a pale amber colour, and possesses a strong, pleasant modified lemon odour, suggestive of the principal constituents, which have now been identified as citronellal and citral. The crude oil contains 90% of these two aldehydes in nearly equal proportion, and in this respect appears to occupy a position intermediate between the oils from *Eucalyptus citriodora* and *Backhousia citriodora*, both of which give the highest recorded yields of the respective aldehydes citronellal and citral.

The relative proportions of these two aldehydes are also apparent from the specific gravity and refractive index of the oil, these constants being approximately what might be obtained when citronellal and citral are mixed in equal proportions.

Experimental.—Three lots of material were collected at Copmanhurst, New South Wales, in September 1916, by Dr. T. Guthrie, Messrs. E. Cheel, and A. D. Ollé; in January 1917 by Mr. R. W. Challinor; and in November 1917 by Mr. E. Cheel. Altogether 686 ℔s. of leaves and terminal branchlets were distilled, the yield of oil averaging from 1·73 to 1·85%. The crude oil was of a pale amber colour, of specific gravity $\frac{15^\circ}{15}$ C. 0·8841; optical rotation a_D +3·6 at 18° C.; refractive index n_D 20° C. 1·4730; contained 90% aldehydes and was soluble in 2 volumes of 70% alcohol (by weight).

The Aldehydes.—The aldehyde content of the oil was determined quantitatively by the sodium bisulphite method. 5 c.c. of oil leaving 0·55 c.c. unabsorbed oil, another 5 c.c. left a residue of 0·5 c.c., which indicates 89% and 90% respectively of constituents absorbed by sodium bisulphite.

A larger quantity of the oil was then treated, 50 c.c. at a time, and the non-aldehydic portion separated, the aqueous solution was extracted several times with ether to remove undissolved oily matter, the ether was distilled off, and the aldehydes regenerated by means of alkali, dried over anhydrous Na_2Suc_4 and separated into two fractions; fraction 1, boiling at 93-94° C. (12 m.m.) and consisting approximately of 48% of the original oil, and Fraction 2, boiling at 110 – 112° (12 m.m.) which was about 42% of the oil.

Identification of Citronellal.—The fraction of lower boiling point was a colourless oil of a strong citronellal odour, its specific gravity at $\frac{15}{15}$° C. was 0·8577; optical rotation at 20° C., a_D + 8·61°, equal to a specific rotation $[a]_D$ 20° of + 10; refractive index n_D 20°, 1·4482.

Molecular weight.—The molecular weight of this aldehyde, determined by the Landsberger boiling point method, using acetone as solvent, gave the following results:—1·1612 gms. of aldehyde in 27·5 c.c. of acetone elevated the boiling point 0·6° C. indicating a molecular weight of 156·2. 1·1612 grams in 36·5 c.c. acetone gave an elevation of 0·45° C. Molecular weight 156·8. The molecular weight of citronellal = 154.

Derivatives.—The naphthocinchoninic acid derivative was prepared in the usual way from pyruvic acid and β. naphthylamine and the crystalline product purified; it melted sharply at 225° C.

Citronellyl β. naphthocinchoninic acid melts at 225° C. With semicarbazide hydrochloride it gave a crystalline semicarbazone which melted at 78 – 79° C.

Citronellyl semicarbazone melts at 82·5° C. On reduction it yields an alcohol of specific gravity $\frac{15}{15}$° C. 0·8602, boiling at 226° C. (761 m.m.) and giving a silver salt of its phthalic acid ester melting at 123° C. Records of the melting point of the silver salt of citronellyl phthalic acid vary from 120 to 125° C. It is thus evident that the aldehyde boiling at 93 – 94° C. (12 m.m.) is citronellal.

Identification of citral.—The aldehyde fraction boiling at 110 – 112° C. (12 m.m.) is a pale yellow oil with a very strong lemon odour like citral. When submitted to treatment with sodium sulphite by Burgess's method, it is completely absorbed, showing the absence of non aldehydic constituents. Its specific gravity at $\frac{15^\circ}{15}$ C. is 0·8929; optical rotation zero; refractive index at 20° C. 1·4875.

The β naphthocinchoninic acid derivative prepared in the usual way and purified, was crystalline and melted at 200° C.

Citryl naphthocinchoninic acid melts at 200° C. These results show this aldehyde to be citral.

The non aldehydic portion of the oil is still under investigation, sufficient material for a complete examination not yet being accumulated.

There appears to be a small amount of a phenol present, which gives a crystalline benzoate with benzoyl chloride, melting at 67° C. Acetylation of a small portion of this residue also indicates the presence of a small amount of an alcohol resembling geraniol or citronellol, but this requires confirmation.

From colour reactions obtained with bromine and with hydrochloric acid, there is also evidence of the presence of small amounts of aromadendrene.

The oil of this Leptospermum is therefore quite distinctive in character, and differs from that of any other species of Leptospermum so far recorded.

This work has been carried out in the Research Laboratory of Messrs. Gillard Gordon Ltd., Sydney, and our thanks are due to this firm for their courtesy in this matter.

NOTES ON SOME PERMO-CARBONIFEROUS FENESTELLIDÆ WITH DESCRIPTIONS OF NEW SPECIES.

By CHARLES FRANCIS LASERON.

With Plates I - XVI.

[*Read before the Royal Society of N. S. Wales, June 5, 1918.*]

Introduction.

Fossil polyzoa are exceedingly abundant in many horizons in the Australian Permo-Carboniferous formation, so abundant in places that their remains constitute the bulk of considerable rock masses. But as yet, perhaps less has been done to identify and study the numerous species found, than in any other group of Australian fossils. The reasons for this are fairly obvious.

In the first place, the specimens mostly consist of casts or impressions in sandstone or shale. And as the structures on which identification depends are for the most part very minute, often no bigger than the grain size of the rocks in which they are preserved, these structures are generally quite lost, and the state of preservation is seldom adequate for purposes of classification.

Secondly, even when the state of preservation is sufficient, means have generally been wanting to enable adequate and correct illustrations to be made. Much of the pioneer work was done before the days of photography, and even in these days the possibilities of the camera do not seem to be adequately realised. Drawings of minute structures are always more or less diagrammatic, and even when correct, generally fail to give that "impression of a thing," or as it is called its facies, the suggestion that is not expressed by point or line, but which nevertheless aids in after recognition. This is of the good drawing, but most of the published illustrations of the Fenestellidæ are anything but good. This has rendered the task of identifying specimens with described species very difficult; and as the types are in most cases unavailable, the difficulty is not lessened. De Koninck's types were destroyed in the Garden Palace fire, Dana's are in America and Lonsdale's, supposed to be in London, are now untraceable.

Fortunately, descriptions by Lonsdale, who has done the bulk of the work on Australian forms, are accurate, and there is less difficulty in recognising his species, than in the case of other authors. But, as previously remarked by other writers, very little dependence can be placed either on the description or on the figures in de Koninck's work; for instance, in recording *Polypora papillata* McCoy, his description and figure are entirely at variance, and in a case like this, where an Australian specimen has been doubtfully identified with a form from a different formation at the antipodes, I think it is justifiable to expunge the record, until such time, if ever, the species is re-discovered or identified.

A third difficulty is often presented, even when specimens are well preserved, in identifying the celluliferous with the non-celluliferous surface of the same species. Owing to the cells themselves becoming filled with matrix, this side generally adheres to the rock when a slab is split; and as a result, by far the majority of specimens display the non-celluliferous side. However, by carefully removing a fragment with a pocket-knife, it is possible in most cases to correlate the two sides of the one species.

With reference to the photographs in this paper, a word might be said. For such groups as the Fenestellidæ, microsections are of little use, for most of the important characters are surface ones, and in addition, sections of shale or sandstone are very difficult, if not impossible to make.

So the micro-photographs were made by reflected light, and even focus over the field was obtained by fitting a diaphragm of zinc with a pin-hole aperture, between the two lenses of the objective in the microscope.

The material here described mostly comes from Branxton, with a few specimens from Allandale, both localities in the Hunter River district, also for comparison, one specimen of *Protoretepora ampla* Lonsdale, from Bundanoon. The Branxton specimens come from the railway cutting immediately to the west of Branxton Station, being found in that series of Polyzoal shales known as the Branxton Beds, which lie just above the basal sandstones and conglomerates of the Upper Marine Series. The Allandale specimens on the other hand are in a hard calcareous shale or sandstone from a railway cutting east of Allandale Station. This with associated conglomerates occurs about the centre of what Professor David[1] calls the Lochinvar Stage, at the base of the Lower Marine Series.

So far ten forms have been separated from the material available, but I am satisfied that others exist in these localities, at least another Fenestella, and probably another Polypora, but as yet there is insufficient material at hand to be sure. Following is the description of the species:—

Class POLYZOA.

Order GYMNOLÆMATA Allman.

Sub-Order CRYPTOSTOMATA Vine.

Family FENESTELLIDÆ King.

Genus PROTORETEPORA de Koninck.[2]

Much doubt has hitherto existed as to the identity of this genus, and its relations to Polypora McCoy. One of the features made much of by de Koninck,[2] and afterwards

[1] Prof. T. W. E. David, (14) p. 47.
[2] de Koninck, (6) p. 138.

accentuated by Robt. Etheridge junr.,[1] was the presence of the celluliferous surface on the interior of the cup-shaped colony. Later Waagen and Pichl,[2] working on the Indian Carboniferous forms, asserted that this character in itself is not of importance, and depended on the direction in which a young fan-shaped colony twisted to eventually become cup-shaped.

In 1894, G. B. Simpson,[3] revising the genera of Fenestellidæ, makes no mention of Protoretepora at all, but creates a new genus, Flabelliporella, to comprise species of Polypora, with a flabelliform or fan-shaped habit, retaining the name Polypora for the cup-shaped species. At the same time he restricts Fenestella to cup-shaped forms, while another new name, Flabelliporina, is used for fan-shaped species previously comprised in that genus. This is perhaps unfortunate, especially in the case of Polypora, for McCoy, in describing his genus, particularly mentions that species are fan-shaped, so that if a new genus is necessary at all, it would have to apply to the cup-shaped species, and in this case the term Flabelliporella would be very contradictory. Simpson's new genera seem for the most part very theoretical, and he does not mention what species come under their heads, a fact recognised by Nichols and Ulrich,[4] who in 1900, synonymised Flabelliporella under the original Polypora. In the same paper these authors synonymised Protoretepora under Polypora, a course previously followed by Waagen and Pichl, but the justification of this yet remains to be proved.

Considering the Australian species at my disposal, two species are undoubtedly congeneric with Protoretepora, of which one, *P. ampla* is the type species. After referring

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[1] R. Etheridge junr., (13) p. 220, 221.
[2] Waagen and Pichl, (8) p. 775.
[3] G. B. Simpson, (12) pp. 879 - 921.
[4] Nichols and Ulrich, (15) p. 39.

to McCoy's original description,[1] I have little hesitation in referring the other three to Polypora. If the Australian species alone might be considered, the differences between the two generic types are distinct, and are as follows:—

In Protoretepora, the colony is cup-shaped or infundibuliform, with the cells upon the inside; in Polypora it is fan-shaped or flat, and while only one surface is celluliferous, this can hardly be said to be either upon the interior or exterior. In connection with this last character, McCoy particularly remarks upon it when he says, "the species of the present genus (Polypora) do not appear to assume an infundibuliform or cup-shaped figure, but are usually flat and fan-shaped."[1]

The branches of Protoretepora are more massive, the non-celluliferous layer is much thickened, particularly in older specimens, and instead of being vertically striated, the striæ are in the nature of concentric plications surrounding the fenestrules.

The cross-bars are not prominent, nor as distinct as in Polypora, and there is a tendency for the fenestrules to be formed by an angulation of the branches as in Phyllopora.

The cells of Protoretepora are rhomboidal in section with thin partition walls, though the mouths themselves are circular or oval, but the position of the cell walls is marked on the surface by a slight ridge, so that the cell mouths appear as circular dots each in the centre of the mesh of a rhomboidal pattern.

On the other hand, in Polypora proper, the branches are straight, with distinct, often rod-like cross-bars, and the non-celluliferous surface is vertically striated.

Referring to the presence or absence of cells upon the cross-bars, in all the specimens of Protoretepora examined,

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[1] McCoy, (3) p. 206

none were actually visible on these processes, though occasionally they seem to encroach upon their borders. This is probably due, however, to the state of preservation, as Mr. W. S. Dun, Government Palæontologist, informs me that cells always occur on the cross-bars of the type *P. ampla* from Tasmania. In Polypora, the smooth or faintly striated cross-bars are absolutely devoid of cells. This is well shown on Plate VIII, fig. 2.

But the character which is probably most important, yet which appears to have been largely overlooked, is that in Polypora, the cells themselves are more or less oval in section, separated by thicker walls, and they are arranged in definite longitudinal lines or ranges, and not diagonally as in Protoretepora; also there is an absence of the rhomboidal ridging upon the surface of the cell-bearing layer.

McCoy in his original description says, referring to the cell apertures, that the margin of these is never raised, but though this might apply to his type species, *P. dendroides*, it hardly applies to other species of the genus.

At this stage, it seems as if the differences between Polypora and Protoretepora were well defined, but a consideration of American and Indian species again involves the whole question in doubt.

In the first place, many of the Indian Carboniferous species, well described and figured by Waagen and Pichl, would on Australian evidence be referable to Protoretepora, for the rhomboidal ridging, dividing the cell mouths on the surface of the colony is occasionally very prominent, and the form of the colony is undoubtedly cup-shaped.

But a study of American species still further increases the difficulty. The Palæozoic beds of the eastern United States are probably the least disturbed, and contain a richer and better preserved fauna than those of any other part of the world, ranging from the Lower Silurian to the Carboniferous period with practically complete continuity; and they contain, especially in the lower beds, amongst other things, magnificent and well preserved series of Polyzoa, with numerous species of Fenestella and Polypora.

Now if we apply our Australian observations to these, we are at once astray. For instance, amongst the numerous species of Polypora in the Upper Helderberg group, Hall[1] mentions only one, *P. flabelliformis*, as being fan-shaped, while all the others are infundibuliform, but the other characters of these species are certainly not those of Protoretepora as we know it, except that the figures of several show them to have thin cell walls. But in no cases are the cells shown upon the cross-bars. In many of the American Polyporæ also, the branches are bent and the cross-bars ill-defined as in Protoretepora.

So that while Australian species are on the whole well defined, and fall readily into two generic types, in America particularly, are many intermediate forms, containing sometimes one and sometimes another of these characters, which here seem generically essential.

However, after considering all the evidence, it would seem advisable for the present, to retain Protoretepora as a genus, at any rate until such time as the discovery in Australia of further connecting links; when it may become necessary to discard Protoretepora in favour of McCoy's genus, Polypora, or at any rate, reduce it to sub-generic rank.

PROTORETEPORA MONTUOSA sp. nov. (Plates I, II, III, fig. 2)

Description:—Colony infundibuliform, celluliferous upon the inner surface. No complete colony is known, but the largest specimen shows that it is capable of attaining a size of several inches. Branches comparatively coarse,

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[1] J. Hall, (9).

the non-celluliferous layer occasionally much thickened. Cell-bearing surface flattened, the external surface ridged and angular, and covered with fine striations which are not longitudinal, but tend to surround the oval, but often nearly circular fenestrules. Cross-bars not prominent and sunk beneath the general level of the main branches. These are much thickened opposite the dissepiments, and there is a marked tendency for the cross-bars to be thus suppressed, the main branches bending and forming the fenestrules by uniting with the adjacent branches.

No perfect celluliferous surface is yet known, but specimens as a general rule, so readily split along the line between the two layers of the colony, that the base of the cells are often visible. By this it is seen, that the cells are rhomboidal in section, packed closely together, their thin walls running diagonally across the branch, from 7 to 10 rows upon each branch, and 3 or possibly 4 in the length of each fenestrule, and an additional 1 or 2 in the breadth of each dissepiment. So far, though several well preserved specimens have been examined, no cells have been actually detected on the cross-bars, though there is a tendency for the cells to encroach upon their borders.

Measurements:—Average length of fenestrule, 1 to 1·2 mm., width ·5 to ·75 mm., width of branches up to 1·5 mm.; and in a space of 10 mm. measured longitudinally there are present on an average 6 cross-bars.

Horizon and Locality:—Branxton (Upper Marine Series).

Relations and differences:—*Protoretepora montuosa* is undoubtedly closely related to *Polypora Koninckiana* Waagen and Pichl,[1] from the Carboniferous formation of India, this species showing similar concentric striations on the non-celluliferous side, the same thickening in older

[1] Waagen and Pichl, (8) pl. 90, fig. 1.

parts of the colony of this layer, and similar rhomboidal cells. I have no doubt they are congeneric, but *P. montuosa* differs inasmuch as there are only 3 or possibly 4 cells in the length of a fenestrule and 7 to 10 rows upon a branch, whereas in *P. Koninckiana*, there are 6 or 7 cells in the first case and only 5 to 7 transversely. With *Polypora transiens* Waagen and Pichl,[1] it also has affinity, but differs in the larger size of the cells, and the fewer number longitudinally. The Phyllopora like bending of the branches is very noticeable in *P. transiens*.

From the only described species of Australian Protoretepora, *P. ampla* Lonsdale, which is figured for comparison, it differs by the much greater number of rows of cells (7 to 10) as against 3 to 4 transversely upon a branch. Perfect material of *P. ampla* has yet to be described and figured.

PROTORETEPORA AMPLA Lonsdale.[2] (Pl. IV.)

Specimens of this species, particularly from this locality, are seldom well enough preserved to identify with certainty, accordingly it is here figured and definitely recorded. This specimen shows well the nature of the colony; the non-celluliferous layer has entirely disappeared, and there is visible the cast of the base of the celluliferous layer, with the rhomboidal cells packed closely together, the walls of which, having decomposed, are represented by deep furrows.

Again in this case no cells are actually visible upon the dissepiments.

Locality and Horizon:—Bundanoon (Upper Marine series).

Geuus POLYPORA McCoy.

The differences between this genus and Protoretepora have already been discussed under the heading of the latter genus.

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[1] Waagen and Pichl, (8) pl. 91, figs. 3, 4, 5.
[2] *Fenestella ampla* Lonsdale (1) p. 180.

Polypora pertinax sp. nov.

(Plates V, VI, VIII, fig. 1, X, fig. 1.)

Description:—Nature of colony uncertain, but probably fan-shaped. The largest specimen is about two inches in length, but this is evidently part of a much larger colony. Branches moderately coarse, very straight and rigid, bifurcating at rare intervals, and thickened slightly opposite the cross-bars. The celluliferous surface is flat, and owing to the matrix filling the fenestrules, the branches appear broader, and the fenestrules smaller, on the non-celluliferous side. The non-celluliferous layer is rounded externally, but is slightly concave on the interior surface, that on which rests the bases of the cells. Both surfaces of this layer are covered with longitudinal striations, more prominent however on the internal surface. The branches are separated from each other by slightly more than their own width on the non-celluliferous surface and slightly less on the celluliferous side. Cross-bars thinner than the branches, distinct, rounded on the one side and flattened on the other, to conform to the shape of the branches, and faintly striated. The fenestrules are oval, about twice as long as broad.

The cells are rounded, the apertures slightly restricted, with exserted rims, and separated from each other by a little more than their own diameter. The celluliferous surface is flat, or even slightly concave, and there are typically three rows of alternating cells on each branch. Previous to bifurcating, the branches generally broaden very much, and the number of cells increases typically to six. There are usually two cells longitudinally in the length of one fenestrule, with an additional one in the width of the cross-bar.

Measurements:—In the space of 10 mm., measured longitudinally, 8 cross-bars were counted. Length of fenestrule ·75 to 1 mm., width ·4 mm.

Locality and Horizon:—Allandale (Lower Marine Series).

Relations and differences:—In 1885 Mr. Robt. Etheridge junr., described from Queensland, a species under the name of *Polypora? Smithii*,[1] which resembles *P. pertinax*, but according to both the description and figure of this species, the material was not very good. However, Mr. Etheridge distinctly states that in *P.? Smithii* there are from 6 to 9 cells in the space of a fenestrule, and as this is a character which seems very constant, it is considered sufficient to separate the two forms.

Again Waagen and Pichl[2] identified one of the Indian species from the Upper Productus Limestone with *Polypora biamica* Keyserling, a Permian form from Russia, and from Waagen and Pichl's description and figure, *P. pertinax* only differs in minor details. Unfortunately I have been unable to obtain access to Keyserling's original description, but feel that the weight of probability is very much against the identification of the two forms.

POLYPORA TUMULA sp. nov. (Pls. VII, fig. 3, IX.)

Description:—Colony fan-shaped, the largest specimen in its fragmentary form, over three inches in length. Habit erect. Branches moderately stout, separated from each other by approximately their own width, bifurcating at rare intervals. Cross-bars stout but thinner than the branches, rounded. Fenestrules oval, about twice as long as broad.

The non-celluliferous layer is thin. Its exterior, only known from casts, is apparently nearly smooth or faintly striated longitudinally. These striations are however more prominent on the interior surface, that is the one on which rests the bases of the cells.

The exterior surface of the celluliferous layer is decidedly irregular, being elevated into numerous protuberances,

[1] R. Etheridge junr., (13) p. 219, pl. 9, figs. 1–3; pl. 44, figs. 9, 10.
[2] Waagen and Pichl, (8) p. 791, pl. xc, figs. 5, 6, 7.

which at times tend to form two definite longitudinal ridges which divide the apertures of the three rows of cells. This character is, however, never so marked as in Fenestella. The cells are in three distinct rows, increasing to 4 or 5 before bifurcation. They are circular in section, and restricted somewhat at the apertures, which are small, with raised edges, separated from each other by a space equal to about twice their diameter; and they may lie either on the summit of the protuberances or in the hollows between. There are from two to three cells in the space of one fenestrule, with generally the addition of another one opposite a cross-bar.

Measurements:—In 10 mm. longitudinally, from 7 to 8 cross-bars, length of fenestrules rarely above ·5 mm., width ·3 to ·5 mm.

Locality and Horizon:—Branxton (Upper Marine Series).

Relations and differences:—I know at present of no Polypora which is at all comparable with this species.

In the slightly carinated form of the celluliferous surface, it approaches *P. carmella* Hall,[1] from the Upper Helderberg of America, but differs in most other characters.

POLYPORA VIRGA sp. nov. (Pl. VII, fig. 4, Pl. VIII fig. 2.)

Description:—Though only known from one fragmentary specimen, this is so well preserved, that its characters are very apparent. Form of colony not known. Branches fairly coarse, flat, bifurcating fairly freely and connected by very thin, rounded, rod-like cross-bars. Fenestrules rectangular, twice to three times as long as broad.

Non-celluliferous surface not known. Celluliferous surface flat and broad, cell apertures circular or slightly oval, comparatively large and close, distant from each other by sometimes less than their own diameter, the rims not

[1] J. Hall, (9) Vol. vi, p. 153, pl. xlii, figs. 1, 2.

exserted. Number of rows three to four, alternating, and increasing to five or six before bifurcating.

Within the space of one fenestrule there are either three or four cells, with usually an additional one in the width of a cross-bar.

Measurements:—In 10 mm. longitudinally 4·5 cross-bars. Width of branches from under 1 mm. to 2 mms. just prior to bifurcation. Average length of fenestrules slightly over 2 mm., and width 1 mm.

Locality and Horizon:—Branxton (Upper Marine Series).

Relations and differences:—The large cell-mouths, and the rounded, occasionally long, rod-like cross-bars are the chief characteristics of this species. It is most nearly related to *P. dendroides* McCoy,[1] but differs particularly in the more upright and less diverging habit.

Genus FENESTELLA Lonsdale.

FENESTELLA FOSSULA Lonsdale.[2] (Pls. XIII, XIV.)

Description:—This species, so far is the finest and most delicate of our Australian Fenestellæ; the branches are thin, separated from each other by rather more than their own width, and connected at regular intervals by much thinner cross-bars. The fenestrules are sub-oval or nearly rectangular, about $2\frac{1}{2}$ to 3 times as long as broad. The non-celluliferous surface is covered by a number of fine longitudinal striations. On the celluliferous surface, the carina is distinct, rising as a low but practically vertical wall, with a smooth, rounded summit, and separating the double row of cells. The apertures of these are comparatively small, circular, alternating with those of the next row, separated from each other by about twice their own width, and their edges do not seem to be exserted as in

[1] McCoy, (3) p. 266, pl. 29, fig. 9.

[2] Lonsdale, (1) p. 183; (2) p. 269, pl. 9, figs. 1, 1a.

most other species of Fenestella. There are usually three in the space of one fenestrule, allowing an additional one for the width of a cross-bar.

Measurements:—In 10 mm. longitudinally, 11 cross-bars; in 10 mm. transversely, 18 branches. Length of fenestrules ·6 to ·7 mm., width ·2 to ·3 mm.

Locality and Horizon:—Branxton (Upper Marine Series).

Remarks:—I believe I have identified, with as little doubt as possible in the absence of the type, Lonsdale's species, originally described from Tasmania. It is here again figured, as all the previously published figures are very poor and of little aid in recognition. De Koninck synonymises *F. fossula* under *F. plebeia* McCoy,[1] and records the latter species from the Carboniferous rocks at Glen William, but as pointed out by R. Etheridge junr.,[2] *F. fossula* differs in being relatively much smaller and finer, with the branches closer. Whether de Koninck undoubtedly received *F. plebia* from Glen William, it is not within my power to contradict or confirm; but as this author's synonymy of the two species is now held to be invalid, and the specific rank of *F. fossula* maintained, the Australian occurrence of *F. plebeia* is, under the circumstances, very much open to doubt.

FENESTELLA INTERNATA (?) Lonsdale.[1] (Pls. X, fig. 2, XI.)

To *F. internata* is referred provisionally a form, the known characters of which agree fairly well with Lonsdale's description. Unfortunately the celluliferous surface is not visible in the one specimen available, and its correct identity must remain at present in abeyance.

The known characters of this specimen are:—Branches thin, separated from each other by about twice their width,

[1] De Koninck, (6) p. 130 – 132.
[2] R. Etheridge, junr., (13) p. 217, pl. 9, figs. 4 and 5.

increasing in width opposite the cross-bars, and very much so before their bifurcation, which is fairly frequent, giving the species a fairly spreading habit. Cross-bars thinner than the branches, distinct and regular. The fenestrules are slightly oval or circular, occasionally shorter than they are broad. The non-celluliferous surface of the branches is covered with longitudinal striations.

This is a strongly marked species, the rounded broad fenestrules giving it a definite identity. Though provisionally referred to *F. internata*, I am somewhat dubious, and quite expect that on further material being obtained, it will prove to be new.

Measurements:—In 10 mm. longitudinally, 13 to 14 cross-bars, and transversely 12 to 13 branches. Length of fenestrules ·5 to ·6 mm. width ·5 to ·75 mm.

Locality and Horizon:—Allandale (Lower Marine Series).

FENESTELLA EXSERTA sp. nov. (Pl. VII, figs. 1, 2, XII.)

Description:—Branches relatively of medium thickness, rather close together, separated by often less than their own width, parallel, bifurcating rarely. Cross-bars rounded, very much thinner than the branches. Fenestrules suboval to nearly rectangular, elongated, four or five times longer than broad. In one specimen, Pl. XII, fig. 1, what has evidently been an accidental fracture during the life of the colony, has been bridged over by several thickened, non-cell bearing, very much elongated dissepiments. Non-celluliferous surface not actually known, but from casts evidently faintly striated. Cells in two rows, their apertures small, alternating, separated from each other by about three times their width. The edges are well exserted, so much that at times they are almost tubular, with the mouths directed obliquely upwards. The carina is not distinct from

[1] Lonsdale, (1) p. 181; (2) p 269, pl. 9, figs. 2, 2b.

the remainder of the surface, as in most other species, but is produced by the two lateral, cell-bearing surfaces meeting at an angle of about 90 degrees. Also, owing to the alternation of the two rows of cells, the carina is at times regularly sinuous, giving a very characteristic appearance to the species. There are from 4 to 5 cells in the length of each fenestrule.

Measurements:—In the space of 10 mm. longitudinally 7 cross-bars. Average length of fenestrule 1 mm., width ·25 mm.

Locality and Horizon:—Branxton (Upper Marine Series).

Relations and differences:—The peculiar nature of the carina, with its sloping lateral cell-bearing surfaces, distinguishes this at once from other Australian species of Fenestella. The difference, in fact, is so great from such typical species as *F. fossula* and *F. cavea*, that I am inclined to think it is generic, and if so, then this genus is new, for there are no other genera of Fenestellidæ which have these characters. However, the carinæ of some of the earlier Fenestellidæ from America show somewhat similar characters, and comparisons may be made with *F. crebipora*, Hall,[1] *F. junceus* Hall,[1] and *F. sylvia* Hall,[1] from the Lower Helderberg, and other forms from the Upper Helderberg, all of which species nevertheless differ in other characters.

Dana's species *F. gracilis*,[2] has, according to de Koninck,[3] who records it from Burragood on the Paterson (Carboniferous), cells with very great marginal enlargement, but differs in other characters. Dana's original figure is very poor indeed, and conveys nothing, except it shows the branches to be irregular, and his description is equally lacking in detail, being evidently taken from material quite inadequate for specific determination.

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[1] J. Hall, (9) p. 43, pl. 20, figs. 1–3; p. 44, pl. 20, figs. 16–18; p. 49, pl. 20, figs. 4–7.
[2] Dana, (7) p. 711, pl. XI, fig. 4. [3] de Koninck, (5) p. 135.

FENESTELLA CAVEA sp. nov. (Pls. XV, XVI.)

Description:—Branches thin, rather far apart, separated from each other by twice or three times their own width, branching somewhat frequently, giving the colony a slightly spreading habit. Cross-bars distinct, rod-like, much thinner than the branches, rather distant but at regular intervals. Fenestrules rectangular, about three times longer than they are broad. Non-celluliferous surface rounded, smooth.

Celluliferous surface with a distinct carina, rising as a low wall with rounded summit, from a flat surface, which bears the cells. These are in two rows, their apertures are very small, circular, separated from each other by 3 or 4 times their own diameter, occasionally so laterally placed as to indent the margin, and with exserted rims. There are regularly six cells in the length of each fenestrule, a character which seems very constant.

Measurements:—In 10 mm. longitudinally 6 to 7 cross-bars. Length of fenestrules 1 to 1·5 mm., width ·5 to ·6 mm.

Locality and Horizon:—Branxton (Upper Marine Series).

Relation and differences:—The fine, widely separated branches and distant dissepiments give a characteristic appearance to this species. In most respects it resembles *F. multiporata* McCoy,[1] which has a similar habit, but it differs in having fewer cells in the length of a fenestrule. This character seems a very constant one in the Fenestellidæ, as in every specimen yet examined, the number of cells never seem to vary more than one, and even this slight variation is generally corrected by allowing for the width of the cross-bar.

In the form of the carina, *F. cavea* resembles *F. fossula* Lonsdale,[2] but differs in most other respects, including habit, size and shape of fenestrules, in its smaller cells,

[1] McCoy, (3) p. 203, pl. 28, fig. 9. [2] Lonsdale, (1) p. 83.

and the presence of six instead of three of these in the length of a fenestrule.

Genus PHYLLOPORA or PROTORETEPORA.

(Pl. III, fig. 1.)

Species indeterminate.

I have only one specimen of this form, which does not unfortunately show sufficient characters to enable it to be determined, but the colony is evidently cup-shaped with the celluliferous surface on the interior. The branches are moderately thick and very irregular, bending and uniting with each other to form the sometimes oval, but more often irregularly shaped fenestrules. Cross-bars are generally absent, and when present are not defined; in fact it is difficult to say whether certain slightly thinner connecting processes are branches or cross-bars.

The non-celluliferous surface is not striated but covered with innumerable small tubercles. Celluliferous surface not known, but in one portion of the specimen there is evidence that the cells are rhomboidal in shape and about three rows are present on each branch.

Locality and Horizon:—Branxton (Upper Marine Series).

Remarks:—The very irregular method of growth and the tuberculated exterior is characteristic of this form, and it is a pity that sufficient material is not available to satisfactorily place it.

Explanation of Plates.

Plate I.

Protoretepora montuosa sp. nov. The exterior of a cup-shaped colony, with a portion of the outer layer in the left hand top corner removed, showing the base of the celluliferous layer with its rhomboidal cells. Upper Marine Series, Branxton.

Plate II.

P. montuosa sp. nov. Fig. 1, Part of the same specimen as in Plate I, magnified 20 diameters, showing the exterior of the colony, and the concentric striations. Fig. 2, Another part of the same specimen, showing the bending of the branches, and the partial suppression of the cross-bars.

Plate III.

PROTORETEPORA OR PHYLLOPORA sp. indet. Portion of the exterior of a colony magnified 20 diameters, showing irregular method of growth and tuberculated surface. Upper Marine Series, Branxton.

Plate IV.

PROTORETEPORA AMPLA Lonsdale. A complete specimen, showing nature of colony, in the form of a cast. The non-celluliferous exterior layer has disappeared, and the bases of the walls of the rhomboidal cells appear as slits on the surface of the specimen. Upper Marine Series, Bundanoon.

Plate V.

POLYPORA PERTINAX sp. nov. Magnified three diameters. Fig. 1, Exterior of a fan-shaped colony. Fig. 2, Interior of another colony showing cell-mouths. Both from the Lower Marine Series at Allandale.

Plate VI.

POLYPORA PERTINAX sp. nov. Fig. 1, The same specimen as in Plate V. Fig. 2, magnified 20 diameters, showing cell apertures on the right, and the worn section of oval cells on the left. Fig. 2, Another specimen from the same locality, magnified 20 diameters somewhat worn, showing the oval cells with thick walls characteristic of Polypora, also the striated inner surface of the non-celluliferous layer.

Plate VII.

Figs. 1 and 2. FENESTELLA EXSERTA sp. nov., magnified 3 diameters; Upper Marine Series, Branxton. Fig. 3, POLYPORA TUMULA sp. nov., from the same locality, magnified 3 diameters; portion of a colony showing celluliferous surface. Fig. 4, POLYPORA VIRGA sp. nov., also from the same locality, magnified 3 diameters.

Plate VIII.

Fig. 1. POLYPORA PERTINAX sp. nov., magnified to 20 diameters; portion of the same specimen as in Plate V, fig. 2, showing cell apertures. Fig. 2, POLYPORA VIRGA sp. nov., magnified 20 diameters; portion of the same specimen as in Plate VII, fig. 4, showing rod-like cross-bars and cell apertures.

Plate IX.

Fig. 1. POLYPORA TUMULA sp. nov., magnified 20 diameters; portion of the same specimen as in Plate VII, fig. 3. Fig. 2. Another specimen of the same species, magnified 20 diameters, showing the tendency for irregularities of the surface to fuse into longitudinal keels.

Plate X.

Fig. 1. POLYPORA PERTINAX sp. nov., portion of the same specimen as in Plate V, fig. 1, magnified to 20 diameters, showing the non-celluliferous surface with longitudiual striations. Fig. 2, FENESTELLA INTERNATA (?) Lonsdale, portion of the same specimen as in Plate XI, fig. 2, magnified to 20 diameters.

Plate XI.

Fig. 1. FENESTELLA INTERNATA (?) Lonsdale, magnified 3 diameters, from the Lower Marine Series at Allandale. Fig. 2, the same as in fig. 1, magnified to 20 diameters.

Plate XII.

FENESTELLA EXSERTA sp. nov. Fig. 1, portion of the same specimen as in Plate VII, fig. 1, enlarged to 20 diameters, showing nature of the cell apertures, median ridge, etc. Fig. 2, portion of the same specimen as in Plate VII, fig. 2, enlarged to 20 diameters.

Plate XIII.

Fig. 1. FENESTELLA FOSSULA Lonsdale, portion of a colony, magnified 3 diameters, from the Upper Marine Series, Branxton. Fig. 2, portion of the same specimen enlarged to 20 diameters showing the non-celluliferous surface with longitudinal striations.

Plate XIV.

Fenestella fossula Lonsdale. Further portions of the same specimen as on the previous plate, showing cell apertures, carina, etc.

Plate XV.

Fig. 1. Fenestella cavea sp. nov., enlarged 3 diameters, showing portion of a colony. Fig. 2, portion of the same specimen enlarged 20 diameters, showing smooth non-celluliferous surface. Upper Marine Series, Branxton.

Plate XVI.

Fenestella cavea sp. nov., portion of another fragmentary specimen, magnified 20 diameters, showing the cell mouths, carina and the bifurcation of a branch. Also from Branxton.

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A SIMPLE PROGRESSIVE TAX, AND ITS BEARING ON THE FEDERAL INCOME TAX AND OTHER ACTS.

By H. S. CARSLAW, M.A., Sc.D.

[*Read before the Royal Society of N. S. Wales, July 3, 1918.*]

§ 1. The simplest form of tax is, of course, that in which the rate is constant: *e.g.*, 6d. in the £, whether the sum on which the tax is levied be large or small.

Next comes a sliding scale of which the following may be taken as an example :

On the first £500, the rate shall be 6d. per £.
On the second £500, the rate shall be 7d. per £.
On the third £500, the rate shall be 8d. per £.
On the fourth £500, the rate shall be 9d. per £.
And ever pound over £2000, shall pay 9½d.

In a case such as this, it is obviously more equitable that the larger rates should be levied only on the successive parts of the income, and not on the whole. If the latter alternative had been adopted above, an income of £500[1] would pay five hundred six-pences, and an income of £501 would pay five hundred and one times sevenpence.

In other words, the extra pound of income would pay £2 2s. 3d., instead of 7d.

Curiously enough, in Great Britain, the Income Tax is calculated in this way.[2] Throughout Australia the different States—with the exception of Western Australia, of

[1] When reference is made to income, the taxable income is understood; *i.e.* the sum on which the tax is levied.

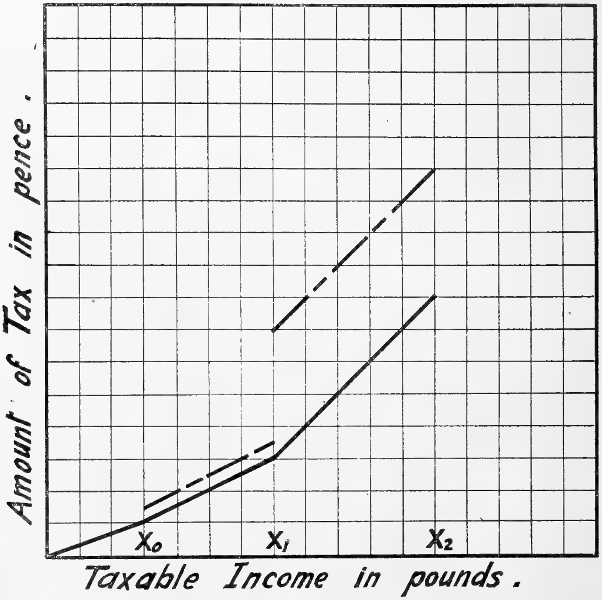
[2] A slight modification has now been introduced at the critical points.

which we shall speak later—adopt the fairer system, in one form or another.[1]

§ 2. It is instructive to note the graphical representation of the sliding scales described above.

Let the income be £x and the amount of the tax T pence. Also let a_0, a_1, a_2, etc., be the rates up to £x_0, and on the parts between £x_0 and £x_1, £x_1 and £x_2, etc. The relation between T and x, is shown by the continuous line in Fig. 1.

Fig. 1.



On the other hand the relation between T and x, when these rates are charged on the whole income instead of on

[1] Income Tax on earned income in New South Wales is computed as follows :—

On the first £700, the rate is 8d. per £.
On the next £1000, the rate is 9d. per £.
On the next £1000, the rate is 10d. per £.
On the next £2000, the rate is 11d. per £.
On the next £2000, the rate is 1s. 0d. per £.
On the next £3000. the rate is 1s. 1d. per £.
Every pound over £9700 pays 1s. 2d.
Also there is a supertax of 3d. per £.

the successive parts, is shown by the broken lines in the same diagram, the first line $T = a_0x$ $(0 < x < x_0)$ being common to both cases.

It will be seen that in the first case T is a continuous function of x, and in the second case it is discontinuous at x_0, x_1, x_2, etc.

§ 3. A natural extension of the scheme in the example at the beginning of § 1 would be to let the equal increments come at intervals of £100, instead of at intervals of £500, the increments being proportionally reduced. In this way we would replace the sliding scale of that example by the following:—

On the first £100, the rate shall be $(5\frac{1}{2} + \frac{1}{10})$ pence per £.

On the second £100, the rate shall be $(5\frac{1}{2} + \frac{3}{10})$ pence per £.

On the third £100, the rate shall be $(5\frac{1}{2} + \frac{5}{10})$ pence per £.

. . . .

On the twentieth £100, the rate shall be $(5\frac{1}{2} + \frac{39}{10})$ pence per £.

And every pound over £2000 shall pay $9\frac{1}{2}$d.

Then the reduction could be carried further, the increments coming at each successive pound.

On the first £1, $(5\frac{1}{2} + \frac{1}{1000})$ pence would be paid.

On the second £1, $(5\frac{1}{2} + \frac{3}{1000})$ pence would be paid.

On the third £1, $(5\frac{1}{2} + \frac{5}{1000})$ pence would be paid.

. . . .

On the two thousandth £1, $(5\frac{1}{2} + \frac{3999}{1000})$ pence would be paid.

And every pound over £2000 would pay $9\frac{1}{2}$d.

But from the mathematical standpoint there is no reason why the reduction should stop at this stage. We might proceed to shillings, pence, and fractions of a penny, and in the limit we would reach a continuously increasing rate of tax from which the same amount of tax would be obtained at the separate pounds.

In this example, the continuous rate would be given by the equation
$$\frac{dT}{dx} = 5\tfrac{1}{2} + \frac{1}{500}x,$$
and we would have $T = (5\tfrac{1}{2} + \frac{1}{1000}x)\,x.$

If the figures had been $(a + \frac{1}{2}b)$ for the first £1, $(a + \frac{3}{2}b)$ for the second £1, and so on, we would have been led to the continuous rate
$$\frac{dT}{dx} = a + bx,$$
and $T = (a + \frac{1}{2}bx)x.$

§ 4. So far as I know, the Commonwealth of Australia was the first to introduce a sliding scale in which the amounts paid on each successive pound—at least up to a certain point—form an arithmetical progression, while every pound over that point pays the same, namely, at the rate $\left(\frac{dT}{dx}\right)$ reached at the end of the last interval in which the increments occur.

According to the Federal Income Tax Act, 1917, the amount of the tax on an income derived wholly from personal exertion may be calculated as follows:[1]

(i.) When the whole taxable income does not exceed £7600, the amount of the tax on a taxable income of £x shall be $(3 + \frac{3}{800}x)x$ pence.

(ii.) When the whole taxable income exceeds £7600, the amount of the tax on the first £7600 shall be £997 10s., and every pound over £7600 shall pay 5s.

It is easy to show that this is equivalent to the following scheme:—

On the first £1, $(3 + \frac{3}{800})$ pence shall be paid.

On the second £1, $(3 + \frac{9}{800})$ pence shall be paid.

[1] In the First Schedule of the Act another form of words is used, but the fundamental clauses lead to the above result. This system was introduced when the Federal Parliament first imposed an Income Tax in 1915. There is now a considerable super-tax.

On the third £1, $(3 + \frac{15}{800})$ pence shall be paid.

And so on, up to the 7,600th pound, which shall pay $(60 - \frac{3}{800})$ pence.

Every pound over £7,600 shall pay 60 pence.[1]

It will be seen that under the first clause an income of £7,600 pays £997 10s., and this is the reason for the first part of the second clause.

The Federal Land Tax is also based upon the same principle. For instance, the part of the schedule dealing with owners, who are not absentees, shows that the amount of the tax on a taxable value of £x may be calculated as follows:—[2]

(i.) When the taxable value does not exceed £75,000, the amount of the tax on a taxable value of £x shall be $(1 + \frac{x}{18,750})x$ pence.

(ii.) When the taxable value exceeds £75,000, the amount of the tax on the first £75,000 shall be £1,562 10s., and every pound over £75,000 shall pay 9 pence.

It will be seen that this is equivalent to the following scheme:—

On the first £1, $(1 + \frac{1}{18,750})$ pence shall be paid.

On the second £1, $(1 + \frac{3}{18,750})$ pence shall be paid.

On the third £1, $(1 + \frac{5}{18,750})$ pence shall be paid.

And so on, up to the 75,000th pound, which shall pay $(9 - \frac{1}{18,750})$ pence.

Every pound over £75,000 shall pay 9 pence.

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[1] When $x = 7600$, $\frac{dT}{dx} = 60$.

[2] These figures refer to the Schedule now in force. The system was introduced in 1910.

The amount of the tax on £75,000 will be seen to be £1,562 10s. under the first clause.

§ 5. In the *Land Tax and Income Tax Act,* 1918 of Western Australia, it is enacted that an Income Tax shall be levied on the chargeable income of taxpayers, as follows:—

"At the rate of twopence in respect to every pound sterling of income chargeable plus an additional rate thereon of ·006 of a penny for every pound sterling by which the income chargeable from all sources exceeds £100. Provided that the rate in the pound shall not exceed two shillings and sixpence."

From the above statement it is to be understood that, if the taxable income is £x and the amount of the tax is T pence, we shall have

$$\begin{array}{lll} \text{(i.)} & T = 2x, & \text{when } x \leqq 100, \\ \text{(ii.)} & T = \{2 + (x - 100) \cdot 006\} x, & \text{when } 101 \leqq x \leqq 4766, \\ \text{(iii.)} & T = 30x, & \text{when } x \geqq 4767. \end{array}$$

It will be found that the amounts paid by each successive pound from the 101st up to the 4766th, form an arithmetical progression of which the first term is 2·606 pence and the common difference ·012 pence.

The 4765th pound pays 58·574 pence.

The 4766th pound pays 58·586 pence.

The 4767th pound pays 49·064 pence.

The 4768th pound and all succeeding pounds pay 30 pence.

The rate of tax $\left(\dfrac{dT}{dx}\right)$ for the value of x which corresponds to the average rate 2s. 6d. (namely $4766\frac{2}{3}$) is 58·6. The Treasury of West Australia loses about 2s. 4d. on each pound of income over £4767, since each of these pounds should pay at the rate reached at the end of the progression.

A similar error occurs in the New Zealand Acts dealing with Land Tax, Income Tax, and Special War Tax.

For example, the First Schedule for Income Tax (*Finance Act*, 1917, p. 32) contains the following clauses:—

(*a*) Where the income on which tax is payable does not exceed £400 the rate shall be 6d. for every £1 thereof.[1]

(*b*) Where such income exceeds £400 the rate shall be 6d. for every £1 thereof increased by one two-hundredth part of 1d. for every £1 in excess of £400, but so as not to exceed in any case the rate of 3s. in the £1.

It will be seen that each £1 over £6400 pays 36 pence, whereas each of these pounds should pay 68 pence.

§ 6. In dealing with incomes derived from property, it is usual to exact a higher rate than when dealing with incomes derived from personal exertion. It is unfortunate that the Commonwealth of Australia, in the Income Tax Acts of 1915—1917, adopted for incomes from property a system far more complicated than the simple progressive tax described in § 4.

The reader is referred to the Appendix for the full statement of the matter as given in the Income Tax Act, 1917, but using the language of the Calculus, the Schedule may be summed up in the following terms:—

Let the income be £x and the amount of the tax T pence.

Then T is a continuous function of x, such that

(*a*) $T = \left(3 + \dfrac{x}{181 \cdot 058}\right) x$, when $x \leqq 546$.

(*b*) $\dfrac{dT}{dx} = \dfrac{23 \cdot 2}{10^3} x - \dfrac{3 \cdot 2}{10^6} x^2$, when $546 < x \leqq 2000$.

(*c*) $\dfrac{dT}{dx} = -5 + \dfrac{25 \cdot 16}{10^3} x - \dfrac{3 \cdot 2}{10^6} x^2 + \dfrac{0 \cdot 1\dot{3}}{10^9} x^3$,

when $2000 < x \leqq 6500$.

(*d*) $\dfrac{dT}{dx} = 60$, when $x > 6500$.

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[1] This clause is a little misleading, as there is a rather complicated set of exemptions.

There is no doubt whatever that the legislators who passed these Acts had very little idea of what the schedules meant; and the various changes in the wording of the clauses since 1915 have made the position no clearer to the average man. The curves of the second and third degree (See Appendix, Schedule II, (*b*) and (*c*)) are a byword throughout Australia.

Of course the truth is that the idea of a continuously changing rate of tax—even the linear rate—is a difficult idea. Those without a knowledge of the Differential Calculus cannot be expected properly to grasp it. And it should surely only be in the last resort that a system of taxation is imposed, involving principles which the majority of the taxpayers cannot be expected to understand.

§ 7. It seems, therefore, worth while to repeat what I have already said elsewhere, ("Sydney Morning Herald," May 2, 1918), that a simple progressive tax on the lines of the First Schedule, as described in §4, could quite easily be substituted for this complicated and most unsuitable scheme. The substitute which I have proposed is as follows:—

Schedule II.—Income derived wholly from Property:—

(i) When the whole taxable income does not exceed £3800, the amount of the tax on a taxable income of £x shall be $(3+\frac{3}{400}x)\,x$ pence.

(ii.) When the whole taxable income exceeds £3800, the amount of the tax on the first £3800 shall be £498 15s., and every pound over £3800 shall pay 5s.

Schedule III.—Income derived partly from personal exertion and partly from property:—

The amount of the tax shall be that for the whole taxable income under the scale given in Schedule II., less the sum by which the amount of the tax on the part derived from Personal Exertion under the scale given in Schedule II. exceeds that under the scale given in Schedule I.

The second schedule given above is obtained in the same way as the first schedule.

The first pound pays $(3 + \frac{3}{400})$ pence.

The second pound pays $(3 + \frac{9}{400})$ pence.

The third pound pays $(3 + \frac{15}{400})$ pence.

And so on, up to the 3800th pound.

A simple calculation will show that a total of £x would pay the sum named in the schedule. Also it will be noticed that the progression stops at the 3800th pound, which pays $(60 - \frac{3}{400})$ pence, and that every pound over £3800 is to pay 60 pence. Further, an income of £3800 pays the sum of £498 15s.

A comparison between the proposed schedule and the corresponding schedule of the present Act can most easily be effected by calculating under each the value of the average rate in pence per £ on an income of £x. By the term *average rate* is meant the amount of the tax in pence divided by the income in pounds—that is, T/x, in the notation of this paper.

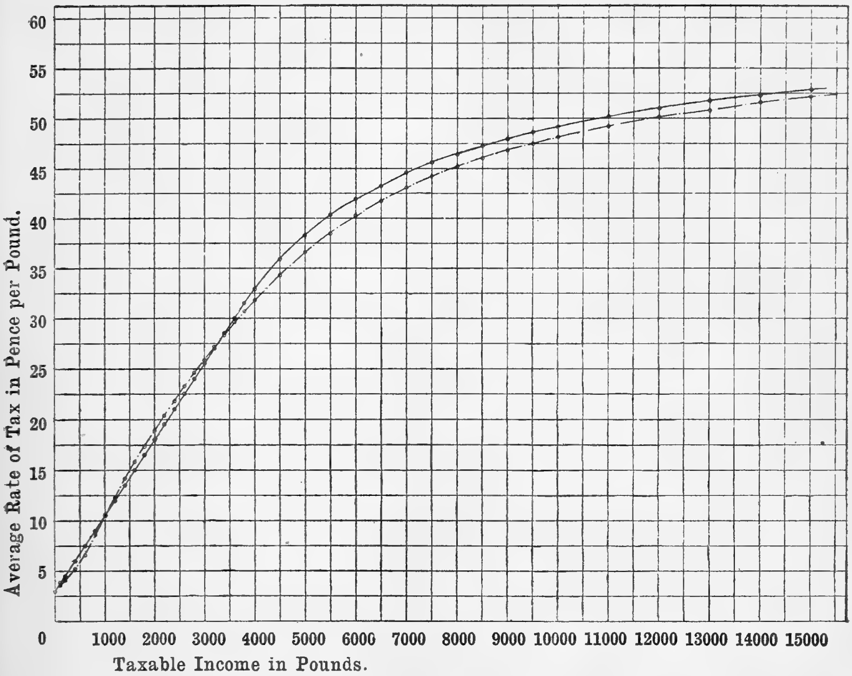
In the following table these rates are given at intervals sufficiently close for our purpose, up to £40,000. It will be seen that up to about £1,000 the rate in the new scheme is slightly higher than the old; from £1,000 to about £3,300 slightly lower; and from about £3,300 onward slightly higher.

Taxable Income.	New Average Rate in pence per £.	Present Average Rate in pence per£.
£200	4·5	4·10
£400	6	5·21
£600	7·5	6·58
£800	9	8·60
£1,000	10·5	10·53
£1,200	12	12·38
£1,400	13·5	14·15
£1,600	15	15·83
£1,800	16·5	17·42
£2,000	18	18·93
£2,200	19·5	20·40
£2,400	21	21·82
£2,600	22·5	23·22
£2,800	24	24·58
£3,000	25·5	25·89
£3,200	27	27·17
£3,400	28·5	28·40
£3,600	30	29·57
£3,800	31·5	30·70
£4,000	32·93	31·78
£4,500	35·93	34·29
£5,000	38·34	36·52
£5,500	40·31	38·49
£6,000	41·95	40·22
£6,500	43·25	41·73
£7,000	44·53	43·04
£7,500	45·56	44·17
£8,000	46·46	45·16
£8,500	47·26	46·03
£9,000	47·97	46·81
£9,500	48·60	47·49
£10,000	49·17	48·12
£15,000	52·78	52·08
£20,000	54·58	54·06
£40,000	57·29	57·03

These results are also shown in Fig, 2, where the graph of T/x, as a function of x, is given to a convenient scale.

The broken line refers to the schedule now in force.

Fig. 2.



It may also be remarked that, in the schedules which I have put forward, the Composite Incomes—that is, incomes derived partly from personal exertion and partly from property, and these must be a large proportion of the incomes on which a tax is levied—have a treatment similar to that which they receive in our New South Wales State Income Tax. The earned income is taken first, and taxed as in Schedule I; the income from property is taken next, and counted under Schedule II as beginning at the place at which the other income ends.

APPENDIX.

Income Tax Act, 1917 (Commonwealth of Australia.)

SECOND SCHEDULE.

Rate of Tax upon Income Derived from Property.

(*a*) For such part of the taxable income as does not exceed £546 the average rate of tax per pound sterling shall be that given by the following formula :—

R = average rate of tax in pence per pound sterling.

I = taxable income in pounds sterling.

$$R = \left(3 + \frac{I}{181{\cdot}058}\right) \text{ pence.}$$

(*b*) For such part of the taxable income as exceeds £546 but does exceed £2,000 the additional tax for each additional pound of taxable income above £546 shall increase continuously with the increase of the taxable income in a curve of the second degree in such a manner that the increase of tax for one pound increase of taxable income shall be—

11·713 pence for the pound sterling between £545 10s. and £546 10s.
12·768 pence for the pound sterling between £599 10s. and £600 10s.
14·672 pence for the pound sterling between £699 10s. and £700 10s.
16·512 pence for the pound sterling between £799 10s. and £800 10s.
18·288 pence for the pound sterling between £899 10s. and £900 10s.
20·000 pence for the pound sterling between £999 10s. and £1,000 10s.
27·600 pence for the pound sterling between £1,499 10s. and £1,500 10s.
33·600 pence for the pound sterling between £1,999 10s. and £2,000 10s.

(*c*) For such part of the taxable income as exceeds £2,000 but does not exceed £6,500, the additional tax for each additional pound of taxable income above £2,000 shall increase continuously with the increase of the taxable income in a curve of the third degree in such a manner that the increase of tax for one pound increase of taxable income shall be—

33·600 pence for the pound sterling between £1,999 10s. and £2,000 10s.
40·000 pence for the pound sterling between £2,499 10s. and £2,500 10s.
45·300 pence for the pound sterling between £2,999 10s. and £3,000 10s.
49·600 pence for the pound sterling between £3.499 10s. and £3,500 10s.
53·000 pence for the pound sterling between £3,999 10s. and £4,000 10s.
55·600 pence for the pound sterling between £4,499 10s. and £4,500 10s.
57·500 pence for the pound sterling between £4,999 10s. and £5,000 10s.
58·800 pence for the pound sterling between £5,499 10s. and £5,500 10s.
59·600 pence for the pound sterling between £5,999 10s. and £6,000 10s.
60·000 pence for the pound sterling between £6,499 10s. and £6,500 10s.

(*d*) For every pound sterling of taxable income in excess of £6,500 the rate of tax shall be sixty pence.

A CONTRIBUTION TO A HISTORY OF THE ROYAL SOCIETY OF NEW SOUTH WALES,

(With information in regard to other New South Wales Societies.)

By J. H. Maiden, I.S.O., F.R.S., F.L.S.,

One of the Honorary Secretaries.

[*Read before the Royal Society of N. S. Wales, July 3, 1918.*]

During the year 1905, the Council contemplated the celebration of the jubilee of the 1856 (1855) Society, but circumstances prevented the intention being carried out. I undertook to prepare a history of our Society up to 1906, but when the celebration was abandoned, I confined my attention to the unravelling of the intricacies of the pedigree of the Society, and to its proceedings up to the date that they had been published in the Society's Journal for 1875.

I have by no means continuously worked at the subject since 1906, but have never lost sight of the matter, and from time to time have gleaned additional information. I now offer my compilation as *matériaux pour servir.* Detailed information has yet to be accumulated between 1823 and 1850, also during 1853 and 1854 and 1859 to 1861, in the files of contemporary newspapers, and notes, and perhaps the text of a few papers read before the Societies dealt with may be recovered, and printed to complete the record. I believe, however, that incomplete as it is, what I have got together will be useful to a future worker to enable him to prepare a really valuable history of our Society.

Some of the older writers were inclined to be easy-going in quoting the titles of Societies, a circumstance which has often rendered my researches difficult. They seemed to forget that a Society had a definite official name, which ought to be used in writing, however it might be referred to colloquially.

I anticipate that the proceedings of our own and kindred Societies, including lists of the papers read, will be of real value to the student of scientific progress in Australia, as they exhibit the progress of science in New South Wales, while the personal touches concerning well known names have a very human interest.

Notes are submitted under the following heads:—

I. Details of the history of various Societies.
II. Miscellanea.
III. Enquiries and Conclusions.

I. Details of the History of Various Societies.

1. Philosophical Society of Australasia (Dec. 1821 – 1822?).
2. Agricultural Society of New South Wales (5th July, 1822 – 22nd February, 1826).
3. Agricultural and Horticultural Society of New South Wales (22nd February, 1826 – 1836).
4. Australian Society to promote the growth and consumption of Colonial Produce and Manufactures (1830 – 1836).
5. Australian Floral and Horticultural Society (1836 – 1848).
6. Australasian Botanic and Horticultural Society (20th June, 1848 – 8th December, 1856).
7. Horticultural Improvement Society of New South Wales (15th January, 1855 – 8th December, 1856).
8. Australian Horticultural and Agricultural Society (8th December, 1856).
9. Australian Philosophical Society (19th January, 1850 – 30th July, 1855).

10. Philosophical Society of New South Wales (30th July, 1855 – 12th December, 1866).
11. Royal Society of New South Wales (12th December, 1866 –).

Floreat !

1. The Philosophical Society of Australasia, December, 1821 – 1822 ?).

Men early began to feel the necessity of a mutual improvement society, and the subject of agriculture being, (one would imagine), non-political, seemed to present itself in an obvious manner. Following is the first definite attempt I can trace to realize the above object.

"An attempt at this time (1818) to form an Agricultural Society came to an untimely end. (Judge Advocate) Wylde hoped by means of balloting for the election of members to prevent the necessity of excluding or including ex-convicts by any rule. With a ballot he thought some would have been elected and others, who were personally undesirable, not. But the Governor (Macquarie) refused to be the patron of the society unless the emancipists were freely admitted; and, lacking his support, the scheme was dropped."—(Marion Phillips, "A Colonial Autocracy," 1909, p. 270).

The time for an Agricultural Society was not ripe, nor did any Society take its place during the reign of Macquarie. It will be presently seen that Governor Brisbane, who was a scientific man (an astronomer), established a scientific Society or Club, and he lost no time about it.

The following notes were read at the fifty-sixth meeting of the Philosophical Society of New South Wales, 17th December, 1862 (extracted from the Minutes).

"The following extract from the "Australian Almanac for 1822," gives an account of the formation and early history of the Society, and will, we doubt not, be read with much interest:—

"PHILOSOPHICAL SOCIETY OF AUSTRALASIA.

President: Major-General Sir Thomas Brisbane, K.C.B., F.R.S.L., and E., and Corresponding Member of the French Institute. Treasurer and Secretary: Henry Grattan Douglass, M.D.[1]

"Members (alphabetically).—Alexander Berry, Esq., Barron Field, Esq., Barrister-at-law; Frederick Goulburn, Esq., Major in the Army; Patrick Hill, Esq., Surgeon, R.N.; William Howe, Esq., Captain Irvine, 11th Bengal Native Infantry; Captain King, R.N.; John Oxley, Esq., Lieutenant R.N.; Edward Wollstonecraft, Esq."

In Trans. Roy. Soc. N.S.W., I, 2 (1867) the enumeration is put slightly differently, and the name of Charles Stargard Rumker, Esq., Astronomer, is added.

Resuming the 1862 minutes, we have, "Extract from the 'Sydney Gazette and New South Wales Advertiser,' of Friday, March 15th, 1822:—On Wednesday morning his Excellency the Governor came to town for the purpose of accompanying the Philosophical Society to the south head of Botany Bay to erect an inscription to commemorate the first landing of Captain Cook and Sir Joseph Banks; but when the party arrived at the north shore, the state of the wind forbade their crossing the bay. The excursion was therefore postponed till the following Wednesday, and the President and members dined where they were, and were honoured by the company of the principal officers of the 'Dauntless,' together with Captain Elliott and Captain Piper."

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[1] He had, earlier in the year, 1821, arrived from Britain, and been appointed by Macquarie Assistant-Surgeon at Parramatta. He received the favour of Brisbane, who supported him during a trying experience. For particulars concerning him, see *Hist. Rec. Austral.*, Vol. x. He became Hon. Sec. of both the 1850 Society and of the Philos. Soc. N.S.W. (1855).

"Extract from the 'Sydney Gazette, etc.,' of Friday, March 22, 1822:—His Excellency the Governor-in-Chief came to town on Tuesday last, and returned to Parramatta yesterday. On Wednesday last his Excellency the President and members of the Philosophical Society of Australasia, made an excursion to the south head of Botany Bay, for the purpose of affixing a brazen tablet, with the following inscription, against the rock on which Captain Cook and Sir Joseph Banks first landed.

> A.D.—MDCCLXX.
>
> Under the auspices of British science, these shores were discovered by JAMES COOK and JOSEPH BANKS, the Columbus and Mæcenas of their time. This spot once saw them ardent in the pursuit of knowledge. Now, to their memory, this tablet is inscribed, in the first year of the Philosophical Society of Australasia.
>
> Sir THOMAS BRISBANE, K.C.B. and F.R.S.L. and E., (Corresponding Member of the Institute of France), President.
>
> A.D.—MDCCCXXI.

"On this interesting occasion the Society had the good fortune to be assisted by Captain Gambier and several of the officers of His Majesty's ship 'Dauntless'; and after dining together in a natural arbour on the shore, they all repaired to the rocks, against which they saw the tablet soldered, about twenty-five feet above the level of the sea, and they there drank to the immortal fame of the illustrious men whose discoveries they were then met to commemorate."

So that, although the Society was established in 1821, and the plate prepared and dated for that year, circumstances prevented the fixing of the tablet until Wednesday, 20th March, 1822.

The work "Geographical Memoirs on New South Wales, by various hands," edited by Barron Field, F.L.S., late Judge of the Supreme Court of New South Wales, (London, 1825), has for sub-title, "other papers on the Aborigines, the Geology, the Botany, the Timber, the Astronomy and the Meteorology of New South Wales and Van Diemen's Land," and some of these papers were read before the "Philosophical Society of Australia," thus

1. "On the Aborigines of New Holland and Van Diemen's Land," by Barron Field, Esq. (Read 2nd January, 1822, before the Society), p. 193,

2. "On the Geology of part of the coast of New South Wales," by Alexander Berry Esq. (Read —1822, before the Society), p. 231.

3. "On the Astronomy of the Southern Hemisphere," by Dr. Charles Stargard Rumker. (Read 13th March, 1822, before the Society) p. 255.

[These three papers were therefore read before the fixing of the tablet.]

4. "On the Maritime Geography of Australia," by Capt. Philip Parker King, R.N. (Read 2nd October, 1822, before the Society), p. 269.

The next paper, entitled "On the Rivers of New South Wales," by Barron Field, President, (of the Agricultural Society) was read 3rd July, 1823, "before the Agricultural Society of New South Wales." It does not seem to be a specially suitable paper for an Agricultural Society, and possibly it was originally prepared by Judge Field for the Philosophical Society (of which he was a member), and since (it is presumed) he found the Society was not then in active work, transferred it to the Agricultural Society.

The rest of the papers in Barron Field's work were official documents or scientific papers not formally read before any Society.

In his preface, he says of the papers whose titles I have quoted, "Such of them as are part (apparently some papers were not published and we do not know their titles.—J.H.M.) of the Transactions of the Philosophical Society of Australia are printed by the permission of the respective authors," and he goes on to say, "for I am sorry to say that that infant society soon expired in the baneful atmosphere of distracted politics, which unhappily clouded the short administration of its President, the present Governor of New South Wales. Let me hope that it is only a case of suspended animation and that our little Society will be resuscitated by the new colonial government." These remarks were dated 28th February, 1825.

At p. 497 of his work he published a "Sonnet on visiting the spot where Captain Cook and Sir Joseph Banks first landed in Botany Bay." The poet refers to the tablet.

There is an account of Barron Field, by Mr. J. Arthur Dowling, in "Journ. Aust. Hist. Soc., ii, 92, 101. See also E. J. Godfrey's "Australian Historical Gleaner," Sydney, 1911, p. 26. See also a note on him in this Journal (XLII, 101, 1908).

Not much is known of the first editor of our collected papers, and hence the following spicy reference to him may come here.

Disraeli wrote as pompously as Field ever did, from Cadiz, on 14th July 1830 to his father, Isaac Disraeli.

"The Judge Advocate at Gibraltar is that Mr. Baron (Barron—J.H.M.) Field who once wrote a book, and whom all the world took for a noble, but it turned out that Baron was to him what Thomas is to other men. He pounced upon me, said he had seen you at Murray's, first man of the day, and all that, and evidently expected to do an amazing bit of literature; but I found him a bore and vulgar, a Storks without breeding, consequently I gave him a lecture on canes, which made him stare, and he has avoided me ever since. The truth is he wished to saddle his mother on me for a compagnon de voyage . . . but yet more endurable than the noisy, obtrusive, jargonic judge, who is a true lawyer, ever illustrating the obvious, explaining the evident, and expatiating on the commonplace."—(Monypeny's "Life of Disraeli," i, 142, 1910).

Rev. W. B. Clarke (This Journal, i, ii) says—"This early union (the 1821 Society) appears to have partaken rather of the character of a Mutual Friendly Association, than of that of a more formal body. It was, in other words, a Scientific Club. At that time, there were no public libraries, and scarcely a bookseller's shop in the Colony, but the members possessed books of their own; these were catalogued and lent to one another, so that the use of them was reciprocal. The business of the Society was transacted at the dwelling houses of the members in succession, where memoirs, prepared on an alternative of a fine of ten pounds sterling, were read and discussed, the only refreshment allowed being a cup of coffee and a biscuit." . . . The Philosophical Society was destined to only a brief period of service. A question arose between the Government and some of the members which led to estrangement. The friendly meetings became fewer, and the fictitious variable value assigned to the dollar (the coin then current) was the cause of breaking up the little band who cultivated science for the love of it.

"This, gentlemen, is all of much importance that I have been able to learn, after search in the publications of the period, and converse with my venerable friend Mr. Berry (who was of course a member of the 1821 Society.—J.H.M.) My late friend Admiral King did, however, inform me, that there were some other little grievances, besides the proceedings of Major Goulburn, which prevented the early resuscitation spoken of by Judge Field. And I know personally, that, at the time when the Australian Society was projected (the 1850 Society.—J.H.M.) there was such a difference between the gallant Admiral and the former Secretary (Dr. H. Grattan Douglass, J.H.M.), as to prevent cordial working on behalf of that Society."

How long this "Scientific Club" or 1821 Society precisely lasted (*i.e.*, when was the date of its last meeting, or the date of its formal disbandment if any) I cannot say; probably not beyond the year 1822, but being a private organization it may have gone on longer. Like Mr. Clarke I have made careful search for information, and I only hope that the Macquarie papers, or the vast masses of contemporary or almost contemporary papers which have been recently acquired by the Mitchell Library, will throw light on the subject as they become indexed and annotated. We only know as much of its proceedings as we do, because Barron Field published its papers; perhaps others exist which were not published.

The following extract from the inaugural address of the late Mr. H. C. Russell at the Australasian Association for the Advancement of Science (1888), refer to the 1821 Society:—"At the very time that Sir David Brewster was using his pen and his influence to stir up the scientific men of England to greater effort in the cause of science, and to the formation of the British Association for the Advancement of Science, the British Government were sending to Sydney one of the most energetic scientific men that ever sat foot upon Australian soil, (James Dunlop, the Astronomer), with a view of keeping alive the dying embers of the first attempt to plant science in this part of the world. And I think it most fitting that, at this first meeting of the Australasian Association for the Advancement of Science, we should remember that first effort to promote science in a country so remote from the home of science. It is difficult now to form any idea of the condition of society in Australia when Sir Thomas Brisbane landed, and nothing but the habit of disregarding difficulties, which a long military experience had taught him, would have made it possible in his mind, to form a scientific society under such circumstances. He landed at the end of November, entered upon his official duties on December 1, 1821,[1] and by January 2 following, he had found out the only scientific men in the colony, formed them into the Philosophical Society of Australia, and had the first paper read. But with all his enthusiasm he soon found that a small army of scientific workers was not so manageable as the armies he had been accustomed to." . . .

But although the strong individuality and preponderating official position of the Governor, who was a distinguished scientific man, enabled him to start a strictly scientific Society, it was not long before, as has been already shown, that it had to lean on the stronger arm of the Agricultural Society founded in 1822.

To show that there was no antagonism between the two earliest Societies, it is sufficient to point out that the Governor (Sir Thomas Brisbane), Major Goulburn, Judge Barron Field, Alex. Berry, Dr. H. G. Douglass, and Captain P. P. King, R.N., were office-bearers of both.

No history of scientific activities in New South Wales would be complete without reference to the work of the Agricultural and Horticultural Societies, particularly during the times of suspended animation of those usually considered as precursors of the Royal Society of New South Wales.

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[1] The Society must have been founded in December 1821, otherwise a paper could hardly have been read before it on the 2nd January following. With an autocratic Governor, and a small community, events could move very rapidly.—J.H.M.

2. The Agricultural Society of New South Wales, (5th July, 1822 – 22nd February, 1826).

Continued as

3. The Agricultural and Horticultural Society of New South Wales, (22nd February, 1826 – 1836 ?.)

I have gone through the "Australian Almanac or New South Wales Calendar" from 1808, and the 1823 issue contains the first reference to any Society.

I give the list of office-bearers of the Agricultural Society, (1823 Almanac) as it throws some light on its organisation.

Patron—His Excellency Sir Thomas Brisbane, K.C.B.

Vice-Patron—F. Goulburn, Esq., Colonial Secretary, J.P.

President—The Hon. Barron Field, Esq., Judge of the Supreme Court.

Vice-Presidents—The Rev. Samuel Marsden; William Cox, Esq. J.P.; Robert Townson, LL.D., F.R.S.E.; Hannibal M'Arthur Esq.

Treasurers—Messrs. Riley, J.P., and Walker.

Secretaries—Alexander Berry, J.P., and G. T. Palmer, Esq.

General Committee—Sydney—J. T. Campbell, Esq., J.P.; John Piper, Esq., J.P.; Edward Wollstonecraft, Esq., J.P.; Nicholas Baly, Esq.; George Rankin, Esq.

Parramatta—John Palmer, Esq.; John Blaxland, Esq.; H. G. Douglass, M.D., J.P.; Rev. T. Hassall; Capt. King, R.N.

Airds, Bringelly, Liverpool and Windsor—William Howe, Esq., J.P,; Robert Lowe, Esq., J.P.; John Oxley, Esq., J.P.; Charles Throsby, Esq., J.P.; Thomas Moore, Esq., J.P.; Richard Brooks, Esq., J.P.; Capt. Brabyn, J.P.; John Harris, Esq., J.P.; Archibald Bell, Esq., J.P.; H. C. Antill, Esq., J.P.; John McHenry, Esq., J.P.; William Lawson, Esq., J.P.; John Wood, Esq.; Andrew Allan, Esq.; John Horsley, Esq.; John Campbell, Esq.; George Cox, Esq.

Corresponding Members of Committee at Newcastle—Rev. G. A. Middleton; J. P. Webber, Esq.; William Dunn, Esq.; Edward C. Close, Esq.

Stock Fund Committee—Rev. S. Marsden; William Cox, Esq.; Dr. Townson; H. M'Arthur, Esq.; John Blaxland, Esq.; J. Oxley, Esq.; G. T. Palmer, Esq.; Chas. Throsby, Esq.; R. Lowe, Esq.

At a meeting held on 5th July, 1822, at Sydney, resolutions were carried for the formation of the "Agricultural Society of New South Wales." The annual subscription was fixed at five guineas, and a subscription fund was started in shares of £25 each to secure the importation of live stock. The first function held by the Society was an inaugural dinner at Parramatta on the 16th July, 1822.

The lists of office-bearers are published in the Almanacs of 1824 and 1825.

Lists of prizes were published in the "Sydney Gazette," *e.g.*, 14th October, 1824, third page.

There is a list of office-bearers in the Almanac for 1826.

In the Almanac for 1827 it is recorded that the Agricultural Society was designated "The Agricultural and Horticultural Society" on 22nd February, 1826, but there is no change in office-bearers. This change of title was adopted in the advertisements of the Society, in the "Sydney Gazette," *e.g.*, first page of 20th September, 1826.

There is no change in the Almanacs of 1828 – 1835, except that the heading appears "Agricultural and Horticultural Society" in 1829, this designation having been omitted in 1828, evidently through a slip.

I then turn to the "New South Wales Calendar," and find the usual list of office-bearers for 1836. There is, however, no mention of the Society in the Calendars for 1837 – 9.

What happened to the Society in the thirties is told in the Royal Agricultural Society's Annual for 1906, p. 16, by H. M. Somer, from which the following particulars are taken.

In 1832 the effects of bad seasons and the depreciation of farm property began to tell very severely on the prospects of the Society. On 20th June, 1833, the fruit trees and plants at the garden which had been conducted by the Society at Parramatta were advertised for sale. Nevertheless, there was a large attendance at the half-yearly meeting on October 3rd, and the meeting was described as one of the most successful that had been held for years. For three or four years the affairs of the Society had been at rather a low ebb.

Because of the spurt, one is rather shocked to read in the "Herald" of 3rd March, 1834, "We presume we shall hear no more of our Agricultural Society."

Mr. Somer says, "What might be described as the dying struggles of the body were continued through 1834, when a half-yearly meeting was to have been held at Walker's Hotel, Parramatta. This meeting, however, resulted in what proved the *coup de grace.* No preparations had been made, and a number of farmers who had come in to compete for the premiums had to return to their homes. The final demise seems to be enshrouded in mystery, and it is probable that a few further spasmodic efforts were made to carry it on." (I have already referred to the office-bearers for 1836, so that it had not been disbanded at least until that year).

Mr. Somer states that "the next important movement is recorded in March 1857," when the Cumberland Agricultural Society was formed. This is referred to in connection with the transactions of the Australian Horticultural and Agricultural Society under date 2nd February, 29th June, and 20th July, 1858. See pp. 248, 250.

4. The Australian Society to promote the growth and consumption of Colonial produce and manufactures, (1830 – 1836).

(Its short title was "The Australian Society," but it must not be confused with "The Australian Society" of 1850.)

In the "Sydney Gazette" of 2nd December, 1830, a leading article says "The objects of the *new* (my italics) Agricultural and Horticultural Society, the formation of which we recently announced to our readers (I have not found the announcement so far.—J.H.M.), are similar to those of its predecessor and contemporary." (Evidently a reference to the *old* Agricultural and Horticultural Society of New South Wales, No. 3 of my list.—J.H.M.).

Further on it speaks of the "public spirited *senior* (italics not mine) Agricultural Society . . . With respect to the intention of the new Society to foster the production of domestic manufactures, which is stated to be one of its chief objects" etc.

The article gives rather a tepid welcome to the new Society, evidently considering that one is sufficient, and pointing out how few immigrants are coming to the Colony, and that what was really needed was population.

The writer of the article probably made a slip of the pen when he referred to the new Society as the "Agricultural and Horticultural Society." The subsequent reference to the fostering of the production of domestic manufactures however, makes it quite clear that it is the Society about to be spoken of.

In the same journal for 25th January, 1831, an advertisement appears "The Australian Society, to promote the growth and consumption of Colonial produce and manufactures. (This is what the promoters themselves say is the name of their Society.—J.H.M.) Members and friends will dine at Morris's Crown and Anchor Tavern, George Street, Sydney, on Wednesday, 26th inst." The advertisement is dated 14th January.

In the "Sydney Gazette" of the 29th January, we have an account, extending to two columns, of the dinner. The dinner seems to have been attended by an insufficiency of waiters. In other respects the meeting did not satisfy the "Gazette."

"The most prominent speaker of the evening was Mr. Nichols, a young Australian, and it is to this gentleman's want of judgment that much of the uproar which occasionally prevailed, is mainly attributable."

About 130 persons were present, and a number of speeches of a personal and political character were made.

We come to the next dinner.

The "Sydney Monitor" of the 30th July, 1831, has the following:—"The members of the 'Australian Society for the encouragement of Colonial Manufactures' to the number of between 130 and 140, including their friends, sat down to an excellent dinner on Tuesday last, (26th instant) at Hart's Hotel, Pitt Street. Mr. Samuel Terry in the Chair, Mr. Simeon Lord, Vice-chair. The band of H.M. 39th Regiment provided the music. There were the usual loyal toasts and many others, some with veiled references. There were four toasts which show the trend of the Society:—

"The Australian Society to promote the growth and consumption of colonial produce and manufactures."

"The Whale Fisheries."

"The fleece of New South Wales."

"Currency lads and Currency lasses."

Beyond the toasts, no 'shop' was talked.

"Under the guidance of the Chairman and Vice, who never flinched from their posts until the meeting broke up, such a vigorous attack was made upon Mr. Hart's stock of wines that the cork-drawing volleys struck on the ear like file-firing on a field day.

"To sum up, the dinner was good, the wines were good, the music was good, the harmony was good, and the Society is likely to be favoured with the votes and interest of a greater number at the ensuing half-yearly dinner, if good eating and drinking on these occasions, be admitted to be a main prop of an institution."

It seems to me quite evident that it was not an educational Society of the Agricultural, Horticultural and Philosophical class.

The "Sydney Gazette" evidently had not a representative at the dinner, for in its issue of the 2nd August, 1831, under the heading "The Australian Society," it quotes the "Monitor's" report *in extenso*, and also reproves its wicked contemporary for making observations in brackets.

I have not been able to trace a subsequent dinner, half-yearly or otherwise.

In the Almanacs, *e.g.* the "Australian Almanac" 1831, we have its name correctly stated, and also the office-bearers:—

"The Australian Society to promote the growth and consumption of Colonial produce and manufactures. President, Samuel Terry; Vice-President, Daniel Cooper; Treasurer, William Hutchinson; Secretary, John Rickards."

I find its office-bearers given in the New South Wales Calendar and Directory for 1831, 1833–1836. There is no mention of it in the Calendar for 1837. The word "cultivation" is used in lieu of "consumption" in the 1833 Calendar.

The Society does not appear to have been a publishing Society, and it probably did its work in a political manner.

At all events I cannot find that it held shows or that papers were read before it.

The "Australian Society of 1832" *(sic)* was looked upon by Professor Smith (p. 3 of his Address) as an "attempted revival" (of the 1821 Society), but I see no evidence to support that view.

5. **The Australian Floral and Horticultural Society,** (sometimes known as **Sydney Horticultural Society**), (1836 –1848).

"The Australian Floral and Horticultural Society" next came into existence. It was instituted in 1836, according to the Pocket Almanac for 1842. Its office bearers are given in the "New South Wales Pocket Almanac (Tegg's) for 1840. In the issue of 1841 it is referred to as the "Sydney Floral Society," evidently through carelessness, and in the issue of 1842 correctly. The "New South Wales and Sydney Directory" for 1843 mentions it.

A copy of the Fourth (Annual) Report, for 1841-2, is in the Mitchell Library.

If not a legal successor of the "Agricultural and Horticultural Society of New South Wales" (which temporarily, at least, suspended operations in 1836), it afforded an outlet for horticultural activities in that year.

This is the first purely horticultural Society, and its list of office-bearers contains well-known horticultural names. Perhaps I may be excused if I print the first list of office-bearers (for 1840) known to me:—

Patron: His Excellency Sir George Gipps, Governor of New South Wales.

President: Mr. Joseph Kenyon.

Vice-President: Mr. W. Oliver.

Treasurer: Mr. J. Rickards.

Secretary: Mr. Robert Kibble.

Auditors: Mr. R. Driver; Mr. R. Broad; Mr. John McCarty.
Committee of Management: Messrs. Sippe, McCulloch, Webb, J. Edrop, W. Brown, McLaughlin, T. W. Smart, J. Hipkiss, T.S. Mort, Anderson, Henderson, J. Kay, F. Kenyon, Baptist, J. Bellamy and McKnight, etc.

I have a note, without reference, "First Show of Floral and Horticultural Society, held September 19th, 1838."

"The Committee meets on the first Thursday in every month, at Mr. Richard Driver's Tavern, corner of King and Castlereagh Streets, for the dispatch of business.

Members are admitted by ballot, on an annual subscription of £1, which admits a member and his family to every show during the year, and to be competitors at the exhibitions." (New South Wales Pocket Almanac for 1842).

There is no mention of the Society in the issues for 1843 and 1844, but the 1843 issue of the New South Wales and Sydney Directory gives a note "Australian Floral Society, corner of Castlereagh and King Streets. Secretary, Mr. R. Hipkiss."

The list of office-bearers re-appears in the "Australian Almanac" for 1848. I may say that I have not been able to see Almanacs for 1845-7 and 1849.

References to this Society are contained in a leading article in the "Sydney Morning Herald" of 27th June, 1848, worded in a kindly yet disparaging manner. It refers to the fact that it had not the patronage of "influential individuals" and that its exhibitions were held in the "Market shed."

See also the reference to the management (p. 235) in Scott's "New South Wales Sporting Magazine" of November 1848, where its name is quoted as "The Sydney Horticultural Society."

This Society was chiefly supported by professional gardeners in contradistinction to amateurs.

6. The Australasian Botanic and Horticultural Society, (20th June, 1848 – 8th December, 1856).

On 8th December, 1856, it amalgamated with the "Horticultural Improvement Society of New South Wales" to form the "Australian Horticultural and Agricultural Society."

As extracts from the rules were published in the advertisement of 20th June, 1848 (to be presently quoted), it is evident that a number of botanists and horticulturists had privately founded the Society and decided on rules and a course of action. When the list of office-bearers and the rules were published in the advertisement, and all that were needed were further members, it is obvious that the Society was in existence, and I quote 20th June, 1848, for its birthday, as the nearest specific date available. Scott's Magazine, quoted below, speaks of the "Provisional Committee" as having been formed "early in the present year" (1848).

An advertisement on the first page of the "Sydney Morning Herald of 20th June, 1848, includes the following words:

"The Australian Botanic and Horticultural Society."

President: His Excellency Sir Charles Augustus Fitzroy.

Vice-Presidents: Sir Alfred Stephen; Major General Wynyard; Hon. E. Deas-Thomson; Alexander McLeay, Esq.; Charles Nicholson, Esq., M.D.

Committee: Thomas Aspinwall; George Bennett; J. C. Bidwell; H. H. Browne; H. B. Bradley; Rev. W. B. Clarke; J. F. Josephson; William Macarthur; William McLeay; George McLeay; Charles Moore; Thomas S. Mort; H. Watson Parker; B. C. Rodd; A. B. Spark; Eustace Smith; T. W. Smart; Rev. W. H. Walsh; Rev. G. E. Turner; R. J. Want; Thomas Woolley.

H. B. Bradley (Solicitor, then of Elizabeth Street), *Hon. Secretary.* (The father of Mr. H. H. B. Bradley, who has been

Honorary Secretary of the Horticultural Society of New South Wales for so many years, and who is now its President.—J.H.M.)

Hon. Treasurer: T. W. Smart.

"Extracts from the Rules of the Society.

"That the object of the Society be the promotion of Botanical and Horticultural Science, and the encouragement of the manufactures and productions of the Colony.

"That the exhibition be held (under the permission of His Excellency the Governor) in the Botanic Gardens.

"That flowers, fruits, vegetables, wines and articles of commerce of colonial production shall be considered eligible for exhibition."

The subscription was one guinea per annum, and meetings were to be held monthly. The above extracts, and other copious particulars, form the advertisement.

The advertisement was repeated in the "Herald" of the following day (June 21st) with the following addition:—

"That with a view to the gradual formation of a library, a portion of the funds of the Society be expended in the purchase of books and periodicals."

The title is here printed "The *Australasian* Botanic and Horticultural Society," instead of "Australian," which was probably a mistake, in the previous advertisement.

In the "Herald" of the 27th June, 1848 (Tuesday) is a leading article headed "The Australasian Botanic and Horticultural Society." It contains the following passage:

"Hitherto the only undertaking of the kind was that which, for some years past, has, at the instigation and labour of a few private individuals, produced an exhibition of flowers, etc., highly creditable to all concerned, but which, from lack of means to extend its usefulness, has not appeared altogether satisfactory to the public, simply because it lacked that which, as long as man inhabits the earth, will always be found useful, the direct patronage and assistance of those who have it in their power to do that which men in the ordinary ranks of life, however talented or however well disposed, cannot do."

It refers to the endeavours of . . . "the old floral Committee to gratify the people and encourage the growth of colonial produce." Also to "an improvement on the old system in the place of meeting, no longer confined to the eternal gyration of the market shed, up one side and down the other" . . . . (This, of course, refers to the proposed holding of the Shows in the Botanic Gardens, whereas, previously they were held in the Old Markets). The company who attend the exhibitions will have the enjoyment of the beautiful scenery of the Botanic Gardens, than which no spot in the British Dominions has more claim to praise or better deserves admiration."

I am much obliged to Mr. Hugh Wright, Librarian of the Mitchell Library, for his kindness in helping me to hunt up the newspaper references.

In the minutes of the Committee of Management of the Botanic Gardens we find (and I am indebted to Mr. Robert Etheridge, Curator of the Australian Museum, for the reference), that on 12th August, 1848, the Society applied to hold its monthly meetings in the 'Committee Room of the Museum.' Approved, when room is completed.

On 21st September of the same year it was decided to give permission to the Society to hold meetings in the Botanic Gardens.

In Scott's "New South Wales Sporting Magazine," No. 2, Vol. I, November 1848, will be found a critical and interesting account of the first exhibition of the Australian (should be Australasian, as already explained) Botanic and

Horticultural Society, held 11th October, 1848, in the "lower Government Garden."

"The promoters of the Society had long seen that there was great room for improvement in the manner of conducting the affairs of the old Sydney Horticultural Society,[1] and had endeavoured to procure the adoption of certain reforms, which they considered necessary, and which the committee of the old Society declined to adopt. This being the case, a Provisional Committee was formed early in the present year, whose labours resulted in the establishment of the present Society. . . ."

The show was held in a tent, and Governor Sir Charles Fitzroy opened it, arriving in the Gardens "by the private gate." He was received "at the pond under the bamboos." (The clump of bamboos is in its old place, though the pond has been somewhat remodelled.—J.H.M.).

The account, of which this is an abbreviation, is interesting because of the references to gentlemen and their gardens, and to some of the plants exhibited on the occasion.

I have before me the "Second Annual Report of the Australasian Botanic and Horticultural Society, with a list of officers, names of members, abstract of expenditure, awards of prizes, list of new plants introduced (during the year 1849-50), and a report of a sub-committee appointed in connection with the objects of the industrial exhibition, and directions for the formation of orchards. Printed by F. M. Stokes, 337 George Street South, MDCCCL." 4to pp. 30.

There is no mention of the Society in the Australian Almanac for 1850.

In Ford's Sydney Commercial Directory for 1851, is a list of office-bearers, which is the same as the original list with the exception that the two McLeay's drop out, and

[1] The Australian Floral and Horticultural Society.

the Secretary is given as (W. G.) Pennington. The office is now 416 George Street.

"The scene is still more lively on annual or half-yearly exhibitions of the Australian Botanic and Horticultural Society, when many thousands assemble to inspect the fruits, flowers, and vegetables, and other colonial products, arranged in marquees, and to listen to the music of the regimental and city bands, sitting or strolling under the shadow of trees of many climes, and looking forth upon the calm grassy cove dotted with boats, the opposite edge of the Inner Domain, crowned with the vice-regal palace, the frigates riding at anchor off the point, the less trim merchantmen in 'the stream' waiting for a wind, and the woody hills of the north shore in the back-ground."—("Our Antipodes," by G. C. Mundy, Vol. I, p. 71.

There is a list of office-bearers in the "Australian Almanac" for 1852, an abbreviated one in that for 1853 (Moore's), and an extended one in the "Australian Almanac" (Ford's) for the same year, from which we learn that the office was now in Wynyard Terrace.

The 1854 Almanac tells us:—"The chief object of this Society is the promotion of botanical and horticultural science. The Society is managed by a President, five vice-presidents, a committee of twelve members, a secretary and a treasurer. A subscription of one guinea constitutes membership with the following privileges:—two tickets for each exhibition and free admittance for the member and the holders of his tickets at 2 o'clock to the exhibition, with a right for the former to introduce ladies on payment of one shilling each and children at sixpence each. Members are entitled to vote at the general meetings, and are privileged to introduce their friends at the monthly meetings. A portion of the funds of the Society is expended annually in the purchase of books and periodicals for the formation of a library to which members have access. A donation of books to the Society to the value of £10 on botanical or horticultural science constitutes the donor a life member if approved by the committee."

In the "Illustrated Sydney News" for 8th October, 1853, is an account of the Society's spring show, held in the Botanic Gardens, on 28th September. There is also an illustration, showing the marquees near the waters of Farm Cove (the sea-wall had not then been erected), round a large pond.

In the issue of the same journal of 31st December, there is an account of the summer show held in the same place on the 27th December. There is also a view of the marquees and surroundings.

A list of office-bearers is again published in the "Australian Almanac" for 1854, with Mr. W. H. Catlett, Secretary, office Botanic Gardens. [Mr. Catlett was afterwards Assistant Secretary of the Royal Society of New South Wales, and of other institutions].

In the "Hort. Mag." VII, 150, is an account of the show held 30th December, 1854.

There is a list of office-bearers in the "Australian Almanac" for 1855.

In the "Illustrated Sydney News" of 26th May, 1855, p. 269, is a view of the "Bazaar" in the Botanic Gardens, but the illustration is the same as that in the issue of 8th October, 1853.

In the "Hort. Mag." VII, 151, is an account of the show of the 5th October, 1855.

In the "Australian Almanac" for 1856, is a list of office-bearers. Mr. Catlett is still secretary, but the office was removed to 230 Liverpool Street.

In October 1856 the Society made overtures ("Syd. Mag. Art.," I, p. 2)[1] to the "Horticultural Improvement Society of N.S.W." with the view to amalgamation. This was carried out on the 8th December following.

The account in the "Syd. Mag." contains the following statements:—"The society . . . seemed in a fair way of flourishing, and no doubt would have done so, but for a short-sighted policy in its early career, which excluded practical men from any participation in its government, and in a short time it dwindled down to nothing but an exhibition society". . .

This is a prejudiced statement, and refers to the old antagonism between the professional element and amateurs, which gave a great deal of trouble in subsequent horticultural societies. The ideals of both are, of course, perfectly capable of adjustment in the same Society.

7. The Horticultural Improvement Society of New South Wales, (15th January, 1855[2]—8th December, 1856).

[Although it was stated that "the proceedings of the Society should date from 1st July, 1856," that was a mere starting point from which subscriptions should run, for the rules had been adopted and a Council elected on the 15th January, and a business meeting held on the 15th May.]

On 8th December, 1856, it amalgamated with the "Australasian Botanic and Horticultural Society" to form the "Australian Horticultural and Agricultural Society."

In the "Sydney Magazine of Science and Art," Vol. I, p. 2, (15th June, 1857), we read:—"The Australasian Botanic and Horticultural Society was established in July (should be 20th June.—J.H.M.) 1848.

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[1] Referred to as "Australian" in the head-line, and "Australasian" in the text. The confusion was a common one.

[2] This is a conservative date; perhaps November 1854, would be better.

"At a meeting of practical men and those interested in the welfare of the Colony and Agriculture and Horticulture, held in November 1854, it was decided to establish a Society —The Horticultural Improvement Society."

In the "Australian Almanac" for 1855, we find:—

"The Horticultural Improvement Society of New South Wales. Secretary *pro tem.* — Humphries. Treasurer *pro tem.* D. Shepherd, Darling Nursery.

The objects of this Society, now in the course of formation, are the advancement of Horticulture throughout the Colonies."

In November 1854 the Society had already been 'mooted,' and at the adjourned meeting, on 15th January, 1855, the Rules were adopted and a Council of 21 members elected, together with—

President: His Excellency Sir William Denison.

Vice-President: Hon. Sir Charles Nicholson, Speaker of the Legislative Council; Sir Thomas Livingstone Mitchell, Surveyor General.

In consequence of some delay in organisation, etc., it was determined that the actual commencement of the proceedings of the Society should date from 1st July, 1855, and subscriptions calculated from that date.

In the "Sydney Herald" of 20th May, 1855, we read:—

"The first meeting of the Horticultural Improvement Society took place on Tuesday evening (15th May), in the theatre of the School of Arts. Sir Charles Nicholson occupied the chair, supported on his right by Colonel Sir T. L. Mitchell, on the left by Lord Audley and Mr. Nichols, M.L.C. Among the audience were a number of ladies, several gentlemen eminent in botanic science, and many others of note and influence. After the chairman had addressed the meeting, Mr. T. W. Shepherd gave a long and interesting address."

Evidently this was considered a preliminary meeting, for in the issue of 8th July, 1855, we read:—

"Yesterday evening the first meeting of this society was held at the Royal Hotel, when a large company, comprising many ladies, were present. The chair was taken by Mr. Reynolds. The Secretary read a paper sent by Mr. Muspratt, F.C.S.L., of Irrawang, on the uses of chemistry as applied to the fertilisation of the soil. Mr. Jessup read a paper on the cultivation of orchids. Mr. Shepherd read a paper on the hybridisation of plants."

From the following ("Sydney Herald" of 21st October, 1855), it would appear that the shows were small agricultural exhibitions:—"The first public exhibition of the Horticultural Improvement Society of New South Wales took place on Thursday, in the Botanic Gardens. The exhibition was a most successful one; there could not have been less than 6,000 persons present. Prizes were taken for shrubs, flowers and vegetables by Messrs. Baptist, T. W. Shepherd, Guilfoyle, Saxby, M'Gill, F. C. M'Kean, Guildenay; fruit, N. Hill and Mrs. Preston; colonial wine, Mr. Muspratt of Irrawang; preserves, Mr. Walker; photographs, Mr. Freeman; leather and saddlery, Hall and Alderson; agricultural implements, Messrs. Lane and Younger. The amount taken at the gates was about £130." There is a full account of this show, which took place on the 18th October, in "Hort. Mag." VII, 140.

The "Australian Almanac" for 1856 gives a list of office-bearers. The Honorary Secretary was William Deane, and the temporary office, 20 Hunter Street.

"The objects of this Society are to promote the development of the resources of Australia by diffusing as widely as possible, scientific and practical information on the study and pursuit of botany, including horticulture and agriculture, by holding monthly meetings at which lectures are delivered, and essays and other communications read and discussed, by awarding prizes for products of superior merit, and for treatises on subjects of importance in connexion with its objects, and by establishing an experimental garden. Members are enrolled on payment of an entrance fee of £1, and a yearly subscription of like amount, and must be proposed by a member and balloted for. Subscribers of £1 per annum (without proposal or ballot) have equal privileges with members, except in not being eligible for office and having no vote. Members and subscribers have the privilege of introducing two friends to all monthly meetings and exhibitions.

"Monthly meetings are held for the present in the Royal Hotel, on the first Tuesday of every month in summer, at half past seven o'clock in the evening, and in winter at seven o'clock."

"A list of the subjects of the papers which have been read" is given at Vol. I, p. 2, "Sydney Mag. Science and Art," and a "list of papers read and published" at p. 6 of the first annual report at the end of the same volume. (There were thirty-four other papers described in this report). The list shows a valuable amount of work accomplished. The rules and by-laws follow at p. 3.

The "Herald" of the 6th February, 1856, reports that:—

"At the Horticultural Improvement Society's monthly meeting held last evening at the Royal Hotel, a number of splendid dahlias, in bloom, all seedlings of the last and present year, were exhibited by Mr. Bell, of North Shore; and some beautiful phloxes, hydrangeas, etc., by Mr. (M.) Guilfoyle. A paper was read by Mr. Graham on the advantage of introducing the cultivation of the Jerusalem artichoke into this colony, both as a food for man and beast. Mr. Guilfoyle thought it was one of those plants which might be successfully employed in covering the sand drifts round the city with herbage. Some cobs of corn, known as Cobbett's corn, grown and ripened in sixty-five days, from seed presented to the Society by Lieutenant Sadlier, were exhibited, and strongly recommended by Mr. Lindsay Shepherd."

1st July, 1856 was (officially) the commencement of the second year of the Society's existence, and 8th December 1856 the date of its dissolution. Its first and last annual report was published up to the previously mentioned date.

There were two public exhibitions, namely, a Camellia Show on 10th and 11th July, 1856, in the concert room of the Royal Hotel (14th July according to "Hort. Mag." VII, 151). The second exhibition or show was held on the 26th September, 1856. For an account of it see "Hort. Mag." VII, 151. From this we learn that bad weather prevailed, and that future shows were postponed *sine die.*

The circumstances of the amalgamation with the Australasian Botanic and Horticultural Society to form the Australian Horticultural and Agricultural Society are detailed at p. 8 of the report. The Horticultural Improvement Society brought £37 17s. 3d. into the funds of the new Society.

The following papers were read before the "Horticultural Improvement Society," but the dates of reading do not appear to have been preserved.

1. In the "Australian Almanac" for 1857, pp. 60 – 65, we have "The pastoral resources of Australia," being remarks extracted from papers read before the members of the Horticultural Improvement Society of New South Wales (evidently an abstract.—J.H.M.), by Mr. T. W. Shepherd, entitled "Native plants and the pastoral, agricultural and horticultural resources of Australia."

2. "Some remarks on the sandal-wood of the South Sea Islands" by John MacGillivray. "Syd. Mag. Sci. Art," II, 196.

3. "Floriculture for Ladies," by Lindsay C. Shepherd, *ib.*, p. 197.

8. The Australian Horticultural and Agricultural Society. (8th December, 1856 –   ).

Formed 8th December, 1856[1] by an amalgamation of the "Australasian Botanic and Horticultural Society" and of the "Horticultural Improvement Society of New South Wales."

It is not necessary for me, on the present occasion, to trace its history past 1860; I trust a historian of Horticultural Societies will bring the information up to date.

In October 1856 the Australasian Botanic and Horticultural Society made overtures to the Horticultural Improvement Society of New South Wales with the view to amalgamation. This was agreed to at a meeting held on the 8th December, 1856, the title of the new association decided upon being "The Australian Horticultural and Agricultural Society."

This body was the precursor both of the Horticultural Society of New South Wales, and of the Agricultural Society of New South Wales.

"The Sydney Magazine of Science and Art," edited by Mr. Joseph Dyer (2 vols., 1858-9), states, on the title page of each volume, "Containing, by authority, the Proceedings of the 'Australian Horticultural and Agricultural Society' and the 'Philosophical Society of New South Wales.' "

The two Societies settled down to work comfortably, one concerning itself with agriculture and horticulture, and the

[1] The "Philosophical Society of New South Wales" was re-constituted seventeen months earlier, but it is convenient to follow the present order.

other devoting itself to other questions in pure and applied science.

The papers in the Magazine are not published in order of reading before either Society, and require some finding. This is probably the fault of wicked authors. Following is an abstract of the contents of the two volumes of the Magazine so far as the "Australian Horticultural and Agricultural Society" is concerned, and it will be seen that there is no sharp line of demarcation between the papers read before this and the Philosophical Society.

At Vol. I, p. 3, we have the Resolutions, Rules and By-laws, in connection with the establishment of the Society.

On 20th January, 1857, the Society held its opening meeting with an address by the President (Governor Sir William Denison). It is printed at pp. 4—7. At Vol. II, p. 104, but under date 4th February, is another paper "On the Agricultural Statistics of New South Wales."

At p. 8 is reported the Fifth Monthly Meeting, held 2nd *(sic)* June 1857. A paper on "Native Plants, and the Pastoral, Agricultural and Horticultural Resources of Australia," (being No. 5 of a series on the same subject) was read by Mr. (T.) W. Shepherd at this meeting, but was not printed. (See an abstract in the "Australian Almanac" for 1857, pp. 60—65. Mr. J. E. Blake read a paper on Australian Wines at the same meeting. This was printed at p. 13 of the Magazine. At p. 18 is given a short paper on the "Chinese Yam or *Dioscorea batatas*" by Mr. John Gelding, read on 1st (*sic*) June, 1857. At p. 23, a paper also read at the June meeting, "Observations on the extraction of the stumps of trees" by Joseph Dyer, will be found.

Bearing the date 3rd July, 1857, there is a paper "On the means best adapted in the present circumstances of the colony for imparting agricultural information," by

James W. Waugh, at Vol. II, p. 105, but there is no indication as to whether it was read before the Society.

At the meeting of 7th July, 1857, we have papers :—

1. "Explanation . . . on native plants and the Pastoral, Agricultural and Horticultural Resources of Australia," by T. W. Shepherd.

2. "On the advantages of changing seeds," by Robert Meston. (Both Vol. I, p. 26).

The First Report of the Australian Horticultural and Agricultural Society (Supplement to Vol. I) is valuable.

The First Annual General Meeting was held in the Hall of the Sydney Mechanics School of Arts, on 22nd July, 1857, His Excellency Sir William Denison in the chair.

The Rules and By-laws are given, an account of the Horticultural Improvement Society of New South Wales, of the Australasian Botanic and Horticultural Society, Lists of Members, etc.

Of the meeting of 4th August, 1857, we have the Transactions at p. 48, also :—

1. Letter from Mr. E. W. Rudder to the President, p. 50, *re Cynodon dactylon* (Doob Grass of the Hindoos). He stated that the grass was introduced into Sydney from India in the year 1834. He also states that *Poa annua*, "Suffolk Grass," was introduced accidentally by him in 1843. (Both grasses were collected in Sydney by Robert Brown, 1802-4. See "Journ. Bot., XLIV, 234.—J.H.M.)

2. "Native Plants and the Pastoral, Agricultural and Horticultural Resources of Australia," No. 1, by T. W. Shepherd. See p. 51 (at p. 49 of the Minutes a paper of similar title is called "No. 6 of a series on this subject.")

3. "Analysis of the Soil, deposited by the River Hunter during the late floods, June 1857," by Theodore West, p. 50.

Meeting of 1st September, 1857. Various letters are given at p. 74, and at p. 75 an illustrated note on "A brief description of a singular insect production found in some parts of Australia" by Theodore West. (Lerp).

In the "Hort. Mag." VII, 151, it is stated that the "Australian Improvement Society" held its Spring Show on 1st and 2nd October, 1857. This is a loose quotation of the title of the "Australian Horticultural and Agricultural Society." A brief account of this show in the Botanic Gardens ("Syd. Mag. Sci. and Art." I, 98), is in rather a minor key. The prize list is given at p. 113.

At p. 110 will be found a paper entitled "Native plants, and the Pastoral, Agricultural and Horticultural Resources of Australia," No. 2 (? the No. 7 of p. 107), by T. W. Shepherd.

Meeting of 3rd November, 1857. See the Transactions at p. 121, also a paper "On the destruction of Colonial Weeds" by R. Meston, at p. 122.

There is also a paper by F. Creswick, entitled "Application of the Italian Wheat Straw for Manufacture of Straw Hats," at p. 124.

Meeting of 1st December, 1857. The Transactions are reported at p. 146, also a paper, "Agriculture and the necessity for a better system of cultivation," by Lewis Markham (a letter to the Secretary to the Governor General), at p. 448.

Meeting of 5th January, 1858. Transactions at p. 176. Papers read:—

1. "On Agricultural Associations and Improvement Societies" by Robert Meston, at p. 179.

2. "On the improvement of pastoral lands," by Henry Badgery, p. 181.

Meeting of 2nd February, 1858. 1. Transactions at p. 184. Reports *re* the proposed "Model Farm and Garden" in the Government Domain at Parramatta will be found at pages 184 and 218. At p. 244 it was stated that the Government had "set aside" 200 acres of the Domain for the "Horticultural Society's Model Farm."

2. "Native Plants" No. 3, T. W. Shepherd, p. 185. No. 4 of the same series will be found at p. 186. (The sub-title is "and the pastoral, agricultural and horticultural resources of Australia.")

3. "The Potato; its culture, disease and preventive," by Lewis Markham, p. 189.

4. "Naming or numbering plants." (The making of tallies), by P. L. C. Shepherd, p. 187.

The Transactions of the Council Meeting of 24th February 1858 are reported at p. 218. There is an account, including the prize-list of the Autumn Exhibition of the Society in the Botanic Gardens on (Thursday and Friday) 25th and 26th February. I have an official letter from H. R. Webb, Assistant Secretary, at the offices of the Society, 63 Hunter Street, asking permission to hold this exhibition.

In "Hort. Mag." VII, 151, in an historical sketch, this Show is again loosely referred to as of the "Australian Improvement Society," and the statement is made that this is the last Show prior to the establishment of the "Horticultural Society of Sydney." The paper was written in 1870 by the late Mr. Luke Wooff, and contains other useful historical notes pertaining to horticulture in Sydney.

Resuming our reference to the "Sydney Magazine of Science and Art," we have:—

2nd March, 1858. Transactions at p. 217. 1. Paper on *Clianthus Dampieri*, by P. L. C. Shepherd, p. 229. 2. "On bone manure and superphosphate of lime," by Henry Waymouth, p. 230.

6th April, 1858. Transactions at p. 224. 1. Paper entitled "The pastoral interest (all right!) and general exhibition of live stock," by Robert Meston, p. 226. 2. "Native Plants, etc., No. 5," by T. W. Shepherd, p. 227.

29th March, 1858. Council Meeting, Transactions, p. 226.

4th May, 1858. Transactions, p. 245. 1. "Artesian Wells," Lewis Markham, p. 248 (in the form of a letter). 2. Mr. T. W. Shepherd's reply to Mr. Meston's paper, published at p. 226, at p. 250. 3. "Native plants, etc., No. 6," by T. W. Shepherd, at p. 251.

27th April, 1858. Transactions, p. 246. This is the last reference in Vol. I.

Vol. II (of the Magazine).

18th May, 1858. Transactions of a Special Council Meeting, p. 2. 25th May, 1858. Transactions, Council Meeting, p. 3.

1st June, 1858. Transactions, p. 3. 1. "Observations on the cultivation of the cotton plant in Australia," by Edwin Hickey, p. 5. 2. "On the application of bones as a fertilizer of the ground" by R. Meston, p. 9.

29th June, 1858. Council Meeting, Transactions p. 23. "The further consideration of the amalgamation of this Society with the Cumberland Agricultural Society, lapsed on account of the absence of the mover," p. 23.

3rd July, 1858. Paper on "Hybridisation of Plants," by T. W. Shepherd, p. 142.

6th July, 1858 (Council Meeting). Transactions, p. 23. "Injurious plants" by F. Creswick, p. 23.

20th July, 1858. Under this date will be found the Second Annual Report of the Society at p. 44, and also at end of volume. Discusses establishment of model farm. Proposed site is a portion of the Government Domain at Parramatta, consisting of about 250 acres. A list of papers is given. Present Society has about 600 members. "On the Aphis insect affecting the Cabbage tribe," by F. Creswick, at p. 48.

27th July, 1858. Council, Transactions, p. 43. Views of the Committee on the proposed amalgamation of this Society with the Cumberland Agricultural Society, the subject asked for, p. 44.

3rd August, 1858. Transactions, p. 42. Paper "On the cultivation of the *Sorghum saccharatum*," by J. W. Gunst, M.D., p. 61 (date not stated). "A treatise on sheep breeding and wool-growing in the Australian Colonies," by T. S., p. 70 (date not stated).

7th September, 1858. Transactions, p. 81. Paper "On the cultivation of the *Sorghum saccharatum*" by W. Redman, p. 82.

The "Herald" of 3rd October 1858, says that "For some reason the Government has refused any longer to permit the exhibitions of the Agricultural and Horticultural Society to be held in the Botanic Gardens."

5th October, 1853. Transactions, p. 104. The Assistant Secretary (H. R. Webb) wrote from 63 Hunter Street asking permission of the Colonial Secretary to hold the Society's Show in the Botanic Gardens on Wednesday and Thursday, 13th and 14th October, 1858, but I do not know whether this took place.

2nd November, 1858. Transactions, p. 112. 1. "Notes on the supply of animal food for the inhabitants of New South Wales and Victoria," by Sir William Denison, p. 113. 2. "Brief notices of several insects detrimental to animal and vegetable substances," by R. Meston, p. 115.

7th December, 1858. Transactions, p. 141. 1. "The Candle-nut" by Dr. J. W. Gunst, p. 141. 2. "Orchids," by C. Jessup (formerly gardener to W. S. Macleay) p. 143.

4th January, 1859. Transactions, p. 150. "An account of the Llama and Alpaca, with notes of a journey from the Bolivian and Argentine province into Chili with a flock of these animals," by Charles Ledger, pp. 151, 182, 190, 221. "On granaries and corn-storing," by R. Meston, p. 156.

1st February, 1859. Transactions, pp. 181. At p. 189 is an article on "The Horticultural Society," complaining of the loss of interest in its proceedings. This seems to presage a crisis.

1st March, 1859. The 26th monthly meeting lapsed, p. 190. The Society is evidently passing through an anxious time. Paper on "Jerusalem Artichoke," by Joseph Graham, p. 197. (The article is dated 5th February, 1856, but the 6 may be a reversed 9).

5th April, 1859. Transactions, p. 215. 1. "On the cultivation of rape or colza for seed, as practised in Normandy" by R. J. Want, p. 216. 2. "Result of Stall feeding in Tasmania," by Edwin Meredith. 3. "The cultivation of the Olive," by David Shepherd, pp. 219 and 242.

3rd May, 1859. Transactions, p. 240. "On the manufacture of sugar from the *Sorghum saccharatum* and Zulu Kafir Imphee," by Dr. Gunst, p. 241.

7th June, 1859. Transactions, p. 241. I see no further references to the Society in the Magazine.

The lists of office-bearers will be found in the "Australian Almanac" for 1858, 1859, 1860. The Hon. Secretary was W. Deane and the Assistant Secretary H. R. Webb.

The 1860 Australian Almanac also contained the following:—"The objects of the Society are the advancement of Agriculture and Horticulture, and the promotion of the productive capabilities of the soil. In furtherance of which, meetings are held on the first Tuesday in each month, at which papers are read and discussed on subjects coming within the objects of the Society.

"Periodical exhibitions are held at which prizes are awarded for superiority in flowers, fruits, vegetables, articles of commerce, agricultural produce and machinery. The library, consisting of works on botany, floriculture, horticulture and agriculture, together with magazines and transactions of kindred societies in other parts of the world, may be consulted by members any day during office hours.

"Terms of membership—one guinea subscription and one guinea entrance, entitling the member to all the privileges of the Society."

Mr. H. R. Webb, Assistant Secretary, wrote to the Chief Secretary from a new address, 9 Hunter Street, asking permission to hold a show in the Botanic Gardens "for two days within three weeks of 2nd March, 1860."

At a Council Meeting of the Philosophical Society, held on the 12th October, 1860, Mr. R. S. Drury of Auckland, New Zealand, having offered the Society a large collection of Tasmanian seeds, it was decided to refer the offer to the Australian Horticultural and Agricultural Society.

I trust that some one will follow up the histories of the Horticultural Societies; the minute books should be in existence.

Mr. Luke Wooff's recollection (quoted above, p. 248) that the show of February 1858 was the last prior to the establishment of "The Horticultural Society of Sydney," is evidently an error.

9. **The Australian Philosophical Society**, (19th January, 1850 – 30th July, 1855).[1]

"The Australian Philosophical Society" afterwards called "The Australian Society." Subsequently the latter name was amplified in "Australian Society for the Encour-

[1] Taken out of chronological sequence, but it will be seen that it is convenient to do so. It really is 7th in order.

agement of Arts, Science, Commerce and Agriculture," these alterations being in use in the same year.

In the "Sydney Morning Herald" of Monday, 21st January, 1850, there is an announcement of "Saturday's Meeting, Dr. Nicholson in the Chair, at the Royal Hotel," when it was resolved to form an "Australian Philosophical Society."

It is added that it is . . . . "upwards of a quarter of a century since there was a Society of this description in Sydney, which assembled under the auspices of Sir Thomas Brisbane" etc. (This, of course, refers to the 1821 Society).

In the "Herald" of Thursday, 24th January, 1850, is a leading article headed "The Philosophical Society."

It contains the following passages:—". . . A number of gentlemen, with Dr. Nicholson for their Chairman, met on Saturday last at the Royal Hotel, for the purpose of establishing a Philosophical Society in this Colony." It was held in the evening. The article warmly supports the idea of forming such a Society.

Its foundation date is therefore the 19th January.

In the "Herald" of the 14th February, 1850, it is stated that "as there were no reporters present, we have no report of the proceedings, but at the request of several of the members we give the speech made by Mr. (James) Norton, explanatory of the objects of the Society."

The statement occupies a column. It is partly occupied with a gloomy retrospect of the failure of past Governments and of individuals. He pleads for encouragement of manufactures, woollen, wine, silk, perhaps sugar and cotton, certainly the olive. "The resources of the colony are yet unknown," and he hopes for a stimulus to knowledge. The whole article is in general terms.

In an advertisement in the "Herald" of Monday, 17th June, 1850, The Society has a new title, viz. "The Australian Society," and there is a paragraph stating that the first soiree will be held at the Royal Hotel this evening and the Governor, the patron of the Society, will be present.

This "soiree" is reported to the extent of a column and three quarters in the "Herald" of Wednesday, 19th June, 1850. The report is headed "The Australian Society."

The President, Mr. E. Deas-Thomson, was absent, and Dr. Nicholson, the Vice President, took the chair, while His Excellency the Governor (Sir Charles Fitzroy) was present.

Dr. Douglass, one of the Secretaries, explained the arrangements for the transaction of the business of the Society, and then read a paper by Sir Thomas Mitchell "On the external structure and undeveloped resources of the County of Cumberland" which occupied almost a column of small type.

The Rev. G. E. Turner exhibited an insect which had been found very destructive to the vine (evidently the vine caterpillar).

A variety of dyed wools was shown by a Mr. Gee, and a discussion took place on dyes generally, including the blue-black dye from the bark of the New Zealand tree Eno (at a subsequent meeting referred to as Hino. The modern spelling is Hinau, *Elœocarpus dentatus* Vahl.—J.H.M.)

Dr. Douglass read a memorandum from the sub-committee on fish, of which Mr. Want was stated to be the most active member. 95 specimens had been procured in a few months, and were exhibited. There were several new varieties "of which descriptions will be published in the Society's Transactions." (If it were intended to publish a separate volume, the idea was never carried out.—J.H.M.)

Mr. Cape asked the Surveyor General a question in regard to the destruction of the Cedar in many places. Mr. Moore "of the Government Gardens," replied that it was practically extinct in many parts of central coastal New South Wales. Mr. Mort exhibited the wool of the Alpaca goat. Dr. Nicholson drew attention to a specimen of a fossil bone of the New Zealand Moa.

On Friday the 21st June, 1850, the "Herald" had a leader entitled "The Australian Society," commending its objects. It says "The establishment of the Australian Society is but the commencement of scientific enquiries in Australia." It gives a resumé of the meeting of the 17th instant, and reminds its readers that at the next meeting will be read a paper on the commercial importance of the fish of Australia.

In the "Herald" of 6th July, 1850, is an advertisement "Australian Society. The next General Meeting will take place on the first Monday in September at the Royal Hotel at 8 p.m. Henry G. Douglass, M.D., and William A. Miles, Hon. Secs."

In another advertisement in the "Herald" of Monday, 8th July, 1850, the Hon. Secs. ask that all persons desirous of sending papers for consideration of the Committee, to be submitted to the Society, will have the goodness to send them before the 3rd Monday in August, in order that a suitable selection may be made for the September meeting.

In the "Herald" of Thursday, August 22nd, 1850, it is stated that the meeting will take place on September 2nd at the Royal Hotel, and all papers must be in the hands of the Hon. Secs. before the 26th.

In the "Herald" of 30th August, 1850, the Society is advertised as the "Australian Society for the Encouragement of Arts, Science, Commerce and Agriculture." Other advertisements subsequently appeared.

The meeting of 2nd September, 1850, has a little over five columns devoted to it in the "Herald" of 5th September 1850. It was the second meeting of members, Dr. Nicholson presided, and the Governor and about forty other members were present.

Sir Thomas Mitchell read a paper on the "Natural Fruits and Grasses of the Colony," giving an account of some of the vegetation he had found on his explorations. An abstract of nearly a column of small type was given.

There were discussions on fish, on insects injurious to the vine, (Rev. G. E. Turner's exhibit of a previous, the first meeting).

Mr. C. Lowe exhibited two shells of the Argonauta or Paper Nautilus, and read a paper thereon. It is reported to the extent of a third of a column of small type.

Mr. Mort read a paper on the Alpaca or Peruvian Sheep, which is reported to the extent of a column of small type.

Dr. Douglass read a paper for Mr. Gee on dyes.

A discussion took place, in which Mr. Edwin Hickey and Rev. W. B. Clarke joined, controverting a statement by Mr. Charles Moore at the previous meeting that the Red Cedar had become extinct in certain coastal districts.

Mr. Clarke discoursed on the Moa, and his remarks are published to the extent of over a column. An interesting discussion took place in which he and Sir Thomas Mitchell joined.

It seems to have been a particularly enthusiastic meeting. The report concludes:—"There were several other papers to read (particularly one respecting a collection of 700 shells collected in Port Jackson by Mr. Want), but as it was now past eleven o'clock, the meeting was adjourned." (It was advertised to begin at 7·45).

In the "Herald" of 14th September, 1850, an advertisement appears of the Australian Society, etc., stating that at a meeting of the Committee held on Tuesday the 10th instant, the Gold Medal of the Society for the year 1852 is offered, or ten guineas, to that person who shall on the 1st April, 1852, prove to the satisfaction of the Society that he has produced the largest quantity of madder root grown in the Colony. Henry G. Douglass signs the advertisement alone as Hon. Sec. This offer arose out of a statement by Mr. Charles Moore, at the first meeting, that he had received some seeds from London, and recommending the plant for trial.

The Society was in a state of suspended animation when, at an inaugural meeting of the Philosophical Society of New South Wales on 9th May, 1856, His Excellency Sir William Denison stated that at a meeting of the members of the Australian Society, held at the Royal Hotel, 30th July 1855, "It was resolved that the Society be remodelled under the title of the Philosophical Society of New South Wales."

In the Treasurer's statement of accounts of the Philosophical Society for the year ending 30th April, 1857, he records "Taken over from the Australian Society, £88 1s. 6d."

It is evident that a Society which retained its office-bearers,—Dr. Douglass the Honorary Secretary, and Mr. R. A. A. Morehead, the Honorary Treasurer—preserved its funds, and took over a number of its members to a newly constituted Society, could neither have been "extinct" or "dead." As a matter of fact, it lived till 30th July, 1855, when it was absorbed into the Philosophical Society of New South Wales, which was the "Australian Society" remodelled.

Mr. Clarke (*op. cit.*, p. 8) says "It (our Society) then in 1850, after a long interval of silence and inactivity, came out as the "Australian Philosophical Society," till in 1856, still contracting its territorial limits, it became represented by the "Philosophical Society of New South Wales," merging itself in that which now represents it, on the 1st May, 1866."

In considering this passage, one may remember that Mr. Clarke was acquainted with the circumstances of the starting of the 1850 Society, he was one of the original members, and was a man with an established scientific reputation at the time. He was (in 1867) addressing men who belonged to the 1850 Society, and who presumably would have corrected him if he had made a wrong inference. Indeed, the foundation of the Society had only taken place seventeen years previously, not very long to look back upon.

At p. 3, 1881, Professor Smith refers to "the resuscitation in 1850 of the old Society, under the name of the 'Australian Philosophical Society'. . . ." He must have known something about this Society, for he is credited in our record as being a member of our (this can only mean the 1850) Society in 1852. At that date (1881) Messrs. Charles Moore and R. A. A. Morehead traced their membership back to 1850.

He goes on to say "The 1850 Society began under favourable auspices, and with influential leaders; but the gold fever of 1851-2 seems to have sapped its vitality, and for two or three years nothing is heard of it, until in July 1855, it met once more and resolved to make a fresh start, under the name of the Philosophical Society of New South Wales. It seems that twenty-two members passed over from the old Society to the new, and they brought with them £88 (£88 1s. 6d., to be exact.—J.H.M.) to start the funds of the new Association."

In Vol. IX (1875) the year of election was inserted against the names of members for the first time, thus the year 1850 is given before the names of Rev. W. B. Clarke, 1852 before that of Prof. John Smith, 1856 before that of Charles Moore and R. A. A. Morehead. In the list for 1880 this was changed to 1850 in the case of the last two names. Mr. Morehead was, indeed, the Treasurer of the 1850 Society.

10. The Philosophical Society of New South Wales, (30th July, 1855 – 12th December, 1866).

(N.B.—The notes under Nos. 10 and 11 consist of unpublished abstracts from the Minutes of the Society from 1855 to 1875, with annotations).

On the occasion of the first meeting (after its foundation) of the Philosophical Society of New South Wales, held on 9th May, 1856, His Excellency the Governor-General (Sir William Denison), "explained the steps which had been taken in forming it out of the previously existing Australian Society (the 1850 Society). The following minute of that Society was read:—"At a meeting of the members of the Australian Society, held at the Royal Hotel, July 30th 1855, (this is the true birthday of the Society.—J.H.M.) It was resolved that the Society be remodelled under the title of the Philosophical Society of New South Wales." There were other resolutions as to office-bearers.

At the first meeting of the Philosophical Society, it was formally declared that "the Australian Society thereupon merged into the one now inaugurated." In other words, the Philosophical Society was a remodelling of a Society founded in 1850.

The language is quite explicit, and was uttered to people who were contemporary with the events, and members of the Societies concerned. I will proceed to give the minutes at length, for they have historic importance.

[At p. 148, "Proc. Roy. Soc. Tas., 1913, Mr. Piesse quotes from Sir William Denison's "Varieties of Vice-regal life." In a letter to Sir Roderick Murchison, 25th June, 1856, Sir William wrote:—

"I have got my Philosophical Society to work at last . . . : I determined I would not be President of an effete body, so I called the members together, read a paper on Railroads, got them to agree to meet regularly once a month for eight months in the year, and shall now, by the help of occasional papers from myself, and of suggestions to others, manage, I dare say, to generate, first an appetite for writing, and then a taste for observation, in order to have something to write about."]

First Meeting of the Philosophical Society of New South Wales in the Lecture-room of the School of Arts, Friday, 9th May, 1856. His Excellency the Governor General, Sir William Denison, in the Chair.

This being the first meeting of the Philosophical Society, His Excellency explained the steps which had been taken in forming it out of the previously-existing Australian Society (*i.e.*, the 1850 Society.—J.H.M.) The following minute of that Society was read:—

> "At a meeting of the members of the Australian Society, held at the Royal Hotel, July 30th, 1855.
>
> "It was resolved, that the Society be remodelled under the title of the Philosophical Society of New South Wales.
>
> "That His Excellency Sir William Denison, Governor General, be requested to accept the office of President of the said Society.
>
> "That the office-bearers be—Vice-Presidents: The Honorable Sir Charles Nicholson, and the Honorable Edward Deas-Thomson. Treasurer: R. A. A. Morehead, Esq. Secretaries: H. G. Douglass, M.D.,; Captain Ward, R.E.; Professor Smith, M.D. The Council:

Professor Woolley, G. K. Holden, Esq., Professor Pell, John Thompson, Esq., Rev. George Turner, R. J. Want, Esq., together with the office-bearers.

"That a deputation, consisting of Sir Charles Nicholson, Captain Ward, and Dr. Douglass, be appointed to wait on his Excellency to request his acceptance of the Presidency, and to know his pleasure as to the calling the Society together."

His Excellency further explained that a Committee had been appointed to draw up Rules for the guidance of the new Society, that this committee had accordingly prepared a code of fundamental laws, which were afterwards adopted at a general meeting, and the Australian Society thereupon merged into the one now inaugurated. The fundamental laws are as follows:—

PHILOSOPHICAL SOCIETY OF NEW SOUTH WALES.

Constitution.

1. The object of the society is to receive at its stated meetings, original papers on subjects of science, art, literature, and philosophy.

2. The office-bearers to consist of a president, two vice-presidents, a treasurer, and two or more secretaries.

3. The council of management to consist of the office-bearers and six ordinary members, three to form a quorum.

4. Candidates for admission as ordinary members, to be proposed and seconded at one of the stated meetings of the society. The vote on their admission to take place by ballot, at the next subsequent meeting; the assent of the majority of the members voting at the latter meeting being requisite for the admission of the candidate.

5. Honorary members to be nominated by three ordinary members at one of the stated meetings of the society. The vote for their admission to take place by ballot at the next subsequent meeting; one adverse vote in five to exclude.

6. The office-bearers and the other members of council to be elected by ballot at a meeting of the society, to be held annually in the month of May. A majority of votes to decide the election.

7. Any vacancies occurring in the council of management during the year, to be filled up by the council of management.

8. The entrance money paid by ordinary members on their admission to be one guinea; and the annual subscription to be one guinea, payable in advance.

9. The sum of £10 may be paid at any time by a member as a composition for the ordinary annual payment for life.

10. Ordinary meetings to be held once a month, during eight months in the year. Special general meetings may be held at any time under the authority of the council of management.

11. Bye-laws proposed by the council management shall not be binding until ratified by a general meeting.

12. No alteration or addition to the fundamental rules of the society shall be made unless carried at two successive general meetings.

His Excellency read a paper on "The development of the railway system in England, with suggestions as to its application to the colony of New South Wales."

[Under the principal title of "Railroads," this paper was referred to by the President in his letter to Sir Roderick Murchison. See p. 260. A copy, printed in the "Herald" will be found in the Society's cuttings book; see also the Magazine I, 8, 9.]

Minutes of Council of Management of the Philosophical Society, 3rd June, 1856.

Council met at Government House. Present:—His Excellency Sir William Denison, Dr. Woolley, Professor

Pell, J. Thompson, G. K. Holden, R. A. A. Morehead, Captain Ward, Professor Smith.

List of members of "Australian Society" submitted. Secretaries to take steps for ascertaining if they wish to continue their membership.

Second Monthly Meeting, Lecture-room, School of Arts, Friday, 13th June, 1856. E. Deas-Thomson, Esq., C.B. in the Chair.

Members elected:—Dr. McEwan, Phillip-street; W. Keane, Esq.; Thomas Bataby Robie, Dungate House, Castlereagh-street; Andrew Allan, 57 Clarence-street; T. Mulholland, Wynyard-square; James Comrie, M.L.C., Miller's Point; the Lord Bishop of Sydney; A. McArthur, Glebe; Charles J. Hodgson, George-street; John West, "Herald" Office; Andrew Garran, "Herald" Office; Charles Elouis, Royal Mint; Simpson Davidson, Belmont Villa, Old South Head-road; Adam Wright, 36 Wynyard-lane; Joseph Lyne Brown, Albert-street, Darlinghurst; Marshall Burdekin, Macquarie-street, Sydney; J. V. Lavers, George-street; W. D. Naper, Government House; A. Denison, Government House; W. Bradridge; Alfred Roberts, 20 Castlereagh-street; Rev. Robert Allwood; Rev. Foster Ashwin; Captain Hawkins, R.E.; Captain D. Scott, Cumberland-street; Conrad Martens, Esq., Mort's Buildings; Joseph Trickett, Royal Mint; W. Stanley Jevons, Royal Mint; E. B. Boulton, Esq., Darling Point; James Henry Thomas, Esq., Cockato Island; O. R. Campbell, Esq., Mort's Buildings; F. Terry, Esq., Railway Station; Edward J. H. Knapp, junior, 34 Elizabeth-street; Gother K. Mann, Esq., Chief Commissioner of Railways; Colonel Morse Cooper; H. H. Browne, Esq.,; Julius Lippman, Dixon-street (Stearin Works); B. Mountcastle, George-street; Robert Thompson, Esq., Mort's Buildings; Henry Haydon, 265 George-street, Richard Thompson, 1 Horbury Terrace; Rev. G. H. Stanley, Macquarie-street; Edward Wise, 40 Elizabeth-street; Thomas Ranken, Gloucester Terrace; Julian E. Salomons, Wynyard-square; J. Malbon Thompson, William-street; R. Windeyer Thompson, William-street; Henry J. Brown, Crown Solicitor's Office; George T. Benbow, 42 Castlereagh-street; James Cowlishaw, Surry Hills; John Roberts; Walter Hooper; Edward Bell; James Robertson; Frank E. Fowler, 177 Liverpool-street; Thomas W. Levinge, General Post Office; William Hanson, Phillip-street, North; R. Rupert Ewen, St. Philip's Grammar School, 89 Botany-street; E. O. Moriarty; S. H. Mansfield; Dr. Berncastle, 10 Wynyard-square; Isaac Aaron, 145 Castlereagh-street; Hugh Houston, Infirmary; J. B. McGuyar, Elizabeth-street; Robert Hunt, Royal Mint; Sheridan Wall, Museum; S. Maurice, Sea View Terrace, Darlinghurst; Frank Haes, 7 Jamison-street; William Roberts; Henry T. Fox; James C. Tucker; William C. Bennett, City Engineer's Office; John Taylor, Barrack-street; W. Catlett; A. L. Catlett; Hector McLean, 7 Jamison-street; Charles Grace, 37 Yurong-street; Henry Phillips, at Messrs. Thacker and Co's; W. G. Pennington; H. P. Plews; Rev. James Fullerton, Pitt-street; Richard Johnson, Pitt-street; James Robertson, junior, Pitt-street; William Randell, Newtown; William Weaver, Ryde; Lieutenant Vigors; R. C. Want, Woolloomooloo; James Mitchell, Cumberland-street; David S. Mitchell, Cumberland-street; W. Burton Wade; Joseph Fowles; George Deffell.

Papers read on steam communication with England:—

1. "On the application of Auxiliary steam power to passenger ships in the Australian trade." (An abstract published at p. 36, Vol. I, of the Magazine).
2. "Proposal for combining a system of postal communication with immigration." (Both papers by Mr. E. Deas-Thomson were printed in full in the "Herald," and copies are in the Society's Cuttings book.)

Third Monthly Meeting, Hall of the Australian Library, Friday, 11th July, 1856. His Excellency Sir William Denison in the chair.

Members elected:—John Flavelle, Henry John Porter, Captain J. S. Sparkes.

Code of by-laws adopted.—The following code of by-laws was adopted for the regulation of the business of the Society.

ORDINARY MEETINGS.

1. An ordinary meeting of the Philosophical Society, to be convened by public advertisement, shall take place at 8 p.m., on the second Wednesday in every month during the last eight months of the year. These meetings will be open for the reception of contributions, and the discussion of subjects of every kind, if brought forward in conformity with the fundamental rules and by-laws of the Society.

COUNCIL MEETINGS.

2. Meeting of the Council of Management shall take place on the Fridays previous to the days on which the ordinary meetings of the Society are appointed to be held, and on such other days as the Council may determine.

CONTRIBUTIONS TO THE SOCIETY.

3. Contributions to the Society, of whatever character, should be sent to one of the Secretaries, to be laid before the Council of Management. It will be the duty of the Council to arrange for promulgation and discussion at an ordinary meeting, such communications as are suitable for that purpose, as well as to dispose of the whole in the manner best adapted to promote the objects of the Society.

INFORMATION OF ELECTION TO BE SENT TO NEW MEMBER,

4. Every member shall receive due notification of his election, together with a copy of the Fundamental Rules and Bye-Laws of the Society.

INTRODUCTION OF NEW MEMBERS TO THE SOCIETY.

5. Every candidate duly elected as member shall, on his first attendance at a meeting of the Society, be introduced to the chair by his proposer or seconder, or by some person acting on their behalf.

ANNUAL SUBSCRIPTIONS WHEN DUE.

6. Annual subscriptions shall become due on the first of May for the year then commencing. The entrance fee and first year's subscription of a new member shall become due on the day of his election.

MEMBERS WHOSE SUBSCRIPTIONS ARE NOT PAID TO ENJOY NO PRIVILEGES.

7. Members will not be entitled to attend the meetings, or to enjoy any of the privileges of the Society until their entrance fee and subscription for the year have been paid.

SUBSCRIPTIONS IN ARREARS.

8. Members who have not paid their subscriptions for the current year shall be informed of the fact by the Treasurer. If 30 days after each intimation any are still indebted, their names shall be formally laid before the Society at the ordinary meeting. At the next ordinary meeting, those whose subscriptions are still due will be considered to have resigned.

VISITORS—RULES FOR ADMISSION.

9. Every ordinary member shall have the privilege of admitting one friend as a visitor to an ordinary meeting of the Society on the following conditions:—

1. That the name and residence of the visitor, together with the name of the member introducing him, be entered in a book at the time.
2. That the visitor does not permanently reside within ten miles of Sydney; and,
3. That he shall not already have attended two meetings of the Society in the current year.

The Council shall have power to introduce visitors irrespective of the above restrictions.

MANAGEMENT OF FUNDS.

10. The funds of the Society shall be lodged at a bank named by the Council of Management. Claims against the Society, when approved by the Council, shall be paid by the Treasurer.

AUDITING OF ACCOUNTS.

11. Two auditors shall be appointed annually at an ordinary meeting to audit the Treasurer's account. The accounts as audited to be laid before the annual meeting in May.

EXPULSION OF MEMBERS.

12. A majority of members at any ordinary meeting shall have power to expel an obnoxious member from the Society, provided that a resolution to that effect has been moved and seconded at the previous ordinary meeting, and that due notice of the same has been sent in writing to the member in question within a week after the meeting at which such resolution has been brought forward.

Papers read.—1. "On the means of constructing Railways financially considered," by Mr. Pennington. (A brief abstract of the paper will be found at p. 75 of the Magazine). 2. "On the application of certain principles of Political Economy to the question of Railways," by Professor Pell. (Published at p. 124, and a complete copy, from the "Herald," of both these papers will be found in the Society's Cuttings book. N.B.—The papers are not published in the Magazine in the order of reading. In some cases they were not published at all.)

Fourth Monthly Meeting, Hall, Australian Library, 13th August. Sir William Denison in the Chair.

New Members.—Rev. F. Armitage; Rev. Thomas Druitt; Captain Lethbridge, R.N.; Messrs. Francis, C.E.; Thomas

Woore, C.E.; W. R. Collett, Government Surveyor of Roads; H. G. Alleyne, M.D.; Charles Nathan, Surgeon; William Macleay, junr., M.P.; Edwin Daintrey, Solicitor; R. M. Isaacs, Barrister-at-Law; H. Waymouth; Saul Samuel; James Williamson; James Hart; Ambrose Foss; C. J. Nealds; A. Bonar, and Thomas Holt.

Papers read.—1. "On the action of Sydney water upon lead," by Professor Smith. (Published at p. 104 of the Magazine.) 2. "On the Iron-making resources of New South Wales," by Mr. Thomas, C.E. (Published at p. 101 of the Magazine. Copies of both these papers, from the Herald, will be found in the Society's Cuttings book).

Fifth Monthly Meeting, Hall, Australian Library, 10th September. Sir William Denison in the Chair.

Members elected.—J. J. Rodd; Alex. Sage; Dr. Bowman; Rev. W. Scott; —Elliott; A. Knipe; Osborn Ottley; J. W. Robinson; Fredk. Rothery; Rev. Dr. Hortzel; M. Israel; H. Mackay; Thomas Woolley; Thomas Felton; Thomas H. Hood, M.L.C.; Francis H. Grundy, C.E.; Dr. Houston.

Papers read.—1. "Electric Telegraphs and Railways between Sydney and London not impossible," by Mr. John Thompson. (I have not seen a copy of this paper, but according to the "Herald" of 14th May, 1857, it was published in pamphlet form). 2. "Sanitary Reform," by Dr. Aaron. (Published at p. 193 of the Magazine. A full account from the "Herald," is in the Society's Cuttings book).

Sixth Monthly Meeting, Hall, Australian Library, 8th October. Sir William Denison in the Chair.

Members elected.—William Bland; James Barlow; Alfred Huntley; S. H. Terry; Chas. Mackay, M.D.; Fred. Chas. Ede.

Paper read—"On the Parramatta Water-works," by E. O. Moriarty, C.E. (Published at p. 76 of the Magazine.

A full account, from the "Herald," is in the Society's Cuttings book).

Seventh Monthly Meeting, Hall, Australian Library, 12th November. Sir William Denison in the Chair.

Members elected.—H. C. Burnell; Charles Stafford; Christopher Rolleston.

Paper read.—"Irrigation," by Sir William Denison. (Published at p. 140 of the Magazine. A full copy, from the "Herald," is in the Society's Cuttings book).

Eighth Monthly Meeting, Hall, Australian Library, 10th December. Rev. Robert Allwood in the Chair.

Members elected.—John Leslie Salter, M.D., Sydney; George William Brown, Esq., Dapto.

Auditors elected.—Andrew Bonar, Esq. and Alfred Roberts, Esq.

Papers read.—1. "On the necessity for a further exploration of the interior of the Australian continent," by John Thompson, Esq., Deputy Surveyor General. (Published at p. 232, Vol. I, of the Magazine). 2. "On the Science of Statistics." by C. Rolleston, Esq., Registrar General. (Published at p. 254, Vol. I, of the Magazine).

As a result of the preceding paper it was moved by E. Wise Esq., and seconded by Alfred Roberts Esq., "that a committee be appointed to collect, as far as practicable, information as to the social economics and statistics of Sydney, and that the committee consist of the following gentlemen:—C. Rolleston, J. Aaron, H. J. Porter, A. Roberts, Ed. Wise, together with the Secretaries. The resolution was carried unanimously.

3. "On the principles on which he has constructed a new grate for burning wood," by Thomas Woore. (Published at p. 32, Vol. I, of the Magazine with a figure. Full copies

of all these three papers, from the "Herald," are in the Society's Cuttings book).

Council Meeting, 8th May, 1857. "With reference to a proposal by Mr. Waugh to publish the transactions of this Society along with other matters, in a monthly magazine, it was agreed that the Council should select papers and prepare abstracts for this publication, and should take 25 copies of the magazine monthly for one year, for the purpose of distribution among other Societies."

Ninth Monthly Meeting, Hall, Australian Library, 13th May, 1857. Sir William Denison in the Chair.

Members elected.—George Russell; Ernest Herborn, Patrick Leslie.

Financial Statement.[1]—The Treasurer presented the following financial statement for the year ending 30th April, 1857:—

RECEIPTS.	£	s.	d.
Taken over from the Australian Society	88	1	6
Entrance Fees from 130 members	136	10	0
Annual Subscriptions from 152 members	159	12	0
Life Subscriptions from two members	20	0	0
	£404	3	6

DISBURSEMENTS.	£	s.	d.
Paid for Stationery and Printing	9	7	6
,, Hire of Apartment for Meeting	27	3	0
,, Advertisements	11	2	6
,, Postage and Sundries	2	1	0
,, Commission etc. to Collector	15	3	2
Total expenditure...	64	17	2
Balance in Union Bank of Australia...	339	6	4
	£404	3	6

(Signed) ANDREW BONAR and ALFRED ROBERTS, Auditors.

[1] Financial Statements were not printed in our Annual Volume until 1875.

Ballot for Office-bearers.—A ballot was then taken for Office-bearers for 1857-8, and the following gentlemen were declared duly elected :—

President: His Excellency the Governor General.

Vice-Presidents: Sir Charles Nicholson, and Hon. E. Deas-Thomson, C.B.

Treasurer: R. A. A. Morehead.

Secretaries: Dr. Douglass, Professor Smith, Captain Ward.

Additional Members of Council: G. K. Holden, Professor Pell, Rev. W. Scott, J. Thompson, R. J. Want, Professor Woolley.

Tenth Monthly Meeting, Hall, Australian Library, 10th June, 1857. E. Deas-Thomson, Esq. in the Chair.

Members elected.—Messrs. Peppercorne, Waugh, Henry Mort, Beazley; Captain Scott, Messrs. Edward R. Drury, Freeman, Dyer.

Papers read.—1. "On Pavements and Street Surfaces," by Lieutenant Vigors. (Published at pp. 11 and 26 of Vol. II of the Magazine). 2. "On the Sanitary condition of Sydney," by C. Rolleston. (Published at p. 37, Vol. II of the Magazine).

Eleventh Monthly Meeting, Hall, Australian Library, 8th July. Sir William Denison in the Chair.

Members elected.—J. Belisario, Dr. Foulis, George Falkner, O. Montefiore, Dr. Williams, Rev. G. Macarthur, Arch. Ashdown, A. H. Barlow, Rev. H. J. Hose, James Norrie.

Papers read.—1. "On the Moon's Rotation," by His Excellency Sir William Denison. (Published at p. 43, Vol. II of the Magazine). 2. "On a new Sun Gauge or new Actinometer," by Mr. Jevons. (Published at p. 58, Vol. II of the Magazine, with figures). 3. "On Sanitary Reform of Towns and Cities," by Dr. Bland. (Published at pp. 41 and 55 of Vol. II of the Magazine).

Twelfth Monthly Meeting, Hall, Australian Library, 12th August, 1857. Sir William Denison in the Chair.

Members elected.—Captain Martindale, R.E.; Arthur Hodgson, John F. Hill; John Stafford.

A specimen of artificial stone was submitted by Messrs. Bensusan and Westley, and a letter description of its properties was read to the meeting.

Papers read.—1. "On Railways," (following up his paper of last year on the same subject), by Sir William Denison. (Published at p. 62, Vol. II of the Magazine). 2. "On Railways with reference chiefly to the Motive Power," by Fred. S. Peppercorne, C.E. (Paper part read by Captain Ward, and published at p. 78, Vol. II of the Magazine).

Thirteenth Monthly Meeting, Hall, Australian Library, Bent-street, 9th September, 1857. Professor Woolley in the Chair.

Members elected.—W. J, Stephens, James E. Blake, John Rae, Ed. Maitland, William C. Uhr, R. L. Jenkins, William Bell, M.D.

Papers read.—"On the waxed paper process of photography," by Frank Haes. (Published at p. 99, Vol. II of the Magazine).

Fourteenth Monthly Meeting, Hall, Australian Library, 14th October, 1857. E. Deas-Thomson, Esq., in the Chair.

Members elected.—Francis Napier, Edwin Dalton, James Smith, Dr. George Walker, Henry Moreing.

Papers read.—1. "On the poison apparatus of venomous snakes," by Alfred Roberts, illustrated by drawings by Dr. Macdonald of H.M.S. "Herald." (Published at p. 130, Vol. I of the Magazine, under the title "On the structure and functions of the venom apparatus in serpents," with a plate of figures, and part 2 at p. 50, Vol. II). 2. "Meteorology of New South Wales," by Rev. William Scott. (Published at p. 128, Vol. II of the Magazine).

Fifteenth Monthly Meeting, Hall, Australian Library, 11th November. W. T. Cape Esq., in the Chair.

Paper read.—"On the use and abuse of tobacco," by Dr. Berncastle.

Sixteenth Monthly Meeting, Hall, Australian Library, 9th December. H. G. Douglass, Esq., M.D., in the Chair.

Members elected.—Dr. Ralph, Spencer Bransby, William MacDonnell.

Paper read.—"On the formation of clouds," by Mr. W. S. Jevons. (Published at p. 163, Vol. II of the Magazine, illustrated, under the title of "On clouds, their various forms and producing causes").

Auditors.—The following gentlemen were re-elected Auditors:—A. Bonar, Esq. and Alfred Roberts, Esq.

Seventeenth Monthly Meeting, Hall, Australian Library, 12th May, 1858. Sir William Denison in the Chair.

An assistant secretary, W. H. Catlett, was appointed, and the minutes of this meeting were the first written by him.

Member elected.—Major Wingate.

Election of Office Bearers.—The election of Office Bearers for 1858-9 then took place with the following results.

President: His Excellency Sir William Denison, K.C.B

Vice-Presidents: The Honorable E. Deas-Thomson, C.B., and Rev. W. B. Clarke.

Treasurer: R. A. A. Morehead, Esq.

Honorary Secretaries: Professor Smith, M.D.; Captain Ward, R.E.

Ordinary Members of Council: Honorable H. G. Douglass, M.D.; Captain Martindale, R.E.; Professor Pell; Alfred Roberts, Esq.; Rev. W. Scott; Professor Woolley.

Paper read.—"On the strength and elasticity of woods of New South Wales and New Zealand," by Captain Ward. (See pages 258 and 261, Vol. II of the Magazine).

Exhibits.—Numerous objects of interest were laid out for the inspection of members, the following gentlemen being the contributors:—His Excellency the Governor-General, K.C.B.; The Honorable E. Deas-Thomson, C.B.; Rev. W. Scott; Professor Smith; Messrs. Woore, Hunt, Jevons, Flavelle, Freeman, and Macdonnell.

Financial statement for the year ending 30th April, 1858:

Receipts.	£	s.	d.
At the credit of the Society in the Union Bank, on 30th April, 1857	339	6	4
Entrance Fees	40	19	0
Annual Subscriptions	163	16	0
Interest from the Bank	1	1	8
	£545	3	0

Disbursements.	£	s.	d.
Stationery and Printing	7	1	6
Advertising	8	12	6
A black board to be used in illustrating papers read to the Society	4	15	0
Refreshments, etc., at the opening meeting	11	5	0
Hire of Hall and lights	41	0	0
Postages	0	10	0
Twenty-five copies of "Sydney Magazine," at 11s. ...	13	15	0
Commission to the collector	15	4	0
Balance in the Union Bank	443	0	0
	£545	3	0

12th May, 1858. (Signed) R. A. A. Morehead, Treasurer.

Audited and approved, Andrew Bonar, and Alfred Roberts, Auditors.

At p. 253, Vol. II of the Magazine will be found the list of exhibits. The number of members is given at 174.

Council Meeting, 28th May, 1858.

Letter read from Mr. J. W. Waugh intimating to the Honorary Secretary that he had been put to considerable expense in publishing some of the Society's papers, with illustrations, in the "Magazine of Science and Art," and requesting to be informed if the Council would be disposed to assist him in any future expense of a similar nature, and further stating that it was his intention to raise the subscription from 12/- to 15/- per annum.

The Secretary was instructed to inform Mr. Waugh that the Council would in future meet the expense of preparing any illustrations required for their papers, and would have no objection to the increased subscription, but the Society would take only 15 copies of each number instead of 25, during the year now commencing.

Eighteenth Monthly Meeting, Hall, Australian Library, 9th June. Andrew Bonar, Esq., in the Chair.

Members elected.—William Kirchner, Esq.; Charles Kemp, Esq.

Paper read.—"Abridgment of a book of papers relating to the History and Practice of Vaccination presented to Parliament by Command of the Queen," by Dr. Greenup, of Parramatta.

[There is a reference to this paper at p. 26, Vol. II of the Magazine. It is stated to be a valuable paper, but far too long for publication in that work.]

Nineteenth Monthly Meeting, Hall, Australian Library, 14th July, 1858. Sir William Denison in the Chair.

Members elected.—The Honorable J. Docker, M.L.C., and Thomas H. Bradridge, Esq.

Paper read.—"On the Poison Apparatus of Venomous Snakes, with a description of some of the species found in this Colony," illustrated by numerous specimens both living and preserved, and by drawings, by Mr. Alfred Roberts. Second part of paper. See p. 58, Vol. II of the Magazine, with two plates; see also p. 272, *supra.*

Twentieth Monthly Meeting, Sydney Chamber of Commerce, 11th August, 1858. Sir William Denison in the Chair.

Member elected.—James Robey, Esq.

Papers read.—"On the Meteorology of New South Wales No. 2," and presented to the Society, the Parramatta Meteorological Tables from June 1857 to July 1858, also Meteorological Results for New South Wales, in Monthly Abstracts from June 1857 to June 1858, together with a pamphlet entitled Instructions for Meteorological Observations in the Colony of New South Wales," by Rev. William Scott. See p. 118, Vol. II of the Magazine, but it was not published.

2. "The Clunes Mine," illustrated by diagrams from H. A. Thompson, Esq., Mining Engineer, Victoria. Read by Captain Ward, who laid the following papers on the table from the same gentleman, "Gold Deposits of Victoria," "Outline of Plan for the formation and working of a Mining Company to open out the Quartz-Fields of New South Wales." Not published.

3. "On Sydney Mortality from the 1st of March, 1857 to the 28th of February, 1858," by Christopher Rolleston, Esq. Not published.

Twenty-first Monthly Meeting, Sydney Chamber of Commerce, 8th September, 1858. Sir William Denison in the Chair.

Member elected.—Mr. W. B. Allen.

Papers read.—1. "On the present state of the supply of the Ores of Mercury," by the Rev. W. B. Clarke. Published at pp. 157 and 170, Vol. II of the Magazine. 2. "On the Filtration of Water through Sand," by His Excellency Sir William Denison. Published at p. 74, Vol. II of the Magazine.

Twenty-second Monthly Meeting, Exchange, 13th October, 1858. Rev. W. B. Clarke in the Chair.

Members elected.—Alexander Dick Esq., John Lucas Esq.

Papers read.—1. "On the construction of Dams," by Professor Pell. Published at p. 94, Vol. II of the Magazine. 2. "On Currency and Banking in New South Wales," by Edward R. Drury Esq. Published at p. 97, Vol. II of the Magazine.

Twenty-third Monthly Meeting, Sydney Exchange, 10th November, 1858. Sir William Denison in the Chair.

Member elected.—J. S. Willis Esq.

Paper read.—"On the Plurality of Worlds," by Rev. William Scott. Published at p. 131, Vol. II of the Magazine.

The Chairman read the result of an Examination of Coal from Bellambi, made at the Royal Branch Mint. (A reference only at p. 117, Vol. II of the Magazine).

Twenty-fourth Monthly Meeting, Sydney Exchange, 8th December, 1858. Sir William Denison in the Chair.

Member elected.—Lieutenant Colonel Percival.

Auditors elected.—Andrew Bonar Esq., The Honorable G. K. Holden Esq.

Paper read.—"On the Progress of Photography and its application to the Arts and Sciences," by Mr. James Freeman. Published at p. 136, Vol. II of the Magazine.

A photographic Conversazione was then held. The exhibits were enumerated at p. 131.

Twenty-fifth Monthly Meeting, Hall, Australian Library, 11th May, 1859. Sir William Denison in the Chair.

Financial Statement.—

Receipts.	£	s.	d.
Balance in the Union Bank on the 30th April, 1858	443	0	0
Entrance Fees	7	7	0
Annual Subscriptions	98	14	0
Interest from Government Debentures	20	0	0
Interest from Bank balance	2	6	7
	£571	7	7

Disbursements.	£	s.	d.
Purchase of 4 Government Debentures of £100 each	387	3	6
Stationery and Printing	7	0	6
Advertising	7	2	9
Refreshments	19	15	0
Hire of Lamps and Tables	8	0	0
Carpenter's Work and Labour	4	0	0
Hire of the Hall of the Australian Library	12	0	0
Hire of the Sydney Chamber of Commerce	16	16	0
Fifteen Copies of the "Sydney Magazine" at 15/- ...	11	5	0
Illustrations for the "Sydney Magazine"	31	7	0
Postage Stamps etc.	0	16	9
Secretary's Salary to 31st December, 1858	40	0	0
Commission to Collector	8	4	0
Balance in the Union Bank on 30th April	17	17	1
	£571	17	7

By Debentures £400

By Balance carried down £17 17 1

(Signed) Chris. Rolleston, Treasurer.

Members elected.—J. H. L. Scott Esq., and Samuel Bensusan Esq.

The Election of Officers for the year 1859 – 60 then took place with the following results:—

President: His Excellency Sir William Denison, K.C.B.

Vice-Presidents: The Honorable E. Deas-Thomson, C.B., and Rev. W. B. Clarke.

Treasurer: Chris. Rolleston, Esq.

Honorary Secretaries: Professor Smith, M.D.; Captain Ward, R.E.

Ordinary Members of Council: Rev. Henry J. Hose; Professor Pell; Alfred Roberts, Esq.; Rev. William Scott; The Honorable R. J. Want, Esq.; Professor Woolley.

Microscopical Committee.—On the suggestion of His Excellency, it was moved by the Honorable R. J. Want Esq., seconded by Sir Charles Nicholson and carried, that it is desirable a Microscopical Committee be elected, to consist of the following gentlemen, with power to add to their number, viz:—Rev. W. B. Clarke, George Faulkner Esq., F. Haes Esq., Professor Pell, Alfred Roberts Esq., Professor Smith, M.D., Captain Ward, R.E., Dr. Williams.

The above report was published at p. 211, Vol. II of the Magazine.

A report of a paper on a "Combustible mineral from Tasmania," by Prof. Penny of Glasgow, was read at this meeting, and will be found at p. 212, Vol. II of the Magazine.

A preliminary meeting of the Microscopical Committee of the Philosophical Society was held at Government House in the month of May, 1859, at which the following gentlemen were added to the Committee or agreed to be added as soon as they have been elected members of the Philosophical Society, viz:—Joseph Burgon Esq., H. H. Browne Esq., Dr. James Cox, Dr. McKay, Charles Moore Esq., C. Watt Esq.

For continuation of the Proceedings of the Microscopical Committee, see p. 312.

Twenty-sixth Monthly Meeting, Hall, Australian Library, 8th June, 1859. E. Deas-Thomson, C.B., in the Chair.

Members elected.—Dr. Boyd, Dr. James Cox, Rev. C. C. Kemp, Joseph Burgon Esq.

Papers read.—1. "On the Construction of Specula for Reflecting Telescopes," by Mr. Henry A. Severn. 2. "On the Means of Deodorizing and Utilizing the Sewage of Towns," (postponed). 3. "On Atmotic Navigation," which was illustrated by several diagrams, by Honorable William Bland.

At this meeting Capt. Ward, R.E., laid on the table a "Specification of a twelve-head stamping mill for crushing quartz," by H. A. Thompson, which was published (with drawings) at p. 231, Vol. II of the Magazine.

Twenty-seventh Monthly Meeting, Hall, Australian Library, 13th July, 1859. Sir William Denison in the Chair.

Members elected.—Messrs. Squire, James Milson junior, Ed. S. Hill, Charles Watt, Louis Phillips, and Henry A. Severn.

Papers read.—1. "On the means of Deodorizing and Utilizing the Sewage of Towns," by Chris. Rolleston Esq. See p. 235, Vol. II of the Magazine. 2. "On a new mode of using Canada Balsam and other adhesive fluids in mounting Microscopic Objects," by Alfred Roberts Esq.

Council Meeting, 5th August, 1859.—" It was reported that the yearly subscription to the Sydney Magazine of Science and Art had terminated, and it was agreed that the subscription be not continued."

Twenty-eighth Monthly Meeting, Hall, Australian Library, 10th August, 1859. W. T. Cape Esq. in the Chair.

It was resolved that the meeting day be changed from the second to the third Wednesday in each month.

Paper read.—" On the Observatories of the Southern Hemisphere," by Rev. William Scott.

The following papers detailing investigations made at the Royal Branch Mint, Sydney, were received from Captain Ward, R.E., and laid upon the table:—1. An analysis of Warriora *(sic)* Coal. 2. An analysis of Bellambi Coke. 3. Results of rough experiments on the heating power of Colonial Coal.

The following contributions were also laid upon the table:

1. A paper "On the adulteration of Milk in Sydney," from the members of the Microscopical Committee who had undertaken the examination of the adulteration of Food.

2. An extract from the New Zealand Government Gazette of the 14th July, 1859, being a Lecture on the Geology of the Province of Auckland by Dr. Ferdinand Hochstetter, Geologist on board the Austrian Frigate "Novara."

3. Transactions of the Philosophical Institute of Victoria, from January to December, 1858.

4. A Photographic Panorama of Port Jackson was exhibited, taken by Mr. J. Freeman from Kirribilli Point, and comprising the harbour from Milson's Bay on the right to Bradley's Head on the left.

Council Meeting, 31st August, 1859.—"The Secretary reported to the Council that Mr. Fairfax would not publish the Society's papers in the "Herald," unless he received all the papers read at the monthly meetings, and that he would not exchange slips with the "Empire."

Resolved that no preference be shown to either paper, and if Mr. Fairfax will not exchange slips, that the papers be given to the "Empire" for publication."

Council Meeting, 16th September, 1859.—"The Secretary reported to the Council that he had taken His Excellency Sir Wm. Denison's paper on the Dental System of Mollusca to Mr. Fairfax to publish and requested him to have the goodness to send a slip to the "Empire," that Mr. Fairfax had declined to do so and that His Excellency's paper had therefore been published in the "Empire."

"The Secretary was authorized to purchase for the use of the Society three copies of any newspaper in which the papers of the Society may be published."

It will be noted that on the "Sydney Magazine of Science and Art" ceasing to be published with Vol. II (1858), there was no medium of publication for papers read before the Society except newspapers, until such time as the Society published a journal of its own.

Twenty-ninth Monthly Meeting, Hall, Australian Library, 21st September, 1859. Sir William Denison in the Chair.

Members elected.—James McDonald Larnach Esq., Edward H. v. Arnheim Esq.

Paper read.—"On Telegraphic communication with England," (by Francis Gisbourn Esq.) which he illustrated by numerous Admiralty Charts and Maps and specimens of the following Telegraphic Cables, viz:—Channel Islands Company's Cable, shore end and deep sea part; Dover and Ostend; Zuyder Zee; Dover and Calais; Port Patrick and Donaghadee; Atlantic Telegraph Company's Cable; Malta and Corfu; Red Sea Cable, deep sea part and shore end; Cagliari Bona Cable, deep-sea part.

Thirtieth Monthly Meeting, Hall, Australian Library, 19th October, 1859. Sir William Denison in the Chair.

Member elected.—A. G. McLean Esq.

Paper read.—"On the Sydney Observatory," by Rev. William Scott, and drawings were laid upon the table of the instrument, together with an Azimuth Scale made by A. Tornaghi of Sydney, under his superintendence.

Thirty-first Monthly Meeting, Hall, Australian Library, 16th November, 1859. H. H. Browne Esq. in the Chair.

Members elected.—W. G. McCarthy Esq., Dr. Adolph Leibius, F. B. Miller Esq.

Paper read.—"Observations on the separation of Gold from 'Mundic Quartz'," by Professor Smith, who exhibited various illustrative specimens.

Council Meeting, 9th December, 1859.—"Resolved that £5 5s. Medals be given by the Society at the May meeting in 1860, for six of each of the following classes of Photography, viz:—Landscapes, Buildings, and Portraits."

Thirty-second Monthly Meeting, Hall, Australian Library, 19th December, 1859. Sir William Denison in the Chair.

Member elected.—Mr. John Goodlet.

The meeting resolved into a Photographic Conversazione. (A list of the exhibits will be found in the Society's Cuttings Book).

Thirty-third Monthly Meeting, Hall, Australian Library. 16th May, 1860. Sir William Denison in the Chair.

Financial Statement.—

Receipts.	£	s.	d.
To balance in the Union Bank on the 30th April, 1859	17	17	1
,, Entrance Fees and Annual Subscriptions ...	138	12	0
,, Interest from Government Debentures	20	0	0
	£176	9	1

Disbursements.	£	s.	d.
By Advertising...	10	10	9
,, Stationery and Printing	0	17	6
,, Refreshments	14	8	0
Carried forward	25	16	3

Disbursements—*continued.*	£	s.	d.
Brought forward	25	16	3
By Hire of Lamps and Tables	7	4	6
,, Carpenter's Work and Labour	0	5	0
,, Hire of the Hall of the Australian Library ...	25	4	0
,, Six Lamps and 1 gallon of oil for the Microscopical Committee	6	11	0
,, Illustrations for the "Sydney Magazine" ...	3	3	0
,, Petty Cash Account, Postage Stamps, etc. ...	2	4	9
,, Gratuity to Messenger for trimming lamps for Microscopical Committee	2	0	0
,, Commission to Collector, etc.	10	15	6
,, Secretary's Salary from 31st Dec. to 31st Dec. 1859	60	0	0
,, Balance in Union Bank	33	5	1
	£176	9	1
,, Government Debentures	400	0	0
,, Balance brought down	33	5	1

(Signed) Chris. Rolleston, Treasurer.

Sydney, 14th May, 1860.

Election of Officers.—

President: Sir William Denison, K.C.B.

Vice-Presidents: Rev. W. B. Clarke and The Honorable E. Deas-Thomson, C.B.

Treasurer: Chris. Rolleston, Esq.

Honorary Secretaries: Professor Smith, M.D.; Captain Ward, R.E.

Ordinary Members of Council: Rev. Henry J. Hose; Edward Moriarty Esq.; Professor Pell; Alfred Roberts, Esq.; Rev. William Scott; The Honorable R. J. Want, Esq.

A large number of exhibits were shown.

Thirty-fourth Monthly Meeting, Hall, Australian Library, 20th June, 1860. Sir William Denison in the Chair.

Member elected.—Henry Lane Esq.

Paper read.—"On the Sydney Observatory," by Rev. William Scott.

Thirty-fifth Monthly Meeting, Hall, Australian Library, 18th July, 1860. Major Wingate in the Chair.

Members elected.—Chas. Bell jun. Esq., Wm. Hillyer Esq., Simon Pittard Esq.

Edward Moriarty Esq., laid upon the table plans and drawings of a new Steam Dredge for Queensland, and also read "Memoranda referring to the destruction of the Dam at Liverpool."

Papers read.—1. "On the detection of Spurious Gold," by F. B. Miller Esq., which he illustrated by testing several specimens of spurious gold dust. 2. Memoranda upon the same subject, by Professor Smith.

Thirty-sixth Monthly Meeting, Hall, Australian Library, 15th August, 1860. Sir William Denison in the Chair.

Paper read.—"On the Adelong Quartz Reefs," by Professor Smith, which he illustrated by a map of the locality and various specimens of Mundic Quartz.

Thirty-seventh Monthly Meeting, Hall, Australian Library, 19th September, 1860. Sir William Denison in the Chair.

Member elected.—Henry Cary Dangar Esq.

Mr. Proschel presented his map of New South Wales and part of Victoria.

Papers read.—1. "On Bridge Building," by His Excellency the President, which he illustrated by numerous drawings and plans of bridges. 2. "On the application of an Anti-Collision Dial of his own invention to prevent collisions at sea," by Mr. C. J. Perry formerly Master Mariner and late Member of the Legislative Assembly of Victoria, who exhibited the use of the Dial before the Society.

Thirty-eighth Monthly Meeting, Hall, Australian Library, 17th October, 1860. Sir Charles Nicholson in the Chair.

Members elected.—Alexander Dawson Esq., Roderick Flanaghan Esq.

Papers read.—1. "On Compass deviation in Iron Ships," by Rev. William Scott. 2. "On Ozone," by Mr. Proschel, of Victoria.

Thirty-ninth Monthly Meeting, Hall, Australian Library, 21st November, 1860. Rev. W. B. Clarke in the Chair.

Paper read.—"On the Mundic Quartz of the Adelong," by Dr. Leibius, of the Mint; which he illustrated by various experiments.

Fortieth Monthly Meeting, Hall, Australian Library, 19th December, 1860. Colonel Barney in the Chair.

Address to His Excellency.—Captain Ward brought up a farewell address from the Society to His Excellency Sir W. T. Denison, which was unanimously adopted and signed by the members present. Following is the text of the Address:—

To His Excellency Sir William Thomas Denison, Knight Commander of the Honorable Order of the Bath, Governor-General in and over all Her Majesty's Colonies of New South Wales, Tasmania, Victoria, South Australia, and Western Australia, Captain-General and Governor-in-Chief of the Territory of New South Wales and its dependencies, and Vice-Admiral of the same.

May it please your Excellency—

We, the members of the Philosophical Society of New South Wales, have learned with regret that we are soon to be deprived of your Excellency's assistance as our President.

On this, the last opportunity we shall have of meeting you in this capacity, we desire to express our warm acknowledgments for the service you have rendered to the Society, and to the cause of science generally.

In parting with your Excellency, we are reminded that to your successful exertions at an early period after your arrival in the Colony, we are indebted for the reorganisation of the Society on a satisfactory basis. We feel also that our best thanks are due to you for your earnest and constant endeavours to promote its interests, and more particularly for the valuable papers treating of the special capabilities and requirements of the Colony, which you have contributed from time to time at our monthly meetings.

We trust that your Excellency's departure to assume the high and responsible office to which Her Gracious Majesty has been pleased to appoint you, will not lessen the interest you have always taken in our labours, nor altogether deprive us of your co-operation and assistance.

In taking leave, we desire to convey to you, as also to Lady Denison and the members of your family, our earnest wish that health and happiness may support and encourage you in the new sphere of duties to which you have been called.

We subscribe ourselves, with unfeigned regard, your Excellency's sincere friends.

[Signed by all the members present.]

The President then read two communications he had received from Mr. Thomas Hale of Bellambi, giving particulars of the horse tramway he had constructed from the coal-mine to the harbour.

These communications were printed in the "Herald," and will be found in the Society's Cuttings Book, with a list of exhibitors and their exhibits at this meeting.

Forty-first Monthly Meeting, Hall, Australian Library, 15th May, 1861. Alfred Roberts Esq. in the Chair.

Financial Statement.—

Receipts.	£	s.	d.
To balance in Union Bank of 30th April, 1860 ...	33	5	1
,, Subscriptions and Entrance Fees	135	9	0
,, Interest on £400 Government Debentures ...	20	0	0
	£188	14	1

Disbursements.	£	s.	d.
By Advertising...	10	11	0
,, Stationery and Printing	9	3	10
,, Refreshments	15	5	6
,, Hire of Lamps and Tables	9	12	6
,, Hire of Hall of Australian Library	25	0	0
,, Petty Expenses—Postages etc.	3	3	8
,, Gratuity to Messenger	2	0	0
,, Freight of Books	1	8	10
,, Commission to Collectors	10	2	0
,, Secretary's Salary from 1st Jan. to Dec., 1860 ...	60	0	0
,, Balance in Union Bank on 30th April, 1861 ...	41	16	9
	£188	14	1
To Balance brought down	41	16	9
	400	0	0
	£441	16	9

Election of Office Bearers.—

President: His Excellency Sir John Young.

Vice-Presidents: Rev. W. B. Clarke and The Honorable E. Deas-Thomson, C.B.

Treasurer: Chris. Rolleston, Esq.

Honorary Secretaries: Captain Ward, R.E., and Professor Pell.

Ordinary Members of Council: Dr. Sprott Boyd; Chas. Moore, Esq.; E. Moriarty, Esq.; Alfred Roberts, Esq.; Rev. William Scott; R. J. Want, Esq.

Members elected.—Mr. John Kinloch and Mr. J. Glaister.

Forty-second Monthly Meeting, Hall, Australian Library, 19th June, 1861. William Bland Esq. in the Chair.

Members elected.—Messrs. A. Tornaghi and George Rowley.

Paper read.—"On the Census of 1861" by Christopher Rolleston Esq.

Forty-third Monthly Meeting, Hall, Australian Library, 17th July, 1861. Sir John Young in the Chair.

Meetings altered from third to second Wednesday of each month.

Mr. A. Shadler caused the attention of the Society to be drawn to his invention of an oven thermometer.

Paper read.—"On the Sydney Observatory and Tebbutt's Comet," by Rev. William Scott.

Forty-fourth Monthly Meeting, Hall, Australian Library, 14th August, 1861. Sir John Young in the Chair.

Member elected.—Mr. John Tebbutt.

Alfred Roberts Esq. read a description of a new species of Foraminiferous Shell from Ovalau, Feegee.

Paper read.—"On the improvements in the navigation of the River Hunter," by Edward Moriarty Esq.

Forty-fifth Monthly Meeting, Hall, Australian Library, 11th September, 1861. Sir John Young in the Chair.

Charles Moore Esq. read his paper entitled "A brief notice of a few of the prevailing but little known scrub timbers of the Colony."

Papers read.—1. "On a new mode of constructing timber bridges." 2. "On a new method of giving support to railway bars." (Both by Thomas Woore.)

Forty-sixth Monthly Meeting, Hall, Australian Library, 9th October, 1861. Sir Charles Nicholson, Bt. in the Chair.

Paper read.—"A short description of the new works now being carried out for the improvement of Wollongong Harbour," by Mr. Edward Moriarty.

Forty-seventh Monthly Meeting, Hall, Australian Library, 20th November, 1861. Sir John Young in the Chair.

Member elected.—Samuel Grey Esq.

Paper read.—"On some recent Geological discoveries in Australasia and the correlation of the Australian formations with those of Europe," by Rev. W. B. Clarke.

Dr. Berncastle's paper "on the Cave Temples of India," was postponed until the next meeting for reading papers.

Forty-eighth Monthly Meeting, Hall, Australian Library, December 11th, 1861. The meeting took the form of a conversazione.

Forty-ninth Monthly Meeting, Hall, Australian Library, 16th May, 1862. E. Deas-Thomson Esq. in the Chair.

[From the Council minutes we learn that the monthly (annual) meeting was postponed until the 16th instant, (Friday) because a ball in aid of the funds of the School of Industry was fixed for the 13th instant.]

Financial Statement.—

Receipts.	£	s.	d.
To Balance in the Union Bank on 30th April, 1861...	41	16	9
,, Entrance Fees	6	6	0
,, Subscriptions	106	1	0
,, Interest on £400 Government Debentures ...	20	0	0
	£174	3	9

Disbursements.	£	s.	d.
By Advertising...	12	2	9
,, Stationery and Printing	6	17	0
,, Refreshments	20	0	0
,, Hire of Lamps and Tables	15	4	6
,, Petty Expenses	6	13	11
,, Hire of the Hall of the Australian Library ...	25	0	0
,, Gratuity to Messenger	1	0	0
,, Commission etc. to Collector	8	9	1
,, Secretary's Salary from 1st Jan. to 31st Dec. 1861	60	0	0
,, Balance in the Union Bank on 30th April, 1862	18	6	6
	£174	3	9
To Balance brought down	18	6	6
,, Four Government Debentures	400	0	0
	£418	16	6

Election of Officers.—

President: His Excellency Sir John Young.

Vice-President: The Rev. W. B. Clarke and The Honorable E. Deas-Thomson Esq.

Treasurer: Chris. Rolleston, Esq.

Honorary Secretaries: Alfred Roberts, Esq. and Professor Smith.

Ordinary Members of Council: F. M. Miller, Esq.; Charles Moore, Esq.; Edward Moriarty, Esq.; Charles Wall, Esq.; Dr. Williams; W. J. Stephens, Esq.

Fiftieth Monthly Meeting, Hall, Australian Library, 11th June, 1862. Sir John Young in the Chair.

Members elected.—Henry Prince Esq.; William Hetzer Esq.; J. F. Josephson Esq.; Fred. J. Jackson Esq.

Paper read.—"On the Cave Temples of India," by Dr. Berncastle, which he illustrated by sketches made on the spot. Published in the "Trans. Philos. Soc. N.S.W." (1862 –1865) pp. 178–191, and the first paper read before the Society so published.

This volume contains no index, and most of the papers contained in it have no particulars as to the date of reading in the volume itself. The volume was published in 1866.

Fifty-first Monthly Meeting, Hall, Australian Library, 9th July, 1862. William Bland Esq. in the Chair.

Member elected.—Mr. Krefft.

Papers read.—1. "On Improvements in Geometrical Science, with their applications in solutions to celebrated problems, and in the investigations of new porisms," by Mr. Martin Gardiner, which he illustrated with numerous diagrams.

Presumably one or more of the four papers on "Geometrical Researches," published in "Trans. Philos. Soc. N.S.W." (1862-5), pp. 61 – 126.

2. "On the Wombeyan Caves," by Dr. James Cox.

Published in "Trans. Philos. Soc. N.S.W." (1862-5) pp. 197 – 204.

Fifty-second Monthly Meeting, Hall, Australian Library, 13th August, 1862. Sir John Young in the Chair.

Mr. Alfred Roberts asked if any gentleman present could furnish some additional information relative to the hairless Aboriginals, some of whom had been seen in the district of the Ballonne. One of them had been brought to Sydney in February last by Mr. Donald McKay, who had kindly afforded him an opportunity of examining the man, but he could not find a trace of hair structure on the scalp or other part of the body, with the exception of the upper eyelid, where a few well formed eye lashes existed. Mr. Roberts thought the subject worthy of further investigation, and hoped members of the Society, having connections with the district from which this man came, would use their influence to obtain further information of an authentic character.

Papers read.—1. "On the desirability of a systematic search for and observation of variable stars in the Southern Hemisphere," by Mr. John Tebbutt, jun. Published in "Trans. Philos. Soc. N.S.W." (1862–5), pp. 126–139).

2. "On the performance of the A.S.N. Co's Steamer 'Diamantina' from Sydney to Brisbane and return to Sydney," by Commodore Seymour, read by His Excellency Sir John Young.

Fifty-third Monthly Meeting, Hall, Australian Library, 10th September, 1862. Sir John Young in the Chair.

Paper read.—"On the Vertebrated Animals of the Lower Murray and Darling, their Habits, Economy and Geographical Distribution," by Mr. Gerard Krefft, which he illustrated with numerous drawings.

N.B.—This is the first paper published in "Trans. Philos. Soc. N.S.W." (1862-5), 1–33, but, as we have already seen, not the first paper read.

Fifty-fourth Monthly Meeting, Hall, Australian Library, 8th October, 1862. Rev. W. B. Clarke in the Chair.

Member elected.—The Honorable T. A. Murray Esq.

Paper read.—"On Comet I. of 1862," by Mr. John Tebbutt. Published in "Trans. Philos. Soc. N.S.W." (1862-5), pp. 140–146 (under the title of 'On the Comet of September 1862, No. 1).'

Fifty-fifth Monthly Meeting, Hall, Australian Library, 12th November, 1862. Sir John Young in the Chair.

Members elected.—Richard Hill Esq., Francis Hill Esq.

Papers read.—1. The President then read extracts from a paper drawn up by R. J. Swanson Esq., Vice-Consul, "On the Climate and Capabilities of the Fiji Islands."

2. "On the Comet of August and September, 1862," by John Tebbutt, junior. Published in "Trans. Philos. Soc.

N.S.W." (1862-5), 146 – 153, under the title of 'On the Comet of September 1862, No. 2.'

Mr. William Keene exhibited an instrument of his own invention for testing the quality of the air in Coal Mines. Also a diagram showing the progress of the coal trade in this Colony from 1859 to 1860.

Fifty-sixth Monthly Meeting, Hall, Australian Library, 17th December, 1862. Sir John Young in the Chair.

Members elected.—Martin Gardiner Esq., I. K. Ingelow Esq., Samuel Clarke Esq.

There were then read extracts from the "Australian Almanac" of 1822, and the "Sydney Gazette" of 15th and 22nd March 1822, relating to the "formation and early history of the Society," which will be found at p. 218, *ante*.

There was a very extensive display of exhibits, all carefully catalogued in the "Herald" of 18th December.

Fifty-seventh Monthly Meeting, Hall, Australian Library, 27th May, 1863. William Macleay Esq. in the Chair.

Financial Statement.—

Receipts.	£	s.	d.
To Balance in the Union Bank on the 30th April, 1862	18	6	6
,, Interest on £400 Government Debentures ...	20	0	0
,, Subscriptions and Entrance Fees	114	9	0
	£152	15	6

Disbursements.	£	s.	d.
By Advertising and Printing	15	16	3
,, Refreshments	17	10	0
,, Hire of Hall of Australian Library	25	0	0
,, Hire of Tables and Lamps	9	4	6
,, Petty Expenses—Postage Stamps, etc., etc. ...	8	13	7
,, Attendance...	3	12	0
,, Commission etc. to Collector	9	1	9
,, Secretary's Salary from 1st Jan. to 31st Dec., 1862	60	0	0
,, Balance in Union Bank	3	17	5
	£152	15	6

	£	s.	d.
To Balance brought down	3	17	5
„ Government Debentures	400	0	0
	£403	17	5

Election of Officers.—

President: His Excellency Sir John Young.

Vice-Presidents: Rev. W. B. Clarke, and The Honorable E. Deas-Thomson, C.B.

Honorary Treasurer: Christopher Rolleston Esq.

Ordinary Members of Council: Edward Moriarty, Esq.; W. J. Stephens, Esq.; Alexander Dick, Esq.; F. B. Miller, Esq.; Chas. Moore, Esq.; Gerard Krefft, Esq.

Honorary Secretaries: Professor Pell and The Honorable Captain Ward.

Paper read.—"On the Reptiles found near Sydney with remarks upon their habits and geographical range," by Mr. Krefft. Published in "Trans. Philos. Soc. N.S.W." (1862-5), 34 – 60, under the title "On snakes observed in the neighbourhood of Sydney," by Gerard Krefft.

Mr. William Macleay laid on the table a copy of Vol. I of the "Transactions of the Entomological Society of New South Wales."

Fifty-eighth Monthly Meeting, Hall. Australian Library, 17th June, 1863. J. F. Josephson Esq. in the Chair.

Member elected.—Dr. Fortescue.

Papers read.—1. "On Snake bites and their Antidotes," by Dr. Berncastle. Published in "Trans. Philos. Soc. N.S.W." (1862-5), 191-6.

Fifty-ninth Monthly Meeting, Hall, Australian Library, 8th July, 1863. Dr. Bland in the Chair. No new business taken.

Sixtieth Monthly Meeting, Hall, Australian Library, 12th August, 1863. Sir John Young in the Chair.

Paper read.—"The correct scientific method of forming Railway Curves and Railways, with an exposition of the injurious effects of the system adopted in this Colony," by Mr. Martin Gardiner. The second part was postponed for a subsequent meeting.

Sixty-first Monthly Meeting, Hall, Australian Library, 17th September, 1863. H. C. Burnell Esq. in the Chair.

Paper read.—"On the Vertebrated Animals of the Lower Murray, their habits, economy, and geographical distribution," by Gerard Krefft, which he illustrated by live and preserved specimens and numerous drawings.

(Continuation of the paper referred to at p. 293.)

Sixty-second Monthly Meeting, October, 1863. No record of proceedings.

Sixty-third Monthly Meeting, Hall, Australian Library, 11th November, 1863. Sir John Young in the Chair.

Mr. Justice Wise suggested to the Council that the Department of Public Works be written to requesting that in excavations for railway and other works, fossils and other objects of interest be preserved.

Mr. G. Krefft then read a description of a new fish from the Hawkesbury River belonging to the genus Therapon, and exhibited a specimen of the same.

Sixty-fourth Monthly Meeting, Hall, Australian Library, 16th December, 1863. Sir John Young in the Chair.

A Conversazione was held and a list of the exhibits was published in the "Herald" of the following day.

Sixty-fifth Monthly Meeting, Chamber of Commerce, 6th July, 1864. Alfred Roberts Esq., in the Chair.

Financial Statement.

Receipts.	£	s.	d.
To Balance in the Union Bank on 30th April, 1863...	3	17	5
,, Interest on £400 Government Debentures ...	20	0	0
,, Subscriptions and Entrance Fees...	88	4	0
,, Balance due to the Union Bank	6	0	4
	£118	1	9

Disbursements.	£	s.	d.
By Advertising and Printing...	10	0	6
,, Refreshments	8	0	0
,, Hire of Australian Library	25	0	0
,, Hire of Tables and Lamps	4	10	0
,, Petty Expenses, Postage Stamps, etc.	2	13	1
,, Attendance...	1	0	0
,, Commission etc. to Collector	6	18	2
,, Secretary's Salary from 1st Jan. to 31st Dec. 1863	60	0	0
	£118	1	9

	£	s.	d.
To Government Debentures	£400	0	0
By Balance overdrawn at the Union Bank	6	0	4
,, Balance	393	19	8
	£400	0	0

Election of Officers.—

President: His Excellency Sir John Young, Bart.

Vice-Presidents: Rev. W. B. Clarke and The Honorable E. Deas-Thomson, C.B.

Honorary Treasurer: J. F. Josephson, Esq.

Ordinary Members of Council: W. C. Bennett, Esq.; The Hon. Joseph Docker, Esq.; Dr. Leibius; E. S. Hill, Esq.; R. A. A. Morehead, Esq.; Professor Smith.

Honorary Secretary: W. J. Stephens, Esq.

It was decided "to republish in a separate form some of the papers which had been read before the Society." This led to the publication of the "Trans. Philos. Soc. N.S.W." (1862-5) already referred to.

The meeting then became a Conversazione.

Sixty-sixth Monthly Meeting, Hall, Australian Library, 17th August, 1864. Charles Moore Esq. in the Chair.

Members elected.—Andrew McFarland Esq., Thomas Baker Esq., Edward Bedford Esq.

Paper read.—"On improved analytic geometry, with examples of its utility in exposing the erroneous assumptions of some distinguished geometers," by Mr. Martin Gardiner. See above, p, 292.

Professor Smith made some observations "On the probable reasons that led Fahrenheit to the adoption of his peculiar thermometric scale.

It was decided to hold the meetings on the first Wednesdays in each month in future. This meeting day has been continued up to the present.

Sixty-seventh Monthly Meeting, Hall, Australian Library, 7th September, 1864. Rev. W. B. Clarke in the Chair.

Members elected.—George Smalley Esq.; Henry (C.) Russell Esq.

Papers read.—"On Australian Storms," by John Tebbutt, Junr. Esq. See "Trans. Philos. Soc. N.S.W." (1862-5), 153 – 164. The Rev. W. B. Clarke then read an elaborate review of Mr. Tebbutt's paper. *Ib.*, 165 – 177.

Mr. Justice Wise hoped that steps would be taken to publish the papers read from time to time before the Society.

He also suggested that a sub-committee be appointed, and the sum of £50 placed at its disposal for the purpose of "collecting together anything that would in any way bear upon the history, language, names, and customs of the Aborigines of Australia."

The Rev. W. B. Clarke stated that some years ago he was Secretary to the Church Board of Missions, and having collected much information concerning Aborigines, he would with pleasure place his papers at the service of the Society.

Sixty-eighth Monthly Meeting, Hall, Australian Library, 5th October, 1864. Rev. W. B. Clarke in the Chair.

Members elected.—P. F. Adams Esq., William Walker M.P., A. Stranger Leathes Esq.

Paper read.—"On Fibre bearing plants indigenous to the Colony," by Chas. Moore Esq., which he illustrated with specimens of the wood and fibre of the following plants, viz.: *Urtica gigas*, *Sterculia heterophylla*, *Hibiscus heterophyllus*, *Pimelea linifolia*, *Brachychiton luridum*, *Gymnostachys anceps*, *Phormium tenax*, *Doryanthes excelsa*, *Sida retusa*.

(Published in Trans. Philos. Soc. N.S.W., (1862-5, 204-9.)

Mr. E. S. Hill and Mr. Porter explained the manner in which the above mentioned fibres were prepared by the aborigines.

Mr. Krefft exhibited a small diamond bird, which he had received from Mr. Wilcox,[1] of the Clarence River having two peculiar detached horny rings upon its legs. Mr. Krefft also exhibited a live Frilled Lizard which he had received from Mr. Thomas Hobbs of Rockhampton.

Sixty-ninth Monthly Meeting, Hall, Australian Library, 2nd November, 1864. Sir John Young in the Chair.

Paper read.—"On Osmium and Iridium obtained from New South Wales Gold," by Dr. Leibius.

(Published in Trans. Philos. Soc. N.S.W., (1862-5, 210 – 215.)

He also exhibited specimens of pure Osmium and Iridium and their compounds.

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[1] For an account of this Collector see this Journal, XLII, 129.

Mr. Martin Gardiner then explained some notes intended as an extension of a mathematical paper read before the Society in 1862, showing a correct method of obtaining the integral area of a figure having simple and compound loops of like and unlike formations. (See above p. 292.)

Seventieth Monthly Meeting, Hall, Australian Library, 7th December, 1864. Sir John Young in the Chair.

Member elected.—Thomas Hale Esq.

On Mr. Alfred Roberts' motion it was decided that the works should be deposited in the Australian Museum until applied for by the Society. (See Council's minutes of 29th October, 1874).

Papers read.—1. "On the Prospects of the Civil Service of New South Wales under the Superannuation Act of 1864," by Honorable Lieut.-Colonel Ward.

(See Trans. Phil. Soc. N.S.W., 1862-5, 215 – 222).

2. "On the Distribution of Profits in Mutual Life Assurance Societies," by Professor Pell.

(See Trans. Phil. Soc. N.S.W., 1862-5, 223 – 236.)

3. "On our Agricultural Statistics and Supply of Food," by Christopher Rolleston Esq.

(See Trans. Phil. Soc. N.S.W., 1862-5, 236 – 244).

Seventy-first Monthly Meeting, Hall, Australian Library, 10th May, 1865. Rev. W. B. Clarke in the Chair.

Financial Statement.—

Receipts.	£	s.	d.
To Subscriptions and Entrance Fees	58	16	0
„ Interest on £400, Government Debentures ...	20	0	0
„ Balance due to the Union Bank	15	2	1
	£93	18	1

Disbursements.	£	s.	d.
By Balance due to the Union Bank 30th April, 1864	6	0	4
,, Rent of Hall of Australian Library	15	0	0
,, Rent of Chamber of Commerce	2	2	0
,, Fairfax and Sons, Advertisements	4	12	6
,, Hanson and Bennett, Advertisements	4	2	9
,, Reading and Wellbank, Printing...	1	2	6
,, Secretary's Petty Cash Account	0	18	0
,, Secretary's Salary from 1st Jan. to 31st Dec., 1864	60	0	0
	£93	18	1

	£	s.	d.
To Government Debentures	£400	0	0
By Amount overdrawn at the Union Bank	15	2	1
,, Balance	384	17	11
	£400	0	0

Election of Officers.—

President: His Excellency Sir John Young.

Vice-Presidents: Rev. W. B. Clarke and The Honorable E. Deas-Thomson, C.B.

Council of Management: W. C. Bennett, Esq.; Gerard Krefft, Esq.; Dr. Leibius; R. A. A. Morehead, Esq.; George Smalley, Esq.; Professor Smith, M.D.

Honorary Secretary: W. J. Stephens, Esq.

Honorary Treasurer: Edward Bedford, Esq.

Paper read.—"On the Transmutation of Rocks in Australasia," by Rev. W. B. Clarke, illustrated by a large collection of specimens of the various rocks. Also by photographic views taken by Professor Smith and Mr. Hunt of several of the localities alluded to in the paper.

(See Proc. Phil. Soc. N.S.W., 1862-5, 267 – 308.)

Seventy-second Monthly Meeting, Hall, Australian Library, 7th June, 1865. George R. Smalley Esq. in the Chair.

Members elected.—Edward Ramsay Esq., Edward Cracknell Esq., M. E. Murnin Esq.

Seventy-third Monthly Meeting, Hall, Australian Library, 5th July, 1865. George R. Smalley Esq. in the Chair.

Members elected.—Rev. William Stack, James Barnet Esq.

Paper read.—"On the Oology of Australia," by Edward Ramsay Esq., which he illustrated by frequent reference to a large collection of stuffed birds, birds' eggs and nests, also to two plates of engravings of eggs by Mr. Edward Forde.

(See Trans. Phil. Soc. N.S.W., 1862-5, 309 – 329).

Seventy-fourth Monthly Meeting, Hall, Australian Library, 2nd August, 1865. Rev. W. B. Clarke in the Chair.

Papers read.—1. "On the Theory of Encke's Comet," by George R. Smalley Esq.

(See Trans. Phil. Soc. N.S.W., 1862-5, 330 – 338.)

2. "On the Manners and Customs of the Natives of the Lower Murray and Darling," by Gerard Krefft.

(See Trans. Phil. Soc. N.S.W., 1862-5, 357 – 374; the last paper in the volume.)

Seventy-fifth Monthly Meeting, Hall, Australian Library, 6th September, 1865. Rev. W. B. Clarke in the Chair.

Papers read.—1. "On the Defences of Port Jackson," by G. A. Morrell Esq., illustrated by maps of the Harbour and plans of the proposed Fortifications.

(See Trans. Phil. Soc. N.S.W. 1862-5, 245 – 266.)

2. "On the Geological Position of the Petroleum Coal," by William Keene Esq., illustrated with numerous specimens.

Seventy-sixth Monthly Meeting, Hall, Australian Library, 11th October, 1865. Rev. W. B. Clarke in the Chair.

Report of the Committee of the Philosophical Society appointed by the Council, July 26th, 1865, to consider the question of altering the title of the Society to that of "The Royal Society of New South Wales," adopted by the Council on the 27th September:—

(1) Considering the languishing condition of this Society, we are of opinion that some effort should be made to restore its vitality and raise it to that important and useful position that it ought to occupy.

(2) It is not easy to account satisfactorily for the decline of this Society. We do not believe that it arises from a general indifference to Art and Science, but there is good reason to suppose that many are deterred from taking a direct interest in its proceedings by the conviction that the subjects discussed are of that abstruse and abstract character that few have had time or opportunity to study; and that there are no general or useful results to be derived from it.

(3) The principal cause of this impression may be traced to the present title of the Society, which assigns to it an exclusiveness by which many are deterred from becoming members.

(4) If then, as we consider a change of name desirable, the question arises, "What shall we adopt in its place"? Now in a British Colony we naturally incline to follow the precedent of Great Britain and its principal Dependencies, and in conformity with the course pursued in "England, Scotland, Ireland, Victoria, and Tasmania," we recommend that "the Philosophical Society" should adopt the more comprehensive and expressive title of "the Royal Society of New South Wales."

(5) So far as we can learn, there appears to be no difficulty in effecting the proposed transformation. The principal formality will be to petition His Excellency the Governor to sanction, on behalf of Her Majesty, the desired alteration of title.

(6) The actual details of the new Society should be the subject of future discussions; at present we suggest the following outline which will serve as a basis for future amendments:—

I. The Royal Society should consist of *Fellows* and *Associates*.

The former might, in the first instance, be selected by His Excellency the Governor, and subsequently as vacancies occurred, or additional Fellowships were determined upon, such selections would be made by the existing Fellows from the Associates.

II. The Associates would pay the same Fees as at present, but a larger contribution might be required from the Fellows.

III. The Society might be subdivided into Sections, after the fashion of the British Association; each Section having its own President and time of meeting, but subject to the general government of the Royal Society and enjoying the same advantages.

IV. The common fund of the Society should be employed, after defraying current expenses in the monthly publications of its transactions; the awarding pecuniary assistance to scientific expeditions; and the encouragement of Art and Science by the offer of rewards and medals for Colonial energy.

V. It should be a great object with the Society to obtain a fixed establishment of its own—consisting of a resident secretary, with the advantages of a Library—forming in fact a sort of Scientific Club. "Unity is strength" and we cannot but think that the other learned societies of Sydney will be willing to combine under one common system which would beneficially influence their future prosperity, and would in no way diminish their present independence.

(Signed) George R. Smalley
August 30th, 1865. Ed. Bedford.

The adoption of the above report having been moved by George R. Smalley Esq. and seconded by Ed. Bedford Esq. was put by the Chairman to the meeting and carried.

It was then moved by W. J. Stephens Esq., seconded by Chris. Rolleston Esq., and carried, that a Sub-Committee be appointed to draw up a code of Rules and Regulations for the proposed Royal Society of New South Wales, and to submit the same for the consideration of the Philosophical Society at their next monthly meeting.

And that such Committee consist of the Rev. W. B. Clarke, Professor Smith, Edward Bedford Esq., Chris. Rolleston Esq., J. F. Josephson Esq., Wm. McDonnell Esq., G. Morrell Esq., G. R. Smalley Esq.

Paper read.—"On certain possible relations between geological changes and astronomical observations," by George R. Smalley Esq.

(See Trans. Phil. Soc. N.S.W., 1862-5, 338 – 346.)

Seventy-seventh Monthly Meeting, Hall, Australian Library, 1st November, 1865. Rev. W. B. Clarke in the Chair.

Member elected.—G. A. Morell Esq.

Proposed change of title of the Philosophical Society of N.S. Wales.

At a General Meeting of the members of the Philosophical Society, held on 1st November, and adjourned to the 8th November, it was resolved and finally confirmed on the 6th December:—

1. That the Philosophical Society shall from the 1st of May, 1866, be called the ROYAL SOCIETY OF NEW SOUTH WALES, subject to the sanction of the Governor.

2. All members of the Philosophical Society, who have paid their subscription at the date of the Governor's sanction to the change of title shall be considered members of the ROYAL SOCIETY OF NEW SOUTH WALES.

The following were then passed as the fundamental rules for the Royal Society of New South Wales:—

Objects of the Society.

1. The object of the Society is to receive at its stated meetings original papers on subjects of Science, Art, Literature, and Philosophy, and especially on such subjects as tend to develop the resources of Australia and to illustrate its Natural History and Productions.

President.

2. The Governor of New South Wales shall be *ex officio*, the President of the Society.

Other Officers.

3. The other officers of the Society shall consist of two Vice-Presidents, a Treasurer, and two or more Secretaries, who, with six other members shall constitute a Council for the management of the affairs of the Society.

Election of Officers.

4. The Vice Presidents, Treasurer, Secretaries, and the six other members of Council, shall be elected annually at an Annual General Meeting in the month of May.

Vacancies during the Year.

5. Any vacancies occurring in the Council of Management during the year, may be filled up by the Council.

Fees.

6. The entrance money paid by members on their admission shall be One Guinea; and the annual subscription to be One Guinea, payable in advance. The sum of Ten Pounds may be paid at any time as a composition for the ordinary annual payment for life.

Honorary Members.

7. The Honorary Members of the Society shall be persons who have been eminent benefactors to this or some other of the Australian Colonies, or distinguished patrons and promoters of the objects of the Society. Every person proposed as an Honorary Member must be recommended by the Council and elected by the Society. Honorary Members shall be exempted from payment of fees and contributions, they may attend the meetings of the Society, and shall be furnished with copies of transactions and proceedings, published by the Society, but they shall have no right to hold office, to vote, or otherwise interfere in the business of the Society.

Confirmation of Bye-Laws.

8. Bye-laws proposed by the Council of Management shall not be binding until ratified by a General Meeting.

Alteration of Fundamental Rules.

9. No alteration or addition to the Fundamental Rules of the Society shall be made, unless carried at two successive General Meetings.

Note.—*The Bye-laws of the Philosophical Society will be considered at the outset the Bye-laws of the Royal Society.*

Adjourned Meeting, Hall, Australian Library, 8th November, 1865. Rev. W. B. Clarke in the Chair.

Paper read.—"On the Geology and Capabilities of the Cape York Peninsula," by Alex. Rattray Esq., M.D.

Adjourned Meeting, Hall, Australian Library, 6th December, 1865. Chris. Rolleston Esq. in the Chair.

Members elected.—Grafton Ross Esq., J. Winnington Esq., Rev. A. H. Wyatt.

Paper read.—"On the present state of Astronomical, Magnetical and Meteorological Science, and the practical bearings of those Subjects," by G. R. Smalley Esq.

(See Trans. Phil. Soc. N.S.W., 1862-5, 347 - 356. This is the paper of latest date, published in the volume in question.)

A letter was read from Mr. Joseph Chambers, addressed to Mr. Charles Moore, in reference to a cave of the aborigines on the Goulburn River.

The rules of the Society were finally amended and approved.

Seventy-eighth Monthly Meeting, Hall, Australian Library, 16th May, 1866. George R. Smalley in the Chair.

Financial Statement:—

RECEIPTS.	£	s.	d.
To Subscriptions and Entrance Fees	67	2	0
,, Cash per Sale of One Government Debenture ...	91	12	0
,, Interest on Government Debentures	17	10	0
,, Balance due to Union Bank	33	7	1
	£209	11	1

Disbursements.	£	s.	d.
By Balance due to the Union Bank on 30th April, 1865	15	2	1
,, Rent of Hall of Australian Library	22	2	0
,, Fairfax and Sons, Advertisements	7	2	0
,, Hanson and Bennett, Advertisements	6	9	0
,, Reading and Wellbank, Printing Account ...	105	11	6
,, Edward Ramsay Esq., Lithographs	6	10	0
,, Petty Cash, Postage Stamps, etc....	1	10	6
,, W. H. Ingram, Collection	5	4	0
,, Secretary's Salary from 1st Jan. to 31st Dec., 1865	40	0	0
	£209	11	1
To Government Debentures	£300	0	0
By Amount overdrawn at the Union Bank	33	7	1
,, Balance	266	12	11
	£300	0	0

(Signed) Edward Bedford, Treasurer.

Officers Elected:—

President: His Excellency Sir John Young.

Vice-Presidents: Rev. W. B. Clarke; The Honorable E. Deas-Thomson Esq.

Council: Dr. Cox; Gerard Krefft Esq.; F. B. Miller Esq.; Charles Moore Esq.; Professor Pell; Professor Smith.

Hon. Secretaries: W. J. Stephens Esq.; G. A. Smalley Esq.

Hon. Treasurer: Edward Bedford Esq.

Member elected.—William Ford Esq.

It was resolved to move His Excellency the Governor to seek the Queen's assent to change the name of the Society from Philosophical Society to that of Royal Society of New South Wales.

Seventy-ninth Monthly Meeting, Hall, Australian Library, 6th June, 1866. Professor Smith in the Chair.

Eightieth Monthly Meeting, Hall, Australian Library, 4th July, 1866. Professor Smith in the Chair.

Paper read.—"On the Ornithology of Lake George," by Mr. Edward Ramsay, which he illustrated with numerous specimens of skins and eggs.

Eighty-first Monthly Meeting, Hall, Australian Library, 1st August, 1866. Professor Smith in the Chair.

Papers read.—1. "Preliminary remarks on the Magnetical Survey of New South Wales," by Mr. Smalley, which he illustrated with diagrams and magnetical instruments.

2. "On the dentition of *Thylacoleo carnifex*," by Mr. Gerard Krefft, which he illustrated with fossils and models.

At this meeting

"Some conversation then followed on the subject of a Scientific Congress. . . . The Chairman said he had no doubt that at some future time there would be an Australian Association for the Advancement of Science, but he did not suppose we had the material for it yet. If anything was done now it would have to be done in connection with some other attraction, such as the Exhibition, which would bring a large number of persons together. Dr. Bedford concurred with the chairman. The proposal was more likely to be carried into effect in Melbourne than in Sydney, for the Exhibition there would collect a large number of persons interested in science and art, and they might use the intervals of leisure which they then only possessed in the way proposed. We were not yet ripe for the complete arrangements such as were carried out in the British Association at home. If anything of the kind were attempted it would be definitely arranged beforehand, and that they should be of a practical character, such for example as the coal formations of Australia, or the extraction of gold from quartz, not merely by machinery, but also by chemical processes. After some other observations of similar purport, the matter was allowed to drop. On the motion of Mr. G. A. Smalley, a vote of thanks was given to the Rev. Dr. Bleasdale and Mr. Knight for their attendance, and for the information which they had communicated in reference to the proposed Congress."

Eighty-second Monthly Meeting, Hall, Australian Library, 12th September, 1866. Professor Smith in the Chair.

Paper read.—" Remarks on the support of the young of Marsupial Animals in the pouch," by Edward Bedford Esq., which he illustrated by a diagram and various Marsupial bones.

Eighty-third Monthly Meeting, Hall, Australian Library, 3rd October, 1866. William Bland Esq. in the Chair.

Paper read.—"On the Genus *Trigonia*, with remarks on the relative position of the living species found in the Australian Seas to the fossil species found in the strata of the Old World," by Dr. Cox, which he illustrated with various diagrams and cabinet specimens.

Eighty-fourth Monthly Meeting, Hall, Australian Library, 7th November, 1866. Professor Smith in the Chair.

Papers read.—1. "Remarks concerning a new species of *Fagus*," by Charles Moore Esq., which he illustrated with dried specimens and a polished section of the wood. (He proposed the name *F. Carroni*, which Bentham subsequently, considering it *nomen nudum*, changed to *F. Moorei*.)

2. "On the Classification of the Small Marsupial Insectivora," by Gerard Krefft Esq., which he illustrated with numerous stuffed specimens and the skulls of the animals.

Eighty-fifth Monthly Meeting, Hall, Australian Library, 12th December, 1866. Rev. W. B. Clarke in the Chair.

The Secretary then read:—

November 15th, 1866.

I am directed by the Governor to forward the enclosed copy of a despatch received by the last mail from the Secretary of State, and to say that His Excellency has much pleasure in transmitting it to you for the information of the Philosophical Society.

I have, etc ,

(Signed) F. TURVILLE.

To W. H. CATLETT Esq , Secretary, Philosophical Society.

(Copy of Despatch).

New South Wales. Downing Street,

No. 10. 24th September, 1866.

I have received your Despatch No. 37 of the 10th of June, requesting on behalf of the members of the Philosophical Society of New South Wales, of which you are the President, that Her Majesty will be pleased to permit that Society to assume the title of the Royal Society of New South Wales.

Having laid this application before the Queen, I have much pleasure in informing you that Her Majesty has been graciously pleased to signify Her Assent to it, and to sanction and approve of the Philosophical Society in future assuming the title of "The Royal Society of New South Wales "

I have, etc ,

(Signed) CARNARVON.

Governor, The Right Honourable Sir JOHN YOUNG, Bt., K.C.B.

The Rev. W. B. Clarke exhibited two species of Fossiliferous *Trigonia* found in the Inferior Oolite of Western Australia, in order to correct a statement made at a recent meeting of the Society to the effect that only living specimens of the genus have hitherto been found in Australia.

Paper read.—"On our Condition and Resources," by Mr. Christopher Rolleston.

The Philosophical Society of New South Wales, after holding 85 monthly meetings then adjourned, (as the Royal Society of New South Wales) for its usual vacation.

Microscopical Committee (or Section).

Established at the monthly meeting of 11th May, 1859. See p. 279.

Following is an abstract of the minutes of the Committee:

22nd June, 1859. Met at 6 p.m. at Australian Library.

Rev. G. E. Turner was added to the Committee.

It was decided to meet at 8 p.m. in future.

Paper read.—"Describing a convenient mode of applying Canada Balsam in mounting microscopic objects," by Alfred Roberts Esq. It was decided to lay it on the table at the next meeting of the Society. It was read, see p. 280.

Exhibits.—The Rev. W. B. Clarke exhibited some beautiful specimens of fossil Entomostraca and other minute shells, and Mr. Alfred Roberts some injected specimens of portions of the intestinal tube from the black snake and from a *Hydropis bicolor*, also some varieties of *Pleurostigma* from Port Jackson.

27th July, 1859, Australian Library, 8 p.m.

Paper read.—"On the adulteration of Milk in Sydney," by Dr. Williams.

7th September, 1859, Hall, Australian Library, 8 p.m.

Paper read.—A paper was read by the President, His Excellency Sir William Denison, explanatory of the microscopic objects he had mounted and laid before the meeting, viz:—Tongues of two *Siphonaria*, *Chiton*, *Chitonellus*, *Risella*, *Turbo*, *Radius*, *Nerita*, and two *Patellas*.

Exhibits.—His Excellency also laid upon the table two photographs of microscopic specimens of sections of wood taken and mounted by Mr. Dalton.

Captain Ward also exhibited several photographs of microscopic specimens of sections of wood taken by himself.

Joseph Burgon Esq. exhibited various forms of Desmidians.

Alfred Roberts Esq., a collection of Diatomaceæ.

5th October, 1859 (Wednesday), Hall, Australian Library. H. H. Browne Esq. in the Chair.

The exhibits included those of Alfred Roberts Esq., of transverse and longitudinal sections of *Sphœria Robertsi*, and a longitudinal section of a tooth of a diamond snake. Captain Ward, R.E., six sectional specimens of Australian woods, mounted in balsam, with their photos. Mr. Henry A. Severn also exhibited several sectional specimens of Australian woods.

2nd November, 1859 (Wednesday).

Alfred Roberts Esq. laid before the meeting specimens of siliceous Orbitoloids dredged up at Cape Byron, N.S.W. by one of the officers of the "Iris" on her last cruise.

7th December, 1859 (Wednesday).

A "Report on Flour and Bread" was furnished to the Society by the Committee which had undertaken the examinations for the adulteration of food.

6th June, 1860 (Wednesday). Meeting lapsed for want of quorum.

4th July, 1860 (Wednesday). At Australian Library.

Diatomaceæ chiefly shown.

1st August, 1860. No quorum because of the inclemency of the weather.

5th September, 1860.

His Excellency Sir William Denison exhibited a set of scales cut by Mr. A. Tornaghi of Sydney for measuring microscopic objects.

3rd October, 7th November and 5th December, 1860, the entries are "Meeting lapsed for want of a quorum." The lapse in November is attributed to the inclemency of the weather.

I can find no more entries, and as Sir William Denison, who instigated the formation of the Committee, and warmly supported it, shortly afterwards left the Colony, the Committee probably lapsed.

11. The Royal Society of New South Wales, (12th December, 1866 – .)

It seems proper to record the 12th December, 1866, the date on which the Royal Assent was communicated to a meeting of the Society, as the new birthday of the Royal Society of New South Wales.

(The following abstract of minutes, almost exclusively of the monthly meetings, are from June 1867 until January 1875, after which date abstracts began to be published in each annual volume).

The minutes of the Council Meeting of 17th June, 1867, record—"The Secretary was instructed to furnish Mr. Clarke with the necessary documents to enable him to write an Historical Sketch of the Society from the commencement." (Later Council Minutes are given below, p. 338). The result of this was the "Inaugural Address to the Royal Society delivered at its first meeting, 9th July, 1867, by the Revd. W. B. Clarke, M.A., F.G.S., etc., Vice-President,"[1] and which is the best account we have of the history of the Society.

First Monthly Meeting, Hall, Australian Library, 9th July, 1867. Sir John Young in the Chair.

Rev. W. B. Clarke, M.A., Vice-President, read the Inaugural Address. It is printed in Vol. I, and contains a valuable historical summary of the Society from its foundation.

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[1] Trans. Roy. Soc. N. S. Wales, for year 1867, Vol. I, p. 1, (1868).

Financial Statement:—

Receipts.	£	s.	d.
To Subscriptions	43	12	0
„ Cash from the sale of two Government Debentures	182	3	2
„ Interest from Government Debentures	7	10	0
	£233	5	2

Disbursements.	£	s	d.
By Balance due to the Union Bank on 30th April, 1866	33	7	1
„ Rent of Hall of Australian Library	16	16	0
„ Fairfax and Sons—Advertisements	4	0	0
„ Hanson and Bennett	4	0	0
„ Reading and Wellbank—Printing and Binding the Transactions of the Society...	98	10	0
„ Cubitt—Diagrams for the Society...	4	10	0
„ Petty Cash, Postage Stamps, etc....	1	15	7
„ Secretary's Salary from 1st Jan. to 31st Dec. 1866	40	0	0
„ Balance in the Union Bank	30	6	6
	£233	5	2

To one Government Debenture	£100	0	0
„ Balance in the Union Bank	30	0	0
By Balance	£130	6	6

(Signed) Ed. Bedford, Treasurer.
W. H. Catlett, Secretary.

The list of office bearers will be found printed in Vol. I.

Second Monthly Meeting, Hall, Australian Library, 7th August, 1867. G. R. Smalley in the Chair.

Members elected.—T. J. Jaques Esq., Walter Adams Esq., James Thompson Esq., Treasury; W. C. Windeyer Esq., M.P., Alex. M. Thomson Esq., University; Dr. Sydney Jones, The Hon. F. Lord Esq., M.L.C., Arthur M. Allen Esq., Dr. Belinfante, 7 Wynyard Square; Captain Purcell, R.A., Dr. Alston, Victor A. Prout Esq., P. B. Walker Esq., Telegraph Office.

Two letters "On Light non-luminous, dated respectively the 21st December, 1866 and 10th January, 1867," addressed to the Rev. W. B. Clarke by Mr. Robert Adams were read by the Chairman.

A nearly complete set of Proceedings of the Royal Geographical Society was presented by His Excellency the President.

Paper read.—" On Non-Linear Co-resolvents," by the Honorable Chief Justice Cockle, F.R.S. (Read by Mr. Martin Gardiner.)

(Printed in Trans. Roy. Soc. N.S.W., I, 27 – 30.)

From this onwards the papers read at the monthly meetings were regularly printed in the annual volume.

Third Monthly Meeting, Hall, Australian Library, 4th September, 1867. Rev. W. B. Clarke in the Chair.

Member elected.—A. B. Weigall Esq.

In consequence of Mr. Wuth's paper "On Bones found in a Cave at Glenorchy, Tasmania, having been printed in the Colonial Monthly and Australian Magazine, the paper was not read, but "Remarks on Mr. Wuth's paper" was read by Gerard Krefft Esq, which he illustrated by numerous osteological remains.

Paper read.—"On the Auriferous and other Mineral Districts of Northern Queensland," by Rev. W. B. Clarke, which he illustrated by photographs of the localities.

Fourth Monthly Meeting, Hall, Australian Library, 9th October, 1867. G. R. Smalley Esq., in the Chair.

Members elected.—Howard Reed Esq., R. D. Ward Esq.

Paper read.—" On the reappearance of Scurvy in the Merchant Service," by Edward Bedford Esq.

Fifth Monthly Meeting, Hall, Australian Library, 6th November, 1867. Rev. W. B. Clarke in the Chair.

Members elected.—The Honorable T. A. Murray Esq., and R. M. Forster Esq.

Paper read.—"On the Rates of Mortality and the expectation of Life in New South Wales as compared with England and other Countries," by Professor Pell.

It was moved by Mr. Smalley and seconded by Professor Smith, and carried, "That the Secretaries of the Royal Society be requested to communicate with the Colonial Secretary with a view of obtaining such extra clerical assistance as shall enable the Registrar General to reduce and finish the Statistics in his office so far as they relate to the number of individuals of all ages that have died in each successive year, and such collateral information as may supply complete Tables of Mortality and expectation of Life in New South Wales."

Notes on the Geology of the Mary River, Queensland, were then read by the Rev. W. B. Clarke.

Sixth Monthly Meeting, Hall, Australian Library, 4th December, 1867. Rev. W. B. Clarke in the Chair.

Members elected.—John Gowland Esq., R.N., and Rev. Dr. Lang, D.D. M.P.

Papers read.—1. "On the Mutual Influence of Clock Pendulums under certain conditions," by G. R. Smalley Esq., which he illustrated by various experiments upon two clocks from the Observatory.

2. "On the Source of the Sun's Light and Heat," by Frederick S. Peppercorne Esq.

Seventh Monthly Meeting, Hall, Australian Library, 3rd June, 1868. His Excellency the Earl of Belmore in the Chair.

Office-bearers were elected for the year 1868. (See Vol. I.)

Member elected.—Mr. F. Allerding.

Financial Statement:—

Receipts.	£	s.	d.
To Balance in the Union Bank on 30th April, 1867	30	6	6
,, Subscriptions and Entrance Fees...	79	16	0
,, Interest from Government Debenture	5	0	0
	£115	2	6

Disbursements.	£	s.	d.
By Rent of Hall of Australian Library	12	12	0
,, Fairfax and Sons—Advertisements	4	4	0
,, Samuel Bennett—Advertisements	3	19	9
,, Reading and Wellbank, Printing Account ...	7	3	6
,, Commission to Collector	1	16	9
,, Petty Cash, Postage Stamps	1	1	3
,, Gratuity to Messenger	1	1	0
,, Assistant Secretary's Salary for the year ending 31st December, 1867	40	0	0
,, Balance in the Union Bank	43	4	3
	£115	2	6

To one Government Debenture	£100	0	0
,, Balance in the Union Bank	43	4	3
	£143	4	3

Mr. G. R. Smalley (Vice-President) read an opening address (See Vol. 1868, p. 1).

Eighth Monthly Meeting, Hall, Australian Library, 1st July, 1868. Rev. W. B. Clarke in the Chair.

Members elected.—M. Metcalfe Esq., Henry Halloran Esq., Rev. James Graham, John Fairfax Esq., Alfred Roberts Esq., Charles Mayes Esq., E. H. O'Neil Esq., Dr. Belisario, Dr. Brereton, E. Reading Esq., Major Roberts, Rev. William Roberts, Thomas Richards Esq.

G. R. Smalley exhibited the Earth Thermometers about to be employed at the Sydney Observatory, and read a short paper "On the value of earth temperatures."

Ninth Monthly Meeting, Hall, Australian Library, 5th August, 1868. Rev. W. B. Clarke in the Chair.

Members elected.—Wm. Tucker Esq., Clifton, North Shore; Fredk. Tooth Esq., Montague Scott Esq., Captain Hovell, Goulburn; Dr. Paterson, LL.D., Rev. Dr. Begg, Rev. Cave-Brown-Cave, A. Hordern Esq., J. D. Comrie Esq., E. Twynam Esq., E. T. Beilby Esq.

Paper read.—"On Improvements effected in modern Museums in Europe and Australia," by Mr. Krefft, which he illustrated by numerous photographs.

Adjourned Monthly Meeting, Hall, Australian Library, 14th August, 1868. Professor Smith in the Chair.

Paper read.—"On the Hospital requirements of Sydney," by Mr. Alfred Roberts, which he illustrated with drawings and plans of hospitals. (This was an historical paper, the author being, more than any other man, the founder of the Royal Prince Alfred Hospital).

Tenth Monthly Meeting, Hall, Australian Library, 2nd September, 1868. Rev. W. B. Clarke in the Chair.

Members elected.—The Honorable Sir William Macarthur M.L.C., J. R. Fairfax Esq., Andrew Garran Esq., Charles Miles Esq., Charles Nathan Esq., Judge Francis.

Paper read.—"On the cause and phenomena of Earthquakes, especially in relation to shocks felt in Australasia," by Rev. W. B. Clarke, which he illustrated by coloured maps and diagrams.

Eleventh Monthly Meeting, Hall, Australian Library, 14th October, 1868. Christopher Rolleston Esq. in the Chair.

Members elected.—Charles Campbell Esq., C. Goodchap Esq., F. Senior Esq.

Paper read.—"On the Water Supply of Sydney," by Professor Smith, which he illustrated by maps and diagrams.

(This was beginning to be an acute question. From this and subsequent papers, it will be seen that consideration of it formed an important part of the work of this Society).

Twelfth Monthly Meeting, Hall, Australian Library, 11th November, 1868. Edward Bedford Esq. in the Chair.

Moved by Henry Russell Esq., seconded by F. Miller Esq., and carried, "That in future there shall be *pro forma* a ballot upon the admission of every member of the Royal Society of New South Wales."

Members elected.—Wm. J. MacDonnell Esq., Walter Dickinson Armstrong Esq., Thomas Holt Esq.

Paper read.—"On the distribution of the Australian Volutes," by Dr. Cox, which he illustrated by a fine collection of Volutes.

Thirteenth Monthly Meeting, Hall, Australian Library, 2nd December, 1868. Professor Smith in the Chair.

Member elected.—Hugh Paterson Esq.

Papers read.—1. "Results of Wheat Culture in New South Wales during the last Ten Years," by Chris. Rolleston Esq. 2. "Remarks on the Dry Earth System of Conservancy," by Edward Bedford Esq.

Moved by Alfred Roberts Esq., seconded by Charles Mayes Esq., and carried, "That a Committee consisting of Mr. Cracknell, Mr. Rolleston, and Mr. Bedford be appointed to draw up a report on the system dealt with in Mr. Bedford's report, and that the report be forwarded to the Government for their consideration."

Adjourned Monthly Meeting, Hall, Australian Library, 9th December, 1868. Professor Smith in the Chair.

Paper read.—"On Pauperism of New South Wales, past, present and future," by Mr. Alfred Roberts.

Fourteenth Monthly Meeting, Hall, Australian Library, 12th May, 1869. Rev. W. B. Clarke in the Chair.

Opening address read by the Rev. W. B. Clarke. (See Vol. III, 1869, p. 1).

Paper read.—"A Review of the progress of Lands Titles Registration in New South Wales," by Mr. G. K. Holden.

Financial Statement:—

Receipts.	£	s.	d.
To Balance in the Union Bank	43	4	3
,, Subscriptions and Entrance Fees	93	9	0
,, Interest from Government Debentures	5	0	0
	£141	13	3

Disbursements.	£	s.	d.
By Rent of Hall of Australian Library	18	18	0
,, Fairfax and Sons—Advertisements	7	1	2
,, Samuel Bennett—Advertisements	6	16	3
,, F. White, Printing Transactions	17	2	6
,, Hire of Tables and Lamps	5	15	0
,, Compagnoni, Refreshments	14	0	0
,, Petty Expenses	3	10	6
,, Commission to Collector	4	4	8
,, Assistant Secretary's Salary	40	0	0
,, Balance in the Union Bank on 30th April, 1869	24	5	2
	£141	13	3

To One Government Debenture	£100	0	0
,, Balance in the Union Bank	24	5	2
	£124	5	2

Office-bearers were elected for the year 1869-70.

Adjourned Meeting, Chamber of Commerce, 17th May, 1869. G. R. Smalley in the Chair.

Paper read,—1. "On the Water Supply of Sydney from George's River and Cook's River," by Mr. Chas. Mayes, which he illustrated with diagrams. 2. "On the results of the Chemical Examination of Water for the Sydney Water Commission," by Professor Smith.

Fifteenth Monthly Meeting, Hall, Australian Library, 2nd June, 1869. Professor Smith in the Chair.

Member elected.—S. L. Bensusan Esq.

Papers read.—1. "An analytical solution to Sir William Hamilton's problem on the inscription of closed n′gon's in any quadric." 2. "Important new theorem in the geometry of Three Dimensions." 3. "An exposition of the American method of levelling for Sections—its superiority to the English and French methods as regards actual field practice and subsequent plotting of the Section." (All read by Martin Gardiner Esq.)

Sixteenth Monthly Meeting, Hall, Australian Library, 2nd June, 1869. His Excellency the Earl of Belmore in the Chair.

Paper read.—"On the Electric Telegraph between England and India, and how to connect the Australian Colonies with the Telegraphic Systems of Europe and America," by Mr. E. C. Cracknell, which he illustrated by 12 electric batteries representing 12 repeating stations on the proposed circuit between Sydney and London, and by diagrams.

Seventeenth Monthly Meeting, Hall, Australian Library, 5th August, 1869. Rev. W. B. Clarke in the Chair.

Member elected.—Mr. G. A. Mansfield.

Paper read.—"On the Geological Structure of the country around Goulburn," by Dr. Thomson, which he illustrated by a geological map of the County of Argyle and by specimens of the rocks and fossils.

Eighteenth Monthly Meeting, Chamber of Commerce, 1st September, 1869. Rev. W. B. Clarke in the Chair.

Members elected.—William Bell Esq., James Sutherland Mitchell Esq., S. Franck Esq., George Thorne Esq., junior.

Paper read.—"On the Origin and Migrations of the Polynesian Nation, demonstrating their discovery and progressive settlement of the Continent of America," by the Rev. Dr. Lang.

Nineteenth Monthly Meeting, Chamber of Commerce, 6th October, 1869. Edward Bedford Esq. in the Chair.

Members elected.—W. A. Duncan Esq., Rev. C. Bode, J. H. L. Scott Esq., J. Williams Esq.

Paper read.—"Improved Solutions to important problems in Trigonometrical Surveying," by Mr. Martin Gardiner.

"The Chairman called the attention of the meeting to a Botanical Abstract published in the Proceedings of the Royal Society of Tasmania, in reference to the time of the leafing, flowering and fruiting of a few standard plants in the Royal Society's Gardens, Hobart Town, and suggested that it would be very interesting if a similar abstract was made in this Colony. Mr. Moore undertook to carry out the Chairman's suggestion."

(I cannot trace that Mr. Abbott's phenological observations, which were the earliest in Australia, were added to in New South Wales).

Twentieth Monthly Meeting, Chamber of Commerce, 3rd November, 1869. G. R. Smalley Esq. in the Chair.

Member elected.—Mr. John Edye Manning.

Mr. Moore intimated to the meeting that he had prepared a paper on the leafing and flowering of shrubs in New South Wales, which he would have much pleasure in putting before the Society at an early meeting. (If this paper was published, it must have been in the daily press).

Paper read.—"On the Origin and Migrations of the Polynesian Nation, demonstrating their discovery and progressive settlement of the Continent of America," (2nd Part) by Rev. Dr. Lang.

Twenty-first Monthly Meeting, Chamber of Commerce, 1st December, 1869. Rev. W. B. Clarke in the Chair.

Member elected.—Alfred de Lissa Esq.

Papers read.—1. "On the refining of Gold by means of Chlorine Gas," by F. B. Miller Esq., which he illustrated with a diagram showing the furnaces and apparatus for generating the chlorine gas, and conveying it into the molten gold, and with samples of gold in the unrefined and refined condition, and with the silver extracted from it.

2. "On a new apparatus for reducing Chloride of Silver," by Dr. Leibius, which he illustrated with slabs of fused Chloride of Silver and the apparatus for reducing them to a metallic state in the shape of a galvanic battery arranged in pairs, consisting of plates of chloride of silver and zinc.

Adjourned Meeting, Chamber of Commerce, 8th December 1869. G. R. Smalley in the Chair.

Members elected.—Dr. Mildred Creed, F. W. Elliott Esq.

Papers read.—"On the Origin and Migrations of the Polynesian Nation, demonstrating their discovery and progressive settlement of the Continent of America," by the Rev. Dr. Lang. (3rd Part).

"Remarks on his Tables for calculating the Humidity of the Air," by H. C. Russell Esq.

Twenty-second Monthly Meeting, Chamber of Commerce, 25th May, 1870. G. R. Smalley in the Chair.

Office-bearers were elected for 1870-1.

Financial Statement:—

Receipts.	£	s.	d.
To Amount in the Union Bank on 30th April, 1869	22	5	2
,, Subscriptions and Entrance Fees...	94	0	0
,, Interest on Government Debenture	5	0	0
	£123	5	2

Disbursements.	£	s.	d.
By Rent of Hall Australian Library...	6	6	0
,, Rent of Room from the Exchange Company ...	14	14	0
,, Fairfax and Sons, Advertisements	6	9	11
,, Samuel Bennett, Advertisements	5	13	9
,, White, Printing Transactions, etc.	28	7	0
,, W. H. Ingram, Collector	2	12	6
,, Assistant Secretary's Salary	40	0	0
,, Petty Expenses, Postage Stamps, etc.	14	10	8
,, Balance in Union Bank on 30th April, 1870 ...	4	11	4
	£123	5	2

To One Government Debenture	£100	0	0
,, Balance in the Union Bank	4	11	4
	£104	11	4

Members elected.—W. F. Cape Esq., Richard Binnie Esq., F. W. Hill Esq., Thomas Rowe Esq.

The Rev. W. B. Clarke, Vice-President, then read an opening Address. (See Vol. IV, 1870, p. 1).

Twenty-third Monthly Meeting, Chamber of Commerce, 15th June, 1870.

Members elected.—Charles Edward Pilcher Esq., Dr. Harteman.

Paper read.—"On Government Savings Banks, Friendly Societies and Government Life Assurance and Annuity Offices," by Mr. Rolleston.

Twenty-fourth Monthly Meeting, Chamber of Commerce, 6th July, 1870. Rev. W. B. Clarke in the Chair.

Member elected.—Colin Fraser Esq.

Paper read.—"Remarks on the Report of the Water Commission with special reference to the George's River Scheme," by Dr. Garran. (The subject bulks largely during the next few weeks).

Adjourned Meeting, Chamber of Commerce, 14th July, 1870. Professor Smith in the Chair.

The death of Mr. G. R. Smalley who had done so much for the Society was announced.

The debate on Dr. Garran's paper (remarks on the report of the Water Commission, especially with reference to the George's River Scheme) was resumed.

Adjourned Meeting, Chamber of Commerce, 21st July, 1870. Professor Smith in the Chair.

Continuation of the discussion on the Sydney Water Supply.

Twenty-fifth Monthly Meeting, Chamber of Commerce, 3rd August, 1870. Rev. W. B. Clarke in the Chair.

Members elected.—Rowland Hill Esq., Dr. Arthur Renwick, Walter W. Spencer Esq., Thomas Croudace Esq., A. H. Richardson Esq.

Moved by the Rev. W. B. Clarke, seconded by Dr. Thomson and carried, "That the Royal Society of New South Wales, at this its first meeting after the death of the late G. R. Smalley Esq., desires to express its sympathy with his family, and to record in its minutes their regret at his loss, and a deep sense of the valuable services which he rendered to the Society during his connection with it."

The debate on the Sydney Water Supply was continued.

(In the minutes was inserted a letter from Rev. W. B. Clarke on the same subject in the "Sydney Morning Herald" of the 5th August.)

Adjourned Meeting, Chamber of Commerce, 17th August, 1870. Professor Smith in the Chair.

Discussion on the Sydney Water Supply continued.

(These debates are the most important which have engaged the attention of the Society since its foundation and were fully reported in the daily press.)

Twenty-sixth Monthly Meeting, Chamber of Commerce, 14th September, 1870. Professor Smith in the Chair.

Members elected.—John Lucas Esq., David Buchanan Esq., A. Cane Esq., Arthur H. C. Macafee Esq.

Paper read.—"On the Botany Watershed," by Mr. Edward Bell.

Adjourned Meeting, Chamber of Commerce, 24th September, 1870. Edward Bedford Esq. in the Chair.

The debate on Mr. Bell's paper was resumed.

Twenty-seventh Monthly Meeting, Chamber of Commerce, 5th October, 1870. Professor Smith in the Chair.

Members elected.—G. E. Faithfull Esq., William Tunks Esq. M.P., Rev. Thomas Horton, William Wallis Esq.

The debate on Mr. Bell's paper was adjourned.

Twenty-eighth Monthly Meeting, Chamber of Commerce, 2nd November, 1870. Rev. W. B. Clarke in the Chair.

Member elected:—A. H. Thomson Esq.

Paper read.—"Notes on the Auriferous Slate and Granite Veins of New South Wales," by Mr. H. A. Thomson; read by Mr. Chris. Rolleston.

Twenty-ninth Monthly Meeting, Chamber of Commerce, 7th December, 1870. Professor Smith in the Chair.

Paper read.—"On the occurrence of the Diamond near Mudgee," by Professor Thomson. The paper was illustrated by geological charts and specimens of the rocks of the district.

Thirtieth Monthly Meeting, Chamber of Commerce, 10th May, 1871. His Excellency the Earl of Belmore in the Chair.

Office-bearers were elected for 1871-2.

Financial Statement:—

Receipts.	£	s.	d.
To Balance in the Union Bank on 30th April, 1870	4	11	4
,, Subscriptions and Entrance Fees...	112	7	0
,, Interest on Government Debenture	5	0	0
,, Balance, amount overdrawn at Bank	15	13	6
	£137	11	10

Disbursements.	£	s.	d.
By Rent of Room from the Exchange Company ...	25	4	0
,, Fairfax and Sons, Advertisements	2	1	0
,, Samuel Bennett, Advertisements	2	2	3
,, Cunninghame and Co., Printing Circulars ...	4	14	10
,, Fredk. White, Printing Transactions	39	0	0
,, A. L. Jackson, Engraving Map	2	10	0
,, J. Degotardi, Engraving Sketch	4	0	0
,, Assistant Secretary's Salary from 1st January. to 31st December	40	0	0
,, W. H. Ingram, for Collector	3	6	0
,, Petty Cash, Postage Stamps, etc...	14	14	7
	£137	11	10

	£	s.	d.
To One Government Debenture	£100	0	0
By Amount Overdrawn at Union Bank	15	13	6
,, Balance	84	6	6
	£100	0	0

Professor Smith, Vice-President, then read the opening address (Vol. v, p. 1).

Paper read.—"On the Nebulæ of Eta Argus," by H. C. Russell.

No meeting was held in June for want of a paper.

Thirty-first Monthly Meeting, Chamber of Commerce, 12th July, 1871. Edward Bedford Esq. in the Chair.

Members elected.—Thomas Hale Esq., William Forlonge Esq.

Papers read.—1. "On Magnetic Variations at Sydney," by H. C. Russell Esq. 2. "On the Deviations of Compasses in Iron Ships," by the Rev. W. Scott.

Thirty-second Monthly Meeting, Chamber of Commerce, 6th September, 1871. Edward Bedford Esq. in the Chair.

Members elected.—Alfred Fairfax Esq., Thomas Robertson Esq.

Paper read.—"On the Constitution of Matter," by Professor Pell, which he illustrated by diagrams.

Thirty-third Monthly Meeting, Chamber of Commerce, 18th October, 1871. Rev. Dr. Lang in the Chair.

Paper read.—"Remarks on the Botany of Lord Howe's Island," by Charles Moore Esq.

H. C. Russell Esq. made a few remarks about the Spectrum of the Nebula round "η Argus" and exhibited Charts published by the Royal Society of Victoria for the Eclipse Expedition." (This was to Northern Queensland.)

Thirty-fourth Monthly Meeting, Chamber of Commerce, 8th November, 1871. Honorable Charles Campbell in the Chair.

Member elected.—John W. Brazier Esq., C.M.Z.S., Lond.

With reference to Eclipse Expedition, Mr. Russell reported that the Government was willing to place £300 on the Estimates for the Expedition, and that the Government of Queensland had consented to lend the "Governor Blackall" Steamer, for the same purpose. Mr. Russell further stated that in addition to the observing party, there would be twenty passengers from Victoria and two from this Colony, leaving accommodation for four more passengers. The only obstacle remaining was raising the sum of £100.

Paper read,—"On New Guinea—a highly promising field for settlement and colonization,—successfully accomplished," by the Rev. Dr. Lang.

Thirty-fifth Monthly Meeting, Chamber of Commerce, 22nd May, 1872. Rev. W. B. Clarke in the Chair.

Members elected.—The Honorable John Campbell, M.L.C., Horatio G. H. Wright Esq.

Officer-bearers were elected for 1872-3.

Financial Statement:—

Receipts.	£	s.	d.
To Subscriptions and Entrance Fees...	79	16	0
,, Interest on One Government Debenture... ...	5	0	0
,, Sale of Government Debenture	102	4	9
	£187	0	9

Disbursements.	£	s.	d.
By Balance amount overdrawn at the Union Bank on 30th April	15	13	6
,, Rent of Room from the Exchange Company ...	12	12	0
,, Fairfax and Sons, Advertisements	2	13	6
,, Samuel Bennett, Advertisements	2	2	6
,, Cunninghame and Co.	3	5	0
Carried forward	36	6	6

Disbursements—*continued.*	£	s.	d.
Brought forward	36	6	6
By Fredk. White, Printing Transactions	24	0	0
,, Assistant Secretary's Salary from 1st January to 31st December, 1871	40	0	0
,, W. H. Ingram, Commission	3	11	6
,, Petty Cash, Postage Stamps, etc...	6	0	0
,, Balance at the Union Bank	77	2	9
	£187	0	9

Rev. W. B. Clarke read the opening address (Vol. VI, p. 1).

Thirty-sixth Monthly Meeting, Chamber of Commerce, 24th July, 1872. Rev. Dr. Lang in the Chair.

Members elected.—George Milner Stephen Esq., B.A., F.G.S., Rev. Waldyve W. Tarleton, B.A., The Hon. J. Squire Farnell, Minister for Lands, The Right Rev. Dr. Marsden, Bishop of Bathurst, Dr. William Crosby Morgan.

The Chairman reported to the meeting that he had received the following letter from the Honourable the Colonial Secretary, viz:—

Sydney, 13th July, 1872.

Rev. Sir and Gentlemen,

With reference to the interview of the 11th ultimo between the Colonial Secretary and yourselves as a Deputation as appointed to urge the claim of the Royal Society of New South Wales to have its transactions printed at the Government Printing Office, I am now directed to inform you that your application has been considered, and that the Government, attaching much public value to the Society's papers, will authorize compliance with your request. The Government Printer will however be instructed not greatly to exceed in bulk and cost the Society's published "Transactions" of last year without express permission obtained on report to this office.

2. I am to add that the Society can communicate direct with the Government Printer on receipt of this letter.

I have, etc.

(Signed) Henry Halloran.

Paper read.—"A suggestion for an improvement in the projection of Maps," by the Rev. Thomas Horton.

The August meeting lapsed for want of a paper.

Thirty-seventh Monthly Meeting, Chamber of Commerce, 11th September, 1872. Christopher Rolleston Esq. in the Chair.

Member elected.—H. J. Bolding, P.M.

Papers read.—1. "On Australian Gems," by George Milner Stephen Esq., which he illustrated by a number of gems in cabinets. 2. "Astronomical Notices," by H. C. Russell Esq.

After some discussion in reference to the Telescope at the Observatory, it was moved by the Honorable Francis Lord, and carried, "That a deputation, consisting of the President of the Royal Society, the Rev. William Scott, Dr. Wright, H. C. Russell Esq., George Milner Stephen Esq., wait upon the Honourable the Premier of the Colony with the view of obtaining the necessary funds for purchasing a telescope for the observation of the transit of Venus."

Thirty-eighth Monthly Meeting, Chamber of Commerce, 2nd October, 1872. Professor Smith in the Chair.

Member elected.—John T. Sleep Esq.

Paper read.—"On the Colored Cluster Stars about Kappa Crucis," by H. C. Russell Esq.

Thirty-ninth Monthly Meeting, Chamber of Commerce, 20th November, 1872. Rev. W. B. Clarke in the Chair.

Member elected.—Archibald Liversidge Esq.

Papers read.—1. "On an improved method of separating Gold from Argentic Chloride as obtained in gold refining by Chlorine Gas." 2. "Remarks on the fallacy of a certain method of assaying Antimony Ores, given by some Manuals of Assaying." 3. "Remarks on Tin Ore and what may appear like it," illustrated by specimens. (All by Dr. Leibius).

Fortieth Monthly Meeting, Chamber of Commerce, 11th December, 1872. Rev. W. B. Clarke in the Chair.

Members elected.—Thos. Hood Cockburn Hood, Esq., F.G.S., John Mackenzie Esq., Examiner of Coal Fields, Robert Prendergast Esq.

Papers read.—1. "Statistical Review of the Progress of New South Wales in the last ten years, 1862 to 1871," by Chris. Rolleston. 2. "On the Deniliquin Meteorite," by Archibald Liversidge Esq.

Forty-first Monthly Meeting, Chamber of Commerce, 30th May, 1873. Rev. W. B. Clarke in the Chair.

Financial Statement:—

RECEIPTS.	£	s.	d.
To Balance in the Union Bank on 30th April, 1872	77	2	9
,, Subscriptions and Entrance Fees...	109	3	0
Less Cheque Book and Collection of Cheques...	0	6	1
	108	16	11
	£185	19	8

DISBURSEMENTS.	£	s.	d.
By Messrs. Cooke and Co., Printing Transactions ...	25	9	3
,, Rent of Hall from the Exchange Company ...	12	12	0
,, Messrs. Fairfax and Sons, Advertisements ...	2	12	2
,, Samuel Bennett, Advertisements...	2	7	0
,, Messrs. Cunninghame and Co., Printing... ...	2	11	0
,, W. H. Ingram, Commission	3	3	9
,, Stamp for Books and Bookcase	11	5	0
,, Gratuity to Messenger	1	0	0
,, Petty Cash Account, Postage Stamps, etc. ...	10	2	6
,, Assistant Secretary's Salary form 1st January to 31st December, 1872	40	0	0
,, Balance in the Union Bank	74	17	0
	£185	19	8

Officers-bearers were elected for 1873-4.

Member elected.—William Adams Purves Esq.

Forty-second Monthly Meeting, Chamber of Commerce, 25th June, 1873. Rev. W. B. Clarke in the Chair.

Members Elected.—H. H. Kater Esq., W. A. B. Greaves Esq., Henry R. Allerding Esq.

The Rev. W. B. Clarke then read the opening address (Vol. VII, p. 1).

In the discussion which ensued, Mr. Charles Moore expressed his hope that a certain portion of the Illawarra district owned by Mr. Macafee might be preserved, it being the only portion of that district in which the early form of the natural vegetation there was preserved.

Forty-third Monthly Meeting, Chamber of Commerce, 9th July, 1873. Professor Smith in the Chair.

Members elected:—Dr. John Pierce, Rev. David Galloway, R.A., William Neill Esq., W. J. Wilshire Esq., James Manning Esq., Mons. Simon, French Consul, James Norton Esq., G. R. Dibbs Esq., Rev. Edward Rogers, Charles M. Fisher Esq, Dr. Irving, Hugh Kennedy Esq.

Paper read.—"On the Solution of certain Geodetic Problems," by Mr. Martin Gardiner.

Forty-fourth Monthly Meeting, Chamber of Commerce, 6th August, 1873. Rev. W. B. Clarke in the Chair.

Member elected.—George Makin Esq. of Berrima.

Papers read.—1. "Note on some passages in the last Anniversary Address," by the Rev. W. B. Clarke. 2. "Our Coal and Coal Ports," by James Manning Esq.

Forty-fifth Monthly Meeting, Chamber of Commerce, 3rd September, 1873. Professor Smith in the Chair.

Member elected.—Stephen S. Vale Esq. of Newcastle.

Papers read.—1. "Local particulars of the Transit of Venus," by H. C. Russell Esq. 2. "On our Coal and Coal Ports," Appendix, by Mr. James Manning.

Forty-sixth Monthly Meeting, Chamber of Commerce, 1st October, 1873. Professor Smith in the Chair.

Members elected.—P. N. Trebeck Esq., Dr. Atherton, Thomas Stevens Esq., Eccleston Du Faur Esq., Samuel James Bray Esq.

Papers read.—1. "Notes on the deposit of Gold in Quartz Veins," by H. A. Thompson Esq., which he illustrated by diagrams and specimens. 2. "Note on the Bingera Diamond District," by Archibald Liversidge Esq., which he illustrated by a collection of minerals from the locality.

Forty-seventh Monthly Meeting, Chamber of Commerce, 5th November, 1873. Professor Smith in the Chair.

Member elected.—Dr. Milford.

Papers read.—1. "The Mammals of Australia and their Classification, Part I, Ornithodelphia and Didelphia," by Gerard Krefft Esq. 2. "On Geodetic Investigations," by Mr. Martin Gardiner.

Forty-eighth Monthly Meeting, Chamber of Commerce, 11th December, 1873. Rev. W. B. Clarke in the Chair.

Members elected.—Henry Austin Esq., Edwin Daintrey Esq., Harrie Wood Esq.

Papers read.—"On our Coal and Coal Ports," by Mr. James Manning.

Forty-ninth Monthly Meeting, Masonic Hall, York Street, 20th May, 1874. Rev. W. B. Clarke in the Chair.

Members elected.—William Dumaresq Esq., Rev. W. French Clay.

Officers were elected for 1874-5.

Financial Statement.—

RECEIPTS.		£	s.	d.
To Balance in the Union Bank on 30th April, 1873...		74	17	0
,, Subscriptions and Entrance Fees	£113 7s. 0d.			
Less 1/- for collection of cheque	0 1 0 —	113	6	0
		£188	3	0

DISBURSEMENTS.	£	s.	d.
By Rent of Chamber of Commerce	16	16	0
,, Fairfax and Sons, Advertisements	4	0	10
,, Samuel Bennett, Advertisements...	3	15	3
,, W. H. Ingram, Collection	2	16	0
,, Messrs. Cunninghame and Co., Printing.. ...	5	0	6
,, A. A. Marshall, Gas Burners	1	10	0
,, Petty Cash Account	6	18	4
,, Cab Hire	0	11	3
,, Gratuity to Messenger	1	0	0
,, Freight of Books	0	8	3
,, Assistant Secretary's Salary to 31st Dec., 1873	40	0	0
,, Refreshments	11	5	0
,, Balance in the Union Bank	91	1	4
	£188	3	0

Papers read.—"On Duplex Telegraphy" which he illustrated by working the instrument, by Mr. E. C. Cracknell.

The Officers of H.M.S. "Challenger" exhibited the apparatus used in deep sea investigations and a collection of the objects obtained.

Fiftieth Monthly Meeting, Chamber of Commerce, 1st July, 1874. Chris. Rolleston Esq. in the Chair.

Members elected.—The Honorable John Hay, M.L.C., Alex. Stuart Esq., John McGarvie Smith Esq., Rev. James L. White, M.A., LL.B., Dr. Fischer, H. A. Lenehan Esq., J. Hardy Esq., The Honorable G. A. Lloyd, M.P., F.R.G.S.,

E. Woodgate Esq., Dr. Taylor, James Jones Esq., J. C. Raymond Esq., Dr. Mackenzie, P. A. Jennings Esq., John Warner McCutcheon Esq., Philip G. King Esq., Leonard A. Vessey Esq., George M. C. Bowen Esq., J. B. Watt Esq., John Hurley Esq., M.P. (C.C.), Edward M. Stephen Esq., D. Nichol Esq., Dr. Eichler.

Paper read.—"On Hospital Accommodation," by Alfred Roberts Esq.

Fifty-first Monthly Meeting, Chamber of Commerce, 23rd September, 1874. Honorable John Smith in the Chair.

Members elected.—Frederick Pedley Esq., G. I. Latta Esq., John Algar Esq.

Papers read.—1. "On the Criminal Statistics of New South Wales," by Chris. Rolleston Esq. 2. "A Description of Eleven new species of Terrestrial and Marine Shells from the North East Coast of Australia," by John Brazier Esq., who exhibited specimens of the same.

Fifty-second Monthly Meeting, Chamber of Commerce, 12th October, 1874. Honorable John Smith in the Chair.

Members elected.—John Dansey Esq., C. S. Wilkinson Esq., Edward Coombes Esq., John Brewster Esq.

Paper read.—"On the treatment of Iron Pyrites," by Mr. G. I. Latta, read by Mr. H. A. Thompson.

Fifty-third Monthly Meeting, Chamber of Commerce, 9th December, 1874. Honorable John Smith in the Chair.

Members elected.—R. B. Read Esq., George Knox Esq., A. P. Neill Esq.

Papers read.—1. "Iron and Coal Deposits at Wallerewang"; 2. "Nickel Mineral from New Caledonia," by Professor Liversidge. 3. "Sydney Water Supply by Gravitation'" by James Manning Esq., which he illustrated by a map and diagrams.

Fifty-fourth Monthly Meeting, Chamber of Commerce, 11th January, 1875. Honorable John Smith in the Chair.

Members elected.—Commodore Goodenough, Edward Knox Esq., The Honorable William Busby, M.L.C., The Honorable Robert Owen, M.L.C.

Papers read.—1. "Results of Observations of the late transit of Venus," by H. C. Russell Esq., which he illustrated by numerous photographs and diagrams. 2. "Results of Observations of the late Transit of Venus at Eden," by Mr. Scott, read by Mr. Russell.

The minutes of the next meeting, 12th May, 1875, will be found at p. xxxi, Vol. IX, and have been regularly published since in abstract.

Council Minutes.

[Following are extracts, of more or less interest, from the Council's Minutes from October 1874 to April 1877.]

Council met in the Chamber of Commerce, 29th October, 1874.

The Secretary was instructed to apply to the Trustees of the Museum for the books belonging to the Society which were taken charge of by Mr. Krefft. (See Society's minutes of 7th December, 1864, and also Council's minutes of 30th June, 1875).

Council met in the Chamber of Commerce, 28th April, 1875.

The Secretary was also instructed to make inquiries whether the Society would get the use of Clarks' Assembly Rooms (our present House.—J.H.M.) for the Society's habitation, or any other suitable rooms in town. The rent not to exceed £50, and to report to the members of Council present at the ensuing meeting on the 5th May.

12th May, 1875, First Entry, Council met in the Society's Rooms, Elizabeth Street.

Professor Liversidge read the following letter from the Honorary Secretary of the New South Wales Academy of Art," viz:—

Rialto Terrace,
11th May, 1875.

Dear Sir,—In accordance with the request in your letter of the 30th ultimo, I enclose you a copy of a minute submitted to the Council of our Society on the 4th inst., respecting the subletting of its new premises to the Royal Society, which was duly approved.

Regretting that press of business in connection with the opening of those premises should have prevented my replying more promptly.

I am, etc.,
(Signed) ECCLESTON DU FAUR,
Hon. Sec.

"Copy of Minute."

It was reported that acting on the general authority placed in their hands for carrying out such arrangements, the Vice-President and Honorary Secretary had entered into an agreement with a gentleman deputed to treat with them by the Royal Society of New South Wales, under which they had sublet the upstairs Room to that Society, as a Board room and office, and the Hall for about 8 nights in the year for their meetings, on the following terms:—

(1) The Royal Society to contribute £50 per annum, payable quarterly.

(2) To furnish the Board Room and to be allowed to place wire blinds in windows with "Royal Society" thereon.

(3) To allow the Council of the N.S.W. Academy of Art the use of the said Board Room for its meetings, about once a month, and, if required for similar meetings of a kindred Society with which the Council might make terms on a similar basis, provided always that such meetings should not clash with those of the Royal Society.

(4) The Royal Society to be allowed to place a notice board on the outside wall of the building on one side of the entrance door

(5) The Royal Society to have the use of the Hall for about 8 nights in the year for their meetings (provided such meetings shall not interfere with the Annual Exhibition to be held for about five weeks in the months of March and April), and to have the use of the Hall, fitttings, tables, chairs, linen and table utensils, the cost of gas on such evenings to be defrayed by the lessors.

This agreement to be in force for the year ending 30th April, 1876. Approved by the Council of the N.S.W. Academy of Arts at meeting held 4th May, 1875.

(Signed) Du Faur,
Hon. Sec.

Professor Liversidge.

Resolved that the terms of the Council of the New South Wales Academy of Art, for the subletting of its new premises to the Royal Society as stated in their minute of the 4th May be accepted.

Professor Liversidge informed the Board that he had purchased and had sent in the necessary furniture and gas fittings for their Board Room. Professor Liversidge's purchase was approved of by the Council.

Council met in the Society's Rooms, Elizabeth Street, 26th May, 1875.

Mrs. Casey was appointed cleaner.

Council met in the Society's Rooms, Elizabeth Street, 30th June, 1875.

A letter was read from Mr. Gerard Krefft, dated 15th June, acknowledging the receipt of the Assistant Secretary's letter of the 25th May, and stating that if anything is in his possession at the Museum belonging to the Council they shall have it when he gets his own property back. (See minutes of 29th October, 1874. Mr. Krefft had been the Curator of the Australian Museum, and a member of the Council, and disputes between the Trustees and Mr. Krefft led to the appointment of a Select Committee of the Legislative Assembly).

Council met in the Society's Rooms, Elizabeth Street, 25th November, 1875.

On Mr. (H. G.) Wright's motion it was decided that the Session should be wound up with a Dinner. (So far as I know, this was the first Annual Dinner of the Society, a pleasant function interrupted by the Great War).

Resolved that the following gentlemen form the Dinner Committee, viz:—Horatio Wright Esq., Chris. Rolleston Esq., Professor Liversidge, H. C. Russell Esq., Dr. Leibius.

It was further decided that Dr. Leibius be requested to act as Honorary Secretary to the Committee.

Council met in the Society's Rooms, Elizabeth Street, 16th March, 1876.

It was decided that the following list of officers should be recommended by the Council to the members for election at the ensuing Anniversary Meeting. (See volume for year).

It was decided that it would not be necessary to make any further arrangement with the Council of the Academy of Arts for the lease of the rooms for the ensuing year.

Committee Meeting, 22nd May, 1876.

It was further decided that the whole Committee should form a deputation to wait upon the Honorable the Minister of Justice and Education upon such day as shall be most convenient to the Minister.

Deputation to the Honorable the Minister for Justice, 26th May, 1876.

In pursuance of a resolution passed at the last Committee Meeting, the following gentlemen waited upon the Honorable Joseph Docker, on Friday the 26th of May, viz:—The Honorable J. Squire Farnell, M.P., H. C. Russell Esq., Professor Liversidge, Charles Moore Esq., The Honorable Francis Lord, M.L.C., Dr. Leibius, Rev. Dr. Lang.

The deputation having been introduced to Mr. Docker by Mr. Farnell, submitted a request to be communicated to the Government for the sum of £2,500 for the erection of a suitable building and £300 annually for the ordinary purposes of the Society.

The deputation was courteously received, and the Minister promised to lay the matter before the Government in the following form, viz:—"To place on the Supplementary Estimates for the current year, the sum of £300, so as to enable the Society to draw from the above named sum an amount equal to the annual subscriptions of the Society, and to place on the Estimates for the year 1877 the sum of £2,500.

The following memorandum was signed by the deputation and handed in to the Minister, viz:—

In re Royal Society's application for Assistance—Reasons for the Application.

1. To enable them to give popular Scientific Lectures.

2. To establish working Sections of the Society for the promotion of special branches of Science.

3. To collect a Standard Scientific Library.

4. To be a central Institution in New South Wales for the collection of Scientific works from all parts of the world. Their recent experience has shown them that the Transactions of their Society will be received as an equivalent for the publications of many of the leading Scientific Societies of Europe and America.

5. In England similar Scientific Societies afford valuable information to the Government on many subjects. The Royal Society of Sydney has done something in the past, and is anxious to do more in the future.

6. The money at their disposal will not enable them to maintain their present relations with the public and other societies,

and is totally inadequate to carry out their extended scheme of usefulness.

7. They have since the commencement of the Society subscribed upwards of (£5,000) Five Thousand Pounds, for the promotion of science and higher education in the Colony. And they now respectfully ask for assistance from the Government in order that they may make their past labours and present capabilities of more use to the public. They feel that they are justified in making this request, because other Societies established here to educate and instruct the public, receive money grants.

8. In England similar Societies are encouraged and assisted with large grants of public money; and provided with Hall and Offices in Burlington House, which has been rebuilt for them at enormous cost.

9. In Victoria the Royal Society has a large Hall and Offices, and an annual grant of money more than equal to their subscriptions.

10. In Tasmania the Royal Society is also provided with accommodation and an annual grant of money.

11. In New Zealand also the corresponding Society is likewise supported by Government grant.

Under these circumstances the gentlemen whose names are attached, were appointed a deputation to wait upon the Minister for Justice and Public Instruction and ask him to take the case of the Royal Society of New South Wales into his favourable consideration, and give them an annual grant equal to their subscriptions, and provide them with accommodation for giving lectures, offices, etc., and money grant of £2,500 to help to provide them with this accommodation.

Council met in the Society's Rooms, Elizabeth Street, 27th September, 1876.

A letter was read from the Sydney Botanical Society, dated 4th September, informing the Council that at a recent meeting of the Sydney Botanic Society the following resolutions were carried:—

"That the offer made through Mr. H. C. Russell to Mr. Fitzgerald, F.L.S., be accepted, namely, that if the members of the Sydney Botanical Society could join the Royal Society in a body with the view of forming a Botanical Section, the usual Entrance Fee would be remitted, also that all the property of the Sydney Botanical Society be handed over to the Royal Society." (It would be interesting to know more about this Society).

Council met in the Society's Rooms, Elizabeth Street, 29th November, 1876.

It was decided that the name of the next Volume should be called "The Journal of the Royal Society of New South Wales."

Council met in the Royal Society's Rooms, Elizabeth Street, 12th April, 1877.

Resignation of Mr. W. H. Catlett of the Office of Assistant Secretary, after holding it for a period of 19 years (this is calculated from 1856. He was Secretary of the Australasian Botanic and Horticultural Society, as far back as 1853.—J.H.M.). The work of the Society had so increased during the last eighteen months that it had been found necessary to increase Mr. W. H. Catlett's duties very considerably.

II. Miscellanea.

Publications.
Meeting Places and Benefactors.
Meeting Days.
Vice-Regal Associations.
Microscopical Committee.
Medals.
Australian Association for the Advancement of Science.

Publications.

8th May, 1857. The Council decided to select papers and prepare abstracts for the "Sydney Magazine of Science" and take 25 copies for one year at 11/- each.

28th May, 1858. Subscription increased to 15/- per volume, but only 15 copies ordered. In addition, the cost of illustrations was defrayed, which in the 1859 balance-sheet stands at £31 7s.

5th August, 1859. The arrangement was not continued. The Magazine was very indifferently edited, and the decision not to continue doubtless arose from that circumstance.

On 31st August, 1859, the Secretary reported that Mr. Fairfax would not publish the Society's papers in the "Herald" unless he received all those read, and that he would not exchange slips with the "Empire."

On 6th September, 1859, the Secretary reported that the impasse between the "Herald" and the "Empire" continued, and a certain paper was therefore published in the latter journal.

It is evident that the Society only published in the newspapers at this time, and this arrangement continued until the publication of the 1862-5 volume. In other words, the papers read during the years 1859, 1860, and 1861, were only published in the "Herald" and "Empire." I have not had an opportunity of tracing all of them, and perhaps a young member may feel impelled to search the files and record the dates and pages where each paper was published, in order that our record may be complete.

But we have got the next best thing, for the abstracts from the minutes show every paper read before the Society, and should lead to each being traced, if published in the newspapers or in some other manner, the pamphlet form being sometimes adopted.

Professor Smith (1881, p. 6) gives a list of papers read before the Philosophical Society from the year 1856 to 1866, doubtless taken, like my own, from the minutes. My list will be found corrected in a few cases, and I have added references to their publication, wherever I could trace them.

At the Annual Meeting of 6th July, 1864, it was resolved to publish the papers of the Society in a separate form, and this led to the publication of "Trans. Philos. Soc. N.S.W." (1862-5).

The printing of the volume by private firms went on till 1872, when on 13th July of that year the Government agreed to print the Journal by the Government Printer on terms stated.

The names of our printers have been:—

1862-5, Reading and Wellbank.
1867-70, F. White, (same firm as F. W. White, below).
1871, Joseph Cook and Co.
1872-86, the Government Printer.
1887, F. W. White to date.

The titles of our Journals are as follows:—

1. "Transactions of the Philosophical Society of New South Wales, 1862-5," (1866).
2. "Transactions of the Royal Society of New South Wales, for the year 1867," Vol. I (1868). This title was continued to Vol. VIII (1874).
3. "Transactions and Proceedings of the Royal Society of New South Wales," Vol. IX for 1875 (1876).
4. "Journal and Proceedings of the Royal Society of New South Wales" Vol. X for 1876 (1877).

There has been no change in the title since.

The Proceedings of the Society were therefore first printed in the 1875 volume, and the Abstracts from the

Minutes I have given in this paper supply the missing information from 1855 to 1874. Professor Liversidge's editorial work commenced with that volume, and the 1875 volume was the first to be indexed.

On 29th November, 1876, the Council decided that the title of the next volume should be "Journal of the Royal Society of New South Wales."

Until recent years, and especially until a few years immediately preceding the war, the daily and weekly press of Sydney published our papers sometimes fairly fully, and often in useful abstract. From 1859 to 1861 we had no other form of publication, and this circumstance probably led the Council of the Society to think that the issue of a volume on its own account was not an urgent matter.

This attitude probably worked against the interests of the Society, for some members of a certain outlook could fairly ask themselves what advantage there was in belonging to the Society when they got no exclusive copy of its proceedings and papers, which were published *in extenso* in the daily press free to everyone.

Meeting Places.

The meetings of the 1850 Society were held in the Royal Hotel, George Street.

The first and second meetings of the Philosophical Society of New South Wales, in 1856 (May and June) took place in the School of Arts, Pitt Street, and the rest in the Australian Library. The third meeting in 1857 (July) and the remainder for the year were held in the hall of the Australian Library (the present Public Library, subsequently added to). In 1858 meetings were held both in the Chamber of Commerce (Exchange) and in the Australian Library, the change to the Chamber of Commerce being a temporary one (minutes of 14th July), because of alterations taking place in the Library.

From 1859 to 1868 the meetings were regularly held in the Australian Library, with the exception of one meeting in 1864 held in the Chamber of Commerce.

The meetings from 1869 till 1875 (when the Society had its own House) were held in the Chamber of Commerce, with one exception, the meeting of May 1874 being held in the Masonic Hall, York Street. In other words, the meetings were almost entirely held in the Australian Library and the Chamber of Commerce.

The entries in the Council Meetings under the dates 28th April and 13th May, 1875, and 22nd May, 1876, referring to the acquisition of the present premises, in order that the Society might have a house of its own, will be read with great interest. The Council met in its own house (as tenants) in Elizabeth Street for the first time on 12th May 1875, while the first meeting of the Society (the Anniversary Meeting of the year) was held on the same date in the same place.

We owe the acquisition of this House to the Council of the day, and especially to the then two honorary secretaries Professor Liversidge and Dr. Leibius, but the principal driving power was that of Professor Liversidge, who worked whole-heartedly for the advancement of the Society from the very day he became a member of it. I knew well the late Dr. Leibius, who was a most loveable character, and he often used to recount to me incidents of those early days. He often said to me "We never got a move on till Liversidge came." Professor Smith refers (p. 12 of his address) most cordially to the work of these gentlemen.

Perhaps this is not an inappropriate place to say that three men stand out, above all others, amongst many whose memory should long be cherished by us as having performed exceptional services to our Society.

1. His Excellency Sir William Denison, whom I may call a refounder of the Society, who insisted on the re-establishment of the Philosophical Society of New South Wales in 1855, regularly attended the meetings, and gave it motive power.

2. The Rev. W. B. Clarke, who joined the Society in 1850, regularly attended its meetings and, by means of his papers, addresses, and exhibits, did much to raise the work of the Society to a higher plane.

3. Professor Liversidge, who practically re-founded the the Society when he became Honorary Secretary in the year 1875, organised its activities on proper lines, and made it the power for good it is to-day. He is our greatest living benefactor.

Meeting Days.

The first three monthly meetings of the Society (May – July, 1856), took place on the second Friday of the month, but on the 11th July it was decided to meet on the second Wednesday of the month, while the Council Meeting was fixed for the previous Friday.

On 10th August, 1859, the meeting was altered to the third Wednesday in the month, and the minutes of the monthly meeting of the 17th July, 1861, record that the meetings were altered from the third to the second Wednesday of the month.

On 17th August, 1864, it was decided to hold the meetings on the first Wednesday in the month, and the Council Meetings on the last Wednesday, and that arrangement has continued to the present time.

It will be observed that the monthly meetings were first numerically recorded from 9th May, 1856. There are two series, the Philosophical Society of New South Wales, first monthly meeting at the date given, and eighty-fifth, 12th December, 1866.

The first monthly meeting of our Society as at present named, took place on the 9th July, 1867, and the meeting at which the present historical account is read, is the three hundred and ninety-eighth, the date being 3rd July, 1918.

Vice-Regal Associations.

The Philosophical Society of New South Wales asked (1856) the Governor-General (as the Governor was then styled) to accept the office of President, following the 1850 precedent, but there was no rule to that effect. The Royal Society of New South Wales had a rule (1866) conferring the Presidency on the Governor, and this continued till 1880. From 1881 to 1900 the Governor was styled Honorary President. In 1901 (Federation year) this office was dropped, and we had no office-bearer of Vice-regal rank. During that year the Governor-General accepted the office of Patron, and the Governor the office of Vice-Patron, and that arrangement continues.

In the days of the Philosophical Society of New South Wales the Governor (General) gave an inaugural address, usually brief. Coming to the Royal Society of New South Wales, His Excellency was supported by two Vice-Presidents, and the senior one made the "Inaugural Address," which began with that of the Rev. W. B. Clarke on 9th July, 1867, at the first meeting of our Royal Society, (Trans. Roy. Soc., I).

In 1868, Vice-President Smalley gave an "Opening" Address, and so did Professor Smith in 1878, but the Rev. W. B. Clarke in 1869 began the present designation of an "Anniversary" Address, which he repeated in 1870, 1872 and 1873 (no address was given in 1874), 1875 and 1876. It is no disparagement of the early addresses to say that those of Mr. Clarke were most numerous and most scientifically valuable. The remaining Vice-Presidents who delivered addresses (and whom now-a-days we would call

Presidents) were H. C. Russell in 1877, C. Rolleston in 1878, Professor Smith in 1879, and C. Moore in 1880. Professor Smith was the first non Vice-regal office-bearer who held the title of President, and that was in 1881, the Governor's title having been changed to Honorary President, as already explained.

The Society continued to only have two Vice-Presidents until the year 1891, when four were appointed, and this arrangement has continued.

Two Governors, at least, associated themselves very earnestly with the work of the Society, and it was the ordinary members, and not His Excellency, who first got tired of the Society.

Sir William Denison presided at the following meetings: Concluding meeting of the 1850 Society, 30th July, 1855, when it was decided to form the Philosophical Society; Inaugural meeting of Philosophical Society of New South Wales, 9th May, 1856 (giving an address on railroads), and five other meetings in that year, three in 1857, six in 1858, five in 1859 and four in 1860, his term of office ending with the year. He gave several addresses and papers, and supported and virtually founded the Microscopical Section.

Sir John Young presided at the meeting of 17th July, 1861, for the first time, and at three other meetings in that year, five in 1862, three in 1863, two in 1864, and not again till September 1867, which was his last appearance.

The Earl of Belmore presided on 3rd June and 14th July, 1868.

Smith (pp. 4 – 5) gives an amusing account of the dwindling attendance which even a Vice-regal President was unable to stem.

I do not think that a Governor again honoured us at a monthly meeting until 6th September, 1916, when His Excellency Sir Gerald Strickland attended, but did not preside.

Microscopical Committee.

One was first elected 11th May, 1859. Its formation had been suggested by His Excellency, Sir William Denison, and it held its first meeting, during this month, at Government House. It seems to have ended with his term of office. For abstracts of its proceedings, see p. 312.

The Microscopical Section was not re-established until 23rd June, 1876, see Vol. x for that year, p. 291. It was in the volume for this year that reports of the sections were first published.

Membership.

Following is the membership so far as I have been able to ascertain it:—1855, 22 Australian Philosophical Society members brought into Philosophical Society of New South Wales; 1855, 153, (Philosophical Society of New South Wales); 1857, (no record); 1858, 174; 1859, 186; 1860, 154; 1861, 1862, 1863, 1864, 1865, (no record); 1866 (the records of membership, Treasurer's accounts, are probably in the keeping of some private person, and it is hoped that they will find their way into our archives); 1867, 108 (Royal Society of New South Wales); 1868, 118; 1869, 118; 1870, 127; 1871, 129; 1872, 134; 1873, 118; 1874, 155; 1875, 264, Honorary Members (in addition) were first elected in this year.

I do not go past 1875, but I may mention that in no year from 1880 to 1892 did membership go as low as 450. In 1883-5 the numbers were 494, 494 and 492. It went below 400 (397) in 1897, and has fluctuated between 300 and 400 ever since.

The report of the Committee, presented on 30th August, 1865, recommended two classes of members, Fellows and Associates. This was decided on at a meeting on the 8th November, but the decision was shortly afterwards reversed.

At the meeting of the 11th November, 1868, it was decided to ballot for the admission of members, and this practice has continued to the present time.

In the 1875 volume was first introduced the record of election, and number of papers published in the journal by an ordinary member, and it contains the first list of honorary members.

The Fundamental Rules were published in the volumes from 1868 to 1875 (as a rule I go no further in this historical sketch), and the Bye-laws in the same volumes (greatly enlarged in the 1875 volume).

The Society was incorporated in the year 1881. A copy of the Act is in the 1881 volume, p. xi.

Medals.

The Australian Philosophical Society in 1850 gave notices of gold medals offered, to be adjudged in 1851 for the production of Madder, growth of Cotton, Metals from Colonial Ore, and Sugar. I do not know whether they were awarded.

Medals of £5 5s. each were, at the Council Meeting of 9th December, 1859, resolved to be given at the May Meeting in 1860 for illustrations of the new art of photography in the classes of Landscapes, Buildings and Portraits.

I have not seen specimens of these medals, and if any are in existence they would form an acceptable exhibit before the Society, or they could be lent in order that they might be photographed.

The Clarke Memorial Medal was established in memory of Rev. William Branwhite Clarke, M.A., F.R.S., one of the most distinguished and zealous members of the Society. See references to it in Vol. XIII, p. 133 (1879), XIV, 295 (1880), and XV, 16 (1881). The first award was made as for 1878, and awards have been made to date. This is the only medal now awarded by the Society.

The Society offered its medal and money prize of £25 for the best communication (provided it be of sufficient merit), containing the results of original research or observation upon various subjects published annually. The first award was made in 1884, and the last in 1896.

Australian Association for the Advancement of Science.

At the monthly meeting of the Royal Society of New South Wales of 1st August, 1866, Professor Smith (who was in the chair) said that " he had no doubt that at some future time there would be an Australian Association for the Advancement of Science, but he did not suppose we had the material for it yet." His remarks will be seen at p. 309. They were in connection with a proposal for a Scientific Congress, to be held with the Intercolonial Exhibition (Melbourne 1866-7), the Official Record[1] of which was published in 1867. The Rev. Dr. Bleasdale and Mr. Knight (the Secretary of the Exhibition) were present at the meeting, and the former showed his well-known Victorian gems.

The actual foundation of such an Association (called Australasian) we owe to Professor Liversidge in the year 1888, and the preliminary steps, undertaken a few years earlier, are recounted by Mr. H. C. Russell, the first President of the Association, at p. 8 of his inaugural address (Vol. I, Rep. "Aust. Assoc. Adv. Science.") Professor Smith's words are worth recording, however.

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[1] This contains some valuable, but little known New South Wales, scientific reports, *e.g.*, *a.* "On the progress and present state of astronomical science in New South Wales," by John Tebbutt, Junior. *b.* "Remarks on the sedimentary formations of New South Wales," by Rev. W. B. Clarke. *c.* "New South Wales coal-fields," by W. Keene. *d.* "Australian Vertebrata (Recent and Fossil)," by G. Krefft.

III. Enquiries and Conclusions.

The relations of our Society to the 1821 Society.
The relations of our Society to the 1850 Society.
The relations of the 1850 to the 1855 (1856) Society.
Genealogical Table of Societies.
The Royal Society of Tasmania older than the Royal Society of New South Wales.

A notice in front of our Annual Volume has appeared in the following form since Vol. x, 1876:—

"The Royal Society of New South Wales originated in 1821 as the 'Philosophical Society of Australia,'[1] after an interval of inactivity, it was resuscitated in 1850, under the name of the 'Australian Philosophical Society,' by which title it was known until 1856, when the name was changed to the 'Philosophical Society of New South Wales,' and finally, in May 1866, by the sanction of Her Most Gracious Majesty the Queen, it assumed its present title."

We will proceed to examine the statement. The only three portions of it that may be disputed are—

1. Our Society......"originated in 1821 as the Philosophical Society of Australasia."
2. The 1821 Society......"was resuscitated in 1850 under the name of the Australian Philosophical Society."
3. It was known by the title of "Australian Philosophical Society" until 1856, "when the name was changed."

Four Presidential Addresses take cognizance more or less of the history of our Society, viz., those of Rev. W. B. Clarke, 1867 (this is the most important of the four; technically Mr. Clarke was a Vice-President, but he was really an Acting President), Charles Moore, 1880, Professor John Smith 1881 (second in importance to Mr. Clarke's); the

[1] Altered later to 'Australasia,'' which is correct.

above have the historical value of contemporaries; and my own, a brief modern sketch, 1912.

In addition we have the admirable historical sketch and statement of the work and objects of the Society which appeared in "Nature," on 23rd June, 1910, over the signature of Professor Liversidge.

The relations of our Society to the 1821 Society.

It will be presently seen that the authorities for the various statements contained in the notice go back for a considerable period.

The minutes of the Philosophical Society of New South Wales for 17th December, 1862, referring to the foundation of the Philosophical Society of Australasia in 1821, speak of "the formation and early history of the Society" (*i.e.* of the Philosophical Society of New South Wales), it being implied that the 1821 Society was the precursor.

Mr. Clarke (*loc. cit.*, p. 8) said, in 1867, "Our own Society has had its changes also. At first, in the year 1821, it commenced as the 'Philosophical Society of Australia' (should be Australasia.—J.H.M.), a very lofty title for its dozen founders and members." It will thus be seen that Mr. Clarke accepted the view that "our" Society "commenced" as the 1821 Society. He knew some of the members of it personally.

In our Journal (Vol. xv for 1881, p. 2) the late Professor Smith said:—"It would not be unfair, indeed, to claim an existence of sixty years, for undoubtedly the first beginning of this scientific organisation is to be traced back to 1821.... It is mentioned among the Institutions of Sydney in the Australasian Almanac for 1825, but not afterwards..."

It seems to me that while the 1821 Society had the same objects as our own, and was indeed its forerunner and exemplar, it is not historically correct to suggest lineal descent from it, or even collateral descent, except with important reservations.

Professor Smith (p. 3) referring to Mr. Clarke's statement as to the "resuscitation in 1850 of the old Society," says, "there must have been an attempted revival at an earlier date, for in the New South Wales Calendar of 1832 I find mention of an 'Australian Society'" etc. This is a reference to the Australian Society of 1830, and at p. 228, I have stated that I know of no evidence to connect our Society with it.

The relations of our Society with the 1850 Society.

In "Sydn. Mag. Sci. and Art" we have:—His Excellency Sir William Denison, on arrival in the Colony, enquired if there were a Society. He found..."there had previously been a Society called the Australian Society (the 1850 Society). This however, had discontinued its operations, and was esteemed extinct. (It however had never been wound up and the funds were intact.—J.H.M.) By the exertions of His Excellency, in connection with some of the old officials"...the 1856 Society was formed.

The Rev. Mr. Clarke (p. 15), guardedly says "The interval between 1822 and 1856 was marked by a partial resuscitation of the Philosophical under the name of the Australian Philosophical Society, which was formed in the beginning of 1850," etc.

Mr. Charles Moore, in his anniversary address to the Society for 1880 (XIV, p. 1) said, "Since the re-establishment of the Society in 1850, although it has undergone many vicissitudes, and changed its name more than once, it has yet been continuous under some form......Of those who joined the Society in 1850, Mr. R. A. Morehead and myself are now the only members who have not severed our connection with it."

Mr. Clarke had previously stated "The members of the Australian Society passed over without re-election, and the former Secretary and Treasurer were retained" (Clarke p. 17). The Secretary was the Hon. Dr. Douglass, and the Treasurer was Mr. R. A. Morehead. Mr. Clarke is talking of the formation of the 1855 (1856) Society, which had, as the first honorary secretary and treasurer the gentlemen who had filled those offices in the 1850 Society.

The statement that the 1821 Society..."was resuscitated in 1850 under the name of the Australian Philosophical Society," does not seem to be borne out by such evidence as I have been able to collect, and it seems to have been more or less connected with the fact that Dr. H. G. Douglass was honorary secretary of both Societies. Everything turns on the meaning of the word "resuscitated," or Mr. Moore's word "re-established," but it seems to me that the 1821 Society, to some extent a Scientific Club, was perfectly dead long before 1850. It was natural that Dr. Douglass should be thought of by the promoters of the new Society, and only he and Alexander Berry were members of the 1821 Society and also of the 1850 Society.

The relations of the 1850 to the 1856 (1855) Society.

It is stated that the former was known by the title of the "Australian Philosophical Society" until 1856, "when the name was changed."

I have given the historical facts in regard to the 1850 Society, which began with the title "Australian Philosophical Society" and soon became known as the "Australian Society." The 1850 Society, although it became dormant soon after the gold discoveries, met again in 1855, handed over its funds to form the Philosophical Society of New South Wales, and its honorary treasurer, honorary secretary and a number of its members passed over into the new Society. It is historically correct for our Society to trace lineal descent from the 1850 Society.

I have pointed out that the birthday of the Philosophical Society of New South Wales is 30th July, 1855, and the date 1856 in the notice should be struck out.

Genealogical Table of Societies.

1. Philosophical Society of Australasia (December 1821–1822?) Extinct.
2. Agricultural Society of New South Wales (5th July, 1822–22nd February, 1826).
3. Agricultural and Horticultural Society of New South Wales (22nd February, 1826–1836?). Extinct.
4. Australian Society...Colonial produce and manufactures (1830–1836?). Extinct.
5. Australian Floral and Horticultural Society (1836–1848). Extinct.
6. Australian Botanic and Horticultural Society (—July, 1848 – 8th December, 1856). = 7. Horticultural Improvement Society of New South Wales (15th Jan., 1855–8th Dec., 1856.
8. Australian Horticultural and Agricultural Society (8th December, 1856–).
9. Australian Philosophical Society (19th January, 1850–30th July, 1855).
10. Philosophical Society of New South Wales (30th July, 1855–12th December, 1866).
11. Royal Society of New South Wales (12th Dec., 1866).

The Royal Society of Tasmania Older than Ours.

The history of Agricultural, Horticultural and Scientific Societies in Tasmania (formerly Van Diemen's Land) is somewhat analogous to our own.

We are indebted to Mr. E. L. Piesse for "The foundation and early work of the Society; with some account of earlier institutions and Societies in Tasmania," which he presented on 13th October, 1913, at a meeting held in celebration of the Seventieth Anniversary of the Royal Society of Tasmania (Proc. Roy. Soc. Tas., 1913, p. 117).

He shows (p. 118) that the "Van Diemen's Land Agricultural Society" was founded in 1821 (neither day nor month stated), thus preceding the New South Wales Agricultural Society, which was not established until 5th July, 1822.

Mr. Piesse (p. 136) also gives an account of the foundation, on the 14th October, 1843, of a Society which was a direct precursor of the Royal Society of Tasmania. I have already stated that, according to my researches, the Royal Society of New South Wales can only trace its lineal descent from a Society founded on 19th January, 1850. I therefore am of opinion that our sister Royal Society is the oldest scientific Society in Australasia, its seniority to ours being six and a quarter years.

May it long continue to flourish!

* * *

Governor Denison (who came to New South Wales from Tasmania) was a great resuscitator of scientific societies. Mr. Piesse (pp. 148, 151) gives an account of his work in connection with the Tasmanian Society (by the way the "Tasmanian Society" has a technical meaning), while at pp. 351 and 357, I have given some notes in regard to his services to the New South Wales one.

Mr. Piesse (p. 158) reminds us that the title of the older Society was, until 1911, "The Royal Society of Tasmania for Horticulture, Botany and the Advancement of Science." So that while the present title "Royal Society of Tasmania" dates from 1911, that of "Royal Society of New South Wales" dates from 1866, which is the only priority we can claim.

While we cannot trace our pedigree to a Society founded in 1821, it will be seen that ever since 1821 there has always been a Society for the diffusion of information in regard to the resources of New South Wales. For many years (both here and in Tasmania) the Society has been often agricultural or horticultural in form, and such scientific matters were brought before the Society of the day as the state of knowledge and the limitations of the colonists permitted. It is gratifying to the compiler of these notes to point out how inherent, desire for knowledge of botany and horticulture always has been in the inhabitants of Australasia.

ON THE TECHNOLOGY AND ANATOMY OF SOME SILKY OAK TIMBERS.

By R. T. Baker, F.L.S.

With Plates XVII - XXIX.

[*Read before the Royal Society of N. S. Wales, August 7, 1918.*]

Introduction.

This common name is applied in the Australian timber trade to quite a variety of timbers, each having a distinct specific origin, and yet all possessing one common character viz., very pronounced rays, or in trade terms a "large silver grain," whilst they all differ in colour, weight, hardness and anatomical structure. It was this confusion which produced the incentive to see if something could be done to scientifically classify these timbers, and at the same time find out some character which would help the trade to differentiate them, and also to introduce a common name at least to each for the benefit of timber dealers and users. The use of scientific names would at once rectify the trouble, and the author makes a special plea to the technologist to give his aid to the introduction of such, and to help scientific industry by placing it on a correct natural basis.

As things are at the present time, if an order be placed for "Silky Oak," several different kinds in colour at least, would probably be supplied, various species being included under the name. The result of using such a variety of timbers in a single house decoration or suite of furniture is not by any means a colour triumph, and such cases have occurred. However great their specific and generic differences, they have at least one thing in common, and that is they all belong to the same Family,—Proteaceæ. New common names have been introduced into this paper in an endeavour to assist the trade, and these could be used till such time as scientific names are employed.

Histological study has opened up a new feature, and attention is drawn to the fact that the preponderance of the rays in the wood material appears to break up the usual uniformity of concentricity of annual rings, so characteristic of dicotyledonous stems, into arcs on a transverse section. In the case of "Bull Silky Oak" the rays in a cross section are so broad and numerous as to make up quite half of the surface. It is the long straight and numerous rays that give the wood of these oaks its radial fissility. The ray feature is so characteristic of the Family that it differentiates the Proteaceæ from all others except the Casuarinaceæ.

The deep broad rays have given rise to the common name of Oak to these timbers, which correspondingly give the well known figure to the silver grain of the European or northern hemisphere oaks, *Quercus*. But here the similarity ends so far as wood structure is concerned. Some of these Oaks can be determined microscopically at once by their cell contents, especially *Orites excelsa.*

The timbers are, with one exception, comparatively light in weight yet comparatively strong, and are regarded mostly as excellent cabinet woods, although they are much appreciated in several trades, such as for coach building, cooperage, dairy utensils, saddle-trees particularly so, as in the case of *Grevillea robusta* and *Orites excelsa*, no timber mentioned in this paper holds nails so well as these. I am informed by Mr. T. I. Wallas "that silky oak timbers have been used in cooperage on the Northern Rivers district, N.S.W. for many years, and also all dairy utensils,—churns, tubs, basins, wine casks, meat pickling tanks and buckets were made of silky oak timber." These would probably be *G. robusta* or *Orites excelsa.* In Queensland *Cardwellia sublimis* is the more generally used Oak.

The characteristic features of each species are shown in the macroscopical and microscopical illustrations. The most remarkable will be seen in the transverse sections, which show the rays dividing the other wood elements into segments, which have their concavity outwards, *i.e.*, towards the bark, an arrangement which is now found to obtain in all the genera of Proteaceæ except Persoonia. In no other Family was this found in any timbers examined, not even the Casuarinaceæ, which has equally as large rays as the Proteaceæ. The small globular bodies found in the wood elements of the several species is a unique feature in timbers and has taxonomic value, in which direction can also be used the disposition of the fibres and wood parenchyma in the several species, and this should aid specific determination.

This paper covers investigations on the timbers of the following species:—*Grevillea robusta*, Silky Oak; *G. Hilliana*, Red Silky Oak; *Embothrium Wickhami*, Satin Silky Oak; *Cardwellia sublimis*, Bull Silky Oak; *Orites excelsa*, Pink Silky Oak.

Acknowledgments.—I am indebted to Mr. T. C. Roughley for the section cutting, autochromes and microphotographs, and to Mr. D. Cannon and Mr. F. Shambler for botanical and timber help respectively; and also to Mr. C. T. White, N. W. Jolly B.A., B.Sc., and Mr. H. W. Mocatta for some Queensland botanical material.

GREVILLEA ROBUSTA A. Cunn., Silky Oak, (B. Fl. v, 459).

Remarks.—This was probably the first tree to receive the name of Silky Oak, or at least the name was first associated with this species, and it has been customary by the uninitiated, to give the name *Grevillea robusta* to every timber in the Sydney market called commercially Silky Oak.

Range.—Richmond and Tweed Rivers, New South Wales, also the coastal districts of Queensland.

Timber.—(a) *Macroscopical.—Physical Properties.*

Colour.—It is the palest of all the Silky Oaks here described, and more nearly approaches in colour that of the true oaks *Quercus*, than any other. The rays, although distinct, are the same tint as their setting, their distinctiveness being caused by the contrasting plane.

Figure or Silver Grain.—It possesses a very attractive figure which more nearly resembles that of *Quercus* than any of the other Silky Oaks. The rays are a very prominent feature on the quarter or silver grain, being broad and of good length, and the fibres often wavy between them add to the beauty. In the tangential section, the ends of the numerous rays give a lace-like appearance to the surface, and in this end-on-view the rays are more pronounced than in the common oak.

Texture and Grain.—The grain may be said to be straight, although at the prominent rays the fibres are bent, but this does not affect the planing or dressing of it, and viewed longitudinally in any cut it would be classed as open. Transversely the texture is close, the fibres predominating and forming a close compact mass between the well defined rays. It works and planes well and takes a good polish.

Transverse Tests.—(The following were made upon selected timber of standard size 38 in. × 3 in. × 3 in., and the same remark applies to the other tested pieces.)

	No. 1.	No. 2.	No. 3.
Breaking load	1,890	2,370	7,000
Modulus of rupture in lbs. per sq. in.	3,720	4,650	14,237
Modulus of elasticity ,, ,,	483,000	486,000	1,700,000
Rate of load in lbs. per minute ...	250	428	875

Weight.—40 lbs. 6 ozs. per cubic foot.

(b) *Microscopical.*

Transverse.—There are four main features in this section which characterise the field of vision in a low power objective, viz, the medullary rays, fibres, parenchyma and pores, and each occupies about an equal area. The wide multiseriate rays are especially conspicuous, running in broad lines through the picture, with uniseriate ones intervening. Between the broad rays the other organs mentioned above occur, the fibres and parenchyma alternating in well marked loops with the concave side outwards, towards the bark. Interspersed amongst the parenchyma, but close up to the fibres are pores, mostly empty; tyloses and resin were not seen.

Radial Section.—When cut clear of the rays, the salient feature is the columns of fibres separated by their thin walled cells from the xylem, parenchyma and vessels. There are two kinds of rays, broad and narrow, the latter showing to better advantage in a micro-section. Both vary in height according to the number of cells in the vertical plane, they naturally form a pronounced feature in the section; most of the cells contain either an amorphous substance or silica, in fact the amount of silica detected in this species exceeded that found in any Silky Oak or other species examined. Small globular bodies were seen in a few of the cells of both the ray and wood parenchyma. Vessels with innumerable bordered pits on the walls form a very attractive object in the field of vision. The wood parenchyma appears to be of a tracheidal nature, the cells showing bordered pits in the radial walls. The fibres run in regular columns alternately with parenchyma tissue, and scattered vessels. The lumen of the fibres is exceedingly narrow owing to the thickened walls of these wood elements.

Tangential Section.—The salient features in this section are the multiseriate rays which occupy a large portion of the field, and which at the broadest part number from 50 to 100, or even more, a few uniseriate occur amongst the fibres. The radial walls of the parenchyma cells show bordered pits in section, and these very numerous markings of the vessels look very beautiful under a high power.

GREVILLEA HILLIANA F.v.M., Red Silky Oak, (B.Fl. v, 463).

Remarks.—This comparatively common name of Red Silky Oak is fairly well chosen, for it is certainly the darkest of them all, although dark brown in a colour scheme would more correctly describe it. It is not so common on the market as the others, and the colour is not so pleasing, although some perhaps would prefer it when furnishing in a dark brown study.

Range.—North Coast districts of New South Wales and the coastal districts of Queensland.

Timber.—(a) *Macroscopical.—Physical Properties.*

Colour.—As already stated the colour is dark—a true brown, and in a colour scheme can easily be distinguished from the other Silky Oaks.

Figure.—The bulk of this wood seems to be made up of small rays, which are finer than those of the other species, consequently the figure in any but a radial section is very small and is not nearly so attractive. In a radial section the whole figure is one mass of fine rays, resembling somewhat ringed or fiddle-backed Blackwood, *Acacia melanoxylon*.

Texture and Grain.—This is the closest grained of all the Silky Oaks, and is characterised by a greasy feel which with the colour differentiates it from all its class. It is consequently easy to work and dress. The pores are almost equal in number to those of *Orites excelsa*, and less numerous than in the other three.

Transverse Tests.—	No. 1.	No. 2.	No. 3.
Breaking load	9,760	9,440	9,660
Modulus of rupture in lbs. per sq. in.	19,520	18,880	19,320
Modulus of elasticity „ „	2,964,705	2,677,640	2,734,177
Rate of load in lbs. per minute ...	813	944	805

Weight.—62 lbs. per cubic foot.

(b) *Microscopical.*

Transverse Section.—A very beautiful figure is obtained from this section when stained with malachite green. The rays form attractive green bands across the fields of varying thickness according to the number of cells, many of which contain a deposit in amorphous form or spherical. Between these occur wood parenchyma, fibre and vessels, the first two arranged in concentric loops, concave always towards the bark. The fibres occupy by far the biggest area, being only separated by the narrow band of wood parenchyma, one, two or three cells wide. The walls of the fibres are very thick, and so only a very small lumen obtains; the cell walls are not numerous. The wood parenchyma cells have the long axis in some few instances in the arc of their disposition, and are almost all filled with a coloured deposit, which makes them still more conspicuous. The vessels are irregularly distributed throughout.

Radial Section.—A section of this face shows clear of the rays a rather regular structure, the columns of fibres alternating with the parenchyma and vessels. The rays, especially the multiseriate ones, are very pronounced, and show globular and amorphous cell contents, the former occurring also in the cells of the wood parenchyma and in the vessels, the only species in which they were so found in the latter. Silica was also detected.

Tangential Section.—The compact mass of fibres and spindle shaped end-on view of the large and small rays, with their varied cell contents are characteristics of this view.

EMBOTHRIUM WICKHAMI F.v.M., Satin Silky Oak, Red Silky Oak. (See Bailey's "Queensland Flora," iv, 1358).

Remarks.—This is easily distinguished from the other Silky Oaks by its specific gravity being the lowest. The first common name well describes the face of a planed surface.

Range.—Brushes of the North Coast of New South Wales and the coastal districts of Queensland.

Timber.—(a) *Macroscopical.—Physical Properties.*

Colour.—A pale pink.

Figure.—This has quite a different facies from any described Silky Oaks. The figure is a decidedly "Oaky" one, and its sheen adds to its beauty. The rays are prominent, but the open texture along with the sheen rather adds to the ornamentation of the timber. It is the most porous timber of them all; most of the fibres occur in bundles.

Texture and Grain.—This is the most open grained of all the Silky Oaks and naturally the specific gravity is the lowest, and although the rays are very prominent, yet it is not interlocked, the fibres running quite straight, and so it is easy to plane. The rays are of a darker shade or colour than the other wood elements, which possess such a very high sheen or satin surface that in cabinet work, especially panelling, there would be no necessity to polish it. It planes and works very easily.

Weight.—30 ℔s. per cubic foot.

(b) *Microscopical.*

Transverse Section.—This is quite unlike in structure any of the other Silky Oaks described in this paper, in fact, unlike any other Proteaceæ so far examined by me. The fibres occupy a large area of the wood structure, and having a large lumen and comparatively thin walls give quite a uniformity of structure, almost similar to that of a conifer; the wall perforations are very rare. The rays too are not by any means broad, and the parenchyma is most limited and not difficult to discern in this section, the cells being filled with an amorphous deposit. The vessels are numerous and mostly didymous and tridymous.

Radial Section.—In places the fibres make quite a solid face and the wood parenchymatous cells are a less significant feature of the section. The ray parenchyma cells are characterised by a brown substance which quite fills them and gives the appearance of a brick wall to this portion of the slide, but this substance occurs in the vertical parenchyma and is only rarely in the vessels. A few specimens of silica were seen.

Tangential Section.—Only in this view is the character of a Proteaceous timber seen, the multiseriate rays and fibres almost making up the whole structure. The fibres appear as very compact, in strong lines around the rays, and few pits were detected. It will be noted from the figure that it is the outer cells of the rays that contain the red colouring substance. Uniseriate rays are small and fairly distributed, whilst vertical parenchyma is a conspicuous feature.

CARDWELLIA SUBLIMIS F.v.M., Bull Silky Oak, Silky Oak, Gold-sprinkled Silky Oak. (B. Fl. v, 538).

Remarks.—The origin of the first common name given above is difficult to trace, and may possibly be used as a term of comparison in regard to the size of the medullary rays, as obtains in a similar case of a Casuarina *(C. Luehmanni)*, which is known as "Bull Oak," the rays in this case being more pronounced than in any other species of that genus, and probably of the whole vegetable kingdom, just as the rays of *C. sublimis* are larger than those of any other of its congeners. According to Mr. R. H. Cambage, "Bull Oak" (Casuarinaceæ) also occurs near the coast in North Queensland,[1] where both these trees go under the name of "Bull Oak" and "Bull Silky Oak" respectively, and probably because they both have such pronounced figures. The rays are prominent in every section of the wood, and can sometimes be shown in a radial section a foot long and half an inch high, when that portion of the ray can be caught in a straight line when cutting.

Timber.—(a) *Macroscopical.*—*Physical Properties.*

Colour.—Brick red, and quite distinguishable from the others described in this paper. It is open in the grain with a comparatively small sapwood in full grown trees, but larger in the younger trees; the neighbourhood of the cambium is generally darker than the other parts of the wood.

Figure.—This wood has certainly the most showy figure of the Silky Oaks, especially when cut on the quarter, the height and length of the rays leaving little of the other wood elements exposed. The figure of course varies according to the angle the timber is cut to the rays. The vessels give it an open grain effect, a neat figure is shown when cut tangentially, and in a transverse section the rays are of course the salient feature.

Texture and Grain.—This is the second coarsest grained species described in this paper, *Embothrium Wickhami* being perhaps somewhat coarser; the large diameter of the vessels and exceptionally wide rays give it this character. The end grain is especially marked by the long distinct numerous lines of the rays which show more clearly than

[1] This Journal, XLVIII, 278 (1914).

in any other species of Silky Oak. The grain may be described as straight, the timber planing easily and a smooth surface is obtained. The silver grain is very fine, due to the large rays, and from which the tree derives its name of "Bull Oak." There is, however, one slight defect in it, namely, occasionally black streaks running through it longitudinally.

Transverse Test.—

Breaking load	5,680
Modulus of rupture in lbs. per square inch	11,360
Modulus of elasticity ,, ,, ,,	1,344,000
Rate of load in lbs. per minute	560

Weight.—36 lbs. per cubic foot.

(b) *Microscopical.*

Transverse Section.—The area of an average field of observation is seen to be evenly occupied in amount by the rays, parenchyma, fibres and pores. In general, the section more nearly approaches that of *Grevillea robusta*, but the fibres are more regularly arranged in parallel or concentric curves (convexity inwards), than in that species, and the same remarks apply to the parenchyma throughout, which is scattered; pores are numerous, containing in some cases material not yet identified. The walls of the fibres are much thinner than in *G. robusta*, and are remarkable for the paucity of perforations. The rays are very prominent, containing minute globular substances in some of the cells.

Radial Section.—The regularity of structure of this species is well seen in this section, the columns of fibres alternating with the wood parenchyma, giving it a tracheidal appearance, and in most instances with spherical bodies in the cells of both forms of parenchyma. The two kinds of rays are well seen; the multiseriate lacking the regularity of the uniseriate, which shows very clearly the outline of each cell, whilst in the former the cell walls are so numerous as to make the structure appear lost in so many lines. Amongst them appear at rare intervals cylindrical or elongated bodies with processes scattered over the surface, a transverse section showing them to be amorphous; therefore they can hardly be classed as sclerenchymatous bodies, but are in all probability silica. Very small spherical bodies are also seen in the cells. The bordered pits of the parenchyma are well seen in section in both the end and side walls. The wood parenchyma is the only instance in which the small spherical bodies were detected.

Tangential Section.—The most conspicuous objects in this view are, the transverse sections of the multiseriate rays, the uniseriate rays being quite insignificant compared to these. The other structure calls for no remarks, being explained in the radial section. A brown amorphous substance is in evidence in several of the vessels which have scalariform septa.

ORITES EXCELSA R. Br., Prickly-leaved Silky Oak. (B. Fl. v, 411).

Remarks.—This species is best known in the bush by the above name, but when cut into planks and placed on the market has the same common designation as *Grevillea robusta*, viz. "Silky Oak," although there really is little difference in the colour of the wood, but microscopically and chemically the differences are very marked.

Range.—Brushes of the North Coast of New South Wales and coastal districts of Queensland.

Timber.—(a) *Macroscopical.—Physical Properties.*

Colour.—It falls, like most of the "Silky Oaks" described in this paper, in a class of browns, this being pale but a shade darker than *Grevillea robusta*, or perhaps light pink would nearly describe it.

Figure.—The rays are a little darker in colour than the rest of the timber, but are fairly deep, perhaps deeper than *Grevillea robusta*, and nearly equal in size to those of *Cardwellia sublimis*. The "oak figure" is of course best seen in the radial surface as obtains in all this class of woods. A neat figure is found when the wood is cut tangentially or at right angles to the rays, which then appear as innumerable flecks on the surface.

Texture and Grain.—It is rather open in texture, but yet closer than that of any other described in this paper except *Grevillea Hilliana*. It planes easily, and is free working, but the prominent rays give trouble in dressing as they easily tear out. It looks well polished or waxed, but when so treated the colour changes to a dark, dirty tint.

Transverse Test.—	No. 1.	No. 2.	No. 3.
Breaking load in lbs.	5,550	5,850	4,750
Modulus of rupture in lbs. per sq. in.	10,744	11,397	9,238
Modulus of elasticity „ „	1,561,234	1,293,231	...
Rate of load in lbs. per minute ...	504	390	327·6

Weight.—37 to 40 lbs. per cubic foot.

(b) *Microscopical.*

Transverse Section.—The unstained section is one of the prettiest specimens of timber to be seen under a microscope. The natural colour a pale brown, brings the whole structure into good definition. The rays are naturally a prominent figure, and are very attractive by the presence of a small globule of an unidentified substance in almost every parenchyma cell, and in the uniseriate rays they look exactly like a string of beads. The fibres are seen to predominate in amount over that of the other elements, occurring in concave masses with the concavity outwards, and simple pits are fairly numerous. These are separated by mostly single rows of pores, and one or two rows of small parenchyma cells.

Radial Section.—In this species the wood parenchyma is very little in evidence, the columns of fibres being separated fairly regularly by the vessels. The multiseriate rays are conspicuous objects, and this is specially emphasised by the globules of a brown substance giving it a bead work appearance; they are also tracheidal in some instances. Sparsely scattered in the rays are a few sclerenchymatous stone, octangular cells, a distinct specific character.

Tangential Section.—The dense masses of fibres are the salient feature of this view, and next to these the multiseriate rays showing the brown globules in the cells and some octagonal sections of sclerenchyma cells, a feature which makes the specific distinction from that of any other found in this series of "Silky Oaks."

EXPLANATION OF PLATES.

Plate XVII.—Transverse sections of *Grevillea robusta, Grevillea Hilliana, Embothrium Wickhami, Cardwellia sublimis* and *Orites excelsa* (all natural size).

" XVIII.—Radial sections of the above.

" XIX.—Tangential view of timber next to bark of the above.

" XX.—Transverse section of *Grevillea robusta* (in colour).

" XXI.—Radial and tangential sections of *G. robusta.*

" XXII.—Transverse section of *G. Hilliana* (in colour).

" XXIII.—Radial and tangential sections of *G. Hilliana.*

" XXIV.—Transverse section of *Embothrium Wickhami* (in colour).

" XXV.—Radial and tangential sections of *E. Wickhami.*

" XXVI.—Transverse section of *Cardwellia sublimis.*

" XXVII.—Radial and tangential sections of *C. sublimis.*

" XXVIII.—Transverse section of *Orites excelsa* (in colour).

" XXIX.—Radial and tangential sections of *O. excelsa.*

SUMMARY.

Species.	Colour-	Order of Hardness.	Weight per cubic foot.	Breaking weights on standard size	Salient feature, Macroscopical.	Salient feature, Microscopical.	Bark.
Grevillea robusta ...	pale brown	3	40 lbs.	7,383 lbs.	Light colour and rays	Minute spherical bodies in wood parenchyma and amorphous substance in ray parenchyma, swag arrangement, of fibres and wood parenchyma transversely.	Most furrowed of all the species, especially so in cultivated trees, much like English oak bark.
Grevillea Hilliana ...	dark reddish-brown	1	62 lbs.	9,620 lbs.	Colour, weight and hardness	Spherical bodies in parenchyma and vessels, preponderance of fibres over other wood elements.	Much like *Orites excelsa* on outer coating, but otherwise far more compact and hard, similar to wattle bark, *Acacia decurrens.*
Embothrium Wickhami	light brownish-pink	5	30 lbs.	...	Lightness in weight, high sheen, open texture	Tracheidal appearance in cross section, red substance in parenchyma.	Tesselated with small tesselations, thin.
Cardwellia sublimis ...	brick-red or light terra-cotta	4	38 lbs.	5 680 lbs.	Colour and pronounced rays	Large vessels or pores, equal proportion of wood parenchyma and fibres, minute presence of spherical bodies.	Somewhat resembling *Orites excelsa* but rougher.
Orites excelsa	pale brown or pinkish	2	$37\frac{1}{2}$ lbs.	5,383 lbs.	Large rays and colour	Numerous large spherical bodies, parenchyma and compact fibres.	Smooth, whitish, thin skin over red under-bark, thick, compact towards the cambium.

THE VERTICAL GROWTH OF TREES.

By R. H. CAMBAGE, F.L.S.

[*Read before the Royal Society of N.S. Wales, August 7, 1918.*]

THE point discussed in this paper in regard to the vertical growth of trees has no reference to the rate of growth, but deals only with the question as to whether the trunk of a tree continues to lengthen among or below the branches while it increases in girth, or whether the increase in height is wholly due to the growth at the tree top. The question is one which has often been discussed, and opinions on the point are very diverse, but actual observations by means of experiments or tests appear to be few.

In regard to an Australian tree, testimony has been recorded by Mr. T. W. Fowler, M. Inst. C.E., who quotes a contractor of standing, as saying that a certain tree when first examined was about one foot too short to provide a twenty-foot beam, but twenty years later had increased sufficiently in length for the purpose.[1] The species or kind of tree was not stated.

Mr. District Surveyor W. G. Walker (*ibid.*, p. 213), refers to an occasion, when some years previously, he saw some twenty-five year old blazes on trees growing on a low-lying rich flat on the Richmond River, and which were between two and three feet higher than those ordinarily made. The inference in this case was that the blazes had been cut at about three to three feet six inches above the ground, and in the subsequent twenty-five years the lower portion of the tree trunk had increased its length by about 60 to 80%. In my own experience I have never noticed

[1] *The Surveyor*, New South Wales, XVII, 187, (1904).

anything to corroborate this observation, old blazes and shields on marked trees having generally been found at about the usual heights.[1]

Some years ago Mr. District Surveyor W. M. Thomas drew my attention to the results of some tests made by Mr. G. W. Cooley, in America, in regard to the stability of bench marks cut near the base of fifteen trees of several different species.[2] The observations extended over a period of five or six years, the tests being made annually. No upward growth was detected, although a change from one to three-hundredths of a foot was noticed from year to year, probably caused by the action of frost during the winter.

It was further pointed out that three nails driven into some of the trees, about four feet above ground, maintained for five years the same relative position with regard to the nails on the bench marks. It may be mentioned that the trees selected for use as bench marks in the above tests were from three to twenty inches in diameter, the majority being one foot and upwards, and it might seem more reasonable to expect an extension, if any, to take place in such trees in the higher rather than the lower portions of the boles.

Some experiments have been carried out by me for years past on very young trees growing in my own garden, and in the Sydney Botanic Gardens, the latter tests being made by permission of the Director, Mr. J. H. Maiden. These tests have been made by placing small tacks in the stem, one foot apart, the measurements being taken from a peg driven into the ground, or in some cases from a nail driven into the base of the stem. Tacks were renewed when

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[1] *The Surveyor,* XVII, 226, (1904).

[2] *Trans. Amer. Soc. Civil Engrs.*, XX, 73, (1889). *The Surveyor,* XVIII 35, (1905).

found to be nearly covered by the bark. The results of these observations go to show that the extension of the stem is made at the summit or growing point of the plant, and not between the branches.

It is difficult to always guarantee the accuracy of the measurements nearer than to half an inch. Where the tree grows perfectly straight and the measurements are taken from a nail driven into the base of the stem, and there are no branches in the way, a high degree of accuracy can be maintained. An objection to measuring from a peg is that as the tree grows, the peg gets pushed out of position, so that it is considered better to start the measurements from a base-nail. Extreme accuracy is difficult to obtain if the tree becomes crooked, or grows out of the perpendicular.[1]

In the following tables the first column indicates the number of nails, one foot apart, driven into the stem on a given date, and also the number of branches between each nail. The remaining columns show the measurements to each nail on subsequent dates, and the number of branches then remaining, there being practically no difference found in the position of the nails in the great majority of cases. The columns also show where higher nails have been placed as the stems increased in height.

The diameter of the stem was measured at two feet from the ground in all cases. As a general rule the top of the plant was about one and a half feet above the highest nail, and this higher portion of the stem was too frail to admit of a nail being driven into it.

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[1] For information concerning the increase in diameter of ordinary timber trees, see a paper entitled "Growth of Trees, with a Note on Interference Bands formed by Rays at Small Angles," by A. Mallock, F.R.S. *Proc. Roy. Soc.*, London, Series B, Vol. 90, No. B 627, (1918).

Eucalyptus parvifolia Cambage (No. 1).

Number of branches between each foot at date of measurement.

24/3/1912 Diam. $\frac{3}{4}$ inch.	22/9/1912	10/5/1914 Diam. $1\frac{3}{4}$ in.	17/10/1915 Diam. $3\frac{1}{4}$ in.	24/7/1918 Diam. 5 in.
				18 feet high
		9 ft.	9 ft.	9 ft. $\frac{1}{4}$ in.
		14 br.	8 br.	3 br.
		8 ft.	8 ft.	8 ft. $\frac{1}{4}$ in.
		12 br.	3 br.	2 br.
7 ft.	7 ft.	7 ft.	7 ft.	7 ft. $\frac{1}{4}$ in.
11 br.	11 br.	2 br.	no br.	...
6 ft.	6 ft.	6 ft.	6 ft.	6 ft. $\frac{1}{2}$ in.
16 br.	16 br.	5 br.	1 br.	1 br.
5 ft.	5 ft.	5 ft.	5 ft.	5 ft. $\frac{1}{4}$ in.
13 br.	12 br.	no br.	...	...
4 ft.	4 ft.	4 ft.	4 ft.	4 ft. $\frac{3}{4}$ in.
15 br.	15 br.	1 br.	1 br.	1 br.
3 ft.	3 ft.	3 ft.	3 ft.	3 ft. $\frac{1}{2}$ in.
9 br.	9 br.	no br.	...	
2 ft.	2 ft.	2 ft.	2 ft.	2 ft. $\frac{3}{4}$ in.
4 br.	4 br.	no br.	...	...
1 ft.	1 ft.	1 ft.	1 ft.	1 ft.
1 br.	1 br.	no br.	...	...
Ground.				

On 24th July, 1918, the tree was very considerably bent over, which accounts for variation in distances between nails.

Eucalyptus parvifolia No. 2.

Number of branches between each foot at date of measurement.

24/3/1912. Diam. $\frac{3}{4}$ inch.	22/9/1912
	8 feet
	? branch
7 feet	7 feet
15 branches	15 branches
6 feet	6 feet
19 branches	19 branches
5 feet	5 feet
12 branches	12 branches
4 feet	4 feet
19 branches	19 branches
3 feet	3 feet
18 branches	18 branches
2 feet	2 feet
no branch	...
1 foot	1 foot
no branch	...
Ground	

Acacia podalyræfolia A. Cunn.

Number of branches between each foot at date of measurement.

23/5/1914 Diam. $\frac{1}{2}$ inch.	17/10/1915 Diam. 1 inch
	$8\frac{1}{2}$ feet high
	7 feet
	2 branches
	6 feet
	5 branches
	5 feet
	1 branch
4 feet	4 feet
8 branches	7 branches
3 feet	3 feet
5 branches	5 branches
2 feet	2 feet
6 branches	6 branches
1 foot	1 foot
4 branches	4 branches
Ground	

Cinnamomum camphora T. Nees.

No. 1.

Number of branches between each foot.

11/5/1912 Diam. $\frac{1}{2}$ inch.	26/12/1912
	5 feet
	6 branches
4 feet	4·1 feet
10 branches	6 branches
3 feet	3 feet
11 branches	12 branches
2 feet	2 feet
5 branches	5 branches
1 foot	1 foot
1 branch	1 branch
Ground	

Cinnamomum camphora

No. 2.

Number of branches between each foot.

10/5/1914 Diam. $\frac{5}{8}$ inch.	13/10/1915 Diam. 2 inches.
$5\frac{1}{2}$ feet high	11 feet high
4 feet	4 feet
5 branches	5 branches
3 feet	3 feet
4 branches	4 branches
2 feet	2 feet
4 branches	4 branches
1 foot	1 foot
1 branch	no branch
Ground	

In the case of *Cinnamomum* No. 1, the tree died shortly after 26/12/12, consequently no further tests could be made. In the case of *Cinnamomum* No. 2, the tree had to be cut down.

Melaleuca leucadendron L.

Number of branches between each foot.

25/5/1912 Diam. $\frac{3}{4}$ inch.	13/6/1914 Diam. $2\frac{1}{2}$ inches.
	6 feet
	6 branches
	5 feet
	7 branches
4 feet	nail gone
13 branches	1 branch
3 feet	3 feet
15 branches	5 branches
2 feet	2 feet
12 branches	2 branches
1 foot	1 foot
1 branch	no branch
Ground	

Acacia pycnantha Benth.

Number of branches between each foot.

27/5/1916 Diam. $\frac{1}{2}$ in.	18/3/1917 Diam. $1\frac{3}{4}$ in.	28/7/1918 Diam. $3\frac{1}{4}$ in.
		16 ft. high
	6 feet	6 feet
	5 branches	6 branches
	5 feet	5 feet
	6 branches	5 branches
4 feet	4 feet	4 feet
6 branches	5 branches	5 branches
3 feet	3 feet	3 feet
1 branch	3 branches	4 branches
2 feet	2 feet	2 feet
3 branches	1 branch	no branch
1 foot	1 foot	1 foot
1 branch	1 branch	1 branch
Ground		

Acacia decurrens Willd , var. *normalis* Benth.
Number of branches between each foot.

18/3/1917 Diam. $\frac{1}{2}$ inch.	24/7/1918 Diam. $2\frac{3}{4}$ inches.
	16 feet high
5 feet	4 ft. $11\frac{1}{4}$ in.
3 branches	3 branches
4 feet	3 ft. $11\frac{1}{2}$ in.
4 branches	3 branches
3 feet	3 feet
6 branches	4 branches
2 feet	2 feet
3 branches	1 branch
1 foot	1 foot
1 branch	no branch
Ground	measured from peg

Acacia neriifolia A. Cunn.
Number of branches between each foot.

10/6/1917 Diam. $\frac{1}{2}$ inch.	20/2/1918 Diam. $\frac{3}{4}$ inch.
6 feet high	$7\frac{1}{2}$ feet high
5 feet	5 feet
7 branches	7 branches
4 feet	4 feet
9 branches	8 branches
3 feet	3 feet
12 branches	6 branches
2 feet	2 feet
10 branches	3 branches
1 foot	1 foot
1 branch	no branch
Ground	

From the foregoing tests it will be seen that the vertical growth in very young trees appears to be practically limited to the terminal shoot or growing point, and does not extend to the lower portion of the stem among the branches.

If this conclusion be accepted as the correct one, there are still two other questions to be considered viz:—(1) Might there not be a prolongation of the bole over a period of 20 or 30 years, and (2) how is it that so many Eucalypts may reach a height of 60 feet to the first limb?

Although careful experiments and testing can alone answer the first question, it would seem remarkable, when apparently no extension of the stem takes place among the branches while the tree is very young and making rapid growth, that it should occur at a later stage.

Take the case of the Camphor Laurel (*Cinnamomum camphora*, No. 2), where the stem increased $5\frac{1}{2}$ feet in length, or double its original, in one year and five months, without anything being added to the lower four feet.

In the case of the Wattle *(Acacia decurrens)*, no increase was found in the first five feet in one year and four months, although the whole stem grew from about 7 to 16 feet in that period. The *Eucalyptus parvifolia* example shows that a length of 7 feet remained stationary for three years and seven months, and at the end of six years only showed change of $\frac{1}{4}$ inch, and this difference probably arose owing to the difficulty of measuring along a bent stem.

Mr. Walker's example suggests a rate of growth of slightly over an inch in one year, but nothing approaching this rate has been found in the present tests. In the case quoted by Mr. Fowler, the rate of increase for a length of nineteen feet was just over half an inch per annum, but even this is more than has been disclosed by the foregoing tests. At the same time the tree selected for a twenty-foot beam would probably be a tall-growing species of Eucalyptus, and I have had no opportunity of testing such a tree. *E. parvifolia* only grows to a height of about thirty feet.

In regard to the second question as to the long clean boles of many Eucalyptus trees, the explanation lies in the fact that where trees grow in warm sheltered situations and are closely packed among many neighbours, they run up rapidly in their upward search for the light, and during this process the young boles produce many branches which never mature, but, at first, when little more than twigs, wither and fall. As the tree grows, the limbs attain a larger size, but many eventually fall and the trunk becomes naturally disbranched, sometimes up to a great height. Should a tree grow in the open it will retain a much greater number of branches and reach only a lesser height than if it had grown under sheltered conditions.

Some evidence in regard to the loss of branches may be found by reference to the table illustrating the growth of

Eucalyptus parvifolia, No. 1. In 1912 there were four branches on that portion of the stem between 1 and 2 feet, but these had all gone in 1914. In the same period, between the heights of 2 and 3 feet, nine branches disappeared, and between the 3 and 4 feet marks fifteen branches were reduced to one. In a comparatively short time after these little branches die off, there is nothing left to show that they ever existed.

So far as the tests recorded in this paper have been carried, they have tended to show that although the boles and branches increase in diameter as the young trees grow, there is practically no extension in length of stem among or below the branches, at least during the first few years. In other words, though conclusive proof is still wanting, especially in regard to tall-growing trees, the results obtained make it appear, that once a young tree throws out definite branches, the portion of the stem below such branches will increase in diameter but not appreciably in length, and acts as a sort of strong base upon which the superstructure of a tall tree may be erected, and nails placed in the stem at any distance apart will retain their positions, relatively to each other, for at least several years, irrespective of how high the tree may grow.

THE DARLING PENEPLAIN OF WESTERN AUSTRALIA.

By W. G. WOOLNOUGH, D.Sc., F.G.S.

With Plate XXX.

[*Read before the Royal Society of N. S. Wales, September 4, 1918.*]

THE foundations of the study of the physiography of Western Australia have been laid deep and strong by Jutson in his masterly survey of the question in Bulletin No. 61 of the Geological Survey of that State, published in 1914. The author desires to express his admiration for the work done by this investigator, a work remarkable quite as much for its sobriety of hypothesis as for its scope of reading, care in investigation and profundity of deduction. As Jutson himself has pointed out, little detailed investigation of physiographic problems has been carried out in Western Australia, and the results of a preliminary statement of physiographic structure cannot be considered as final or complete. From time to time the author hopes to add contributions to the subject. The present note in some ways elaborates, and in others differs from the views of the previous author.

With Jutson's main premise, that the "Great Western Australian Plateau" is a vast uplifted peneplain, the author is entirely in agreement. Peneplain is here used in the sense of an almost level, or, at most, a gently undulating surface, carved out at an altitude very near base-level of erosion (usually sea-level), by the ordinary forces of sub-aerial erosion under humid conditions. As a result of many years of teaching experience, it has been found extremely difficult to get beginners to remember the fact, that a peneplain is not a mathematical plane; and the same difficulty seems to exist in the minds of some geologists. Criticisms are frequently levelled at descriptions of peneplains because differences of level, amounting sometimes to a couple of hundred feet, are noted.

The evolution of a perfect peneplain, while rapid in its earlier stages, is undoubtedly almost inconceivably slow as completion is approached; and it is for this reason that, in most of the peneplains of Australia, various types of "residuals" of the older land surface, from which the peneplain has been carved, are left standing above the general level. Mechanical transportation of detritus is almost non-existent during the later stages of erosion, by reason of the extremely sluggish nature of the streams. On the other hand, chemical weathering, and the action of solutions are strongly predominant. In another paper (in the press) the author has endeavoured to show that these phenomena, combined with the action of a copious, but markedly seasonal rainfall, have been necessary and sufficient conditions for the production of the laterite capping which is so ubiquitous a feature throughout the length and breadth of Western Australia. The latter part of the thesis has been put forward by Simpson[1] and others, but, so far as the author is aware, the formation of the material

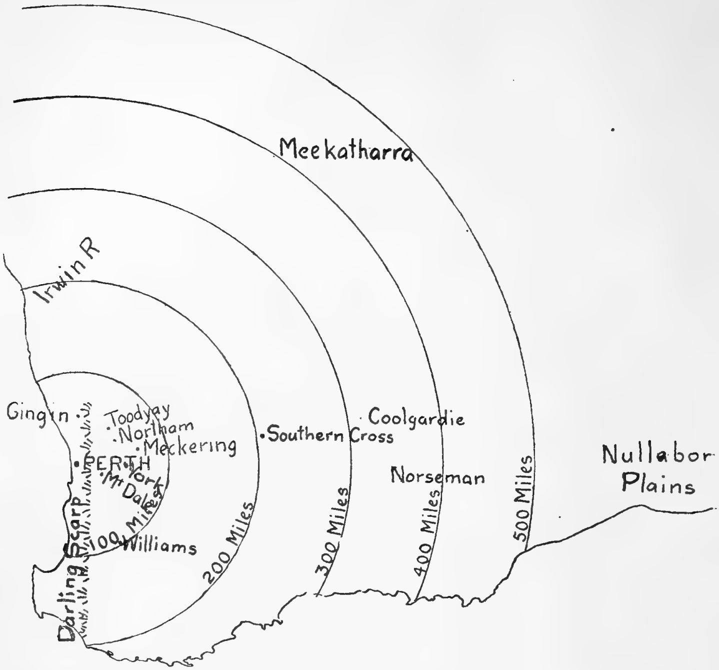
[1] Simpson, E. S., Laterite in Western Australia, *Geol. Mag.*, Decade v, Vol. IX, pp. 399 - 406, 1912.

Burton (*Rec. Geol. Surv. India*, XLVIII, pp. 204 - 218, 1917) believes that the laterites of the Central Provinces of India are lacustrine in origin, and in this he follows Middlemiss, Wetherell, and Fermor, (references in paper quoted). That such cannot be the case with the laterites of Western Australia is clearly shown by the occurrence of fine quartz and aplite veins *in situ* in the leached "pipe clay," which always forms the foundation of the laterite of the Darling Range. It seems probable that two essentially different but superficially similar substances are being called "laterite" in India and Western Australia respectively.

on a land surface *of low altitude* has not been insisted on previously.

If this view is correct it follows that the *original* laterite formation of Western Australia may be taken as an indication of the peneplain surface. The question is suggested, why are not all peneplains indicated by laterite cappings? The answer is that several conditions, other than ordinary (and therefore in general partial) peneplanation, are necessary. So long as normal and effective drainage exists, the ferruginous and aluminous solutions are largely carried away seawards. It is only when practical stagnation is attained, that is, when the peneplain stands for long ages at base level, that the necessary concentration of solutions takes place. In the second place the alternation of seasonal desiccation and saturation is also necessary. This coincidence of circumstances is rarely attained. This view of the case bears out Jutson's main contention with regard to the origin of the Western Australian Uplands. To the South Western section of these Uplands he applies the term Darling Peneplain, and it is to this portion of the area that the author wishes to draw attention chiefly. The altitude of the laterite "level" rises gradually from about 800 feet above sea level at the Darling Scarp overlooking the coastal plains, to 1,400 feet at Coolgardie, and 1,700 feet at Meekatharra.

The surface of the Darling Range is remarkably level (neglecting the obviously recently-denuded valleys of the existing streams) and the skyline is very even. When examined in closer detail, however, quite considerable differences in altitude of different parts of the laterite cap are noticeable. These are, in part, and probably principally, due to the sagging of the outer edges of "Mesa" cappings through the removal of the very decomposed granitic material on which the laterite universally rests.



In part, however, there is a real and fundamental difference of level. So far as the observations of the author extend (and the Darling Range area has been fairly thoroughly traversed) these residual differences amount to less than 200 feet in most cases, and this difference does not appear excessive when the proviso that a peneplain is not a mathematical plane is remembered. The present height of the laterite surface is due to epeirogenic uplift of the whole area under discussion to the extent of the difference in altitude between the laterite-level and sea-level. A tilt as well as an uplift is at first suggested. When, however, it is considered that the difference in altitude between Coolgardie and the Darling Scarp is only 600 feet, and the distance is about 300 miles, it is apparent that the gradient of the surface must have been negligible even if the same difference existed prior to uplift. There is then no necessity to postulate a tilt as well as bodily uplift, though it is possible that such a tilt may have taken place.

Up to this point the author's observations are merely a corroboration and amplification of the principles laid down by Jutson. Here, however, the author desires to diverge somewhat. Jutson has made no mention of residuals of an older landscape standing above the surface of the Darling Peneplain, and such residuals are by no means abundant or conspicuous. One's outlook from one of the laterite scarps usually so circumscribed, owing to the heavy jarrah forests and to the youthfulness of erosion of the stream valleys, that an extensive prospect is rarely obtained. The author was fortunate enough to visit the estate of Mr. A. R. Gorrie near Chidlow's Well, and to obtain thence a magnificent panorama of part of the Darling Peneplain (Plate XXX, fig. 1). From this point of view the existence of monadnocks of considerable dimensions was at once recognised. The chief of these is Mount Dale, associated with which are a number of other out-standing peaks including Eagle Hill, Mount Randell and others. On two recent motor journeys between Perth and Albany, near views of Mount Randell (about 45 miles south of Perth) were obtained, and the general contour of the mountain strongly bears out the views stated as to its mode of origin. The same group of hills also forms a conspicuous landmark from the higher ground near Williams (100 miles south of Perth) and from this aspect also their residual character becomes apparent. There is therefore evidence of the existence of a higher, and therefore older, level of erosion for which the name of the "Mount Dale Level" is proposed.

Jutson has noted the highly mature character of many of the valleys on the surface of the Darling Peneplain, of which the Avon River at York and Northam is a striking example. It appears to the author, however, that Jutson has not fully appreciated the significance of these valleys, which are extremely widely developed in the Darling Range area. They form a series of sub-parallel troughs, roughly meridional in direction, and parallel with the general "grain" of the country. They are very wide in proportion to their depth, that is, are highly mature, and are of the utmost economic importance, since they constitute the arable portion of the "Wheat Belt" of Western Australia. They *are carved out of the laterite covered plateau*, and their bottoms lie at least 200 feet below its level. The floors and sides are clear of laterite coating, and the basement granites and "greenstones" of the country are exposed.

The author regards these great longitudinal valleys as evidence of a slight uplift which occurred *after* the formation of the Darling Peneplain, and *before* its elevation to its present altitude. This uplift was of small amount, but sufficed to rejuvenate the drainage, and to reinstate the normal processes of corrosion; and the land surface remained in a stable condition long enough for advanced maturity of erosion to be attained, without production of a complete peneplain. For this reason the author suggests the name "Mature Valley Level" for the partial peneplain which was produced under the circumstances described. If a local name is preferred instead of that suggested, (and such is probably better, since there are other mature valley levels in Australia and elsewhere) the name "Meckering Level" may be substituted, since the prosperous agricultural town of Meckering occupies one of these valleys. Meckering is preferred to Beverley, York or Northam, as being more distinctively Western Australian, though the mature valley topography is even more marked at the towns mentioned.

At the time of the principal Darling Range uplift, these mature valleys were occupied by long, gently-flowing "subsequent" streams, some of which probably fell southwards while others flowed to the north. As a result of the production of the Darling Scarp, new, active, consequent rivers came into existence. In the area under review these streams flowed from east to west, and, rapidly extending their valleys headwards, they gradually dismembered the older streams and produced the present arrangement of the drainage. While this latter part of the question is treated by Jutson, the author differs from him in some of his conclusions as to matters of detail, and intends to deal with the matter of river development in a subsequent paper.

At Northam and York (Figs. 59 and 60, Jutson *loc. cit.*) the Avon River has not yet been affected by the piracy carried out by the Swan. The stream occupies its ancient mature valley. A little further north, at Toodyay, however, the Swan is actively incising its valley and is in a comparatively youthful stage of development. Its bed lies far below the original valley bottom, but the positions of both the Darling Peneplain and of the Meckering Level can be traced quite readily; the former in the level-topped laterite covered hills of the 1,000 foot level, and the latter in the broad, gently sweeping, curved shoulders of these hills (Plate XXX, fig. 2).

In many parts of the Darling Range there is a strong suggestion of two mature-valley levels, but much more investigation will be necessary before such a fact can be substantiated. Passing eastward across the mature valleys of the Avon, Logan and other streams, the clearness of definition of the Meckering Level is lost, though, all the way, to Southern Cross at all events, the existence of mature valleys is noticeable. This is only what would be expected on the theory of a slight uplift after perfect peneplanation. The roughening of the land surface would be most pronounced near the coast, and would become less marked inland. While it is really beyond the scope suggested by the title of the present paper, the author wishes to suggest the possible bearing of the theory, above outlined, upon the problem of the topographic development in the great interior Salt Lake Region. Jutson has implicitly stated that the summits of the higher levels in this region are the remnants of the Great Plateau. The author desires to make this statement explicitly, and to claim the laterite residuals like the Red Hill at Coolgardie (Plate XXX, fig. 3) as the remnants of a peneplain contemporaneous and coextensive with the Darling Peneplain. During the great rest-period, when laterization was going on, this surface was at a much lower level than at present, quite low enough to account for the submergence below sea-level which has been noted at Lake Cowan (Norseman).

While it is by no means so certain as the fact of the existence of a western coast not far from the present one, there is strong probability that a coast line existed away to the south-east of the Coolgardie area. The comparatively recent date of the limestones of the Nullarbor Plains (Eucla Limestone Plateau of Jutson) suggests former extension of the Southern Ocean as a veritable Mediterranean Sea far into the south-eastern portion of the State.

The uplift which produced the Meckering Level on the western side rejuvenated the drainage on the eastern side as well. As Jutson has pointed out, there is every reason to believe that the climate of the interior of Australia was formerly much moister than it is now. Under such conditions a development of mature valleys analogous to those of the Meckering level may be postulated. As these would be base-levelled, their lower courses would undoubtedly enter salt water, and Lake Cowan may have been a bay or estuary.

About the time of the main Darling Uplift, which may also have caused the Bunda Scarp, the progressive desiccation of the climate prevented the development of young consequent streams on the eastern side of the peneplain, and the previous normal erosion gave place to the cycle of arid erosion through which the region is passing at present. The author is of opinion that such a mode of development reconciles the somewhat divergent views which have sought to explain the great salt lake systems by arid erosion, by river erosion or by wave action.[1]

The author has not travelled sufficiently extensively in the salt lake region to be able to speak with the same certainty as with respect to the Darling Range area, but wishes to suggest that some of the higher hills in that area such as Mount Burgess, north of Coolgardie, may possibly be residuals of the Mount Dale level. It is possible also that the recognition of a mature valley cycle of erosion may assist in explaining some of the difficulties which exist in connection with the origin of the deep leads of Norseman and elsewhere. Jutson has explicitly assumed such a cycle, subsequent to the main planation of the area (*loc. cit.*, p. 98).

Age of the Different Levels.

The author agrees in every point with Jutson as to the evidences of date of peneplanation afforded by the Irwin River sections and those from that point southward to Gingin. The author has had an opportunity recently of re-examining the Irwin River area, and is convinced not only that: "the Jurassic rocks in the Irwin River district were uplifted with the granite," (Jutson, p. 94), but that the laterite level marking the Darling peneplain is continuous across the old fault plane which marks their junc-

[1] Gregory, J. W., "The central lakes of Westralia and the Westralian peneplain," *Geog. Journ.* 1916, pp. 326–331. Jutson, J. T., "Erosion and the resulting land forms in sub-arid Western Australia, including the origin and growth of the dry lakes," *Geog. Journ.*, 1917, pp. 418–437. Montgomery, A., "The significance of some physiographic characteristics of Western Australia," *Journ. Roy. Soc. W.A.*, vol. II, 1915-6, pp. 59–96.

tion. The evidence with regard to the Cretaceous rocks at Gingin is almost, if not quite as conclusive, except that the topmost member of the Cretaceous series, being a porous sandstone, is not a suitable rock to produce laterite. It is, however, so strongly ferruginous as to suggest that it was a superficial formation when laterization was in progress. Its position with regard to the laterite to the Darling Range is not identical with that on the Jurassic formation (fifty miles further north). It is certain, however, that it has been displaced to some extent by the formation of the main Darling fault. There is no doubt, then, that the peneplanation is post-Jurassic, and there is extremely strong presumption that it is post-Cretaceous.

With regard to its upper limit of age, the author is much more doubtful, and is inclined to place it much further back than does Jutson. The latter argues from the immaturity of development of existing valleys in the Darling Range, but, as the author has shown, these valleys do not date from the termination of what may be termed the "great laterite cycle," but from the close of the "Meckering Level" cycle. Assuming the latter to have been contemporaneous with the formation of the Norseman Beds, it is to the Meckering Level cycle that Jutson's reasoning applies with full force. This being so, the age of the Darling Peneplain must be notably older, since a considerable period must have been necessary, not only to excavate the valleys of the Meckering Level, but to bring them into such marked adjustment with geological structure as seems to be the case. The author would therefore place the date of the close of the main peneplanation at least at the lower limit (older Pliocene) assigned by Jutson, with a strong probability that it may even be somewhat older still.[1] Reasons

[1] The author feels strongly, that in view of the uncertainty which exists with respect to the correlation of the Australian Tertiaries, the use of such terms as Miocene, Pliocene, etc., is of doubtful advantage, and would prefer the use of a term such as Norseman or Eucla to indicate the ages of the formations developed respectively at these two places.

have been given for believing that the duration of the great laterite cycle was almost inconceivably protracted. *The beginning* of this period must therefore have been much earlier in Tertiary time, and the date of the Mount Dale peneplanation may have been quite early in that era.

Summary.

The author agrees with Jutson in describing the uplands of South-Western Eastern Australia as an uplifted peneplain but goes further, and claims that not one but several periods of uplift, with intervening periods of crustal stability, can be recognized. For the oldest peneplain, represented by a few scattered residuals only, the name "Mount Dale Level" is suggested.

The name "Darling Peneplain" should be confined to the laterite covered surface so widely developed in Western Australia, and reasons are advanced for believing that an enormously protracted period of crustal stability is demanded for the production of this peneplain.

A subsequent small elevation caused the development of an extensive series of mature valleys, for whose base level the name "Meckering Level" is suggested. It is probable that, during this cycle of erosion, mature valleys were carved on the eastern as well as the western side of the land surface, and that these valleys subsequently decided the development of the great salt lakes of the goldfields areas. Probably the marine beds of Norseman were developed during this period, and possibly also some of the deep leads.

A sharp uplift of the highlands, with an isostatic depression of the coastal area, brought about the existing conditions of topography. Dissection of the uplifted Darling Peneplain, now at an average altitude of about 1,000 feet above sea-level, caused dismemberment of the mature valleys of the Meckering level.

The author differs somewhat from Jutson in the ages assigned to these earth movements, and believes that the early or late Pliocene date assigned by that author to the Darling Peneplain should refer to the Meckering Level. The formation of the Darling Peneplain was older, while that of the Mount Dale Level may be as ancient as early Tertiary.

EXPERIMENTS ON THE BEHAVIOUR OF IRON IN CONTACT WITH SULPHURIC ACID.

By C. E. FAWSITT, D.Sc., and A. A. PAIN, B.Sc.,

[*Read before the Royal Society of N.S. Wales, September 4, 1918.*]

Two papers on this subject have already appeared.[1] Comparatively little research on this subject has been carried out, yet the matter is of great importance; the researches already published *(loc. cit.)* have therefore been continued. There are many peculiarities about the action of sulphuric acid on iron that have still to be cleared up, but we have confined our present experiments to two questions only.

Part I.—*A comparison of Iron in concentrated Sulphuric Acid with Passive Iron.*

Although iron is attacked very noticeably when first inserted into concentrated sulphuric acid, the action is much less vigorous after a few hours, and suggestions have been made by some chemists to us that in this case we may have to do with something resembling a "*passive*" state of iron. We have therefore performed some experi-

[1] Fawsitt and Powell, *Journ. Soc. Chem. Ind.*, XXXIII, 234, 1914; and Powell, *Proc. Roy. Soc. N.S.W.*, XLVII, 59, 1913.

ments with wrought iron and 96% sulphuric acid (pure for analysis).

If the word "*passive*" be here used as denoting "*inactive*," then there is no great objection to it, for the activity in the case of action on wrought iron and cast iron is excessively slight. But the word "passive" could not at any rate be applied to iron in pure sulphuric acid as denoting a state in any sense similar to that of the state of iron when placed in 1·4 sp. gr. nitric acid. The results of the following experiments bring out the difference between the two cases.

I.—I A. When passive iron, lying in 1·2 nitric acid was touched with platinum, neither iron, nor the platinum experienced any change noticeable to the eye.

I B. When iron lying in concentrated sulphuric acid (96%) was touched with platinum, then although there might have previously been no bubbles of gas coming from the iron, bubbles of gas appeared after contact almost immediately on the platinum.

II.—II A. The cell. Passive iron [1·2 nitric acid] Platinum was found to have a potential of 0·13 to 0·3 volt, while the cell Active Iron [1·2 nitric acid] Platinum had a potential of 0·95 to 1·1 volts. In both cases the iron was positive to the platinum.

When passive iron immersed in 1·2 nitric acid was touched with tin or copper, the iron became suddenly active, and the potential immediately rose to that of the second cell, viz., 1·1 volts. When the passive iron was lifted into the air for a few moments and replaced in the solution, there was no considerable influence on the potential of the cell.

II B. The E.M.F. of the cell. Iron [concentrated sulphuric acid] Platinum was found to be much more variable than the E.M.F. of the cell where iron, passive or active, is tested against platinum in nitric acid. This is shown in Table I.

Table I.

Time after contact of iron with acid.	Potential
1 Minute	1 · 2 volts
8 ,,	1 · 1 ,,
16 ,,	0 · 95 ,,
30 ,,	0 · 8 ,,
65 ,,	0 · 62 ,,

After 65 minutes insertion in the acid, the iron was touched with a piece of tin, when the potential rose only to 0·68 volts. The iron was then scratched vigorously with tin, when the potential rose to 0·79 volts. The potential however started to fall again immediately. On bringing the iron now into the air for one minute, and again introducing into the sulphuric acid, the potential was found to have risen to 0·95 volt. The voltage immediately began to decrease slowly again as before. Whenever the iron was lifted into the air for one minute, the potential rose considerably, and in some cases as much as 0·4 volt.

III.—Passive iron (made passive by 1·4 sp. gr. nitric acid) was put into concentrated sulphuric acid (96%).

In the concentrated sulphuric acid the potential of the cell —Passive Iron [concentrated sulphuric acid] Platinum— was found to be from 0 to 0·2 volt. When the passive iron was brought into the air for a minute, and then replaced in the sulphuric acid, the potential was not noticeably affected. On touching the passive iron (while in the sulphuric acid) with a piece of copper, the potential rose suddenly to 1 . 15 volts.

It will be seen from these experiments that wrought iron made passive by 1·4 nitric acid, bears no simple relation to ordinary (active) iron which has been lying in pure concentrated sulphuric acid for some time.

The slow action of concentrated sulphuric acid on iron or steel, whereby hydrogen is produced, is dependent on all the usual factors governing the action of acids on metals. The peculiarities noticed in the case of iron and concentrated sulphuric acid are due partly to the protective coating of $FeSO_4$, H_2O which tends to cover the iron soon after the action has begun; partly also, we think, to the fact that iron is capable of absorbing hydrogen; and partly to impurities in the iron. Concentrated sulphuric acid does not of itself passidify iron.

Part II.—*Variation in the rate of action according to the Concentration of Acid.*

It would probably be expected that dilution of the acid would greatly increase the velocity of action. Our experiments have shown, however, that the increase in action is not in any way proportional to the increase in the percentage of water in the acid, but rather that no great increase in the rate of action is obtained when the acid is reduced from 94 per cent. to a concentration of 85 per cent. H_2SO_4 (15% water). Below a concentration of 85% sulphuric acid, the velocity increases somewhat more noticeably as the concentration of H_2SO_4 diminishes. A further decidedly greater increase in velocity is noticed in proceeding from 70% acid to 64·5% acid. Some investigations into the rate of action of concentrated sulphuric acid on iron have been made by Knietsch.[1] Broadly speaking, it might be said that his experiments give somewhat similar results to those we have obtained.

An exceptionally slight action was obtained in our experiments with 89·3% H_2SO_4. Knietsch, on the other hand, obtained a minimum action with 94% H_2SO_4. This may possibly be accounted for by the different kind of iron used in the two researches.

[1] *Journ. Soc. Chem. Ind.*, XXI, p. 343, 1902.

The rather sudden increase in velocity of action which we have observed in proceedings from 85% to 80% and from 70% to 64·5% acid, may not be unconnected with the fact that the monohydrate, H_2SO_4, H_2O contains 84·5% of H_2SO_4 while the trihydrate H_2SO_4, 3 H_2O contains 64·7% H_2SO_4.

The amount of action depends to some extent on whether the acid is kept in movement or is left undisturbed in contact with the iron. One set of experiments, Series A, was conducted without shaking, and the rate measured by reading the volume of gas (reduced to N.T.P.) evolved from the iron and acid contained in a flask. In Series B, the flasks containing the iron and acid were shaken, and the rate measured by noting the diminution in weight of the iron used.

Series "A."

The iron used was a steel wire of the following composition:—carbon 0·51%, phosphorus 0·046%, silicon 0·083%, sulphur 0·058%, manganese 0·48%. The steel wire had a diameter of 0·0706 centimetres.

A length of 634 cm. of wire, weighing 20 grams, was polished with emery paper and was cut up into lengths of 5 cm. This lot of 20 grams weight was the amount used in each experiment, and the surface exposed to the acid was approximately 143 sq. cms. in each case. The volume of the acid used was 120 cc. This was put into a Jena distilling flask (130 cc.) with the portion of the neck above the side tube shortened so as to reduce the gas space in the flask to a minimum. The side tube was shaped to a delivery tube permitting the collection of evolved gas over mercury. After introducing the iron and acid, the neck of the flask was closed with a paraffined rubber stopper. This arrangement was proved to be gas-tight under a pressure of 24 cm. of mercury. The flasks were placed in a water thermostat at 30° C., and the gas was collected in a measuring tube over mercury.

Owing to it being necessary to displace a small and variable amount of mercury in the delivery tube before any readings of the volume could be made, it was necessary to wait for 1 – 8 days, before the first reading could be taken. When therefore no reading for the volume of gas is given in the first few days (Table II), this does not mean that no gas was evolved, but that it was not possible to register the volume with the method of collection which was adopted. Using 120 cc. of acid, there is not a very marked change in the concentration of the acid even in several weeks, for although acid is being used up by water it is also used up in order to form the compound $FeSO_4, H_2O$, which has been shown[1] to be the compound formed in the action of concentrated sulphuric acid on iron. $Fe + H_2SO_4 + H_2O = FeSO_4, H_2O + H_2$.

An extreme case is next given where the action is taken as much greater than anything actually experienced in these experiments. Taking 94% acid as an example, and allowing this to act on steel for 45 days at 30° C., the maximum amount of gas which could be produced in this time (30° C.) from 140 sq. cm. of the steel used, is say, $45 \times 24 \times 3{\cdot}5$ cc. = 3780 cc. This (maximum) amount of gas is calculated on the assumption that the velocity throughout was the maximum velocity ever obtained in an experiment with 94% acid at 30° C.

These 3·780 litres would use up 16·8 grams of sulphuric acid (H_2SO_4). 16·8 grams of acid and 3·93 grams of water are thus removed. Now the original acid had a volume of 120 cc. and weighed 217·4 grams; this contains 205·8 grams H_2SO_4 and 11·6 grams water. After 45 days action 189 grams acid and 7·7 grams water are left, so that the per-

[1] Powell, *Proc. Roy. Soc. N.S.W.*, XLVII, 59, 1913.

centage of H_2SO_4 in the acid is 96·08. A concentration of 84·5% acid corresponds to the composition of the monohydrate H_2SO_4, H_2O and so will not gain or lose in concentration when acting. More dilute acids will lose in concentration.

As the acids employed usually had a much smaller action in these experiments than that formulated in the calculation, any alteration in the concentration of the acid from the initial values may be regarded as negligible.

In a previous research[1] it was suggested that the real (maximum) velocity of the action of concentrated sulphuric acid might not always be obtained owing to the adhering coats of ferrous sulphate and other causes. In many of those cases, shaking appears to be all that is necessary to produce the maximum velocity.

In many of the experiments, the results of which are given below, the velocity of action increased continually towards the maximum as time advanced, even when the flasks were not shaken; one could explain this by assuming that the faster the evolution of hydrogen gas, the more stirring action there is of the acid at the surface of the iron exposed; or one could assume that the products of the action have some accelerating effect on the action. It was assumed in a previous research, using the same steel and 94·6% acid, that the velocity of action obtained at 30° C. viz. 2·4 cc. per sq. dcm. per hour, approximated pretty closely to the the maximum velocity obtainable. In the first experiment (Series A, Table II) the flasks were left quite undisturbed except for the stirring action of the gas evolved, and the velocities obtained with 94% acid were somewhat less than those obtained originally by Fawsitt and Powell (*loc. cit.*) with 94·6% acid. The concentration of acid in those solutions was determined in the first instance by density, but

[1] *Journ. Chem. Soc. Ind.*, XXXIII, 234, 1914.

TABLE II.—*Evolution of gas expressed in cubic centimetres at N.T.P. from 1 sq. decimetre per hour at 30°C.*

Time from first contact	94% H_2SO_4	94%	90·9%	89·3%	89·3%	87·9%	87·9%	85%	85%	80%	80%	77·4%	77·4%	70%	70%	64·5%
½ day	...	...	...	...	0·006	0·008	0·1	...	...	0·02	...	0·62	0·66	...	...	2·2
1 ,,	...	.	...	...	...	...	...	0·014	...	0·2	...	0·07	0·02	0·61	0·42	4·1
2 ,,	...	...	...	...	0·018	0·07	0·4	...	...	1·04	0·38	0·74	0·37	0·9	0·8	5·8
3 ,,	...	...	...	...	...	...	...	...	...	...	...	1·7	...	...	1·4	
4 ,,	...	...	...	...	0·035	...	...	0·05	0·07	...	...	...	...	1·4	2·0	
5 ,,	...	...	...	...	...	0·13	0·075	0·12	0·11	2·6	2·0	...	...	...		
6 ,,	0·003	...	...	...	...	0·155	0·12	0·16	0·16	3·4	2·9	2·9	...	...		
7 ,,	0·005	...	0·016	0·12	0·044	0·2	0·16	0·21	0·20	...	3·5	3·1	...	1·8		
9 ,,	0·10	...	0·17	...	0·053	0·26	...	0·30	...	...	...	3·4	...	2·0		
11 ,,	...	0·06	0·17	...	0·064	0·44	0·34	...	0·38	...	2·6	...				
13 ,,	...	0·17	...	...	...	...	0·36	0·46	0·51	...	4·9	3·8				
15 ,,	0·30	0·27	0·30	0·14	...	0·25	...	...	0·60	4·9	...	...				
17 ,,	0·44	0·43	0·46	0·14	...	...	...	...	...	...	...	3·1				
19 ,,	...	0·51	...	...	...	...	...	0·67	0·74	4·5	...	...				
21 ,,	0·61	0·58	0·71	0·15	0·086	0·7	0·6	...	0·85	...	...	...				
23 ,,	...	...	..	0·12	...	.	...	...	...	...	...	3·8				
25 ,,	...	0·70	...	0·13	...	0·84	...	0·85	...	4·4	...	...				
28 ,,	0·79	0·83	0·96	0·13	...	0·75	...	0·92	1·08	3·6	...	2·7				
31 ,,	0·89	...		0·12	...	...	...	1·02	...							
34 ,,	...	...	1·16	...	...	...	...	0·96	1·20							
37 ,,	...	...	1·40	0·14	...	...	...	...	...							
40 ,,	1·36	...	...	...	...	...	...	0·91	1·1							
43 ,,	1·33	...	1·44													
46 ,,	...	...	1·25													

in the case of most of the concentrations given in Table I, a determination was also made by titrating the acid with alkali.

In Table II the gas evolved has been calculated to cc. of gas evolved per sq. decimetre per hour, on the assumption that the whole of the surface of the steel used (143 sq. cm.) was freely exposed to the action of the acid. This is only approximately true, as the small pieces of steel touched each other in places.

Series "B."

Samples of steel of the same kind as in series "A" but only 5 grams in weight (the surface being 35 sq. centimetres) were exposed to the action of concentrated sulphuric acid in large test tubes, and the tubes were then placed in a thermostat at 30° C. and shaken from side to side by a mechanical shaker worked by a motor. In this case the gas evolved was not measured, but the weight of the iron was taken before action, and after 28 days of action; the iron on being taken out of the sulphuric acid was washed with alcohol, then with water, then with alcohol and dried before the final weighing. The results obtained are as follows:—

Table III.

Concentrated acid.	Weight of iron lost in 28 days.
97·4	0·0993
94·0	0·8605
90·0	1·2223
89·3	0·1401
89·3	0·1331
87·9	0·5230
85·0	0·5264
80·0	2·9145

The experiments with 89·3% concentrated acid show distinctly less action than those with 94·0% acid, thus confirming the results obtained in the unstirred experiments.

Comparing the 94% acid when shaken with the results obtained in Table II, we notice that ·8605 gram of iron is lost in 28 days from 35 square centimetres of surface. This means that 340 cc. of hydrogen were produced by the solution of this ·8605 gram of iron, or 1·4 cc. per hour per sq. decimetre. This is the average rate for the 28 days, and is just about equal to the rate (1·36) obtained from the undisturbed acid after 43 days. As the average rate for 94% acid for 28 days in Series "A" (Table II) is only 0·35 cc. per sq. decimetre per hour, the accelerating effect of shaking is thus very noticeable. It is noticeable also in the other concentrations of sulphuric acid used.

Conclusions.—(1) The solvent effect of sulphuric acid, of concentration (80% – 94%) H_2SO_4, on steel is noticeably increased by shaking the vessel containing the acid and steel.

(2) 97·4% H_2SO_4 and 89·3 H_2SO_4 have less action on the steel used than 94%, 90·9%, 87·9% or 85% acid.

(3) As the action of the acid on iron or steel produces a form of ferrous sulphate monohydrate ($FeSO_4$, H_2O) on the surface of the iron, this causes a slowing down of the action and prevents action almost entirely in some cases.

(4) No real similarity exists between iron which is slowly dissolving in concentrated sulphuric acid and "*passive*" iron as produced by dipping iron into 1·4 sp. gravity nitric acid.

NOTE ON THE RESINOUS EARTH OCCURRING AT THE HEAD OF THE NAMBUCCA RIVER, N. S. WALES.

By HENRY G. SMITH, F.C.S.

[*Read before the Royal Society of N. S. Wales, September 4, 1918.*]

DURING the last few years instances have been recorded of the occurrence, in more than one locality in New South Wales, of an earthy substance which readily burns when a lighted match is applied to it. It has also been noticed that in the neighbourhood of this peculiar earth, water often shows iridescent films upon the surface. Peculiarities such as these are commonly thought to be due to the presence of oily substances, and naturally the idea has arisen that possibly petroleum oil may occur in close proximity to these readily ignitible earths. Natural liquid petroleum supplies would, of course, be of the greatest value to Australia, so that the question has considerable fascination for some people. If the material, the subject of this note, is representative of that found in the other localities in New South Wales, then the supposition that its presence is an indication of petroleum oil must be abandoned.

Investigation of the ignitible earth from the head of the Nambucca River shows it to be of organic origin; of this there seems to be little doubt for the following reasons:—

1. The ignitible substance is a resin.
2. The residue after removal of the resin by alcohol contains a fair amount of nitrogenous products, the nitrogen being evolved as ammonia on heating with soda-lime.
3. Phosphoric acid is present in some quantity in the ash.
4. Benzoic acid can be obtained in small amount from the material by sublimation.

The resin is not fossil, but, on the other hand, is apparently of somewhat recent formation, because the interiors of some of the lumps were quite soft when received, so much so that they could be drawn out in strings. On exposure this resin hardened considerably. The resin does not show resemblance to Coniferous resins, and about two-thirds consists of neutral bodies. Other New South Wales resin-yielding plant genera do not appear to offer a reasonable solution of the difficulty, so that it is necessary to seek further.

Earthy nodules are often found associated with the resinous earth in the locality mentioned; they are sometimes quite large and are coated with organic material, and have the general appearance of "Black-fellow's Bread," *Polyporus Mylittæ.* Is it that complete alteration of the organic material of these "Native truffles" under certain peculiar conditions, has brought about the formation of these resins?

Mr. Angus McKay, of Macksville, to whom I am indebted for the material, has supplied the following information concerning it. "The substance occurs at the head waters of the Nambucca River, at Taylor's Arm, and is first found at a depth of two feet under the ground, but has also been located at 30 feet. It occurs in layers of varying thickness up to 6 inches, and is found occasionally over an area of 15 to 20 miles by about 15 miles. It is principally found in what appears to have been an old river bed, in which a considerable quantity of black sand occurs."

The material submitted consisted of brittle and friable lumps, the largest roughly about two inches across. The larger masses are of a friable earthy nature, with bands of a more solid resin of an orange to lemon-yellow colour, the laminated nature of which often gives the appearance of a woody structure. The lumps readily ignited, melting easily to a dark coloured mass, and continued to burn with a smoky flame and a resinous-like odour. The low melting point of the resin suggested perhaps the idea of a natural sealing wax. The resin is readily soluble in ether, alcohol, chloroform and acetone, and is partly soluble in petroleum ether.

The amount extracted by alcohol from average material of the most resinous lumps, containing 1·9 per cent. of moisture at 100° C., was equal to 65·2 per cent. Of the remainder 10·9 per cent. was removed on ignition, leaving 23·9 per cent. of ash. Of this amount 8·3 per cent. was removed on boiling with hydrochloric acid, which represents less than 2 per cent. on the whole material. The soluble portion of the ash contained phosphoric acid equal to 0·086 per cent., calculated on the whole. Iron, calcium, magnesium and potassium, besides a small quantity of sulphuric acid, were also present. The insoluble portion of the ash consisted mostly of silica, although no soluble silica was detected,

The alcoholic extract of the resin was dried on the water bath as much as possible, but as the melting point of the hardest purified resin is between 80° and 84° C., it was difficult to complete the drying in this way, so it was spread in thin layers upon glass plates and set aside to thoroughly dry in the air. The specific gravity of the resin thus prepared was 1·128 at 20° C.

A portion of the thoroughly dried resin was dissolved in ether and neutralised with alcoholic potash; only a small quantity, less than one per cent., of an insoluble potash salt was formed, this was filtered off, water added to filtrate, and the neutral resins extracted by ether in a separator. The aqueous portion was then evaporated down, acidified with hydrochloric acid and the resin acids separated. During the process a slight odour of benzoic acid was detected, so a portion of the the resin acids was sublimed. A crystalline sublimate was obtained which from tests applied indicated benzoic acid. A larger portion of the original material was then sublimed through paper in a suitable apparatus, and sufficient acid thus obtained to enable it to be purified. It gave the tests for benzoic acid, and melted at 121° C.

A similar resinous earth from near Ourimbah, New South Wales, supplied by Mr. B. E. Broué, had all the properties of the above. It ignited readily and burnt with a smoky flame and a similar odour. The resin was readily extracted by alcohol, and when dry resembled in all respects the resin from the Nambucca River. It melted at the same temperature. The amount of material available did not permit of a complete examination.

In the Annual Report of the Department of Mines, N.S. Wales for 1890, page 308, Mr. J. C. H. Mingaye, F.I.C., reports on a substance from Bowra, in the Nambucca District, which was apparently of a somewhat similar nature.

ACACIA SEEDLINGS, PART IV.

By R. H. CAMBAGE, F.L.S.

With Plates XXXI – XXXV.

[*Read before the Royal Society of N. S. Wales, October 2, 1918*]

SYNOPSIS:

VITALITY OF SEED IN SEA-WATER.
SEQUENCE IN THE DEVELOPMENT OF LEAVES.
NUMBER OF PINNÆ ON ONE LEAF.
ABSENCE OF BIPINNATE LEAVES.
DESCRIPTIONS OF SEEDLINGS.

Vitality of Seed in Sea-water.

In order to further test the vitality of Acacia seeds in sea-water, two seeds each of *A. penninervis* var. *falciformis* and *A. melanoxylon*, both from Jenolan Caves, N. S. Wales, which had been in sea-water for 469 days, were planted after having first been placed in boiling water, and one seedling of the former appeared in about two, and the other in six weeks, while a seedling of the latter came up in four weeks.

A seed of *A. Farnesiana* from Central Queensland, remained in sea-water for 1,375 days, or $3\frac{3}{4}$ years, and was then quite hard and sound. After having been placed in boiling water it was planted, and germinated in a week.

Sequence in the Development of Leaves.

In previous papers of this series it has been pointed out that of 81 species of Acacia seedlings raised, 74 had one simply pinnate leaf, and this was succeeded by a bipinnate leaf. The remaining 7 species always produced an opposite pair of pinnate leaves, and these were succeeded by a bipinnate leaf. In a few instances a species usually having only one pinnate leaf was found to have an opposite pair.

In addition to those mentioned in previous lists (Parts I to III), the following species have produced only one pinnate leaf, and this brings the number up to 83:—

A. diffusa Lindl.	*A. cultriformis* A. Cunn.
A. sentis F.v.M.	*A. Howittii* F.v.M.
A. hakeoides A. Cunn.	*A. Chisholmi* Bailey
A. difformis R. T. Baker	*A. cardiophylla* A. Cunn.
A. decora Reichb.	

Three further species have now been found to have an opposite pair of pinnate leaves, which brings the number of such species up to ten. These are *A. alata* R. Br., (with an exception), *A. continua* Benth., and *A. Oswaldi* F.v.M.

Number of Pinnæ on One Leaf.

In Part III, (p. 393), a list is given of phyllodineous Acacias which may have two or more pairs of pinnæ on the same leaf, and the following are now added to such list:— *A. lanigera*, *A. oxycedrus*, *A. pendula*, and *A. pycnantha* may have two pairs, *A. trinervata* four, and *A. rubida* six pairs. As each pair of pinnæ is attached to the midrib, the appearance of the leaf is somewhat remarkable in cases such as where *A. neriifolia* has three pairs. Where the lamina is continued between the first and second pairs, the midrib comes to the upper margin of such lamina at the base of the first or basal pair. The width of the lamina varies between the first and second pairs, but between the second and third pairs the extension of the midrib is not dilated. (Fig. 1.)

Absence of Bipinnate Leaves.

Seeing that bipinnate leaves are such a feature of the genus, especially among the seedling foliage, it is of interest to observe that one species, *A. alata*, does not appear to produce such leaves at all. In about a dozen seedlings so far examined, there has been an opposite pair of simply-pinnate leaves, though in one case only one such leaf appeared, and these have been succeeded by a phyllode, but in no case has there been a bipinnate leaf. Further tests will be made.

Fig. 1. *Acacia neriifolia.* Leaf with three pairs of pinnæ. Natural size.

Acacia Oswaldi commences with an opposite pair of pinnate leaves, and these may be succeeded by a pinnate, a bipinnate leaf, or a phyllode. In a few cases where the third leaf has been simply-pinnate, the fourth has been reduced to a phyllode, and in such cases, as also where No. 3 has been a phyllode, there has been no bipinnate leaf on the plant. Lubbock describes this species as having abruptly pinnate leaves, but speaks of one first leaf as "pinnate, with one pair of pinnæ," the word pinnæ being possibly intended for leaflets. He appears to have had only two seedlings to guide him.[1]

[1] "A Contribution to our Knowledge of Seedlings," by Sir John Lubbock, I, 473, (1892).

Descriptions of Seedlings.

ALATÆ.

ACACIA ALATA R. Br. Seeds from Botanic Gardens, Sydney, (J. H. Maiden), a Western Australian plant. (Plate XXXI, Numbers 1 to 3).

Seeds rusty-brown, oval, 4 mm. long, 3 mm. broad, 1 to 1·5 mm. thick.

Hypocotyl erect, terete, creamy to brown, 7 mm. to 1·5 cm. long, 1·5 mm. thick at base, 1 mm. at apex, glabrous, or rarely with a few short roots just above the base.

Cotyledons sessile, sagittate, oval to oblong-oval, 5 mm. long, 3 to 3·5 mm. broad, outer or underside yellowish-green at base, purple towards apex, inner or upper-side green to purplish-green, remaining erect, becoming revolute and soon falling, glabrous.

Stem sinuous, slightly angular owing to position of decurrent leaf-stalks, green, glabrous to faintly pilose. First internode ·5 mm.; second 3 to 8 mm.; third 7 mm. to 1·3 cm.; fourth 4 mm. to 1·3 cm.; fifth 5 mm. to 1·2 cm.; sixth 8 mm. to 1 cm.

Leaves—Nos. 1 and 2. Abruptly pinnate, forming an opposite pair, petiole 4 mm. to 1·2 cm. long, terete, green, glabrous; leaflets one to two pairs, oblong-acuminate, mucronate, 5 to 7 mm. long, 2 to 3 mm. broad, midrib fairly distinct, secondary vein showing under pocket lens, light green on both sides, underside slightly paler; rachis up to 3 mm. long, glabrous, excurrent; stipules 1 to 1·5 mm. long. In one case only a single pinnate leaf appeared.

No. 3. A linear phyllode, 5 to 7 mm. long, ·5 to 1 mm. broad, tapering to a pungent point, slightly decurrent, margins pilose; stipules 1 to 2 mm. long.

No. 4. A linear phyllode, 7 to 8 mm. long, 1 to 2 mm. broad, pungent-pointed, decurrent, glabrous or with hirsute margins; stipules about 1 mm. long.

No. 5 and upwards. Falcate, pungent-pointed phyllodes, bifacial and decurrent, each one extending down to the next on the same side of the stem, the whole phyllode having a remarkable flange-like appearance, midrib approximately at right angles to the stem, the decurrent portion of the lamina being marked by reticulating veins, margins hirsute; stipules spinescent, 1 to 3 mm. long, gland not conspicuous on first few phyllodes.

This is the second seedling described in this series where the No. 3 leaf has been reduced to a phyllode, the previous one being *A. excelsa*.[1] In some examples of the latter species, however, the third to fifth leaves were bipinnate, but in about a dozen seedlings examined of *A. alata*, no instance of a bipinnate leaf was found. In one example the second and subsequent leaves were reduced to phyllodes.

Continuæ.

Acacia continua Benth. Seeds from Broken Hill, N.S. Wales (Archdeacon F. E. Haviland and E. C. Andrews). (Plate XXXI, Numbers 4 to 6).

Seeds dark brown with paler centre, obliquely obovate, 3 to 3·5 mm. long, 2 to 2·5 mm. broad, 1 mm. thick.

Hypocotyl erect, terete, green to pale pink, 1·3 to 1·6 cm. long, 2 mm. thick at base, 1 mm. thick at apex, glabrous.

Cotyledons sessile, slightly auricled, obovate to oval, 4 mm. long, 3 mm. broad, underside creamy to brown or reddish-purple, sometimes with raised centre line, inner or upperside pinkish-brown, remaining erect and soon falling.

Stem terete, except where affected by the slightly decurrent leafstalks, brown at base, green above, striated with several nerves. First internode ·5 mm.; second 1 mm.; third 1 mm.; fourth 2 mm.; fifth 2 to 3 mm.; sixth 3 to 5 mm.; seventh 4 to 6 mm.; eight 5 to 8 mm.

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[1] This Journal, Vol. LI, p. 403.

Leaves—Nos. 1 and 2. Abruptly pinnate, forming an opposite pair, petiole slender, 5 to 8 mm. long, green, glabrous; leaflets two to three pairs, oblong-acuminate, 6 to 7 mm. long, 1·5 to 2 mm. broad, upperside light green, underside at first reddish-brown, becoming pale green, venation obscure, midrib showing under pocket lens on underside; rachis 3 mm. long, glabrous, excurrent; stipules 1 mm. long.

No. 3. Abruptly bipinnate, petiole 1·3 to 2 cm. long, slender, green, glabrous, excurrent; leaflets three to four pairs, the number not being constant on each pinna of the same leaf, obovate to oblong-acuminate, 3 to 5 mm. long, 1 to 2 mm. broad; rachis 6 to 9 mm. long, glabrous, excurrent; stipules linear, 1·5 mm. long.

Nos. 4 and 5. Abruptly bipinnate, petiole 1 to 2·4 cm. long, slender; leaflets four pairs, often mucronate; rachis 7 mm. to 1 cm. long, glabrous, excurrent; stipules as in No. 3.

Nos. 6 to 8. Usually abruptly bipinnate, petiole 1·5 to 2·3 cm. long, glabrous, or with scattered hairs, excurrent; leaflets four to five pairs, obovate to oblong-acuminate, often mucronate; rachis 8 mm. to 1·3 cm. long; stipules linear-acuminate, with an almost spinescent point, up to about 2 mm. long.

Nos. 9 to 12. These may be phyllodes vertically broadened to about 1 mm., sometimes almost, but never quite terete, from about 7 mm. to 1·5 cm. long and continuous with the stem, not articulate, striate with two or three nerves, straight, or sometimes falcate or recurved, tapering into a pungent point; stipules present on most plants but absent from some. No. 9 may be abruptly bipinnate, petiole up to 2·3 cm. long, leaflets four to five pairs.

PUNGENTES—(Spicatæ).

ACACIA OXYCEDRUS Sieb. Seeds from Galston Road, Hornsby, and Faulconbridge, N.S. Wales. (Plate XXXI, Numbers 7 to 9).

Seeds brownish-black, oblong to almost cylindrical, 4 mm. long, 2 mm. broad, 2 mm. thick.

Hypocotyl erect, terete, pale green, 1·1 to 3 cm. long, 1·5 to 2·5 mm. thick at base, 1 to 2 mm. thick at apex, glabrous. In one case a root grew to a length of 7 mm. at about 6 mm. from the base of the hypocotyl.

Cotyledons sessile, not auricled, oblong, apex rounded, 6 mm. long, 2·5 to 3·5 mm. broad, outer or underside pale yellow, sometimes reddish towards apex, slightly wrinkled longitudinally, inner or upperside yellowish-green, becoming dark green, glabrous.

Stem terete, green, hirsute. First internode ·5 mm.; second 1 to 7 mm.; third 1 mm. to 1 cm.; fourth 1 mm. to 1·4 cm.; fifth 1 mm. to 1·5 cm.; sixth 1 mm. to 1·3 cm.; seventh 3 mm. to 1·2 cm.; eighth 1 to 8 mm.

Leaves—No. 1. Abruptly pinnate, petiole 3 to 8 mm. long, green, faintly pilose; leaflets three to five pairs, oblong-acuminate, mucronate, 5 to 7 mm. long, 1·5 to 2·5 mm. broad, midrib and secondary vein, as well as lateral venation, showing under pocket lens; rachis 7 mm. to 1·1 cm. long, glabrous, excurrent; stipules about 1 mm. long, tapering from a broad base to a fine point. Out of about twenty seedlings raised, one example from Hornsby had an opposite pair of simply pinnate leaves.

No. 2. Abruptly bipinnate, petiole 6 mm. to 1·6 cm. long, pilose, excurrent, leaflets two to four pairs, oblong-acuminate, mucronate, 5 to 6 mm. long, 1·5 to 2 mm. broad, the basal pair sometimes smaller; rachis 4 mm. to 1 cm. long, faintly pilose, excurrent.

Nos. 3 and 4. Abruptly bipinnate, petiole 1 to 3·3 cm. long, pilose, excurrent; leaflets two to five pairs; rachis 6 mm. to 1·5 cm. long, faintly pilose, excurrent; stipules acuminate, 1·5 to 2 mm. long. In one case, No. 3 had two pairs of pinnæ.

Nos. 5 and 6. Abruptly bipinnate, petiole 1·4 to 3 cm. long, sometimes vertically flattened to 1 mm. broad, No. 5 having a strong nerve along the lower margin, and No. 6 sometimes having a definite midrib below the centre of the lamina, in the upper portion of which is a finer vein, margins nerve-like, pilose, excurrent; leaflets four to six pairs; rachis 8 mm. to 1·7 cm. long; stipules as in Nos. 3 and 4. No. 6 may sometimes be a phyllode.

Nos. 7 to 10 may be pungent pointed phyllodes, from 5 mm. to 1·2 cm. long, ·6 to 2 mm. broad, with midrib just below and finer vein above centre, the upper vein sometimes coinciding with the margin, especially towards the apex, pilose; stipules about 1·5 to 2 mm. long, pointed, but at this youthful stage scarcely spinescent. No. 7 may be abruptly bipinnate, petiole up to 3 cm. long; leaflets four to six pairs.

UNINERVES—(Armatæ).

ACACIA ASPERA Lindl. Seeds from Temora, (Rev. Father J. W. Dwyer per J. H. Maiden), and Wyalong, N.S. Wales. (Plate XXXII, Numbers 1 to 3.)

Seeds black, oblong-oval to oblong, 5 mm. long, 2 to 2·5 mm. broad, 1·5 mm. thick.

Hypocotyl erect, terete, pinkish-brown or very pale brown, 1·2 to 2·6 cm. long, 1 to 1·5 mm. thick at base, ·7 to 1 mm. thick at apex, glabrous.

Cotyledons sessile, slightly auricled, oblong-oval to oblong, apex rounded, 6 to 7 mm. long, 3 mm. broad, outer or underside green, with one or two raised longitudinal lines, upperside green, glabrous, becoming revolute in about two weeks, and later sometimes partly cylindrical, remaining on the plant until the phyllodes appear.

Stem terete, glabrous, to pilose. First internode ·5 to 2 mm.; second 3 mm. to 2·2 cm.; third 5 mm. to 1·9 cm.; fourth 5 mm. to 2 cm.; fifth 3 mm. to 1·2 cm.; sixth 4 to 8 mm.

Leaves—No. 1. Abruptly pinnate, petiole 4 mm. to 1·1 cm. long, green, glabrous or rarely faintly pilose; leaflets two to four pairs, oblong-acuminate 4 to 6 mm. long, 1·5 to 2 mm. broad, midrib distinct on underside, greyish-green on both sides, glabrous; rachis 4 mm. to 1·3 cm. long, green, glabrous, excurrent; stipules 1 mm. long.

No. 2. Abruptly bipinnate, petiole 9 mm. to 1·4 cm. long, slender or sometimes slightly flattened vertically, green, pilose, excurrent, the subulate point being sometimes 1·5 mm. long; leaflets one to four pairs, the number not being constant on each pinna of the same leaf, 3 to 5 mm. long, the basal pair smaller, sometimes mucronate, margins may be ciliate; rachis 3 to 7 mm. long, pilose, excurrent; stipules 1 mm. long, flat at base and tapering to a weak point.

No. 3. Abruptly bipinnate, petiole 1·3 to 1·6 cm. long, sometimes vertically flattened to 1 mm. broad, with the midrib slightly above the lower margin, pilose to hirsute, excurrent; leaflets two to three pairs, the number not constant on each pinna; rachis 4 to 6 mm. long; stipules pilose to hirsute, 1·5 mm. long. In one case No. 3 and upwards were phyllodes.

No. 4. Sometimes a phyllode, or abruptly bipinnate, petiole up to 1·7 cm. long, leaflets three pairs; stipules as in No. 3.

Nos. 5 to 8. Phyllodes from about 1 to 3 cm. long, 1 to 2·3 mm. broad, oblong-linear, with a few scattered hairs, somewhat oblique, tapering towards the base, and terminating in a short, straight or curved point.

This is the third seedling described in this series where the No. 3 leaf has been reduced to a phyllode, the previous ones being *A. excelsa* and *A. alata* (supra).

In one case, after the second bipinnate leaf had appeared, a simply pinnate leaf grew in the axil of the cotyledon, a most unusual occurrence, and a further remarkable feature was that the under, and not the upperside was next to the stem of the plant.

UNINERVES—(Angustifoliæ).

ACACIA MONTANA Benth. Seeds from Temora, (Rev. Father J. W. Dwyer per J. H. Maiden). Plate XXXII, Numbers 4 to 6).

Seeds dark brown, oblong-oval to obovate-oblong, 4 mm. long, 2 to 2·5 mm. broad, 1 to 1·3 mm. thick.

Hypocotyl erect, terete, pale brown, 1·7 to 3·5 cm. long, 1 mm. thick at base, ·8 to 1 mm. thick at apex, glabrous.

Cotyledons sessile, slightly auricled, oblong-oval, about 6 mm. long, 3 mm. broad, outer or underside pale green, often with one or two longitudinal raised lines, and sometimes with a warty protuberance near centre, upperside green, glabrous, soon becoming horizontal and doubling downwards from about the middle, often remaining until after the advent of the phyllodes.

Stem terete, except where affected by decurrent leaf-stalks, pinkish-brown towards base, green above, becoming brown and pubescent. First internode ·5 to 2 mm.; second 2 mm. to 1·1 cm.; third 6 mm. to 1·8 cm.; fourth 4 mm. to 2·2 cm.; fifth 5 mm. to 2·7 cm.; sixth 5 mm. to 2·6 cm.; seventh 5 mm. to 1·8 cm.

Leaves—No. 1. Abruptly pinnate, petiole 4 mm. to 1 cm. long, green, glabrous; leaflets usually two pairs, sometimes three, obliquely oblong-obovate, 4 to 7 mm. long, 2 to 3 mm. broad, midrib often distinct, secondary vein showing under pocket lens, upperside green, underside paler, rachis 3 to 6 mm. long, green, glabrous, excurrent; stipules reduced to scales about 1 mm. long.

In one instance leaves Nos. 1 and 2 were both simply-pinnate, forming an opposite pair.

No. 2. Abruptly bipinnate, petiole 6 mm. to 1·4 cm. long, green, glabrous, excurrent; leaflets two to three pairs, the number not being constant on each pinna of the same leaf, the pinna also often irregularly pinnate, oblong-acuminate to oblong-obovate, 3 to 6 mm. long, 2 to 3 mm. broad; rachis 5 mm. to 1 cm. long, glabrous, excurrent; stipules as in No. 1.

Nos. 3 and 4. Abruptly bipinnate, petiole 1·1 to 1·6 cm. long, sometimes vertically flattened to 1 mm. broad just above the middle, with a strong nerve or midrib along the lower margin and extending to the base of the pinnæ, with perhaps a fine vein running along the upper portion of the lamina, glabrous or with a few scattered hairs, usually excurrent; leaflets three to four pairs on both, oblong-acuminate, often mucronate, margins ciliate; rachis 6 mm. to 1 cm. long; stipules with flat broad bases, tapering to apex, 1·5 mm. long.

Nos. 5 to 8. These may be phyllodes or they may be abruptly bipinnate, petioles 1·1 to 2·1 cm. long, with scattered glandular hairs, vertically flattened from ·5 to 5·5 mm. broad, with a strong midrib just below the centre of the lamina and a finer vein above; leaflets three to four pairs; rachis 7 mm. to 1·5 cm. long, with a few scattered hairs, excurrent; stipules as in Nos. 3 and 4.

Nos. 9 and 10, and sometimes including Nos. 5 to 8. Phyllodes, 2 to 3 cm. long, up to 5 mm. broad, very like those of *A. aspera* in shape but differing in venation, narrowed at the base, often with a small outward curved point at the apex, midrib distinct, and finer vein above which is not always continuous to the apex, lateral venation fairly clear, small gland near base, slightly viscid but less so than phyllodes of more mature plants.

UNINERVES—(Racemosæ).

ACACIA CHALKERI Maiden.[1] Seeds from Wombeyan Caves, New South Wales, (O. Trickett). Growing on limestone formation. (Plate XXXII, Numbers 7 to 9).

Seeds black, oblong to oblong-oval, 4 to 5 mm. long, 2 to 3 mm. broad, 1 mm. thick.

Hypocotyl erect, terete, reddish-green to brownish-red above soil, pale beneath soil, 1·2 to 3 cm. long, 2 to 2·7 mm. thick at base, 1 mm. thick at apex, glabrous.

Cotyledons sessile, sagittate, oblong-oval, about 7 mm. long, 3 mm. broad, becoming revolute in a week or two, outer or underside dark green, with a few raised longitudinal lines, inner or upperside green, glabrous.

Stem terete, green, glabrous. First internode ·5 mm.; second 1 to 6 mm.; third 1 to 8 mm.; fourth 3 mm. to 1·6 cm.; fifth 4 mm. to 1·7 cm.; sixth 6 mm. to 1·3 cm.; seventh 4 mm. to 1·3 cm.

Leaves—No. 1. Abruptly pinnate, petiole 3 to 5 mm. long, green to reddish-green, glabrous; leaflets three pairs, 3 to 4 mm. long, 2 mm. broad, oblong-acuminate, the terminal pair being sometimes obliquely cuneate, venation obscure, midrib showing under pocket lens, upperside green, underside brown to pale green, glabrous; rachis 3 to 6 mm. long, green, glabrous, excurrent, the point being often brown; stipules reduced to scales.

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[1] This Journal, XLIX, 482, (1915).

No. 2. Abruptly bipinnate, petiole 5 mm. to 1·3 cm., glabrous, excurrent; leaflets two to three pairs; rachis 3 to 7 mm. long, glabrous, excurrent.

Nos. 3 and 4. Abruptly bipinnate, petiole 7 mm. to 1·8 cm. long, No. 4 being sometimes vertically flattened slightly, and showing a strong nerve along the lower margin; leaflets three to five pairs, oblong-acuminate; rachis 5 mm. to 1·1 cm.; stipules reduced to scales.

Nos. 5 and 6. Abruptly bipinnate, petiole 1 to 2·5 cm. long, often vertically flattened up to 1 mm. broad with the midrib towards the lower margin, glabrous, excurrent; leaflets four to six pairs. In one case No. 6 was reduced to a phyllode.

Nos. 7 and 8. These may be phyllodes, or abruptly bipinnate, petiole up to 2 cm. long, 2 mm. broad, with the midrib just below the centre of the lamina, glabrous, rarely with a small gland above or below the middle, excurrent; leaflets five pairs.

Nos. 9 and 10. Phyllodes, oblanceolate, commonly from 3 to 5 cm. long, up to 5 mm. broad, with the midrib slightly below or in the centre of the lamina, and terminating in a short mucrone. On one plant No. 9 was 6, and No. 10 was 7 cm. long, linear-oblanceolate, the broadest portion only measuring 2·5 mm. This is much longer and narrower than is usually the case with the mature foliage. There is often a small gland a little above the base.

ACACIA NERIIFOLIA A. Cunn. Seeds from Howell, N.S. Wales (T. S. McCrae). (Plate XXXIII, Numbers 1 to 4).

Seeds black, oval to oblong-oval, 5 mm. long, 3 mm. broad, 2 mm. thick.

Hypocotyl erect, terete, red, up to 3·6 cm. long, up to 2·3 mm. thick at base, ·7 to ·8 mm. thick at apex, glabrous.

Cotyledons sessile, auricled, oblong, apex rounded, 5 to 7 mm. long, 3·5 mm. broad, becoming revolute and cylindrical, soon falling, outer or underside pale brown to yellowish and straw-coloured, central portion raised, sometimes rugose with gland-like formations, upperside reddish-brown.

Stem terete, bluish to brown, pilose to tomentose. First internode ·5 mm.; second 2 mm. to 1·1 cm.; third 3 mm. to 1 cm.; fourth 3 mm. to 1·4 cm.; fifth 5 mm. to 1·7 cm.; sixth 7 mm. to 2·5 cm.; seventh 1 to 2·2 cm.; eighth 1 to 2·8 cm.; ninth 1·2 to 3·5 cm.

Leaves—No. 1. Abruptly pinnate, petiole 2 to 8 mm. long, green, glabrous; leaflets three to five pairs, oblong-acuminate, often mucronate, 5 to 7 mm. and rarely 1·2 cm. long, 1·5 to 3·5 mm. broad, midrib often distinct, secondary vein and some lateral venation seen under pocket lens, upperside green, glabrous, underside red to reddish-green, often becoming pale green, the midrib dark red and usually raised; rachis 1 to 2·2 cm. long, pale green, glabrous, excurrent.

No. 2. Abruptly bipinnate, petiole 8 mm. to 1·3 cm. long, green, sometimes with gland below middle of upper margin, excurrent; leaflets three to five pairs, the leaflets not always opposite, 3 to 6 mm. long, 1·5 to 2·5 mm. broad, the basal pair sometimes smaller, oblong-acuminate to obovate, often mucronate, upperside green, underside pale reddish-green; rachis 5 mm. to 1·1 cm. long, glabrous, excurrent; stipules reduced to scales.

No. 3. Abruptly bipinnate, petiole sometimes slightly flattened vertically, 1·2 to 1·5 cm. long, often with gland below middle of upper margin, excurrent; leaflets four to six pairs; rachis 1·1 to 1·7 cm. long; stipules as in No. 1.

No. 4. Abruptly bipinnate, petiole vertically flattened to 1·2 mm. broad with strong nerve or midrib along the lower margin, gland towards base on upper margin, 1·7 to 2·7 cm.

long; leaflets six to eight pairs, the number not always equal on each pinna of the same leaf, up to 7 mm. long; rachis 2 to 2·3 cm. long.

Nos. 5 and 6. Abruptly bipinnate, petiole up to 4 mm. broad in the case of No. 6, gland towards base, 1·5 to 3·9 cm. long; leaflets eight to ten pairs on either; rachis up to 3·7 cm. long.

Nos. 7 and 8. Abruptly bipinnate, sometimes with two pairs of pinnæ, petiole up to 6 mm. broad in No. 7 and 9 mm. in No. 8, with the midrib below the centre of the lamina, 2·7 to 4·7 cm. long; leaflets eight to eleven pairs.

Nos. 9 and 10. Abruptly bipinnate, sometimes with two pairs of pinnæ, petiole up to 4·7 cm. long, 1 cm. broad, gland near base; leaflets nine to eleven pairs.

Nos. 11 and 12. Abruptly bipinnate, often with two pairs of pinnæ, petiole up to 4·3 cm. long and 1·4 cm. broad.

Nos. 13 and 14. Leaflets sometimes up to fourteen pairs.

This species is very variable in regard to the stage at which phyllodes appear. In one case No. 9 was reduced to a phyllode while several later leaves were bipinnate. On plants two feet high there may be numerous leaves with petioles developed as broad phyllodes, but having one, two and even three pairs of pinnæ (Fig. 1). There is usually a gland at the base of the dilated petiole, and also at the bases of the second and third pairs of pinnæ.

ACACIA OBTUSATA Sieb. Seeds from Wingello and Tallong, N.S. Wales. (Plate XXXIV, Numbers 1 to 3).

Seeds black, oblong-oval, 4 to 5 mm. long, 3 to 3·5 mm. broad, 1·5 to 2 mm. thick.

Hypocotyl erect, terete, pale pink to brownish-red, 1 to 2 cm. long, 1 to 2 mm. thick at base, about 1 mm. thick at apex, glabrous.

Cotyledons sessile, slightly auricled to sagittate, oblong to obovate, 6 to 7 mm. long, 3 to 3·7 mm. broad, outer or underside brownish-red to red, with two or three longitudinally raised lines, inner or upperside reddish-green, glabrous.

Stem terete, reddish to bluish-green, glabrous. First internode ·5 mm.; second 1 to 2 mm.; third 1 to 2 mm.; fourth 1 to 4 mm.; fifth 2 to 8 mm.; sixth 2 to 7 mm.

Leaves—No. 1. Abruptly pinnate, petiole 3 to 5 mm. long, glabrous, excurrent; leaflets three pairs, oblong-acuminate, the terminal pair sometimes obovate, sometimes mucronate, 5 to 7 mm. long, 1·5 to 3 mm. broad, upperside green, margins often red, underside reddish to pale green, midrib sometimes obscure and at others fairly distinct; rachis 5 to 9 mm. long, glabrous, excurrent.

No. 2. Abruptly bipinnate, petiole 6 mm. to 2·7 cm. long, sometimes with a small gland on upper margin, glabrous, excurrent; leaflets three to five pairs; rachis 7 mm. to 1·2 cm. long, glabrous, excurrent.

No. 3. Abruptly bipinnate, petiole 1·2 to 3 cm. long, vertically flattened up to 1 mm. broad, with strong nerve along lower margin and gland on upper edge, glabrous, or with a few scattered hairs, excurrent; leaflets three to seven pairs, the numbers not constant for each pinna of the same leaf, 4 to 5 mm. long, the basal pair smaller, oblong-acuminate, the terminal pair sometimes obovate, often mucronate; rachis 1 to 1·9 cm. long, glabrous; stipules reduced to flat acuminate scales.

No. 4. Abruptly bipinnate, petiole 1·5 to 3·6 cm. long, vertically flattened up to 2 mm. broad, strong nerve or midrib very close to lower margin, the upper edge nerve-like and sometimes with a gland below the middle, glabrous or with a few scattered hairs; leaflets five to nine pairs; rachis 1·2 to 2·2 cm. long, excurrent.

No. 5. Sometimes a phyllode, or it may be abruptly bipinnate, petiole 3 to 3·5 cm. long, up to 4 mm. broad, with midrib below the centre, and with nerve-like margins and sometimes a gland on upper edge; leaflets six to eight pairs.

Nos. 6 to 8. Phyllodes with fairly central midrib and nerve-like margins, and gland towards base.

Acacia hakeoides A. Cunn. Seeds from Wyalong and Tottenham, N.S. Wales. (Plate XXXIV, Numbers 4 to 6).

Seeds dull black, oval to oblong-oval. 4·5 to 6 mm. long, 2·5 to 3·5 mm. broad, 1·5 to 2 mm. thick.

Hypocotyl erect, terete, brownish-green, 1·2 to 2·7 cm. long, 2 mm. thick at base, 1 mm. thick at apex.

Cotyledons sessile, slightly auricled, oblong-oval to oblong with apex rounded, 6 to 8 mm. long, 3 to 3·5 mm. broad, outer or underside yellowish to brownish-green, paler towards apex, with a few longitudinally raised veins, the central one the largest, upperside green, soon becoming revolute.

Stem terete, reddish-brown, pilose. First internode ·5 mm.; second ·5 to 1 mm.; third 1 mm.; fourth 1 to 2 mm.; fifth 1 to 5 mm.; sixth 4 to 8 mm.; seventh up to 9 mm.

Leaves—No. 1. Abruptly pinnate, petiole 4 to 6 mm. long, greenish-brown, glabrous, or with a few short stiff hairs, excurrent; leaflets three to four pairs, oblong-acuminate, up to 9 mm. long, 2 to 4·5 mm. broad, upperside green, underside paler, venation indistinct, midrib sometimes showing without the aid of a pocket lens; rachis 5 to 9 mm. long, glabrous, excurrent.

No. 2. Abruptly bipinnate, petiole 8 mm. to 1·4 cm. long, greyish-green, pilose, excurrent; leaflets three to four pairs, rarely two; rachis 4 mm. to 1·3 cm. long, glabrous, excurrent; stipules reduced to small scales.

No. 3. Abruptly bipinnate, petiole 1·2 to 2·5 cm. long, vertically flattened to sometimes 1·5 mm. broad, with a strong nerve or midrib along lower margin, upper margin brownish and somewhat nerve-like, pilose, excurrent; leaflets four to five pairs, oblong-acuminate, often mucronate, the terminal pair often obovate, the basal pair small, margins often brownish-red; rachis 6 mm. to 1·3 cm. long, glabrous, or with a few scattered hairs.

No. 4. This may be a linear-lanceolate phyllode 6 to 8 cm. long, narrowed towards the base, or it may be abruptly bipinnate, petiole 1·8 to 4·7 cm. long, up to 4·5 mm. broad, much narrowed towards the base, midrib slightly below centre of lamina, pilose; leaflets four to six pairs, the number on any of the bipinnate leaves not always constant on both pinnæ of the same leaf; rachis up to 1·4 cm. long; stipules flat, acuminate scales, 1 mm. long.

Nos. 5 to 7. Phyllodes, at first reddish, becoming green, up to 10 cm. long, 7·5 mm. broad in widest portion, sometimes with a straight or hooked point, faintly pilose, with gland below middle.

ACACIA CRASSIUSCULA Wendl. (*A. pycnophylla* Benth.). Seeds from Mount Melville, Albany, Western Australia (Professor W. G. Woolnough). (Plate XXXV, Numbers 1 to 4).

Seeds black, oblong, 4 to 5 mm. long, 2 mm. broad, 1 mm. thick.

Hypocotyl erect, terete, creamy to pale pink, 1 to 1·5 cm. long, 1 mm. thick at base, 1 mm. thick at apex, glabrous, except that in one case it was noticed that several roots grew from a point about 5 mm. above the base of the hypocotyl.

Cotyledons sessile, very slightly auricled, oblong, apex rounded, 6 to 7 mm. long, 2 to 2·5 mm. broad, remaining erect and soon falling, outer or underside brownish-red, sometimes wrinkled longitudinally, inner or upperside reddish, glabrous.

Stem terete, green, glabrous. First internode ·5 mm.; second ·5 mm.; third and fourth 1 mm.; fifth 1 to 2 mm.; sixth about 2 mm.; seventh 2 to 4 mm.; eighth 5 to 7 mm.

Leaves—Nos. 1 and 2. Abruptly pinnate, forming an opposite pair, petiole 3 to 6 mm. long, pale red to reddish-brown and reddish-green, glabrous; leaflets two pairs, 3 to 4 mm. long, 1·5 to 2 mm. broad, oblong-acuminate, mucronate, venation obscure, midrib showing under pocket lens, upperside green, margins red, underside bright red, often becoming reddish-green, glabrous; rachis 2 to 3 mm. long, reddish, glabrous, excurrent.

No. 3. Abruptly bipinnate, petiole 7 mm. to 1·2 cm. long, greenish-brown, often slightly dilated vertically, with gland on upper margin, usually a little below the middle, glabrous, excurrent; leaflets two pairs, oval-oblong to oblong-acuminate, the terminal pair sometimes obovate, often mucronate, margins often reddish, upperside green, underside paler with midrib distinct.

Nos. 4 and 5. Abruptly bipinnate, petiole 8 mm. to 1·5 cm. long, slightly dilated vertically, gland just below middle on upper margin, glabrous, excurrent; leaflets two pairs on No. 4, and three pairs on No. 5, up to 6 mm. long, 4 mm. broad, mucronate; rachis up to 1·2 cm. long; stipules reduced to flat, acuminate scales.

Nos. 6 and 7. Abruptly bipinnate, petiole up to 1·7 cm. long on No. 6, and up to 2·5 cm. on No. 7, dilated vertically to 1 mm. broad, gland below middle, and sometimes a second gland at base of pinnæ, with strong nerve along lower margin, glabrous, excurrent; leaflets three to four pairs; rachis up to 2·5 cm. long on No. 7.

Nos. 8 and 9. Abruptly bipinnate, petiole up to 3·5 cm. long on No. 8, and 4·8 cm. long, 2 mm. broad, on No. 9, midrib below centre of lamina; leaflets five pairs; rachis up to 2·4 cm. long.

No. 10. Abruptly bipinnate, petiole linear, up to 7·8 cm. long, 3 mm. broad, with definite midrib; leaflets five pairs.

Nos. 11 and 12. Linear, erect, phyllodes, up to about 10 cm. long, with gland near base.

Although the phyllodes are markedly erect, the leaves below them are disposed horizontally, and give to the little plants a prostrate appearance, especially prior to the advent of the phyllodes.

PLURINERVES—(Oligoneuræ).

ACACIA HOWITTII F.v.M.[1] Seeds from Melbourne, (E. E. Pescott. Cultivated). (Plate XXXIV, Numbers 7 to 9).

Seeds brown to black, oblong to oblong-oval, 3 to 4 mm. long, 1·5 to 2 mm. broad, 1 mm. thick.

Hypocotyl erect, terete, reddish-brown, 7 mm. to 1·5 cm. long, up to 1·8 mm. thick at base, ·8 mm. thick at apex, glabrous, except that in one case six roots grew at about 5 mm. from the base.

Cotyledons sessile, auricled, oblong, apex rounded, about 5 mm. long, 2 mm. broad, soon becoming revolute, remaining until the phyllodes appear, outer or underside brown, upperside green, glabrous.

Stem terete, the decurrent stems of the phyllodes often giving it a striated appearance which partly disappears with age, green, somewhat viscid, pilose to hirsute. First

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[1] *Vict. Nat.* x, 16, (May, 1893).

internode ·5 mm.; second 1 to 2 mm.; third 1 to 5 mm.; fourth 2 to 5 mm.; fifth 3 to 8 mm.; sixth 4 mm. to 1 cm.

Leaves—No. 1. Abruptly pinnate, petiole 3 to 4 mm. long, green, glabrous; leaflets three to four pairs, oblong-acuminate, the terminal pair usually obovate, 4 to 5 mm. long, about 2 mm. broad, upperside green, underside paler, venation obscure; rachis 5 to 7 mm. long, glabrous, excurrent.

No. 2. Abruptly bipinnate, petiole 8 mm. to 1·2 cm. long, excurrent; leaflets three to four pairs, oval to obovate, usually mucronate; rachis 7 to 8 mm. long; stipules reduced to flat, acuminate scales.

Nos. 3 and 4. Abruptly bipinnate, petiole 7 mm. to 1·4 cm. long, dilated vertically, sometimes to nearly 1 mm. broad in the case of No. 4, with strong nerve along lower margin, pilose; leaflets five to seven pairs, oblong-oval to obovate, about 5 mm. long, 2 to 2·5 mm. broad; rachis 1·2 to 1·6 cm. long, excurrent.

No. 5. This may be a phyllode, or abruptly bipinnate, petiole about 1 cm. long, dilated, hirsute; leaflets six to seven pairs.

Nos. 6 to 9. Phyllodes, from obovate to obliquely-ovate, mucronate, 7 mm. to 2·5 cm. long, up to 1 cm. broad, 2 to 3-nerved, the upper vein not always extending to the apex, lateral veins numerous, glabrous. Later phyllodes usually become viscid. On plants 1 foot high the phyllodes may not exceed 1·5 cm. long, by 9 mm. broad.

BIPINNATÆ—(Botryocephalæ).

ACACIA SPECTABILIS A. Cunn. Seeds from Gungal, N.S. Wales (J. H. Maiden). (Plate XXXV, Numbers 5 to 7.)

Seeds black, oblong, 5 to 6 mm. long, 2·5 to 3 mm. broad, 2 mm. thick.

Hypocotyl erect, terete, pale red, soon becoming dark red, 1·2 to 2·7 cm. long, 1 to 2 mm. thick at base, ·6 to 1 mm. thick at apex, glabrous.

Cotyledons sessile, auricled, oblong, apex rounded, 8 mm. long, 3·5 mm. broad, becoming revolute and cylindrical within one week, outer or underside yellowish, sometimes becoming brownish-red, with raised portion 1 mm. broad extending along centre from base to apex, outer flanges thinner, inner or upperside yellowish to reddish-green, becoming green, glabrous on both sides.

Stem terete, green to reddish-green, later becoming bluish, hirsute. First internode ·5 to 2 mm.; second 2 mm. to 3 cm.; third 7 mm. to 1·5 cm.; fourth about 1 cm.; fifth 1·4 to 2·4 cm.; sixth 1·8 to 5·3 cm.; seventh 3·2 to 6 cm.

Leaves—No. 1. Abruptly pinnate, petiole 4 to 6 mm. long, reddish to reddish-green, with a few scattered hairs; leaflets four to five pairs, oblong-acuminate, 4 mm. to 1 cm. long, 2 to 3·5 mm. broad, midrib often distinct on underside, secondary vein showing under pocket lens, upperside green, sometimes reddish-green, underside reddish to reddish-green, becoming pale green, margins often red; rachis 6 mm. to 2·4 cm. long, reddish-green, becoming green, glabrous or with a few hairs, excurrent; stipules reduced to small scales.

No. 2. Abruptly bipinnate, in one case with two pairs of pinnæ, the lower pair not quite opposite, petiole 7 mm. to 2·1 cm. long, pilose, with a band of reddish-green at the base; leaflets five to six pairs, 4 to 8 mm. long, 2 mm. broad, the basal pair smaller, oblong-acuminate, often mucronate, the terminal pair often obovate; rachis 1 to 1·6 cm. long, with brown band at base, glabrous, excurrent; stipules as in No. 1.

Nos. 3 and 4. Abruptly bipinnate, No. 3 with one or two pairs of pinnæ, and No. 4 with one, two or three pairs, petiole from 1 cm. in No. 3 to 2·5 cm. in the case of the common petiole of No. 4 having three pairs of pinnæ, pilose to hirsute; leaflets six to eight pairs in No. 3, and six to nine in No. 4, often mucronate; gland on petiole and often at base of terminal pair of pinnæ; rachis 1·2 to 2·4 cm. No. 4 may be an apparent tripinnate leaf.[1]

Nos. 5 and 6. Abruptly bipinnate, No. 5 with three and four pairs of pinnæ, and No. 6 with five pairs; the common petiole up to 3·5 cm. long in No. 5, and 5·7 cm. in No. 6, hirsute, excurrent; leaflets on the terminal pair of pinnæ nine to ten pairs; gland on petiole and often at base of terminal pair of pinnæ; rachis on the terminal pair of pinnæ up to 3 cm. long.

A plant a little over one foot high may have nine pairs of pinnæ on one leaf.

EXPLANATION OF PLATES.

Plate XXXI.

Acacia alata R. Br.

1. Cotyledons and opposite pair of pinnate leaves. From Western Australia, cultivated in Botanic Gardens, Sydney, (J. H. Maiden).
2. Opposite pair of pinnate leaves and phyllodes.
3. Pod.

Acacia continua Benth.

4. Cotyledons, with tips of opposite pair of pinnate leaves showing. Broken Hill (E. C. Andrews).
5. Opposite pair of pinnate leaves, bipinnate leaves and phyllodes.
6. Pod and seeds.

Acacia oxycedrus Sieb.

7. Cotyledons and pinnate leaf. Hornsby.
8. Pinnate leaf, bipinnate leaves and pungent pointed phyllodes. Nodule on root.
9. Pod and seeds.

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[1] This Journal, Vol. LI, 394, (1917).

Plate XXXII.

Acacia aspera Lindl.

1. Cotyledons. Temora (Rev. J. W. Dwyer).
2. Cotyledons, pinnate leaf, bipinnate leaves and phyllodes.
3. Pod and seeds. Wyalong.

Acacia montana Benth.

4. Cotyledons. Temora (Rev. J. W. Dwyer).
5. Pinnate leaf, bipinnate leaves and phyllodes.
6. Seeds.

Acacia Chalkeri Maiden.

7. Cotyledons with young pinnate leaf showing. Wombeyan Caves (O. Trickett).
8. Pinnate leaf, bipinnate leaves and phyllodes.
9. Pod and seeds.

Plate XXXIII.

Acacia neriifolia A. Cunn.

1. Cotyledons with tip of pinnate leaf. Howell (T. S. McCrae).
2. Pinnate leaf, bipinnate leaves and phyllodes.
3. Large bipinnate leaf on plant two feet high.
4. Pod and seeds.

Plate XXXIV.

Acacia obtusata Sieb.

1. Cotyledons. Tallong.
2. Pinnate leaf, bipinnate leaves and phyllodes. Wingello.
3. Pod and seeds.

Acacia hakeoides A. Cunn.

4. Cotyledons. Tottenham.
5. Pinnate leaf, bipinnate leaves and phyllodes. Wyalong.
6. Pod and seeds.

Acacia Howittii F.v.M.

7. Cotyledons. Melbourne (E. E. Pescott. Cultivated).
8. Pinnate leaf, bipinnate leaves and phyllodes.
9. Seeds.

Plate XXXV.

Acacia crassiuscula Wendl.

1. Cotyledons, with tips of opposite pair of pinnate leaves on each side. Albany, Western Australia (Prof. W.G. Woolnough).
2. Opposite pair of pinnate leaves, also first and second bipinnate leaves.
3. Bipinnate leaves and phyllodes.
4. Pod and seeds.

Acacia spectabilis A. Cunn.

5. Cotyledons and pinnate leaf. Gungal (J. H. Maiden).
6. Pinnate leaf and bipinnate leaves.
7. Seeds.

PRELIMINARY INVESTIGATIONS ON A BACTERIAL DISEASE OF TOBACCO.

By G. P. DARNELL-SMITH, B.Sc., F.I.C.

With Plate XXXVI.

[*Read before the Royal Society of N.S. Wales, November 6, 1918.*]

The incidence of Blue Mould.—"Blue Mould" due to the fungus *Peronospora hyoscyami* has long been a serious disease of tobacco in Victoria, and during the last two seasons it has wrought great havoc in New South Wales. It makes its appearance particularly in seasons when the rainfall is excessive. As in the case of most fungus diseases, a particular relationship must exist between the weather, the plant attacked, and the fungus, before the latter can establish itself and spread with rapidity. "Blue Mould" especially attacks young plants in the seed beds; and when the particular relationship above referred to exists, it spreads so rapidly that if it makes its appearance the whole seed bed may be damaged in the course of a few days.

The conditions in a tobacco seed bed are ideal for the spread of a fungus disease. The seed is sown broadcast, and the young plants come up in hundreds close together. The general practice is to pull the more sturdy plantlets as they mature and to plant them out in the fields. Under this method the seed bed is for a long time covered with young plants in close juxtaposition, so that a disease upon any one plant has every chance of spreading. Moreover, in the early stages, the seed bed is kept continually moist by watering, and the young plants are covered over with a layer of loosely scattered straw or dried grass to prevent them from scorching; the atmosphere surrounding them is therefore continually damp. The conidiospores of *Peronospora hyoscyami* are produced in countless numbers upon branched conidiophores upon the under side of the leaf only, and to the naked eye the underside of the leaf appears to be covered with a fluff of a faint violet tinge. This fluff is composed of conidiophores and spores. The spores germinate readily, and have not the appearance of spores capable of undergoing a long resting stage. While the production of oospores is common among many members of the Peronosporaceæ, the oospore of *Peronospora hyoscyami* is, according to Massee,[1] unknown. I have not been able to find any trace of oospore formation in the specimens I have examined, but the intermittent manner in which the disease makes its appearance, renders it probable that oospores exist. In the allied genus *Phytophthora infestans* the oospore was only discovered by Clinton[2] in 1910, though it had been sought for by mycologists since 1845. I have been unable to detect *Peronospora hyoscyami* upon *Datura Stramonium* or other weeds belonging to the Family Solanaceæ, growing near tobacco beds upon which it might overwinter.

Plants attacked by *Peronospora hyoscyami* early lose their bright green colour, and a practised eye can quickly detect the change. The point of development at which the "blue mould" chiefly attacks the plants is in the seedling stage when they have from four to eight leaves; these have been previously figured.[9] On older plants that have been transplanted to the field I have not often found the mould itself, though often they show spots and withering of the leaves; this I am inclined to attribute to a different cause.

Tobacco culture in New South Wales is largely in the hands of Chinese; their seed beds are usually close to their planting-out grounds and adjacent to old seed-beds; it is not surprising therefore that the disease frequently re-appears year after year. In 1917 I had two interesting illustrations of the way in which the disease may be transported. At Tamworth some Chinamen had tobacco seedbeds on high land on virgin soil on a spur of the Moonbi Ranges, many miles from other tobacco growing land. The crop was free from "Blue Mould" until the owners visited some of the gardens of their compatriots where the disease was rampant and then returned. At Tumut, one grower in an isolated spot made a handsome return by supplying seedlings to those whose beds had been destroyed by "Blue mould." But he got tired of lifting and delivering the seedlings himself, and those who wanted them had to come and get them themselves. Shortly after this his beds also were attacked by "Blue Mould."

A Bacterial Disease of Tobacco.—Seedlings that have been attacked by *Peronospora hyoscyami* may die out completely or they may exhibit a partial recovery, sufficient to induce the grower to transplant them. Such plants may grow in the field and almost completely recover, or they may attain a certain size and then wilt. They seldom have the appearance of normal healthy vigorous plants, and are very liable to develop brittle stems that break off in a very moderate breeze. The stems of all such plants when cut sharply across, just above the root, show a ring of vascular tissue that is discoloured—it is brown or black. Cutting the stem across at intervals, this discoloured tissue may be traced upwards towards the apex. The colour becomes fainter, but it can be traced even with the naked eye into the veins of the big leaves.

The distribution of this colour in the vascular tissue of the stems and leaves is very similar to the distribution of the black pigment in cabbages affected with "Black Rot." This disease occurs in New South Wales, and the organism *Pseudomonas campestris* (Pammel) Erw. Smith, has been isolated from diseased specimens.

In tobacco plants from the neighbourhood of the discoloured tissue, I have obtained smears full of bacteria, and have obtained cultures of them from various parts of the plant. They exist in such numbers that there seems good reason to suppose that they are the cause of the discoloration and the diseased condition. A tobacco plant has bast inside and outside the ring of wood; in the neighbourhood of this bast the bacteria are very numerous. The wood of a diseased stem snaps easily, and often shows little splits and cavities filled with a dark material. A plant affected by bacteria shows, when young, a peculiar appearance. The stem, immediately above the roots, swells and becomes tumid, sometimes almost bulbous. The stem may be abnormally swollen for two inches or more. If the plant remains short and swollen, it is regarded as being worthless for planting out, but if, as sometimes happens, it begins to lengthen and lose its swollen appearance, it may be worth transplanting, though it never fully recovers.

Tyloses are very frequently to be observed in the vascular tissue of the swollen plants, and in the vascular tissue of older diseased plants. The production of swellings and tyloses is rather a commom symptom of bacterial infection, and it was this that first led me to suspect bacterial infection.

Erwin Smith(5) to whose recent monumental work on Bacteria in relation to Plant Diseases I shall have frequently to refer, states:—

"In hypertrophied tissues the individual cells are larger than normal. Usually both hyperplasia and hypertrophy occur in the same growth, *e.g.* in olive-tubercle. Good examples of hypertrophied cells occur also in root nodules of Leguminosæ. Here their volume may become many times that of the normal cell. Dr. Hunger pointed out that tyloses are very common in the vessels of plants attacked by *Bact. solanacearum*, and ascribed their formation to the presence of the bacteria. Of the correctness of this view I have since satisfied myself. The writer has seen the same thing in the wood of young shoots of the mulberry attacked by *Bact. mori.* Here the stimulus to growth appears to be due to poisonous products absorbed by the vessels of the plant in advance of the movement of the bacteria. This is quite in accord with what we know of the action of many poisons, minute doses stimulating and larger doses destroying."

E. Smith figures a potato shoot inoculated with a non-virulent culture of *Bact. solanacearum* Va. The inoculated stem is swollen.

I have not come across any reference to bacterial infection following an attack of *Peronospora hyoscyami.* E. Smith, however, gives a translation of a paper by Dr. Hunger on the Dutch Eastern Diseases of Tobacco.[6]

Dr. Hunger describes the symptoms of the disease, which are very similar to the disease found in New South Wales so far as the effect upon the vascular system is concerned, but I have not observed the production of such complete wilting of the leaves of the mature plant as he describes. He concludes:—

"The inclination to this formation of tyloses is caused by a bacterium (*Bacillus solanacearum* Smith), which by means of many sorts of external wounds is given an opportunity to enter into the interior of the plant. When once entered into the xylem vessels the vessel wall is through them partially absorbed, so that the above mentioned tyloses are formed. The slime-disease described here is altogether a secondary phenomenon, which is made possible by external wounds.

"In by far the most cases injury of the plant takes place either on the root or on the stem concealed underground. In the latter case I mean the stem part which has been covered with earth by heaping up the ground. The woundings may be due to many causes. In the first place should be mentioned wounds due to plant and animal parasites. Among the first named I reckon chiefly the parasitic moulds, especially *Phytophthora nicotianæ.*

The Wilt disease of Tobacco described by Erwin Smith, and shown by him so definitely to be due to *Bact. solanacearum*, shows many characters similar to those found in the diseased tobacco crops in New South Wales, that I have examined. (These crops had been planted out after infection in the seed bed with *Peronospora hyoscyami*). The questions therefore arose—does *Bact. solanacearum* occur in Australia? and is it the cause of a tobacco plant disease? The evidence on the first point is not satisfactory.

Though diseases among Solanaceous plants have been ascribed to *Bact. solanacearum*, no definite evidence that this bacterium is really the causative organism is forthcoming.

Erwin Smith(4) deals very severely with the papers of Tryon on a potato disease in Queensland, ascribed by him to *Bacillus vascularum solani*. He concludes:—

"Mr. Tryon is either describing mixed infections or else a different disease (*i.e.* different from the disease caused by *Bacillus solanacearum*)—why not 'Schwarzbeinigkeit' due to *Bacillus phytophthorus*. We shall never know the specific cause of this Australian potato disease until some *bacteriologist* takes hold of the problem, isolates and describes the organism in ways recognised as proper, and demonstrates his ability to reproduce the disease with one particular organism by means of pure culture inoculation."

I have not yet been able to complete inoculation experiments, but from diseased potatoes that were grown in New South Wales, and which showed all the symptoms of Brown Rot disease due to *Bact. solanacearum* (Smith), pure bacterial cultures, however, have been obtained; these have been tested upon various media. In their morphology and in their reactions upon the sugars, they agree with the characters given for *Bact. solanacearum* by Erwin Smith. They differ only in the reaction upon milk. When we consider the variable nature of milk, and of the variable way in which lactic bacteria act upon it, this is not a point upon which great stress can be laid.

Dr. Honing, working on tobacco diseases in Sumatra, published eleven papers (1911 – 1913)—these have been summarised by Erwin Smith. In paper (2) he states "The Deli-strain (in Sumatra) is somewhat more variable than Smith (in America) and Uyeda (in Japan) have announced. Because the Deli isolations have given three different results (in milk) depending on the age of the cultures and on the kind of milk used, the possibility is not excluded that Uyeda actually had another bacterium."

For the purpose of comparison, Erwin Smith's characters of *Bact. solanacearum* are given. They are followed by Table I. in which are given the characters of the bacterium which has been isolated from potatoes in New South Wales. In Table II are given the characters of another bacterium which has been isolated from tomato plants in New South Wales, showing a wilt-disease and which agrees in very many respects with *Bact. solanacearum.*

"From 'Bacteria in Relation to Plant Diseases,' by Erwin Smith Vol. III, p. 199.

Brown Rot of Potatoes (*Bacterium* or *Pseudomonas solanacearum*).

Named *Bacillus solanacearum* by Erwin Smith in 1896. It is motile by means of one polar flagellum, and therefore should be classified as *Bacterium* or *Pseudomonas solanacearum*. This is a specific communicable disease of Potatoes, Tomatoes, Egg-plants, etc. In potato tubers it rots the region of the vascular ring. The organism is a short rod often termo-like with rounded ends, often occurs in pairs, usually 4·5 by 1·5 mu, *no* spores.

Sugars—No acid or gas.

Milk—Converts slowly to alkaline translucent fluid.

Litmus-milk—Gradually changes to indigo or hyacinth blue.

Gelatine—Does *not* liquefy.

Gram.—Negative.

Agar Plate—Surface colonies slow growing, roundish, white at first, then brownish.

Bouillon—Clouds with formation of flocculent particles in top layers.

Pigment—Brown in agar and gelatine; soluble in water and glycerine; insoluble in absolute alcohol, sulphuric ether, chloroform, turpentine, benzine, xylol, benzole, and carbon bisulphide.

Potato slope—Grows readily, producing pale to dark brown stain. Reduces nitrates to nitrites.

Table I—*Potato* BB 689 *(B. solanacearum ?)* 27/11/17.
No. 1. Incubated 14 days at 38°.

Morphology etc.—Gram negative, cocci to short rods often in pairs

Sugars—No acid or gas.

Milk—Clotted.

Litmus-milk—Bluish-purple clot.

Gelatine—No liquefaction (5th day).

Agar-plate—Dirty white moist circular semi-transparent colonies (3rd day).

Broth—Flocculent surface growth and deposit.

Potato—Copious moist growth becoming brownish.

No. 2 as No. 1, but the blue colour of litmus-milk became discharged in 14 days.

Table II—*Tomato* BB 98 *(B. solanacearum ?)* 27/11/17.
Results at end of 4 weeks.

Sugars—No acid or gas.

Milk—Digested.

Litmus-milk—Indigo blue.

Gelatine—Liquefied with green fluorescence, dense clouded growth at bottom of liquid.

Broth—Pellicle and deposit.

Potato—Dirty white to brownish.

There is therefore strong *prima facie* evidence that *Bact. solanacearum* exists in Australian soil. Some experiments made later with pure cultures of bacteria obtained from diseased tobacco plants, where the reactions of *Bact. solanacearum* were expected but were not obtained, led to the re-testing the Bacterium, No. 1, obtained from potatoes after it had been kept in the laboratory for four months and re-subcultured at long intervals. The results were remarkable, the bacterium produced acid but no gas in media containing glucose and lactose, while the mannite broth was rendered alkaline. Milk was clotted with an acid reaction, and litmus milk became partially bleached in 17 days.

These results show that for comparative results cultures of bacteria must be freshly obtained. Even when bacteria are subcultured for a length of time upon media that may be regarded as eminently suitable, they may change their characters. An example may be given in the case of *Streptococcus lacticus*. In my laboratory a number of strains of these organisms are kept differing slightly in the rapidity with which they produce lactic acid in milk. Pure cultures of these organisms are supplied to butter factories to be used as "starters" in the ripening of cream. The organisms are subcultured every day upon milk. On one occasion the milk was found to be slimy and it was thought that contamination by another organism had taken place. Careful examination and subculturing from old tubes that had not been discarded revealed no such contamination. The same phenomenon has occurred several times since, and there seems no doubt but that after frequent subculturing, *Streptococcus lacticus* may cease to give its normal reactions with milk and cause it to be become slimy.

Hasting[7] has observed a similar phenomenon in America: "Many of the cultures gradually lose their fermentative properties and do not form acid rapidly and in sufficient amounts to insure exhaustive churning and to produce the desired degree of flavour in the product. Cultures frequently become slimy or ropy on propagation. This is not necessarily due to contamination with specific slime-forming organisms but rather to a change in the lactic organism itself. Such an abnormality usually persists for a short period only, and the conditions that govern its appearance and disappearance are not known."

Too much reliance therefore for the purposes of identification cannot be placed upon the reactions with the sugars of any organism unless it has been freshly obtained.

While in tomato plants from Emu Plains showing undoubted signs of wilting, bacteria have been found in countless numbers in the cells, and which were easily visible in the cells in sections, in the tobacco plants that I have examined the bacteria are not easily visible in sections. Yet from diseased plants from Tamworth, from Barraba, and from Texas (N.S.W.) it has been possible to obtain with ease what were apparently pure plate cultures. *Bact. solanacearum* apparently exists in our soils, and my view at present is that the wounds in the stem caused by the rotting leaves of the seedlings attacked by *Peronospora hyoscyami* afford a means of entrance to the bacteria into the plant. If a series of sections be taken across young plants attacked by *Peronospora hyoscyami*, a point or points will be found where a connection is visible between the decayed end of a leaf and the brown discoloured vascular system of the stem. In some few roots I have found eel worms, but they have not been found sufficiently often to suggest that they make a wound through which the bacteria enter. The method followed of obtaining cultures has been to isolate a very small piece of the diseased tobacco stem under strictly aseptic conditions, to place this piece in broth and then to pour agar plates from the broth.

The plates obtained have been always apparently pure cultures. The colour of the colonies varies from white to dirty white, and a typical plate is shown at Plate XXXVI, fig. 1. Two distinct types of growth however are obtained, round colonies with a smooth margin and dendritic colonies. The organisms from these, however, show the same morphology and give the same reactions on the sugars.

This variation in the form of the colonies is remarkable, and one would expect to find two different organisms. E. Smith,(8) however, figures a petri-dish poured-plate from the cavity in stem of an inoculated plant showing the presence of a white organism producing branching colonies. A similar branching colony recovered from an inoculated plant in one of my experiments is shown at Plate XXXVI, fig. 2.

Particulars of the cultures obtained from diseased plants from Tamworth are given in Table III. Thus from three diseased tobacco stems three plates were poured. From the plates obtained two colonies on each plate were compared, there being only two types of colony on the plates.

Plate 1,	Col. 1,	like each other in sugar reactions.
„	Col. 2,	differed only in their plate growth, (1) being dendritic, (2) circular.
Plate 2,	Col. 1,	like each other in sugar reaction.
„	Col. 2,	and resemble Cols. 1 and 2 of Plate No. 1, but differ from them in sugar reactions.
Plate 3,	Col. 1,	like each other in sugar reaction.
„	Col. 2,	and similar also to Cols. 1 and 2 of Plate No. 2, they resemble Cols. 1 and 2 of Plate No. 1 in plate growth.

Thus we have two types of growth, the dendritic and the circular in each plate, and two types of sugar reactions, those given by the organisms on Plate 1 and those given by the organisms on Plates 2 and 3.

From these cultures tobacco plants were inoculated as under :—

Pot 1,	Plants 3,	Culture No. 1 (1)	This organism was recovered at the end of 2 months.
„ 2,	„ 2,	„ „ 2 (1)	„ „

Table III at 4th day.—*Tobacco Stems* (3) (*? B. solanacearum*) *from Tamworth*, 22/1/18.

	No. 1 (1)	No. 1 (2)	No. 2 (1)	No 2 (2)	No. 3 (1)	No. 3 (2)
Morphology	short motile pod, gram. negative	as 1 (1)	as 1 (1)	as 1 (1)	as 1 (1)	as 1 (1)
Sugars—Glucose	acid, gas		acid, gas			
Mannite	,,		acid, gas			
Dulcite	,,	as 1 (1)	no change	as 2 (1)	as 2 (1)	as 2 (1)
Lactose	no change		acid, gas			
Saccharose	acid gas		acid, gas			
Milk	clot and separation	as 1 (1)	clot (10 days)	as 2 (1)	clot	soft clot (10 days)
Litmus-milk	as milk; colour discharged	as 1 (1)	color discharged	clot, colour discharged	clot, colour discharged	no clot, colour becoming discharged
Gelatine	liquefied (funnel)	as 1 (1)	white, nail head, beaded, no liquefaction	as 2 (1)	white, irregular surface growth stab., no liquefaction. Green fluorescence	as 3 (1)
Agar plate	grey or dirty white, dendritic, moist	grey or dirty white circular	as 1 (1)	as 1 (2)	as 1 (1)	as 1 (2)
Broth	turbid, surface floccules, deposit	as 1 (1)	turbid, deposit	turbid, surface floccules, deposit	as 2 (2)	as 2 (2)
Potato	moist, spreading brownish	as 1 (1)	moist, spreading dirty white	as 1 (1)	moist, spreading brownish	dirty white

The inoculated plants (white Burley tobacco plants) after two months showed a tumescence of the stem and a slight yellowing of the vascular tissue. The cell nuclei as in tumid diseased plants in the field were frequently much enlarged. Check plants stabbed at the same time with a sterile needle showed no alteration in growth.

Cultures were obtained from the inoculated plants at the end of two months and the reactions of the organism which are given in Table IV leave no room to doubt that it is the same organism as that inoculated. It is noteworthy that two of the colonies examined gave no acid and gas on the sugars, a characteristic of *B. solanacearum*.

Table IV.—*Organisms recovered from Inoculated Tobacco Plant, Pot No. 2.*

	No. 1 (1)	No. 2 (1)	No. 2 (2)	No. 2 (3)
Sugars—				
Glucose	acid, gas	no change	as 2 (1)	as 1 (1)
Mannite	acid, gas	"		
Dulcite	no change	"		
Lactose	acid, gas (slight)	"		
Saccharose	acid, gas	"		
Milk	clot, separation, gas	separation, digestion	as 2 (1)	as 1 (1)
Litmus milk	clot, separation, gas decolorised	almost complete digestion, liquid brown	as 2 (1)	clot, separation, no gas decolorised
Gelatine	irregular surface growth, broken margin, wavy puncture growth no liquefaction	liquefied, half inch band only	as 2 (1) granular liquid	as 1 (1)
Agar plate	dirty white, rounded, slightly wavy margin	dirty white. circular, convex, moist	grey circular thin colony submerged	large grey, thin colony submerged
Broth	pellicle, turbid	turbid, deposit	film, turbid, deposit	no film, turbid, deposit

Remarks.—Results at end of seven days—1 (1) and 2 (3) is the same organism that was inoculated; recovered at end of two months.

A second series of inoculations was carried out, the roots and not the stem of the plants being inoculated.

Colony 1, Plate 1 [1(1)] and Colony 1, Plate 2 [2 (1)] were inoculated into roots and recovered after 47 days.

Details of the reactions of the recovered organisms are given in Table V.

Table V.—*Inoculated Tobacco Plants, Second Series.*

	No. 1 (1) BB 72. From Pot 1, root inoculated.	No. 2 (1) BB 72. From Pot 2, root inoculated.
Morphology	short rods; gram negative	cocci to short rods, gram negative
Sugars—Glucose	acid and gas	acid and gas
Mannite	acid and gas	acid and gas
Dulcite	acid and gas (slight)	no change
Lactose	acid, no gas	acid and gas (slight)
Saccharose	acid, no gas	acid and gas
Milk	tendency to clot, clot and separation (6 days)	tendency to clot, clot (6 days)
Litmus milk	slight clot, separation	clot, separation
Gelatine	slow funnel liquefaction	no liquefaction
Agar plate	dirty white to grey, dendritic, moist (5 days)	dirty white, circular to irregular, moist (3 d.)
Broth	thin, pellicle, turbid, deposit	pellicle, turbid, deposit
Potato	fawn, moist spreading	white, moist spreading

In the first series of inoculations (stem inoculations) the inoculated plants showed the tumescence of the stem that is characteristic of the disease in the early stages.

In the second series of inoculations (root inoculations) the inoculated plants showed no tumescence up to the time at which the organism was re-isolated. We may conclude that the organism had lost its virulence, or that root inoculation does not produce the disease so rapidly as stem inoculation.

Further supplies of diseased plants were obtained and plates made from them; the details of the culture reactions are given as under:—Plants from Texas, Table VI; from Dungowan, Table VII; from Tamworth, Table VIII.

Table VI.—*Tobacco Stems* (3) 11/2/18, *B.B.* 129, *from Texas.*

	Plate I (1)	Plate I (2)	Plate II (1)	Plate II (2)	Plate III (1)	Plate III (2)
Morphology	medium rods, doubtful gram granitic	medium rods, gram negative	short rods, gram negative	short rods, gram negative	short rods, gram negative	short rods, gram negative
Sugars—Glucose	acid no gas	acid and gas	acid no gas	acid no gas	acid no gas	acid no gas
Mannite	acid no gas	acid and gas	alkaline no gas	alkaline no gas	,, ,,	,, ,,
Dulcite	no change	alkaline no gas	,, ,,	,, ,,	no change	no change
Lactose	acid and gas	acid and gas	,, ,,	,, ,,	,, ,,	,, ,,
Saccharose	no change	acid and gas	,, ,,	,, ,,	acid no gas	acid no gas
Milk	part clot	clot and separation	digestion, yellow	digestion, yellow	clot, separation	clot, separation
Litmus milk	acid clot	acid clot separation	digestion, colour discharged	digestion, colour discharged	acid clot, separation	acid clot, separation
Gelatine	small cup-shaped liquefaction	funnel liquefaction	funnel liquefaction green fluid	funnel liquefaction, green fluid	rapid liquefaction	rapid liquefaction
Agar plate	greyish dendritic moist flat surface	dirty white, circular, moist surface	large, yellow-green spreading fluorescent	circular, yellowish moist	dirty white, dendritic, moist	dirty white, circular, moist
Broth	turbid throughout deposit	pellicle, deposit	pellicle turbid, greenish	pellicle, turbid, greenish	turbid throughout deposits	turbid throughout deposits
Potato	dirty white moist spreading	brownish, moist, spreading	brown, moist, spreading	brown, moist, spreading	white, moist, spreading	dirty white, spreading

Remarks.—Reactions at the end of six days.

Table VII.—*Tobacco Plants from Barraba and Dungowan Creek* (B.B. 169 *and* 170).

	Stem, Plate I (No. 1)	Stem, Plate II (No. 1)	Stem, Plate II (No. 2)	Root, Plate III (No. 1)
Morphology	short rods, gram negative	short rods, gram negative	short rods, gram negative	short rods, gram negative
Sugars—Glucose	acid no gas	acid no gas	acid no gas	no change
Mannite	,, ,,	acid and gas	acid and gas	,,
Dulcite	no change	no change	no change	,,
Lactose	,,	acid no gas	acid and gas	,,
Saccharose	acid no gas	no change	no change	,,
Milk	soft clot	clot	clot	digestion
Litmus milk	digestion	acid clot	acid clot	colour discharged, digestion
Gelatine	funnel liquefaction	no liquefaction, wavy growth	no liquefaction, waxy growth	liquefaction
Agar plate	dirty white spreading, lobed	dirty white, circular, slight wavy margin	dirty white, moist, circular	yellowish, circular
Broth	pellicle	turbid deposit	turbid deposit	turbid
Potato	fawn, wrinkled	fawn, moist	white, moist	fawn, moist
	Root, Plate IV (No. 1)	**Root, Plate IV (No. 2)**	**Inflorescence, Plate V (1)**	**Inflorescence, Plate V (2)**
Sugars—Glucose	acid and gas	acid no gas	acid no gas	acid no gas
Mannite	,, ,,	,, ,,	no change	no change
Dulcite	,, ,,	acid and gas	,,	,,
Lactose	no change	,, ,,	,,	acid no gas
Saccharose	acid and gas	no change	,,	,, ,,
Milk	soft clot	clot	,,	clot
Litmus milk	soft clot, color discharged, partial digestion	clot, colour discharged	alkaline only	acid clot
Gelatine	funnel liquefaction	no liquefaction, wavy growth	no liquefaction, fluorescent	funnel liquefaction
Agar plate	dirty white, deeply lobed moist	dirty white, circular, moist	dirty white, circular, moist	yellow, circular, moist
Broth	deposit	turbid, deposit	turbid, deposit	deposit only
Potato	yellowish, moist	fawn, moist	yellowish, moist	yellow, moist

Remarks.—Reactions at the end of six days.

Table VIII.—*Tobacco Plants (Tamworth).*

	Plate I (No. 1)	Plate I (No. 2)
Sugars—Glucose	no change	no change
Mannite	,,	,,
Dulcite	,,	,,
Lactose	,,	,,
Saccharose	,,	,,
Milk	digestion	digestion
Litmus milk	complete digestion	complete digestion
Gelatine	liquefaction	liquefaction
Agar plate	dirty white, dendritic	dirty white, circular moist

In examining these tables we find that the following colonies give reactions very closely resembling those ascribed to *Bact. solanacearum*:—

Table VIII, Plate I, No. 1 ,, ,, ,, ,, 2 ,, VII, ,, III, ,, 1	this organism differs only from *B. solanacearum* in the liquefaction of gelatine.
,, ,, ,, V, ,, 1	this organism differs only from *B. solanacearum* in giving acid on glucose and green fluorescence on gelatine.

From the various diseased tobacco plants examined, pure cultures of bacteria have been obtained almost without exception. The colonies on the poured plates were moist, dirty white in colour, and either circular or dendritic; this difference in shape of the colonies seems to be of not much importance, since the morphology and the reactions agree in any comparative series of the two. The organisms are motile, gram negative short rods. With three exceptions all gave acid on glucose, and as regards milk, sixteen out of the twenty cultures examined caused it to clot.

I am indebted to my assistant Mr. W. A. Birmingham for much careful work in connection with the organisms isolated and examined.

Summary.

1. *Peronospora hyoscyami* is the cause of a disease which gives rise to serious loss in tobacco seed beds.

2. Plants that have been attacked by *Peronospora hyoscyami* in the early stages show characteristic symptoms of disease when planted out.

3. The symptoms are swelling at the base of the stem, brown discolouration of the vascular system in the stem and leaves, and later cavities in the stem, brittleness of the stem and a certain amount of wilting of the leaves.

4. These symptoms are those which have been described by E. Smith, as associated with Granville Wilt in U.S.A., (Sumatran slime disease of Tobacco, Japanese Stem Rot, etc.) and shown by him to be due to *Bact. solanacearum.*

5. A bacterium has always been found associated with the disease in New South Wales.

6. Cultures of the bacteria have been obtained; they agree with *B. solanacearum* in their morphological characters, but differ culturally.

7. Plants have been inoculated with pure cultures of the bacteria isolated, some symptoms of the disease produced and the bacteria reisolated in pure culture.

8. There are indications that cultural differences obtained with different strains of *B. solanacearum* arise through differences in age or treatment of the cultures.

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Explanation of Plate.

PLATE XXXVI.

Fig. 1—Pure culture of bacteria re-isolated after two months from a plant that had been inoculated.

Fig. 2—Photograph of a dendritic colony among a number of circular ones.

TWO NEW SPECIES OF EUCALYPTUS.

By R. H. CAMBAGE, F.L.S.

[With Plates XXXVII - XXXIX.]

[*Read before the Royal Society of N. S. Wales, November 6, 1918.*]

1. EUCALYPTUS PUMILA n. sp.

Arbuscula alta, cum truncis multis separatis, in altum pedes quindecim vigintive extendens, trunci diametrum unciarum duarum triumve habens.

Ramusculi angulares præcipue ad extremitates.

Folia (reversio) tenera ovata ad ovata-lanceolata, 3 – 5 cm. longa, 1 – 1·5 cm. lata.

Folia matura. Linearia-lanceolata ad ovata-lanceolata, modice crassa, sex ad duodecim cm. longa, unum ad tria cm. lata, sæpe leviter falcata, utrobique obtuse viridia, extremitates fuscæ et flaccidæ, systema venosa modice clara, venæ laterales angulis circiter 40 ad 55° e cortâ mediâ dispositæ, vena inter margines plerumque juxta marginem, olei glandulæ numerosæ. Petiolus 1 – 1·5 cm. longus.

Gemmæ. Fuscæ cum colore viridi tinctæ, prope sessiles vel cum pediculis circiter unum mm. longis, operculum conoide, quinque ad septem mm. longæ, calycistubus vix longitudinis dimidius, pedunculus aliquanto complanatus circiter unum mm. longus.

Flores. Circiter septem ad tredecim in umbellâ, antheræ modicæ, callæ parallelæ.

Fructus. Prope sessiles, hemisphericales, diametrus circiter septem mm. plerumque cum quatuor valvis exsertis, ora crassa, convexi.

Cortex. Tenuis et levis ad humum, interdum cum vittis pendulis longis, crassus ·5 – 2 mm., color cinereus vel subviridis.

Lignum. Fuscum in centrum, durum.

A tall shrub of many separate stems reaching 15 – 20 feet high, with stem-diameter of 2 – 3 inches.

Branchlets.—Angular, especially towards the tips.

Juvenile (reversion) foliage.—Ovate to ovate-lanceolate, 3 – 5 cm. long, 1 – 2·5 cm. broad.

Mature leaves.—Linear-lanceolate to ovate-lanceolate, fairly thick, 6 – 12 cm. long, 1 – 3 cm. broad, often slightly falcate, dull green on both sides, tips brown and withered. Venation fairly distinct, lateral veins arranged at angles of from about 40 – 55 degrees with the midrib, intramarginal vein usually close to the edge. Oil glands numerous. Petiole from 1 – 1·5 cm. long.

Buds.—Greenish-brown, almost sessile or with pedicels about 1 mm. long, operculum conoid, 5 to 7 mm. long, the calyx-tube scarcely half that length, peduncle somewhat flattened, about 1 cm. long.

Flowers.—About 7 – 13 in the umbel, anthers of medium size, the cells parallel.

Fruits.—Almost sessile, hemispherical, about 7 mm. in diameter with usually four exserted valves, rim thick, convex.

Bark.—Thin and smooth to the ground, sometimes ribbony, ·5 – 2 mm. thick, slaty to greenish in colour.

Timber.—Brown towards centre, tough.

Habitat—Near Pokolbin, a quarter of a mile west of portion 146, Parish of Rothbury, County of Northumberland, New South Wales.

This species is a Mallee growing on the side of a hill amongst *Eucalyptus siderophloia* Benth., *E. maculata* Hook., *Callitris calcarata* R. Br., *Casuarina Luehmanni* R. T. Baker, and *C. stricta* Ait. The specific name is in allusion to the dwarfed habit of the tree.

Seedlings—*Hypocotyl* red, erect, glabrous.

Cotyledons slightly emarginate, 1·7 mm. long, 5 mm. broad, lobes oblong-obtuse, upperside green, underside red, glabrous; petiole 2 mm. long.

Seedling foliage opposite for two or three pairs, entire, glabrous, oval-lanceolate to ovate and ovate-lanceolate, obtuse. First pair up to 1·4 cm. long, 7·5 mm. broad, upperside green, underside red to purple, petiole 2 mm. long. Second pair up to 3 cm. long, 1·8 cm. broad, underside red to purple, petiole 5 mm. Third pair up to 4·7 cm. long, 2·4 cm. broad, underside at first reddish-purple, becoming pale green, petiole up to 7 mm.

Stems red.

The seeds germinated 12½ years after being gathered. Plants, when about 6 – 8 inches high, developed nodules or swellings about the axils of the cotyledons, which had fallen.

Affinities.

Its closest affinity appears to be with *E. dealbata* A.Cunn., from which it differs in bark and timber, as well as the texture of the leaves, and the position of the intramarginal vein. The seedling foliage is also different.[1] *E. dealbata*

[1] The evolution of the Eucalypts in relation to the cotyledons and seedlings, by Cuthbert Hall, M.D., *Proc. Linn. Soc. N.S.W.*, Vol. XXXIX, pl. xlvi.

will sometimes grow in Mallee form, but in such cases the bark remains fairly thick and the timber soft. In bark, timber, oil and habit *E. pumila* much resembles *E. Behriana* F.v.M., but differs in the flowers, fruits and leaves.

Leaves of this Eucalyptus were procured and distilled in August 1907 at the Technological Museum. Messrs. Baker and Smith report on the oil as follows:—

"The yield of oil is large, 617 ℔. of leaves with terminal branchlets giving 9 ℔. 10 oz. of oil—equal to 1·56 per cent.

"The oil is very rich in eucalyptol, and both in yield and eucalyptol content this species is one of the best from which to distil Eucalyptus oil for pharmaceutical purposes, and in this respect may be associated with *E. Smithii*, *E. polybractea* aud *E. Morrisii*. The oil contains some pinene, but the dextrorotatory form only slightly predominates, and consequently the large fraction of rectified oil does not vary but slightly in optical properties from that of the crude oil. This is contrary to the general experience with oils of the eucalyptol class, as in those the dextrorotatory pinene generally predominates. There are only a few species which give an oil, the rectified portion of which has a less dextrorotatory than the crude oil; *E. dealbata* is one of the species having this peculiarity as well as *E. Behriana*, *E. maculosa*, and a few others. No phellandrene could be detected. A small amount of the lower boiling aldehydes was present; the odour indicated that butaldehyde and valeraldehyde were present, thus following the general rule. The crude oil in appearance and other characteristics resembles those of this group generally, and the rectified oil is slightly tinted yellow.

"The higher boiling portion contains a very small portion of an aldehyde; this is perhaps aromadendral, but it was not separated. The sesquiterpene only occurs in small amount. The crude oil had specific gravity 0·9237 at 15° C. Rotation a_D 2·3°; refractive index 1·4683 at 20° C., was soluble in 1·1 volumes of 70% alcohol by weight, and contained 74 per cent. eucalyptol by the phosphoric acid method. On redistillation 89 per cent. came over

Addendum slip to be pasted in Journal of the Royal Society of N. S. Wales, Volume LII., *p.* 457 (1918).

Eucalyptus Mitchelli, Cambage. The undersigned, having ascertained that the name is pre-occupied for a fossil species by Ettingshausen in "Contributions to the Tertiary Flora of Australia," the name *E. Mitchelliana* is proposed in lieu of *E. Mitchelli*.

R. H. CAMBAGE.

between 167 – 183° C. (cor.), this had specific gravity 0·9166 at 15°C.; rotation a_D 2·2°; refractive index 1·4668 at 20°C. Between 183 – 250° C. 8 per cent. distilled; this had specific gravity 0·9359 at 15° C.; rotation a_D +0·6°; refractive index 1·476 at 20° C. It contained rather a large amount of eucalyptol, and gave the bromine reaction for the sesquiterpene, also the aldehyde reaction. Of the most closely allied oils it more nearly approaches *E. dealbata* than that of any other species which has yet been investigated, although the resemblance between it and the oil of *E. Behriana* is also strongly marked.

"Being a Mallee, it was thought that it might contain a considerable amount of calcium oxalate in the bark. The green bark taken from small sticks, had a thickness of 1 to 2 millimetres; it was found to contain 3·85% of calcium oxalate. The amount of calcium oxalate in the bark of the largest piece having a diameter of 3 inches was 5·39 per cent. The crystals in the bark of this species differ in no respects from those of Eucalyptus barks generally (see paper with plate by H. G. Smith.[1] The amount of of lime in the bark of *E. dealbata* was 1·19 per cent."

2. Eucalyptus Mitchelli n. sp.

Arbor umbrosa in altum pedes quinquaginta crescens, trunci diametrum duorum pedum habens.

Folia matura. Linearia lanceolata, a septem ad quatuor decim cm. longa, a septem mm. ad 1·4 cm. lata, cum apice directo vel falcato, utrobique æqualiter viridia, glabrosa et notabile nitida, aliquanto coriacea, costa media modice clara, venæ laterales aliquanto obscuræ et angulis 7 – 15°e costâ mediâ dispositæ, margines quasi nervi sunt, olei glandulæ numerosissimæ petiolum 1 – 1·3 cm. longum.

Gemmæ—Sessiles, operculum acutum, longæ circiter a tria ad quatuor mm. gemmæ vix tam longæ quam calycistubus, racemus stellatus, pedunculum longum circiter unum mm.

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[1] This Journal, xxxix, 23, (1905).

Flores—In umbellâ tenus undecim, antheræ parvæ, color ut lactis flos, versatiles, renantherosi.

Fructus—Sessiles, globosi-truncati, fusci, nitidi quasi fuscati, interdum punctis parvis palladis clavati, longi a quinque ad sex mm. diametrum quinque sexve mm. habentes, apud os restricti, labrum interius unum mm. crassus valve depressæ.

Cortex—Levis et alba nisi quod squamas paucas asperes apud basem habet.

Habitat—Summum jugum montis "Buffalo" prope casam ad provinciam "Victoria" pertinentem, in formationem siliceam graniteam quatuor millia et quadringenti pedes super mare nascens.

An umbrageous tree reaching 50 feet high with stem-diameter of 2 feet.

Mature leaves linear-lanceolate, from about 7–14 cm. long, 7 mm. to 1·4 cm. broad, with straight or hooked point, equally green on both sides, glabrous and remarkably shiny, somewhat coriaceous, midrib fairly distinct, lateral veins rather obscure, and arranged at angles of from 7–15 degrees with the midrib, margins nerve-like, oil glands very numerous, petiole 1–1·3 cm. long.

Buds sessile, operculum pointed, about 3–4 mm. long, scarcely as long as the calyx-tube, the cluster stellate, peduncle about 1 mm. long.

Flowers up to eleven in the umbel. Anthers small, creamy-white, versatile, renantherous.

Fruits sessile, globular-truncate, brown, shining as if varnished, sometimes studded with small pale dots, 5–6 mm. long, 5–6 mm. in diameter, restricted at the orifice, inner rim 1 mm. thick, valves sunk.

Bark smooth and white except for a few rough flakes at the base.

Habitat—Summit of Mount Buffalo, Victoria, near the Government Chalet, growing on siliceous granite formation at 4,400 feet above sea-level, and known as Willow Gum. The species flowers in December.

Seedlings—*Hypocotyl* erect, terete, red, glabrous, up to 2·3 cm. long.

Cotyledons obtusely quadrilateral to orbicular-reniform, entire, about 3 mm. long, 5 mm. broad, upperside green, underside red to reddish-green, glabrous; petiole about 3 mm. long.

Seedling foliage opposite, entire, glabrous, oblong-lanceolate to elliptical-lanceolate, petiole 1 – 2 mm. long; midrib prominent on underside, lateral veins fairly distinct, and arranged at angles of from 40 – 60 degrees with the midrib. On seedlings 5 inches high the second pair of leaves were elliptical-lanceolate, and up to 2 cm. long by 8 mm. broad, while the sixth pair were elliptical, and 2·5 cm. long by 1 cm. broad.

This species is named in honour of the late Sir Thomas Livingstone Mitchell, Surveyor General, who collected many native plants, and was the second explorer to pass Mount Buffalo.

Affinities.

1. With *E. vitrea* R. T. Baker. From this it differs somewhat in its leaf venation, for the prominent, almost parallel veins of *E. vitrea* are not represented in this new species. The pedicellate hemispherical fruits of *E. vitrea* are also different; the operculum of that species is shorter and more obtuse, while the peduncle is very much larger. The bark of the new species is smooth and white, that of *E. vitrea* being fibrous over the greater part of the trunk.

2. *E. nitida* Hook. f. From this it differs in its more globular fruits, pointed instead of obtuse buds, and is an umbrageous tree, while *E. nitida* is only a tall shrubby plant.

3. With *E. stellulata* Sieb. It resembles this species in its stellate buds and to some extent in the shape of its fruits, but differs in its leaf venation, colour of bark which is white, while that of *E. stellulata* is slate-coloured, and in its seedling foliage.

4. With *E. Moorei* Maiden and Cambage. Its resemblances and differences are similar to those mentioned in the case of *E. stellulata*, and in addition *E. Moorei* only grows as a Mallee-like shrub of about 10 – 12 feet high.

I have to thank Mr. J. Newton of the Chalet, Mount Buffalo, for supplementing my collection of specimens.

EXPLANATION OF PLATES.

Plate XXXVII.

Eucalyptus pumila.

1. Seedling plant. Pokolbin.
2. Juvenile (reversion) foliage.
3. Buds and leaves.
4. Fruits.

Plate XXXVIII.

Eucalyptus Mitchelli.

1. Seedling with cotyledons. Mount Buffalo.
2. Seedling leaves, except first pair and cotyledons.
3. Buds, fruits and leaves.

Plate XXXIX.

Eucalyptus Mitchelli.

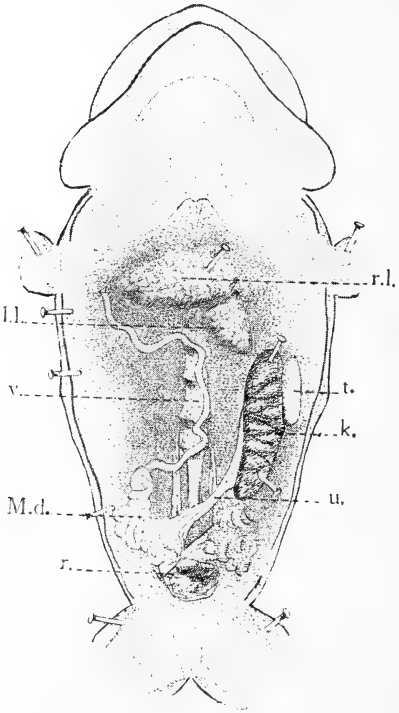
Trees at back of Chalet, Mount Buffalo.

A NOTE ON THE OCCURRENCE OF MUELLERIAN DUCTS IN THE MALE OF *HYLA CÆRULEA* WHITE.

By T. HARVEY JOHNSTON, M.A., D.Sc., and C. D. GILLIES, M.Sc.

[*Read before the Royal Society of N. S. Wales, November 6, 1918.*]

THE pronephric or Muellerian ducts normally become the oviducts in the vertebrate female, but they usually disappear in the mature male. In the Anura, however, these ducts are almost universally present in the male in varying degrees of development. In the case of *Hyla cærulea* White, the Australian green tree frog, a series can be obtained from specimens devoid of the ducts altogether, to those showing a development of these structures almost rivalling the female genital ducts in size, though the usual condition is not so pronounced, and is figured in text Fig. 1. The Muellerian ducts lie externally to the ureters and are closely connected with the posterior outer edges of the latter, but the former enter the cloaca separately. This portion of the Muellerian duct, which is associated with the ureter, is dilated, and in some of the preserved specimens contained a jelly-like substance. Near the posterior aspect of the kidney, the duct runs independently of the ureter and becomes conspicuously coiled. By means of a dissecting needle, a lumen can be traced up the duct for some distance, but eventually the latter becomes too constricted to enable this to be done along the remainder of its length. The anterior portion of the duct is not closely coiled, but travels in a sinuous manner to terminate dorsally near the base of the lung. Sections were made of testes of males with Muellerian ducts typically developed, to see if there was any tendency towards an ovotesticular condition, but the histology was normal.



Explanation of Figure.—*k*, kidney; *l.l.*, left lung; *M.d.*, Muellerian duct; *r*, rectum; *r.l.*, right lung; *t*, testis; *u*, ureter of right kidney; *v*, vertebral column.

Sketch of a male *Hyla cœrulea* with the Muellerian ducts typically developed. (The alimentary canal and liver have been removed, while to expose the right Muellerian duct the lung, kidney and testis of that side have been displaced to the left.) The figure was kindly drawn by Mr. Hubert Jarvis, Assistant Entomologist, Brisbane.

ON SOME AUSTRALIAN CLADOCERA.

By MARGUERITE HENRY, B.Sc.

(Communicated by Prof. S. J. JOHNSTON, D.Sc.)

With Plates XL – XLII.

[*Read before the Royal Society of N.S. Wales, December 4, 1918.*]

Introduction.

In the beginning of 1917 I undertook to work on the life-history of the nematode parasite of cattle, *Onchocerca gibsoni*, under the direction of the Special Committee appointed by the Commonwealth Advisory Council of Science and Industry. In the course of this work it became necessary to examine the fresh-water crustacea in the district in which the work was being carried on. This work, begun in Kendall, on the North Coast, N. S. Wales, was continued at the Zoological Laboratory at the Sydney University.

Material Investigated.

The greater part of the material investigated was obtained from ponds and creeks at Kendall, where crustacea were very abundant; five of the new species here described were collected in that locality. Collections were also made from a creek at Nelson's Bay, Port Stephens; from the Lett River, Blue Mountains; Centennial Park, Sydney; and from a pond in the Sydney University grounds. Miss Somerville, B.Sc., kindly made collections for me in the following places and forwarded the preserved material. Two tubes from Mudgee, and two from Bathurst, collected in December, contained very few crustacea; in collections from Cumbalum, Casino, and Byron Bay made in January, they were fairly abundant, and two tubes from Corowa obtained in March were very rich in Crustacea. All the localities cited are in New South Wales.

Methods Employed.

When possible the material obtained was examined alive, and samples of it were kept alive for some time; this was always the case at Kendall, and with the collections made at Centennial Park and the University. The specimens were drawn with the aid of a camera lucida while still alive. Various means of fixing and preserving were tried, such as glycerine alcohol, sublimate acetic and Carl's fixative; of these the glycerine alcohol was found to be the most satisfactory. Specimens that were unstained and had been fixed in glycerine alcohol were placed under a bell-jar until the alcohol had evaporated and were then mounted in glycerine jelly; these proved to be quite satisfactory, and the more delicate crustacea were always mounted in this way, as the staining process injured their shape and internal structure. The stains used were hæmatoxylin and borax carmine; the latter proved more suitable for those parts that needed closer examination.

I have to thank Professor S. J. Johnston for his valuable advice and assistance in the preparation of the paper. The Cladocera comprised in this paper are—

Family Daphnidæ.

Daphnia carinata King
Scapholeberis kingi Sars
Simocephalus elizabethæ King
,, *australiensis* Dana
Simocephalus acutirostratus King
Ceriodaphnia spinata sp. n.
Moina tenuicornis Sars

Family Lyncodaphnidæ.

Ilyocryptus longiremus Sars
Macrothrix spinosa King

Family Lynceidæ.

Camptocercus australis Sars
Acroperus avirostris sp. n.
,, *sinuatus* sp. n.
Alona wallaciana sp. n.
,, *kendallensis* sp. n.
,, *longirostris* sp. n.
,, *whiteleggii* Sars
,, *affinis* Leydig
,, *cambouii* Richard
Alonella clathratula Sars
Graptoleberis testudinaria Fischer
Dunhevedia crassa King
Pleuroxus reticulatus sp. n.
Chydorus denticulatus sp. n.
,, *clelandi* sp. n.
,, *globosus* Baird
,, *ovalis* Kurz

Family DAPHNIDÆ.

Genus DAPHNIA Müller.

DAPHNIA CARINATA King

This form was first described by King in the *Proc. Roy. Soc. Van Diemen's Land*, Vol. II, Part II.(6) A more detailed description was later given by Sars in "Freshwater Entomostraca from the neighbourhood of Sydney,"(11) and in "*Daphnia carinata* King."(18)

This species was fairly abundant in two tubes of crustacea obtained at Corowa in March. It had been recorded previously from Palestine and Syria, and in Australia from the Waterloo Swamps, Sydney, and at St. Arnaud, Fairfield, and Cheltenham in Victoria.

Genus SCAPHOLEBERIS Schoedler.

SCAPHOLEBERIS KINGI Sars.

This species was described by Sars in "Freshwater Entomostraca from China and Sumatra."(22) It had formerly been described by King as *Daphnia mucronata* in the *Proc. Roy. Soc. Van Diemen's Land.*(6)

This form was found in abundance at Kendall from October to June. Outside Australia it has been recorded from South Africa and Sumatra.

Genus SIMOCEPHALUS Schoedler.

SIMOCEPHALUS ELIZABETHÆ King.

This form was first described by King(6) as *Daphnia elizabethœ.* It was later more fully described by Sars in "Additional Notes on Australian Cladocera."(13)

Numerous specimens of this species were found in a pond in the grounds of Sydney University in June, and from Mudgee in December. King records finding this species at Newtown, Parramatta, near Stroud, and at Port Stephens.

Simocephalus australiensis Dana.

This species was first described by Dana, in the "U.S. Exploring Expedition," Crustacea II, as *Daphnia australiensis.* A more extended description with good figures was later given by Sars in "Additional Notes on Australian Cladocera."(13)

This form was found in abundance at Kendall from October to June. A few specimens were obtained from a pond at Sydney University in June, and numerous ephippia-bearing specimens were collected at Corowa in March. This species has been recorded from South Africa, from Gracemere in Queensland, and from Sydney.

Simocephalus acutirostratus King.

King first described this form in the *Proc. Roy. Soc. Van Diemen's Land.*"(6) It was later more fully described by Sars in "Freshwater Entomostraca from the neighbourhood of Sydney."(11)

A few specimens of this form were obtained at Casino in January. The size of these was smaller than is usual in this species, the largest specimen obtained being only 2 mm. long. King records this species from Denham Court, N. S. Wales, and Sars from a waterhole in Bourke Street, Sydney.

Genus CERIODAPHNIA Schoedler.

Ceriodaphnia spinata sp. n.

(Plate XL, figs. 1, 2.)

The length of the adult female is 1·2 mm. The carapace, seen laterally, is rounded oval in outline, dorsal and ventral margins are evenly curved, the posterior prominence very distinct and rather short pointed; it is situated above the middle axis of the body.

The head, as compared with other species of the genus, is not very much depressed; it is distinctly marked off from the carapace dorsally by a comparatively deep groove.

The reticulation of the carapace is not very distinct. The free edges of the valves are minutely denticulate. The eye is large with conspicuous crystalline lenses. The ocellus is very small, subrectangular. The antennules are short and somewhat rectangular, each has a spine at the edge and is tipped with a bundle of bristles.

The tail-piece (fig. 2) is strongly built, and its posterior edge is fairly straight. There are ten spines on the infra-anal margin; these are strong and curved, but the tenth is very small. The end claws are long and curved. Each bears a row of small spinules along its whole length; no secondary denticles are present at their base. The caudal setæ are long and feathered anteriorly. There are three feathered spines on the supra-anal prominence, and two on the posterior. As many as six summer eggs may be present. There is one winter egg in the ephippium.

This species somewhat resembles *Ceriodaphnia reticulata* Jurine. In general shape, the head is more erect and the posterior prominence more distinct and pointed in *C. spinata*. It also differs in the presence of denticles on the margin of the carapace, a greater number of anal spines and the row of tiny spinules along the whole length of the end-claws instead of the row of seven spinules near the base as in *C. reticulata*.

Specific Characters.—Carapace, seen laterally, rounded oval in outline, with the posterior prominence above the middle axis of the body, very distinct. Head not very much depressed. Surface of the carapace not distinctly reticulated; margins minutely denticulate. Eye large, ocellus very small. Antennules rectangular, each with a spine and a bundle of bristles. Tail-piece strong, ten infra-anal spines present; end-claws with a row of small spinules. Average length 1·2 mm.

Locality.—Corowa, collected in March. Type specimen in the Australian Museum, No. P 4327.

Genus MOINA Baird.

MOINA TENUICORNIS Sars.

This form was described by Sars in "Freshwater Entomostraca from the neighbourhood of Sydney."(11)

This species was obtained at Corowa in March, where it was present in abundance. It has been recorded from South Africa and from a waterhole in Bourke St., Sydney.

Family LYNCODAPHNIDÆ.

Genus ILYOCRYPTUS Sars.

ILYOCRYPTUS LONGIREMUS Sars.

Sars described this species in "Additional Notes on Australian Cladocera."(13)

This species was collected at Kendall in November and December, and it was also found at the University and Centennial Park in June. It is also recorded from North and South America, East Africa, Celebes, and from Gracemere, Queensland.

Genus MACROTHRIX.

MACROTHRIX SPINOSA King.

King first described this form in his paper "On Australian Entomostracans."(6) Sars gave a more extended description in "Additional Notes on Australian Cladocera."(13)

A few specimens of this form were obtained at Corowa in March. King records this species from Liverpool and Sydney, and Sars from the Crescent Lagoon near Rockhampton, Queensland. Outside Australia it has been recorded from South America and South Africa.

Genus CAMPTOCERCUS Baird.

CAMPTOCERCUS AUSTRALIS Sars,

This form was described by Sars in "Freshwater Entomostraca from the neighbourhood of Sydney,"(11) from a single specimen.

A single specimen of this form was found at Kendall in October, and a number at Port Stephens in September. Sars records this species from Centennial Park, Sydney.

Genus ACROPERUS Baird.

ACROPERUS AVIROSTRIS sp. n.

(Plate XL, figs. 3, 4.)

The length of the adult female is from 0·57 – 0·68 mm. The carapace is compressed, and viewed laterally, the shape is truncated oval; the greatest height is more than half the length and occurs in front of the middle. The dorsal margin is fairly strongly arched; the ventral edges of the valves are convexly curved in front, but straight for the remainder of their length; the posterior edges are obliquely truncated, slightly curved. The postero-dorsal angle is very obtuse, almost obliterated; the postero-ventral angle is distinct and bears two denticles on each valve.

The head is bent down, the dorsal margin forming an even curve with that of the carapace. The rostrum is wide and blunt.

The surface of the carapace is marked by a series of distinct oblique striations. The ventral margins of the valves are fringed with a row of long bristles.

The eye is of moderate size; the ocellus is only slightly smaller and situated closer to the eye than to the end of the rostrum.

The antennules are long and slender, reaching nearly as far as the tip of the rostrum; the tuft of sensory bristles at their apex extends beyond the rostral tip.

The antennæ are long and slender with long swimming bristles. There are three bristles and a spine on the terminal segment of the outer branch, and three bristles on the terminal segment of the inner branch. The lip-plate is somewhat triangular in form.

The tail-piece (fig. 4) is moderately long and broad; the supra-anal angle is distinct but somewhat blunt. There are no spines present on the infra-anal margin, but above it is a row of about eleven bundles of fine spinules of which the outermost are longer and larger than the rest. The end-claws are situated on a prominence; they are very long, straight for the greater part of their length, with gently curved tips; each bears two denticles, one at the base and one finer than the other about the middle of its length; there is a row of spinules between these two denticles.

This species resembles most nearly *Acroperus harpæ* Baird, described in the "Natural History of the British Entomostraca."(1) The general shape is different; the head comparatively smaller, the eye and ocellus larger and not so far removed from the dorsal margin. The depression of the posterior edge as seen in *A. harpæ* is absent. The antennule has no long sensitive papilla.

Specific Characters.—Carapace, seen laterally, truncated oval; dorsal margin arched, ventral edges of the valves convex in front; posterior edges slightly curved, oblique. Postero-ventral angle armed with two denticles. Head bent down, rostrum blunt. Eye moderately large, ocellus slightly smaller. Antennæ reaching nearly as far as the tip of the rostrum. Surface of the carapace obliquely striated. Tail-piece provided with eleven comb-like bundles of spines, end-claws long, each with two denticles and a row of spinules. Two eggs present in the brood-pouch lying side by side. Average length 0·62 mm.

Locality.—Collected at Port Stephens, Kendall and Cumbalum in the spring and summer months. Type specimen in the Australian Museum, No. P 4328.

Acroperus sinuatus sp. n.

(Plate XL, figs. 5, 6.)

The length of the adult female reaches 0·59 mm. The carapace is compressed; seen from the side, its shape is truncated oval. The dorsal margin is only slightly arched; the ventral edges of the valves are straight for the greater part of their length and form an abrupt angle with the anterior free edges. The posterior edges are sinuated, forming an obtuse angle with the ventral edge, convex about the middle, concave dorsally, meeting the dorsal margin at almost a right angle. There are no denticles present on the postero-ventral angle.

The head is rather large; the dorsal margin forms an even curve, continuous with that of the carapace. The anterior contour of the head is almost vertical. Inferiorly the head terminates in a very blunt rostrum pointing downwards. The sculpture of the carapace consists of distinct, oblique striations.

The eye is large, with conspicuous crystalline lenses; the ocellus is smaller and situated slightly nearer to the tip of the rostrum than to the eye.

The antennules are long and reach beyond the tip of the rostrum; each bears a tuft of sensitive bristles at the apex.

The tail-piece (fig. 6) is more slender than in the foregoing species, and the supra-anal angle is not so distinct, but the armature closely resembles it, there being eleven lateral bundles of spines present; the end-claws are long, each bearing two denticles, one at the base and the other about the middle of its length; a row of spinelets is present between the two denticles.

There may be two summer eggs present in the brood pouch, one in front of the other.

This form differs from *A. avirostris* in the peculiar shape of the posterior edges and the absence of denticles on postero-ventral angles. It also differs in the position of the ocellus and the length of the antennules.

Specific Characters.—Viewed laterally, the carapace has a truncated oval form; the dorsal margin is slightly arched, the ventral edges of the valves fairly straight, forming an abrupt angle with the anterior edges, *posterior edges sinuated*, *no denticles* present on the postero-ventral angle, shell obliquely striated. Head bent down terminating in a blunt rostrum. Ocellus situated *nearer the tip of the rostrum* than to the eye. Antennules reaching *beyond the tip* of the rostrum. Tail-piece long and narrow, eleven comb-like bundles of lateral spines present; end-claws long with two denticles one at the base and one at the middle with a row of spinelets between the two. Length of the adult female 0·59 mm.

Locality.—Kendall, collected in November. Type specimen in the Australian Museum, No. P 4329.

ALONA WALLACIANA sp. n.

(Plate XLI, figs. 7, 8.)

The length of the largest specimen examined is 0·49 mm. The carapace is compressed, and, viewed laterally, has an oblong oval form; the greatest height 0·31 mm. is slightly in front of the middle. The dorsal margin is evenly arched; the ventral edges of the valves are almost straight; the posterior edges slightly arcuate, evenly rounded off at the corners.

The head is hood-like, its dorsal margin forming a continuous, even curve with that of the carapace; inferiorly the head terminates in an acute rostrum which does not reach ventrally as far as the inferior edges of the valves.

The surface of the carapace is marked by numerous small pits arranged close together. The ventral edges of the valves are fringed with a row of fine bristles.

The eye is moderately large; the ocellus is about the same size, square in shape and situated nearer to the eye than to the tip of the rostrum.

The antennules are short and thick, not nearly reaching the tip of the rostrum. They bear a number of bristles at the tip. The antennæ are small; in structure they agree with those of other species of the genus. The lip-plate is comparatively large and rounded.

The tail-piece (fig. 8) is long and slender, slightly narrowed towards the apex. There are about fifteen pairs of spines present on the infra-anal margin, those nearer the end-claws being larger and stronger; above the anal spines is a row of marginal combs. The end-claws are very long, curved at the tips; a strong secondary denticle is present at the base of each reaching to half the length of the end-claws.

This species agrees most nearly with the Australian form *Alona archeri* described by G. O. Sars in "Additional Notes on Australian Cladocera."(13) It differs from the latter in the following details:—The sculpture of the shell has not the longitudinal rows of pits characteristic of *A. archeri*, the pits being massed together in an irregular manner. The ocellus is very much larger, square in shape and situated comparatively closer to the eye. The proximal spines of the tail-piece lack spinules on the upper edge; the lateral spines of *A. archeri* are replaced by combs in *A. wallaciana* and the secondary denticles at the base of the end-claws are longer and stronger.

Specific Characters.—Carapace seen laterally is oblong oval; dorsal margin arched, ventral edges straight, corners evenly rounded. Surface of the carapace marked with irregular pits. Ocellus equal in size to the eye, square shaped. Antennules short, not reaching to the end of the rostrum. Tail long and slender; fifteen pairs of anal spines and a row of lateral combs present; end-claws long with strong secondary denticles. Colour yellow. Length of adult female 0·49 mm.

Locality.—Kendall, collected in May from creeks on Mr. Wallace's farm. Type specimen in the Australian Museum No. P 4330.

Alona kendallensis sp. n.

(Plate XLI, figs. 9, 10.)

The length of the adult female is 0·88 mm. Seen laterally, the carapace is somewhat quadrangular, obliquely truncated behind. The greatest height, 0·49 mm., occurs behind the middle. The dorsal and ventral edges of the valves are almost straight, the posterior edges are slightly arcuate.

The head is somewhat depressed with an acute rostrum pointing downwards and almost reaching the ventral edges of the valves. The forehead is very sloping, joining the dorsal edge of the carapace somewhat abruptly. The surface of the carapace is marked by distinct longitudinal striations. The ventral edge of each valve bears a row of long bristles, which are continued round the postero-ventral angle.

The eye is of moderate size, with conspicuous crystalline lenses. The ocellus is very slightly smaller than the eye, and situated much nearer to it than to the tip of the rostrum. The antennules are narrow, and extend about two-thirds the length of the rostrum. The antennæ are comparatively small; they exhibit the usual structure.

The tail-piece (fig. 10) is very strongly built, nearly uniform in width throughout. There are twelve pairs of spines on the infra-anal margin with spinules on the posterior border of each. The end-claws are strong with a very well developed denticle at the base of each. A row of about twelve marginal combs is present.

This species somewhat resembles *Alona whiteleggii* Sars, but differs in the greater width of the posterior edges, the straight dorsal margin and the more depressed head; the tail-piece is like *A. whiteleggii* in shape but has fewer spines and further these possess spinules on their posterior edges.

Specific Characters.—The carapace seen laterally, is quadrangular, very wide posteriorly; dorsal and ventral margins straight. Posterior edges arcuate. Head depressed with a long acute rostrum. Carapace longitudinally striated. Ocellus almost as large as the eye. Tail-piece large, twelve pairs of spines on the infra-anal margin, provided with spinules; twelve marginal combs present, end-claws and secondary denticles strong. Length 0·88 mm.

Locality.—Kendall, collected in October. Type specimen in the Australian Museum, No. P 4331.

ALONA LONGIROSTRIS sp. n.

(Plate XLI, figs. 11, 12.)

The length of the specimen examined is 0·74 mm. Seen laterally, the shell exhibits an oblique oval form, obliquely truncated behind; the greatest height is 0·41 mm. and occurs just behind the middle; the dorsal margin is arched, the ventral edges of the valves are straight for the greater part of their length, curving upwards posteriorly.

The head is depressd, with an elongated pointed rostrum reaching below the ventral edges of the valves; the dorsal margin of the head forms an even curve with that of the carapace.

The surface of the carapace is not striated but marked by a number of pits; the ventral edges of the valves bear a row of bristles and there is a group of bristles on the postero-ventral corner.

The eye is of moderate size; the ocellus is smaller and situated closer to the eye than to the tip of the rostrum.

The antennules are not as long as the rostrum, but the sensory tufts of filaments at their apices reach beyond its tip.

The tail-piece (fig. 12) is strongly built, of almost uniform width throughout; the supra-anal angle is not very distinct; there are twelve pairs of short thick spines present on the infra-anal margin, and also a row of about ten lateral combs; the end-claws are strong, each with a secondary denticle which reaches half its length; the denticles each bear a row of spinules.

Specific Characters.—Carapace seen laterally oblong oval, obliquely truncated behind, dorsal margin arched, ventral straight, curving posteriorly. Head depressed. Rostrum reaching below the ventral edges of the valves. Surface of the carapace pitted. Ocellus smaller than the eye, closer to it than to the tip of the rostrum. Tail-piece broad, with twelve pairs of short, thick infra-anal spines, and ten lateral combs; end-claws strong; secondary denticles long, each bearing a row of spinules.

Locality.—This form was collected at Byron Bay in January. Type specimen in the Australian Museum, No. P 4332.

ALONA WHITELEGGII Sars.

This species was described by Sars in "Freshwater Entomostraca from the neighbourhood of Sydney."[11]

This form was abundant at Kendall during the summer months. It is recorded by Sars from Centennial Park, Sydney.

Alona affinis Leydig.

This species was first described by Leydig in "Naturgeschichte der Daphniden," 1860. Lilljeborg gives a detailed description with good figures in "Cladocera sueciæ."(7)

Several specimens of this large form were obtained at the Lett River, Blue Mountains. It has been recorded from Europe, Asia, North and South America, South Africa and Greenland.

Alona cambouii Richard.

This form was first described by Richard in "Nouveaux Entomostracées d'eau douce de Madagascar." Sars gives a good figure of it in "Pacifische Plankton-Crustaceen."(15)

A few specimens of this species were obtained at Port Stephens in August. It has been recorded from Madagascar, Palestine, South America, New Zealand.

Genus ALONELLA Sars.

Alonella clathratula Sars.

This form was described by Sars in "Freshwater Entomostraca from the neighbourhood of Sydney."(11)

This species was found in abundance at the Lett River in September. A few specimens were obtained at Kendall in October. It has been recorded from South America and in Australia from the Maroubra Swamp, Sydney.

Genus GRAPTOLEBERIS Sars.

Graptoleberis testudinaria Fischer.

This form was first described by Fischer in "Mém de l'Acad. Impér. de St. Petersb. des Savants ètrangers, T. VI, page 191. Lilljeborg gives a detailed description with good figures in " Cladocera sueciæ."(7)

A solitary specimen of this form was obtained from a pond in the University grounds in June. It has been recorded from Europe, North and South America, Asia, Iceland and the Azores.

Genus DUNHEVEDIA King.

Dunhevedia crassa King.

This form was first described by King in "Australian Entomostracans."(6) A more detailed description is given by Sars in "Additional Notes on Australian Cladocera."(13)

This species was obtained at Sydney University in June, and at Cumbalum in January. King records this form from Dunheved (St. Mary's, N.S.W.), and Varraville near Denham Court, N.S.W. It has also been recorded from Ceylon.

Genus PLEUROXUS Baird.

Pleuroxus reticulatus sp. n.

(Plate XLII, figs. 13, 14.)

The length of the adult female is 0·31 mm. Seen laterally, the carapace is oblong oval in shape, the greatest height being 0·20 mm., and occurring somewhat in front of the middle.

It is narrowly truncated posteriorly, the posterior edges being straight. The dorsal margin is strongly arched, the ventral edges of the valves are straight in the posterior part, curving up to the anterior edges somewhat suddenly. A blunt denticle is present at the postero-ventral corner.

The dorsal margin of the head forms a continuous, even curve with that of the carapace; the rostrum is long, slender and sharply pointed. The surface of the carapace is marked by a reticulate sculpturing as well as by a number of minute pits joined together so as to form a superimposed network of marks. The ventral edges of the valves are fringed each with a row of bristles.

The eye is large; the ocellus is about half as large and is situated very much closer to the eye than to the tip of the rostrum.

The antennules, which are tipped with a bunch of sensory papillæ, extend about half the length of the rostrum.

The antennæ have the structure characteristic of the genus; they are comparatively short.

The tail-piece (fig. 14) is moderately strong and of uniform breadth throughout. The supra-anal angle which is distinct, is an obtuse angle. The end-claws are situated on a little prominence; they are rather strong and slightly curved; each has a rather large denticle removed a little from the base; there is also a very small secondary denticle at the base. The spines on the infra-anal margin are fairly short; there are about eleven pairs present; seven comb-like groups of bristles occur on either side of the anal furrow.

This species in many ways resembles the larger form *Pleuroxus inermis*, described by G. O. Sars in "Freshwater Entomostraca from the neighbourhood of Sydney." It differs however in the presence of a denticle on the postero-ventral corner and in the very different sculpturing of the carapace.

Specific Characters.—Carapace seen laterally oblong oval in shape; narrowly truncated posteriorly; dorsal margin arched; ventral edges curved, protuberant in front; postero-ventral corner with a blunt denticle. Head small, terminating in a long slender rostrum. Sculpture of valves consists of a reticulation together with pits.

Eye of moderate size, ocellus smaller, much closer to the eye than to the end of the rostrum. Tail-piece of uniform breadth; spines on the infra-anal margin fairly small, seven lateral combs; terminal claws with two secondary denticles each, one large one small. Length 0·31 mm.

Locality.—Collected at Port Stephens in August. Type specimen in the Australian Museum, No. P 4333.

Genus CHYDORUS Baird.

CHYDORUS DENTICULATUS sp. n.

(Plate XLII, figs. 15, 16.)

The length of this form reaches ·46 mm. The shape is sub-globular; seen laterally, the dorsal margin of the carapace is strongly arched, forming a very obtuse angle with the posterior edges, the ventral edges of the valves are curved anteriorly straight for the greater part of their length, also forming an obtuse angle with the posterior edges, the latter are slightly curved.

The head is small; the dorsal margin forms an even curve with that of the carapace, the rostrum is long and narrow slightly recurved, appressed to the trunk. The eye is of moderate size; the ocellus is smaller, rounded in shape and situated twice as far from the end of the rostrum as from the eye.

The surface of the carapace is marked by small pits which are larger and more conspicuous in the dorsal part, a few striations present in the antero-ventral portion. The ventral edges of the carapace are beset with feathery hairs and the anterior half has in addition a row of small denticles.

The antennules are small and reach less than half the length of the rostrum.

The tail-piece (fig. 16) is strongly built; behind the anal prominence the dorsal edge is a pronounced S-shape; there is a very distinct supra-anal angle. There are about fifteen groups of spines present on the infra-anal margin. The end-claws are long, and have one long and one short accessory denticle at the base of each.

Two summer eggs are present in the brood-pouch.

Specific Characters.—Shape sub-globular; dorsal margin of the carapace arched, ventral curved anteriorly and posteriorly straight in the middle, narrow posterior edges.

Rostrum long and recurved. Surface of the carapace pitted. Ocellus smaller than the eye; nearer it than to the tip of the rostrum. Antennules less than half the length of the rostrum. Tail-piece strong, S-shaped behind the anal prominence, fifteen groups of anal spines, end-claws each with one large and one small denticle at the base. Length ·45 mm.

This form was collected from a pond at Sydney University in June. Type specimen in the Australian Museum, No. P 4334.

CHYDORUS CLELANDI sp. n.

(Plate XLII, figs. 17, 18.)

This is a very small form, the largest specimen examined only attaining 0·38 mm. Seen laterally, the carapace has a rounded form; the dorsal margin is strongly arched, joining the posterior edges at an obtuse angle; the ventral edges of the valves are also strongly arched; the posterior edges are very short and gently curved.

The head is produced into a long acute rostrum, closely appressed to the trunk; the dorsal margin forms an even curve with that of the carapace.

The eye is large for such a small form; the ocellus is slightly smaller and situated nearer to the eye than to the tip of the rostrum.

The antennules are short and rather thick, reaching about half the length of the rostrum.

The surface of the carapace is pitted. The carapace is thickened along the ventral and posterior edges. The ventral edges bear a row of short bristles.

The tail-piece (fig. 18) is comparatively wide, with a very prominent supra-anal angle; twelve spines are present on the infra-anal margin. The end-claws are long, with spinules along half their length; one denticle is present at the base of each.

Specific Characters.—Carapace seen laterally rounded, dorsal and ventral margins curved, posterior edges short. Rostrum long and narrow. Eye large. Antennules short and thick. Carapace pitted. Tail-piece with a prominent supra-anal angle; twelve spines on the infra-anal margin. End-claws long with one secondary denticle at the base of each, and a row of spinules along half their length.

This form was found at Kendall, Lett River and Sydney University pond. Type specimen in the Australian Museum, No. P 4335.

CHYDORUS GLOBOSUS Baird.

This form was first described by Baird in the "Natural History of the British Entomostraca."(1) Lilljeborg gives a full description with good figures in "Cladocera Sueciæ."(7)

Several specimens of this form were found at Sydney University in June. It has been recorded from Europe and from Centennial Park and Botany near Sydney.

CHYDORUS OVALIS Kurz.

This form was first described by Kurz in "Dodekas neuer Cladoceren." Lilljeborg gives a detailed description in "Cladocera Sueciæ."(7)

This species was present in a tube of material collected at Centennial Park in June. It has been recorded from several European countries.

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Explanation of Plates.

The drawings which were made by Mr. F. W. Atkins of the Technical High School, Sydney, were all done with the help of the camera lucida.

PLATE XL.

Fig. 1. *Ceriodaphnia spinata* × 65
,, 2. Tail-piece of *Ceriodaphnia spinata* × 90
,, 3. *Acroperus avirostris* × 83
,, 4. Tail-piece of *Acroperus avirostris* × 237

Fig. 5. *Acroperus sinuatus* × 65
„ 6. Tail-piece of *Acroperus sinuatus* × 303

Plate XLI.

Fig. 7. *Alona wallaciana* × 100
„ 8. Tail-piece of *Alona wallaciana* × 243
„ 9. *Alona kendallensis* × 70
„ 10. Tail-piece of *Alona kendallensis* × 240
„ 11. *Alona longirostris* × 85
„ 12. Tail-piece of *Alona longirostris* × 150

Plate XLII.

Fig. 13. *Pleuroxus reticulatus* × 178
„ 14. Tail-piece of *Pleuroxus reticulatus* × 265
„ 15. *Chydorus denticulatus* × 80
„ 16. Tail-piece of *Chydorus denticulatus* × 300
„ 17. *Chydorus clelandi* × 87
„ 18. Tail-piece of *Chydorus clelandi* × 335

NOTES ON EUCALYPTUS, No. VI.

(WITH DESCRIPTIONS OF TWO NEW SPECIES IN CO-OPERATION WITH MR. R. H. CAMBAGE, F.L.S.).

By J. H. MAIDEN, I.S.O., F.R.S., F.L.S.,

[*Read before the Royal Society of N. S. Wales, December 4, 1918.*]

[The arrangement of this paper is, as far as convenient, alphabetical. Two groups are, however, dealt with, viz., the *calycogona* group and the Stringybark group, which has compelled some difference in the arrangement. C.R. means my "Critical Revision of the Genus Eucalyptus."]

E. calycogona Turcz.
E. celastroides Turcz.
E. gracilis F.v.M.
E. normantonensis n.sp., Maiden and Cambage.

(In this Journ. XLIX, 323 – 327, I drew attention to *E. calycogona* Turcz. and its allies, and desire to make an additional contribution to the subject).

1. E. CALYCOGONA Turcz. See this Journ. XLIX, p. 323.

I have received excellent specimens from Bruce Rock, Merriden district, W.A. (Dr. F. Stoward, No. 18), Yeelanna and Butler, Eyre's Peninsula. S.A. (W. J. Spafford, No. 3). Diligent search has hitherto failed to find it in New South Wales, but I hope to find it in New South Wales just north of the Victorian Mallee country.

The leaves are decurrent, see plate 9 fig. D, C.R., Vol. I. This is also shown in the specimens of Mr. Spafford. This decurrence of the leaves should be compared with the decurrent seedlings.

I have compared the juvenile leaves (suckers) of *E. calycogona*, Parilla Forest, S.A., W. Gill, June, 1918, with those of *E. gracilis*, Karoonda, Hundred Hooper, S.A., W. J. Spafford, No. 19, and the only difference I can find is one of roughness, which appears to be referable to the more numerous oil dots in the leaves of *E. calycogona*.

Those of *E. gracilis*, Lake View, Griffith, N.S.W., W. D. Campbell, are almost identical with W. J. Spafford's No. 19. They are a little immature, but the outline and venation are the same as in the South Australian specimen. These observations alone show the close relations of *E. calycogona* and *E. gracilis*. In C.R., Part iii, p. 81, I have referred to the imperceptible gradations between var. *gracilis* (*E. gracilis* F.v.M.) and the angular calyx form (*E. calycogona*). Mueller indeed labelled typical *E. calycogona*, *E. gracilis*. In this Journ. XLIX, p. 324, I refer to an intermediate form, and add Euston to Mildura, V. (W. J. Brownscombe). But it seems so different in the angular flowers and fruits.

Fruits of *E. calycogona* (W. J. Spafford, Yeelanna and Butler, Eyre's Peninsula, S.A.) are the largest I have seen, and remind one of those of *E. Forrestiana* and *E. tetraptera*.

2. E. CELASTROIDES Turcz.

(*E. calycogona* Turcz. var. *celastroides* Maiden, C.R. iii, 79; Journ. W.A. Nat. Hist. Soc. iii, 168-9, 1911).

It is not certainly known from any State other than W.A. Certain W.A. localities are given in C.R. iii, p. 83, and I may add to them a number quoted in my "Journ. W.A. Nat. Hist." paper. To them may be added Yilgarn and Kellerberrin (both W. V. Fitzgerald).

I quote transit forms from S.A., this Journ. XLIX, p. 324, and the specimens quoted in C.R. iii, 83, from Vic. belong to *E. fruticetorum* F.v.M., as indicated, a species of which we know more than at that time.

The juvenile leaves of *E. celastroides* have already been described in my W.A. paper, where also will be found a tabular comparison of other points of that species and *E. gracilis*. I am sorry I have not been able to obtain seeds so as to describe the seedlings.

3. E. GRACILIS F.v.M.

(*E. calycogona* Turcz., var. *gracilis*, Maiden, C.R. iii, 81; this Journ. XLIX, 324).

Mueller always held the view that *E. gracilis* included *E. calycogona*, but the fact is, although there are connecting forms (see p. 487) they are really distinct. *E. calycogona* is the older name.

It would appear that there are two more or less defined forms—

(*a*) That of S.A., Vic. and N.S.W.

(*b*) That of W.A.

(*a*) *E. gracilis* F.v.M., (See copy of original description in C.R. iii, 81) came from the "desert on the Murray River" (we no longer look upon the "Mallee country" as desert), and whether from S.A. or Vic. territory we do not know. We have matched the type from both sides of the boundary-line. We have now collected from a number of localities, chiefly in South Australia.

(*b*) Let us turn to the W.A. form. I have given some notes, more or less referring to it, this Journ. XLIX, 324. For an account of the tree, and its juvenile leaves, see my description in Journ. W.A. Nat. Hist. Soc., iii, (Jan. 1911).

Comparing (*a*) and (*b*), there is some local variation in the width of the leaves. The broad-leaved form of (*a*) may have leaves as wide as those seen in (*b*), but the buds and fruits of (*a*) are larger and of a different shape. The fruits of (*a*) are more obconic, and the buds clavate—not cylindroid as in (*b*).

Speaking generally, we may say that (*b*) differs from (*a*) in the broader and thinner leaves, the longer and more slender peduncles and pedicels, in the less clavate, more cylindroid buds, and also in the uniformly smaller fruits, which have some tendency to be urceolate. Form (*b*) seems to be more uniform in character than (*a*).

I venture to look upon (*b*), or the W.A. form, as a variety, and therefore suggest the name *Yilgarnensis*, i.e. *E. gracilis* var. *Yilgarnensis* for it, following Diels, see C.R., iii, 82.

At present it seems to me that there is not sufficient evidence to keep (*a*) the N.S.W., V. and S.A. *gracilis* specifically apart from (*b*) the W.A. form. The W.A. plant attains a larger size than I have known the species to attain east of the Great Australian Bight, but it would appear that this is reasonably explained by assuming that the species has its *optimum* in the Western State.

The attention of our W.A. and S.A. friends may be invited to the problem, particularly in regard to variation in the species in eastern W.A. and western S.A. localities, when the whole matter can be reviewed.

As regards the juvenile leaves of *E. gracilis*, the branches are angular; leaves oblong to oblong-lanceolate, one to two and a half inches long, half to one inch broad, veins numerous, often distinctly trinerved, the intramarginal vein usually distant from the edge; occasionally one or two lateral veins almost parallel with the midrib as in the adult foliage, the smaller ones at an angle of about 60°, and again variously branched; lower petioles short, compressed, the upper ones more terete.

4. E. NORMANTONENSIS n. sp., Maiden and Cambage.

This proposed species has already been referred to twice in this Journ., viz., XLIX, 326-7, in which I looked upon it as an aberrant form of *E. calycogona* var. *gracilis.* The second occasion is in XLIX, 422, by Mr. R. H. Cambage, who collected the material both he and I provisionally described. He points out that it is probably referred to by Leichhardt, "Overland Expedition to Port Essington," p. 337, in words he quotes. It seems to us that it is worthy of specific description.

"Box"-arbores parvæ altæ pedes decem ad triginta, interdum aliquem de "Mallee" admonentes. "Box"-cortex in arboris trunco et ramis magnis. Rami superiores interdum leves et subvirides. Arbores localiter ut "Box" cognitæ.

Folia juvenilia.—In conditione immaturissimâ non visa, sed subglauca sunt, ramusculi angulares, folia lanceolata, exique petiolata, longa circiter novem cm. (tres uncias et dimidium) et 2-2·5 cm. lata, irregulariter pinnata, venæ secundariæ apud angulum 45° e mediâ costâ; vena intramarginata clare a margine denota.

Folia matura.—Lucide viridia, aliquanto nitida, contusa nullum oleiodorem dant. Angusta-lanceolata, pyramidata, speciatim in apice, directa vel aliquanto falcata, petiolata, ad decem cm. (quatuor uncias) et longiora, et plerumque infra unum cm. lata, viridia cum flavedine, utrobique color idem, cum multis inconspicuis fere pinnatis venis secundariis.

Flores.—Pedunculi aliquanto breves terminales in exemplis conducibilibus, in singulis umbellis circiter quinque ad septem flores aliquanto parvi. Gemmæ obtuse clavatæ, calycistubus gradatim pyramidatus in pediculum. Gemmæ sæpe alterius vel externi operculi vestigium gerunt. Operculum hemisphærium cum mucrone brevissimo, in longum circiter supremi calycis tubi trientem. Antheræ ut in *E. gracilis.*

Fructus—Fructus parvus, cylindraceus-urceolatus, circiter quatuor mm. longus et tres mm. latus. Ora angusta ab annulo stamines constante coronata, capsula profunde suppressa.

Typus.—R. H. Cambage, No. 3930 (fructifer).

Pauca millia passuum ad orientem et meridiem e "Normanton" (sinus "Carpentaria" civitas "Queensland") in formationem arenaceam et cretaceam calculos ferreos continentem.

Etiam in viam a "Normanton" ad "Cloncurry" inter rivos "Normanton" et "Flinders" occurrit.

Small Box-trees of 10 to 30 feet, sometimes suggestive of Mallee. Box-bark on trunk and large branches. Upper branches sometimes smooth and greenish. Known locally as "Box."

Juvenile leaves.—Not seen in the earliest state, but are sub-glaucous, branchlets angular, leaves lanceolate, shortly petiolate, up to say 9 cm. ($3\frac{1}{2}$ inches) long, and 2-2·5 cm. broad, irregularly pinnate, the secondary veins at about an angle of 45° with the midrib; intramarginal vein distinctly removed from the edge.

Mature leaves.—Bright green, somewhat shiny, give no odour of oil when crushed. Narrow-lanceolate, tapering, particularly to the apex, straight or somewhat falcate, petiolate, up to 10 cm. (4 inches) and more, and usually under 1 cm. wide, yellowish green, the same colour on both sides, with numerous not conspicuous almost pinnate secondary veins.

Flowers.—Peduncles shortish, terminal in the specimens available, each umbel with about five to seven rather small flowers. Buds bluntly clavate, the calyx-tube gradually tapering into the pedicel. The buds often carry the remains of a second or outer operculum. The operculum hemispherical, with a very short mucro, about a third as long as the ridge calyx-tube. Anthers as in *E. gracilis.*

Fruits.—Fruit small, cylindroid-urceolate, about 4 mm. long and 3 mm. broad. The narrow rim crowned by a persistent staminal ring, the capsule deeply sunk.

Type.—R. H. Cambage, No. 3930 (in fruit).

A few miles to the east and south of Normanton (Gulf of Carpentaria, Queensland), on a sandy cretaceous formation containing ironstone pebbles.

Also occurs on Normanton-Cloncurry road between Normanton and Flinders River.

Normanton (Ivie Murchie).

The description has been drawn up from Mr. Cambage's No. 3930, with the exception of that of the ripe bud and stamens in which Mr. Murchie's specimen has been used.

Affinity.

With *E. gracilis* F.v.M. It is closely allied to this species, but the leaves are of a different texture, and there is a sticky exudation in patches, the result of insect punctures. The juvenile leaves are broader and have a different venation to that of *E. gracilis.* There are no conspicuous oil-dots on the buds, as in the case of *E. gracilis.* The fruits, although very similar in shape to those of *E. gracilis*, are crowned by the persistent staminal rings as in some of the Ironbarks and Boxes.

J. E. Tenison-Woods[1] speaks of *E. gracilis* in Queensland, but we now know that most of the specimens to which he refers belong to *E. Thozetiana* F.v.M. Local observers might, however, inquire if those trees seen by him "on the dry sandy scrubs on the Burdekin River, not far from Charters Towers," refer to that or the present species.

The Stringybarks.

E. capitellata Sm.

E. Blaxlandi n. sp. Maiden and Cambage.

E. eugenioides Sieb., incl. *E. oblonga* DC.

E. macrorrhyncha F.v.M. and var. *brachycorys* Benth.

E. Muelleriana Howitt (*E. dextropinea* R. T. Baker).

E. lævopinea R. T. Baker.

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[1] Proc. Linn. Soc. N.S. Wales, vii, 337.

In many respects these plants form one of the most difficult groups of the Eucalypts. I have dealt with the subject at some length in C.R. viii, (1907). Since that time I have never ceased to give attention to the group, including study of various seedlings over long periods. I submit notes on some (not all) of the Stringybark species.

5. E. CAPITELLATA Sm. (1793).

The following specimens seem to call for special mention:

a. Middle Harbour, Port Jackson (J. H. Camfield, 29th May, 1897) See 4a, 4b of Plate 37. C.R. The juvenile leaves are often leathery in texture, cordate to orbicular, with a mucro.

This form seems to be dwarf, or at all events it does not grow into a large tree so far as has been noted. It includes my Round Mountain, Guy Fawkes specimens (collected 1893), and the Walcha and Deepwater specimens of Messrs. Cambage and Andrews, all from New England (see C.R., viii, pp. 214, 215).

Going south, this form seems to extend round the coast at least as far as Portland, Victoria (see figs. 8 to 10, plate 37, C.R.) and also apparently to the Mount Lofty Range, South Australia. It is to be noted that the young foliage may also be thinner and softer than the thick specimens which often attract the eye because of their coarseness.

b. A dwarf form (almost mallee like), foliage very scabrous in a young state (abundantly provided with stellate hairs) cordate, sometimes approaching orbicular, and never lanceolate in the young state. When young it irresistibly reminds one of *Angophora cordifolia.* When the leaves are small as well as young, they may remind one of those of a *Correa*, and indeed are striking looking. As the leaves mature, they become shiny on both sides, very coriaceous and oblong to broadly lanceolate, with a mucro, and with the edges recurved. *E. tetraptera* seems to have the most coriaceous leaves hitherto recorded, but some of these leaves are quite as thick.

This form has been found in the Hornsby-Berowra Creek (fresh water) district, thence to Willoughby and Middle Harbour (Port Jackson), and, going south of Port Jackson, at Heathcote and Waterfall. I am especially indebted to Mr. W. F. Blakely for notes and a perfect series of specimens from the Hornsby district.

The relations of (*a*) and (*b*) have not yet been fully worked out. They may be identical, and perhaps may be accepted as a type of the somewhat unsatisfactorily described *E. capitellata* Sm.

c. The Outer Domain, Sydney. See fig. 4a, plate 38. It will be seen that the juvenile leaves of this form are lanceolate with an almost absence of stellate hairs. In shape and in vestiture No. *c* differs from No. *a*. Specimens from Sutherland (J. L. Boorman, 16th October, 1918) in no way differ from those from the Outer Domain. The precise range of this form, which is a large tree, has not been worked out, because of the difficulty of getting juvenile foliage, or of raising seedlings.

(It is easy to omit some seedlings when one has to deal with a genus of over 200 species, and where, in some species, it has been found necessary to grow scores of seedlings, examining and depicting them in different stages over a series of years).

d. The Blue Mountains form (Blackheath, etc.). See pages 216 and 217, part viii, C.R., also fig. 3a, plate 38.

This is a large tree, and if we compare these specimens with Cox's River (Cambage and Maiden), also a large tree, we find juvenile leaves broadly-ovate to broad-lanceolate, shortly and distinctly petiolate, and that the Blue Mountains form has a precise replica in the Outer Domain juvenile leaves just referred to.

What I have provisionally called the Blue Mountains form includes 6a plate 38 (Hill Top), and also specimens from localities as far removed as Gippsland, Victoria, Wombeyan Caves, and New England, N.S.W., in which the texture of the young foliage varies from soft to harsh (and numbers of stellate hairs) according to age.

At the same time, these Blue Mountains juvenile foliage specimens resemble those broad-leaved ones of *E. eugenioides* (see p. 497) to some extent—sufficient to put one on one's guard.

e. We have also a form from New England chiefly, so far as collected, at Wilson's Downfall, Macpherson Range, Wallangarra, Armidale, etc. Also a large tree, which has broad-lanceolate up to orbicular juvenile foliage, (I have not seen any coriaceous), with buds as depicted on plate 37. The fruits are smaller than those of the type (*i.e.* are of the size of those of 1b, 4c, 8c, plate 38); sessile to pedicellate. The pedicellate fruits are mostly flat-topped, and with a smooth, distinct rim. The shape of these rimmed fruits may be seen in 1f, plate 38, but in that case the fruits are sessile, the series depicted under fig. 1, however, shows an amount of variation in a South Australian form which is repeated in the New England, N.S.W. specimens now under review.

6. Eucalyptus Blaxlandi Maiden and Cambage, n. sp.

It is evident that Nos. *a* and *b* (*E. capitellata*) are fundamentally different from Nos. *c* and *d*, which are conspecific. The latter are constituted a new species, and the name selected is in honour of Gregory Blaxland, who was leader of the first party to cross the Blue Mountains, where many trees of this species are to be found.

It has been described by Mr. Cambage and myself in Proc. Linn. Soc. N.S.W., Vol. xxx, 193 (1905); see also C.R., viii, 216, so there is no need for re-description.

We constitute as type, Blackheath, Blue Mountains (J.H.M., Jan. 1905) as being a conveniently accessible locality for obtaining material.

E. Blaxlandi has sometimes a blue cast of the leaves, *e.g.* Hill Top, N.S.W., p. 215, part viii, C.R., Eden, etc., and hence it sometimes goes under the name Blue Leaf Stringy-bark. This bluish cast is often observed in dried specimens of young growth from various localities. This blue cast is also seen in *E. lœvopinea.*

The flower buds are in the Port Jackson district (the type locality) very angular, and this angularity is very common in the species, but even in that district, and frequently elsewhere, they may lose their angularity more or less, and even become clavate. There is also some variation in the size and amount of exsertion of the valves of the fruits.

7. E. EUGENIOIDES Sieb. (1825).

A good deal of uncertainty and confusion has arisen around this species, partly because of the wide variation in the juvenile foliage. Fig. 2a, plate 40, represents a portion of the type, but we may have it narrower (see 1a, plate 39), or broader (1b, plate 39, or 10a, 14a, 18a, plate 40). The very remarkable narrow, sometimes almost linear, juvenile leaves, seen in this species are very striking, and are so often seen in *E. eugenioides* that they have got to be looked upon as typical (somewhat similar leaves are seen in plate 1, C.R. in *E. pilularis*), and juvenile foliage which can by no means be looked upon as narrow, has been considered aberrant, whereas the extremely narrow leaves are probably themselves aberrant, since they are usually seen in crowded branches. We are beginning to learn that juvenile leaves are as variable as any other organ, and *e.g.*, the variation in *E. viminalis* is quite considerable.

The young foliage of *E. eugenioides* is markedly crinkly, and abundantly furnished with stellate hairs. But those of the seedlings are rarely narrow; they are usually of medium width, that is, approximating to that of fig. 2a (plate 40) already referred to. The young leaves of *E. eugenioides* are also variable in regard to length of petiole, often being sessile or nearly so.

The strikingly narrow young foliage is common in New South Wales on the southern sandstone, say from Hill Top and the Upper Nepean and Nepean generally, through Burragorang to the Blue Mountains and the Sydney district. Going north, we have it in the coastal districts at least as far north as the Hastings, and climbing to New England, in many cases getting broadish.

The broadish forms are common in Victoria (Gippsland) and in New South Wales in the coastal area at least as far north as Conjola, then west to Wingello. It occurs from Port Jackson to the Hawkesbury, but also may be narrowish. The broad form is common in New England, but some Glen Innes specimens are also narrowish. The broad form extends to Queensland, *e.g.* Stanthorpe and Nerang. The narrow leaved forms appear to be commonest in poor, rocky, soil, but the matter requires further investigation.

The Blue Mountains form of *E. Blaxlandi* has juvenile leaves, in a certain stage, sufficiently similar to the broad juvenile leaves of *E. eugenioides* just referred to, to put one on one's guard. Speaking generally, the seedlings of *E. Blaxlandi* are less crinkly (undulate), and less hairy, than those of *E. eugenioides;* they are also less petiolate.

E. oblonga DC., see p. 234, part viii, C.R., also figs. 6 and 7, plate 40, is a coriaceous leaved, angular-budded, nearly sessile, globular fruited form, commonly, though by no means invariably, found in elevated and exposed situations. It seems to me an environmental form of *E. eugenioides.* I have already referred to *E. oblonga* in Vol. XLVII, p. 229.

For *E. ligustrina* Sieb., hitherto looked upon as a form of *E. eugenioides*, see p. 503.

8. E. MACRORRHYNCHA F.v.M. (1853).

The juvenile leaves have stellate hairs, but their shape is more lanceolate than those of *E. capitellata*, the species it most closely resembles. The branches are sometimes withy-like. The buds are clavate and shiny in var. *brachycorys*, or as we approach New England, N.S.W.

The fruits vary in shape from hemispherical to conoid. The rim may be sharp as in the type, or domed, or the fruit may be nearly spherical. The valves of the capsule may be in threes, but by no means invariably so.

Var. *brachycorys* Benth. See C.R., part viii, p. 226.

The readiest character of this variety appears to be the clavate, shiny bud; the leaves also are shiny and markedly veined, indicating exposure. The fruits vary from sharp rimmed to a rounded dome, and the rim may be quite broad.

It seems to be mainly confined to New England, *e.g.*, Bluff River, Torrington, or Emmaville, Nundle and Hanging Rock. The other localities quoted by me at p. 226 do not appear to be correct.

9. E. MUELLERIANA Howitt (*E. dextropinea* R. T. Baker).

See plate 2, C.R., for figure of type.

The width of the rim and the extent of exsertion of the valves alike vary. So far as morphological characters are concerned, I have collected fruits of both *Muelleriana* and *lævopinea* from the same tree at Barber's Creek, N.S.W. Some of the figures of fruits in plate 4, C.R., have since been proved not to belong to *E. pilularis.*

E. Muelleriana, while most commonly called Yellow Stringybark, often also goes under the name of White Stringybark, apparently through laying stress on the weathering of the bark.

The seedling-leaves are longer-lanceolate than those of *E. macrorrhyncha*, are stem-clasping, and with stellate glands rather than stellate hairs. This species is, as regards seedlings, close to *E. pilularis*, as indeed the fruits also show. It sharply differs from *E. eugenioides* in the seedlings.

10. E. LÆVOPINEA R. T. Baker (1898).

This is a species with clavate, shiny buds, and commonly a flat, nearly horizontal rim, but with perplexing relations to *E. Muelleriana*, *E. eugenioides* and *E. macrorrhyncha*.

It seems, in its approximately typical form, to be confined to the northern parts of N.S.W., *e.g.* Rylstone, Upper Hunter, Liverpool Range, Counties of Hawes and Pottinger, Nundle, southern New England.

In its typical form it is large-fruited, but smaller-fruited forms are found over a wider range. A smaller fruited form has been given by Messrs. Baker and Smith the variety name of *minor*, but it is quite impossible to separate this from *E. eugenioides*. The form with the non-exsert valves to which they have given the name *E. Wilkinsoniana* cannot be separated from *E. lævopinea*, even as a variety. Great acquisitions have been made to the National Herbarium during the last few years, and some forms have disclosed an amount of variation which was not thought possible at one time. I am of opinion that the Stringybark species are variable to an extent not exceeded by any other group of Eucalypts. The remarks made by me in regard to var. *minor* and *E. Wilkinsoniana* in C.R., viii, p. 221, were written thirteen years ago, and, having been carefully re-examined with vastly additional material, seem to be true now.

Messrs. Baker and Smith ("Research on the Eucalypts" 1902) state that the oils of *E. lævopinea* and *E. Wilkinsoniana* differ in the presence of eucalyptol in the latter, and in other details. I cannot trace any modification of this statement, and I challenge the general truth of it as regards the oils of say half a dozen trees reputed to be *E. lævopinea* and *E. Wilkinsoniana* respectively.

11. E. CORRUGATA Luehmann. See C.R., part xvi, p. 198.

Mr. Walter Gill recently collected this Western Australian species near Kalgoorlie, which increases its range somewhat, since it was previously only known from the vicinity of Southern Cross.

He also obtained juvenile foliage, hitherto unknown. The single specimen is very glaucous, and the rhachis quadrangular. Leaves decussate, stem-clasping, the midribs slightly decurrent, thin, equally glaucous on both sides, oblong or elliptical to oblong-lanceolate, with a short mucro, small, say 5 cm. (2 inches) by 3 cm. ($1\frac{1}{4}$ inch) long. These juvenile leaves remind one of those of the *E. globulus, Maideni, goniocalyx* group.

12. E. GOMPHOCEPHALA DC. See C.R., part xxi, p. 19.

This species, which is mainly coastal in Western Australia, goes by the name "Tuart," which is, as far as I am aware, exclusive at the present time. Old spellings are "Tewart" and "Too-art."

I have come across some interesting references, which show a name for the York Gum, *Eucalyptus fœcunda*, so close to Tuart as to be something more than a coincidence, and perhaps those West Australians who study aboriginal names may be able to explain what is the connection between them.

Captain Lort Stokes in his well-known work speaks of the York Gum as abundant in York on good soil, and adds that the native name is "To-art." Just about the same time, that is to say, at the end of the thirties, Drummond writes to Sir J. D. Hooker in the London Journal of Botany ii, 359, as follows:—"The Eucalyptus, found on the sandy loam, is called by the settlers York Gum, by the natives Doatta; they use the bark of the root as food in the dry season, chewing it along with the gum of the Manna (The Manna is an Acacia which produces a large quantity of gum in the dry season. Common in the valley of the Avon. *Acacia microcarpa*)."

I have no doubt in my mind that "Doatta," "To-art," and "Tuart" were intended by the blacks for the same class of tree. Perhaps they gave the name originally to the York Gum, and afterwards the white man fixed it on to the modern "Tuart."

13. E. GRANDIS (Hill) Maiden, n. sp.

Ex. Walter Hill in "Catalogue of the Timbers of Queensland," (Lond. Exh. 1862), p. 25. See also C.R., xxiii, p. 58, with pl. 100, figs. 8 – 13.

Syn. *E. saligna* Sm. var. *pallidivalvis* Baker and Smith, "Research on the Eucalypts," p. 32 (1902).

This is the "Flooded Gum" of coastal New South Wales and Queensland, referred to also in my "Forest Flora of New South Wales," i, 79. I have come to the conclusion that it is worthy of specific rank, and although the original description is very imperfect according to modern standards, the fuller descriptions by Messrs. Baker and Smith and myself leave no doubt as to the identity of the species. It occasionally goes under the name of "Blue Gum." I have a brief note as to distribution in this Journal, LI, p. 456.

It was collected by George Caley in the Sydney District, (probably somewhere about the Hawkesbury) in 1800 – 1810, 59 being the British Museum number of specimen kindly presented by Dr. A. B. Rendle, F.R.S. Messrs. Baker and Smith record it from Barber's Creek, in the Goulburn district, N.S.W., which is much the most southerly locality recorded. By far the most northerly locality is that of the following, sent by Mr. District Forest Inspector H. W. Mocatta from northern Queensland. "Flooded Gum.—Near Atherton and throughout northern table-lands; found principally in high country on scrub fringes, very tall, straight barrel of large girth, carries black scaly bark from 10 to 15 feet upwards from butt, thence upwards a white smooth bark, continually shedding outer bark in long festoons from branches downwards."

The specimen referred to under *E. saligna* in B. Fl., iii, 245, as "Richmond River, (Beckler)" is *E. grandis*.

It is cultivated in Algiers, North Africa, under the name of *E. botryoides* var., according to a specimen I received from Dr. L. Trabut, No. 110, in 1904.

Var. GRANDIFLORA var. nov.

Many species have a large fruited form, and it appears to me that *E. grandis* is one of these. Fruits cylindroid, slightly urceolate, 1 cm. long, 8 mm. broad, calyx-tube usually with one marked rim tapering into the flattened pedicel. Peduncles 2 – 2·5 cm., flattened. The fruits glaucous, valves slightly exsert. E. H. F. Swain, Carinda, near Woolgoolga, N.S.W., No. 47, associated with Blue Gum, Ironbark and Apple (Sept. 1905).

This is identical with or closely allied to (1) Bulladelah, N.S.W. (A. Murphy, Jr., June, 1911); (2) "Rough bark up to limbs, but not Bangalay *(E. botryoides)*," Green Point near Gosford, N.S.W. (A. Murphy, July, 1910).

This proposed variety requires further investigation. It has red timber, and varies in regard to the amount of rough bark on the butt. It has affinities both with *E. robusta* Sm. and *E. Kirtoniana* F.v.M.

14. E. INCRASSATA Labill. var. See C.R., iv, pp. 97, 105.

Mr. J. T. Jutson has sent from Comet Vale, 63 miles north of Kalgoorlie, W.A., under No. 116, flowering twigs with the operculum nearly hemispherical, and produced into a very long narrow terete process, giving it a remarkable appearance. The bases of the filaments are pink as is the case in many species. The plant has fruits which are intermediate in form between those of var. *angulosa* and the normal species.

In view of the profusion of names given to forms of *E. incrassata*, it may not be desirable to add to them.

15. E. LIGUSTRINA DC. Prod., iii, 219.

Syn. *E. eugenioides* Sieb. var. *nana* Deane and Maiden, Proc. Linn. Soc. N.S.W., p. 799, with plate xxxiii (1898). See also C.R., viii, 234.

Since the statement in C.R., was made, I have obtained additional material of *E. ligustrina* type (in bud and leaf), and of *E. eugenioides* var *nana*, and am unable to distinguish the former from some of the latter, our knowledge of the latter enabling us to practically complete the life-history of the species.

The original description of *E. ligustrina* would have been inadequate except for the herbarium specimens, imperfect as they are. *E. ligustrina* is the adult form of that which was mainly depicted in the juvenile form in *E. eugenioides* var. *nana*.

To the description of *E. eugenioides* var. *nana* (*loc. cit.*) it may be added that the seedlings of *E. ligustrina* are on a diminutive scale as compared with those of *E. eugenioides*, but display an affinity with that species; indeed the nearest affinity of *E. ligustrina* is to *E. eugenioides*.

I match a specimen, Lawson, Blue Mountains (J. H. Camfield, April 1897) quite satisfactorily with the type of *E. ligustrina*, and it has fruits which connect it with those of the type of *E. eugenioides* var. *nana*. Mr. A. A. Hamilton, King's Tableland (home of the type of the latter) has shown that it attains a height in that locality of fifteen feet, and that it is a stringybark. Its size is obviously a question of shelter.

In C.R., viii, 234, it will be observed that the species extends to West Dapto, about sixty miles south of Sydney (R. H. Cambage). Some of the adult leaves from both Dapto and the Blue Mountains show that the name *ligustrina* (*ligustrum*-leaved) has some appropriateness.

16. E. LONGICORNIS F.v.M. (Syn. *E. oleosa* F.v.M. var. *longicornis* F.v.M.)

Following is a translation of the unsatisfactory original description:—

"*E. oleosa* var. *longicornis* (*E. longicornis* F. M., coll.), includes a tree well known in Western Australia under the name of 'Morrel.' It attains a height of 120 feet, and has a rugose ash-coloured bark (Rhytiphloiæ) on the trunk, persisting to the branches. It grows interspersed amongst *E. loxophleba* (*fœcunda*) and *E. salmonophloia*, showing affinity in bark to the former and in foliage to the latter. It is nearest to *E. oleosa*, and may perhaps be a variety of it, but it differs in the size of the tree, in the lustre and length of the leaves, the greater length of the peduncles and pedicels, and in the elongated operculum. The characters which separate it from *E. salmonophloia* are the persistent bark, the operculum, longer and more acute, the slender style and the distinctly larger fruits." (Fragm., XI, 14, 1878).

In his "Forest Resources of Western Australia," (1879) Mueller figures *E. longicornis*, but at p. 12, in referring to Fragm., XI, 14, says "It is needless to devote to this Eucalypt a special description, as most probably it constitutes a mere variety of the preceding *(E. oleosa)*. It differs, however, in its comparatively tall stature, attaining a height of 120 feet, and perhaps more," and he repeats the differences from *E. fœcunda* and *E. salmonophloia*, already given.

In "Eucalyptographia," under *E. oleosa*, Mueller says, "In Western Australia occur several kinds of trees, the precise relation of which to *E. oleosa* is not yet clearly understood; they are the Morrell, *E. longicornis* (he adds *salmonophloia*, *salubris*, *leptopoda* and *decipiens*)......All attain a height of about 100 feet (*E. leptopoda* certainly does not, and I have my doubts as to some of the others.—J.H.M.), and *E. longicornis* may only be the favourably developed arboreous state of *E. oleosa;* its bark is totally persistent, the foliage is like that of *E. salmonophloia*, the lids are horn-like elongated, which suggested the name, and outer stamens are straight in bud."

So far as I know, this is the last statement Mueller made in regard to *E. longicornis*, and he omitted the name from his Census.

In C.R., part xv, 166, and at figs. 4 and 5, plate 66, I have referred to this tree, and have suggested the identity of this particular Morrel with the Poot, also of Western Australia.

I am now of opinion that Mueller's *E. longicornis* is sufficiently distinct from *E. oleosa* to be considered a species, and therefore I recommend adoption of the name. The species has been sufficiently characterised, although Mueller did not describe it as formally as he would have done, had he been more certain of it. The size, the bark, the timber and other botanical points, show sufficient differences.

I leave *E. oleosa* var. *glauca* Maiden, the Morrel of eastern W.A. (see C.R., xv, p. 172) for a subsequent note.

17. E. MACROCARPA Hook. See this Journal, LI, 451.

A branch in the Botanic Gardens, Sydney, collected by Mr. W. F. Blakely, 26th July, 1918, has in its upper portion, distinctly alternate leaves (remaining stem-clasping), although above and below the leaves are distinctly opposite. This branch, and others, also show very distinctly the decurrence down the stem of a ridge starting from the midrib of the leaf.

18. E. MICRANTHERA F.v.M. See C.R., xx, 308.

This excessively rare and imperfectly known Western Australian species has been sent to me by Mr. H. P. Turnbull of the Alexander River, about half way between Esperance and Israelite Bays, on the south coast.

Unfortunately he was unable to recognise the specimen, and so to say the exact spot where he collected it, and thus obtain more material, but he has obtained fruits, (unfortunately the seed had all dropped out), and these, being new to science, may be described as follows:—They are hemispherical in shape, and about 7 mm. in diameter, shining, with one moderately prominent angle. The pedicels short and flattened, supported by a flattened peduncle of twice the length. The rim horizontal or slightly rounded, the teeth of the calyx flush with the rim or slightly exceeding it.

E. micranthera certainly resembles *E. cneorifolia* DC., in the narrowish leaves and sessile inflorescence. The peduncle of *E. micranthera* is broader and more compressed; the fruits are very similar in both species, but the anthers are smaller in *E. micranthera* and the filaments broader and more yellowish, or yellowish-green. The leaves of *E. micranthera* have longer petioles and are somewhat broader.

19. E. PACHYPHYLLA F.v.M., Journ. Linn. Soc., iii, 98 (1859).

In Ewart and Davies' "Flora of the Northern Territory," p. 306 (1917) I indicated that I believe this is a valid species, and that my *E. pyriformis* Turcz., var. *minor*, C.R., ii, (Part xvii) 232 and 235, should merge in it. I desire to draw attention to this species, which is in some confusion.

At p. 232 I give a literal translation of the original description (by the way, *orgyalis*, which then puzzled me, means length of a fathom). Flowers were unknown, the fruits (in threes) are carefully described, peduncles and pedicels very short. The affinity was given to *E. alpina.*

Bentham (B. Fl., iii, 237) then described the species, but he pointed out the inadequacy of the material, and even doubted if it should be given specific rank. In Fragm. x, 5 (1876) Mueller recorded it from Glen of Palms, Macdonnell Range, Northern Territory (E. Giles), and described the flowers (5 – 7 and nearly sessile) for the first time. He indicated its true affinity to *E. pyriformis.*

Mueller then figured the species in his "Eucalyptographia," and, as usual, he missed the opportunity of figuring the type. The localities he quotes are, with one exception, those of the type and of Giles. The exception is Lake Amadeus. At p. 233 of my C.R., I have already pointed out that he figures a pedicellate form, which is nearest in shape of the fruits, though not in number in head, to my fig. 7b, plate 75.

Mueller's type does not appear to be in existence, but Nos. 5 and 6 of my plate are probably very close to it. So are Nos. 147 and 361 of the specimens referred to by me in Ewart and Davies' "Flora," but those of 371 have larger fruits, with longer pedicels.

From Tanami, western Northern Territory (Dr. H. I. Jensen, No. 206, 1914) I have received both *E. pachyphylla* (resembling No. 371) and a small flowered *E. pyriformis* under the same number, and undoubtedly the species are closely related.

Mueller's "Eucalyptographia" plate of this rare species is misleading to the extent that it will cause most people to think that it correctly depicts his *E. pachyphylla*. As a matter of fact, it shows a multiflowered, pedicellate form. To put botanists on their guard, I consider it desirable to indicate the plant figured by Mueller as var. *pedicellata*.

20. E. PYRIFORMIS Turcz., var. KINGSMILLI var. nov.

A shrub, or small tree attaining a height of about 20 feet, with rough bark on the trunk, the upper branches being smooth. The crimson flower-buds give the tree a most ornamental appearance.

Known from the East Murchison to Lake Way, Western Australia. The type from close to a mining camp called Mount Keith, about 160 miles north of Leonora (W. Kingsmill, July, 1918).

Juvenile leaves (not seen in their earliest stage, *i.e.* not quite opposite, but earlier than I have ever seen them in any form of *E. pyriformis*), narrow-lanceolate, say 4 – 6 cm. long and 1 cm. in the widest part, with petioles of about 1 cm. Equally pale green on both sides, venation not conspicuous, the secondary veins at an angle of about 45° with the midrib.

Mature leaves apparently not different from those of the normal form of *E. pyriformis*.

Flowers in an umbel usually of three, with a rounded or flattened peduncle of about 4 cm., with pedicels of half that length. Anthers as in *E. pyriformis*. Buds with calyx-tubes nearly hemispherical and about 2 cm. in diameter. The operculum continued into an almost pungent point. Both calyx-tube and operculum covered with about eight thin prominent wings, about 4 mm. deep, giving the buds a remarkable appearance. The style about 1·5 cm. long, persistent, with the stigma of scarcely increased diameter.

Disc at first concave, with a sharp raised inner ring flush with the top of the calyx-tube, which continues to grow upward, and at the same time expanding outwards, completely absorbing the concave cavity (noted in the early stages of its growth), until it reaches a height of 3 – 4 mm. above the level of the truncate calyx rim.

Fruit nearly hemispherical, 2·5 cm. in diameter, with eight prominent wings; these and the remainder of the calyx-tube (calycine rim) raised about the staminal ring.

This bizarre and showy variety, which promises to be an interesting addition to gardens in semi-tropical districts of low rainfall, is named in honour of the Hon. William Kingsmill, M.L.C., who has for many years taken a most active interest in forestry matters in Western Australia, and who has frequently assisted my botanical work for that State.

E. PYRIFORMIS Turcz. var. ELONGATA Maiden, C.R. xvii, 235.

Mr. C. A. Fauntleroy of Uberin Hill, Dowerin, W.A., sent some specimens of the above through Mr. W. C. Grasby, with the following useful note:—

"Both pink and white (or cream) flowers grow together. In one instance I found both colours on one bush, but the rule is separate plants for cream, pink and almost crimson. A large patch that I visited had scarcely a plant that was eight feet high, oftener three to four feet, and a quantity less than knee high was blossoming. It is a difficulty to find a straight stick among it; each plant has a number of crooked little stems. While the pink ones generally seem to have a browner bark and shorter stem to the nuts (fruits), I could not say they were hard and fast rules, for an opinion formed at one bush was contradicted at the next. They are growing on open plain on yellow sand, grey sand and gravelly, with, I think, clay not very far below the surface; sand-plain pear trees (*Xylomelum*, J.H.M.) are also growing on the same ground. There is some of this Mallee near the railway, west from Dowerin, but I got these specimens about sixteen to eighteen miles north of Dowerin."

21. E. SIDEROXYLON A. Cunn. See C.R., xii.

The fruits are usually as figured at plate 55, but I have received from the Forestry Commission from near Eden, N.S.W., fruits as large as those of the related *E. leucoxylon* F.v.M. var. *macrocarpa* J. E. Brown, figured at 12c, pl. 56.

22. E. STOWARDI Maiden. This Journ. LI, 457.

Some excellent specimens from Mr. C. A. Fauntleroy, Uberin Hill, Dowerin, W.A. (through Mr. W. C. Grasby), not only give an additional locality for a rare species, but enable me to indicate its affinity.

At p. 460, I surmised that its closest affinity was *E. occidentalis* Endl., and these specimens leave no doubt on the point. They have the angular filaments seen in that and allied species, and peculiar, I believe, to the Cornutæ. Mr. Fauntleroy also supplies a small log, which is quite smooth, with long, thin tough ribbons, and barely two inches in diameter for the most part, though where it is swollen, as the result of the boring of an insect, it is more than three. The colour of the small timber is white, varying to pale brown in the centre.

23. E. VIRGATA Sieber. Syn. E. LUEHMANNIANA F.v.M.

Consequential changes will be that, as far as the synonymy proposed in the monograph of the species in C.R. ix, 273, is concerned, *E. obtusiflora* DC., *E. stricta* Sieb., and *E.*

fraxinoides[1] Deane and Maiden (see also this Journal XLVII, p. 235) are recognised as valid species, while *E. virgata* var. *triflora* Maiden, is proposed as a variety of *E. stricta*. For a note on the distribution of *E. Luehmanniana*, see this Journal LI, 450.

For a history of *E. virgata*, see C.R., ix, p. 275, and the following notes.

G. Don ("Dichlamydeous Plants," ii, 818) translated the original description as follows:—

"*E. virgata* (Sieb. *pl. exsicc. nov. holl.* No. 467), lid of calyx conical, length of the cupula (calyx-tube); peduncles axillary and lateral, hardly longer than the petioles, and are 2-edged, as well as the pedicels; leaves oblong-linear, acuminated at both ends, thickish, coriaceous and nearly veinless. Native of New Holland. Leaves 4 – 6 inches long and about 6 – 9 lines broad. Twiggy Eucalyptus Tree.'

Then Bentham, in B. Fl. iii, 202 (1866) compiled a new description of *E. virgata*, speaking of it as "A tree of considerable size, with a furrowed persistent fibrous bark." (Oldfield).

He also, *inter alia*, adds a description of the fruit for the first time, "narrow pear-shaped," with other details of the fruit. (Sieber did not collect the fruit).

Let us now examine the material he attributed to *E. virgata*. I find that it consists of three species, viz.:—

1. Sieber's No. 467, which, says Bentham, came from "Port Jackson or Blue Mountains." This is *E. virgata* Sieb.

[1] This species is only found on the crowns or highest points of the Main Dividing Range, Tallanganda State Forest, between Braidwood and Queanbeyan (C. Weston). W. A. W. de Beuzeville, sending it from Parker's Gap, in the same district, says it is known locally as "White Mountain Ash." "Most highly prized of all local timbers. Has a rough, non-fibrous bark, extending about 5 – 8 feet up the stem, when the bark becomes quite smooth and white."

2. The remainder of the New South Wales specimens quoted by him, and also the Victorian ones from Sealer's Cove (the collector should be *Walter*, and not *Walters*). These all belong to *E. Sieberiana* F.v.M., one of the trees called Mountain Ash.
3. The South Australian specimens, which are *E. vitrea* R. T. Baker, as I shall show at p. 517.

In Spicer's "Handbook of the Plants of Tasmania," p. 149 (1878) we have "*Eucalyptus sp.* Ironbark, George's Bay. (Perhaps identical with *E. virgata* Sieb.)"

Then Mueller ("Eucalyptographia" Decade 2, 1880) describes his *E. Sieberiana* to include Spicer's plant, and gives *E. virgata* as a synonym. Like Bentham he includes three species, and the same three, for his Lake Bonney and other South Australian species are *E. vitrea*, while he takes the "Yowut" or Mountain Ash as his type.

Erroneously assuming that the name *E. virgata* is "very misleading, because only under very exceptional circumstances (he has, as 'exceptional circumstances' probably the South Australian specimens in his mind's eye), is this usually tall timber tree reduced to a virgate and twiggy state," he took the high handed step, not unfamiliar to him, of suppressing one properly constituted botanical name and substituting another.

He subsequently, however, considered *E. virgata* to be a synonym of *E. stricta* Sieb., which is not in accordance with fact. See Decade 10, "Eucalyptographia," (1884). *E. virgata* as a specific name was, however, ignored by Mueller until the publication of the second Census in 1889, in which also *E. stricta* appears.

If we again turn to Decade 10, we find under *E. stricta*, both *E. virgata* and *E. Luehmanniana* F.v.M. appearing as synonyms of *E. stricta*, in the second page of the text "the variety *Luehmanniana*" of *E. stricta* being referred to in the following passage, "But the real *E. virgata* does undergo a development in another direction, enlarging to that startling state which was distinguished as *E. Luehmanniana.*"

In other words, Mueller suppressed *E. virgata* twice, placing it under *E. Sieberiana* and under *E. stricta.* But he brings it forward again in his *Second Census*, giving only the reference Fragm. xi, 38, which was earlier than that of the "Eucalyptographia," Decade 10, which is the last known comment by him on the synonymy.

His *E. Sieberiana* is accepted (as a new combination) because we selectively choose the Mountain Ash as the type. Mueller makes precisely the same number of mistakes as Bentham did, but the latter employed the name *E. virgata*, which we must read *sensu strictu.*

Figures 1 and 2 of plate 43, C.R., are what they purport to be, the type, together with a modern specimen of *E. virgata.* Figures A and B of plate 94 of my "Forest Flora of N.S.W." depict a larger specimen of figure 2, above, and are from the same source.

Turning to my remarks on the range of *E. virgata* in C.R., part ix, p. 281, the notes on the three trees may be supplemented as follows. Including the previous specimens, I have now perfect suites of all three.

(a), (b) and (c). Messrs. W. F. Blakely and J. L. Boorman visited the spot on 24th August, 1918, and matched the following from the same clumps of plants. Mr. Blakely's words are "Mallee-like shrubs, or sometimes reduced to two stems. Ten to twenty feet high. Timber very hard. Branches almost slate blue; occasionally mottled brown. Young tips conspicuously bright yellow against the glaucous green of the adult foliage."

I again refer to these Spit plants at C.R., ix, 287, under *E. Luehmanniana*, and at plate 44, figs. 6h, 6k and at p. 290 again refer to the affinity of *E. virgata* and *E. Luehmanniana*. My additional investigation of these Spit plants has shown that these specimens, attributed to *E. virgata*, are conspecific with *E. Luehmanniana*. My interpretation of *E. virgata* in C.R. was not wrong; it was too narrow, and should have been extended to include *E. Luehmanniana*.

I believe I have now cleared up a difficult piece of synonymy, which was rendered more difficult in regard to the critical problem of matching the type, owing to the fact that, in the vicinity of the Spit, *E. virgata* and *E. obtusiflora*, which simulate each other somewhat, were intermixed, but Messrs. Blakely and Boorman have kept the specimens from every individual plant distinct.

E. Luehmanniana F.v.M., Fragm. xi, 38, came from (translation) "sandy-stony tableland about 2000 ft. high, eight English miles towards the north from the Bulli District, very rare among ferruginous gravel. W. Kirton." This is practically the southern part of the National Park, the best known locality for the species.

I have a fragment of the type (leaf and buds only) labelled by Mueller "*Eucalyptus virgata* Sieber, Bulli, W. Kirton." I have compared it with Sieber's No. 467, and can see no difference. I do not doubt that it is typical for *E. Luehmanniana*. Mueller, as the description shows, had ampler material than I have seen.

Messrs. Baker and Smith (Proc. Roy. Soc. Tas., 1912, pp. 56-8) make a literary excursus of over two pages, in which they discuss *E. virgata* and *E. Sieberiana*, arriving at the conclusion that the Tasmanian tree is different to the New South Wales and Victorian one, the former being *E. virgata* and the mainland one *E. Sieberiana*, and thus introducing a new hypothesis. It is evident that they have seen neither the types nor the specimens seen by the authors they quote, but they arrive at the following two conclusions :—

1. *E. virgata.* "Sieber's specimens no doubt belong to the dwarf tree or 'Mallee'" (of the Blue Mountains). "If this is correct......we accept Sieber's name for the mountain shrub which has identical morphological characters with *E. Sieberiana* F.v.M." In other words, *E. virgata* is identical with the Mountain Ash. They go on to say "The discovery, or rather the identification botanically and chemically with the mainland one is of scientific interest, for whereas the latter, as far as known, is only a Mallee on the Blue Mountains in New South Wales, in Tasmania it is a medium-sized tree."

Commenting on the etymology of *virgata*, they go on to say that "the name is very appropriate, for the Blue Mountains specimens are all 'twiggy or virgate,' and the bark of the Tasmanian tree is 'streaked or striped,' for the hard, compact bark runs down in streaks or ridges."

2. The name *E. Sieberiana* must now be deleted from the flora of Tasmania (*op. cit.*, p. 58).

* * *

As a matter of fact, *E. virgata* is synonymous with *E. Luehmanniana*, which has not yet been found on the Blue Mountains, while *E. Sieberiana* is a New South Wales, Victorian and Tasmanian tree, as stated by Mueller in the original description, and he expressly states that it is found in the Blue Mountains.

E. ambigua DC. See C.R., Part vi, p. 158, and Part ix, p. 278.

It may be that some of the specimens referred to it belong to *E. nitida* Hook. f., but the "fourth cultivated specimen" referred to, so resembles Port Jackson specimens of *E. Luehmanniana* and *E. obtusiflora*, as to be worthy of a passing reference.

The seedlings of *E. virgata* from the Spit and elsewhere (including typical *Luehmanniana* from the National Park), are identical; they also are identical with those of *E. virgata* var. *altior* (*E. Luehmanniana* var. *altior* = *E. oreades* R. T. Baker). The above all show glaucous plants when they are a few inches high. In their young stages they resemble those of *E. obtusiflora* DC. a good deal, but the latter form yellowish-green seedlings at a few inches high. Space will not allow my dwelling on the matter of seedlings on the present occasion.

24. E. VITELLINA Naudin, "Descr. et emploi des Euc. introd. en Europe," Antibes (France), 1891, p. 65, and E. VITREA R. T. Baker, Proc. Linn. Soc. N.S.W., xxv, 803, (1900) with plate xv.

In my C.R. vi, 164 – 167 (1905), I drew attention to the fact that Naudin looked upon his species as a natural hybrid between *E. coriacea* and *E. amygdalina*, a point I emphasised at p. 167 as regards *E. vitrea*. Without suggesting hybridism, the original description draws attention to the affinity of the new species to the two species named. I refer to the *vitellina-vitrea* question in C.R., vii, p. 189.

In my "Forest Flora of N.S.W.," part 23, plate 86 (1906), I figured *E. vitrea* from such material as was available to me at the time, and both here and in some of the illustrations at pl. 34, C.R., broader leaved forms were shown than in Mr. Baker's original drawing of the type.

The type of *E. vitrea* came from New South Wales (Crookwell, Bungendore, and Marulan). In my C.R. (see also Explanation of Plates) and Forest Flora, I added a number of New South Wales localities with more or less diffidence, because of the variation in a then very little-known species, extending its range to Sutton Forest near Moss Vale, northward (since to near Wombeyan Caves, R. H. Cambage and J.H.M.) and to near the Jenolan Caves, westward (R. H. Cambage), and to Delegate, on the Victorian border (W. Baeuerlen).

I also drew attention to its occurrence in Victoria, and besides the localities cited, now give Narre Warren, near Dandenong (J. Staer); Sandhills near Stradbroke (A. W. Howitt), and "Height 10 feet," Portland (H. B. Williamson).

But it is through Mr. Walter Gill, Conservator of Forests of South Australia, with whom I have been in correspondence at intervals since 1905 in regard to this species, that I have obtained many specimens (showing the extent of its local variation). He speaks of it as "a stunted form of weeping habit, known as 'Messmate' by the local people (the original *E. vitrea* was described as 'White-topped Messmate.'—J.H.M.)

"Grows in low-lying country, lying under water in winter, Penola Forest Reserve, Penola, 20 miles north of Mount Gambier, not far from the Victorian border."

Quite recently I have received it from the same district from E. S. Alcock through J. M. Black :—"Trees, average height 15 – 20 feet, some trees growing erect, but many of them more or less drooping, and more or less scraggy. Bark grey on the outside of the trunk and brownish nearer the wood. The rough bark extends right along the limbs, and only the small ones have smooth bark. On Glencoe-Mount Gambier Road."

It is referred to under "South Australia" in B. Fl., iii, 202, as "*E. virgata* Sieb. A shrub of 10 – 15 feet, with a white and grey bark, in the stunted stringybark forests 15 miles N.W. of Mount Gambier *(Wilhemi?)* in Herb. F.

Mueller." The Mount Gambier specimens already referred to enable me to make this identification.

So that its range in three States is extensive and the localities given will be connected in due course, for it has been a good deal confused in collections with *E. amygdalina* on the one hand and *E. coriacea* on the other.

Examining my type specimens of *E. vitellina* and comparing them with the specimens of *E. vitrea* which have accumulated from many localities since 1905, I have come to the conclusion that the two species are closely related, and spring from the same parents. I do not know whence the seed which produced the type of *E. vitellina* came; probably from a Victorian source. I can, I believe, match it with coastal Victorian-South Australian specimens.

A difficulty in looking upon the two species as conspecific is Naudin's use of the word "lineaire" to describe the juvenile leaves. He speaks of them as not lasting long, and in view of the narrowness of the mature leaves in his type, I am of opinion that he described nearly opposite leaves, which are certainly linear-lanceolate. The mistake is easily made, especially as the tree was growing at Golfe Juan, some miles from Cape Antibes, his own head-quarters. A letter to M. Poirault, M. Naudin's successor, ascertained the fact that no strictly juvenile leaves could be found with the type specimens.

At the same time, since in my view the existence of *E. vitellina* as a species hangs on the evidence as to the juvenile leaves, I hesitate to categorically state that M. Naudin's description of them is wrong, however strongly I may think that such is probable.

Other reputed differences seem to me of less importance. For example, I have no difficulty in reconciling the differences in the barks as described; the barks of E. *vitrea* vary, within limits, according to age of tree and locality.

M. Naudin, Mr. Baker and I have indicated the affinities to *E. coriacea* and *E. amygdalina.* In the present state of our knowledge, the latter species (in the connection referred to) should be given as *E. radiata* Sieb.

It is possible that the differences between the types of the two forms may be explained on the assumption of a leaning towards one or other of the parents. In most of the localities in which *E. vitrea* has been found, both *E. coriacea* and *E. radiata* occur, but as regards localities in which one or other of the reputed parents do not occur, it is not unreasonable to suppose that seeds have been conveyed (by stages, if necessary) by one or other of the usual methods, and that these seeds have germinated and produced seed-bearing trees, which have continued the processes indicated indefinitely.

SOME NEW SPOROZOON PARASITES OF QUEENSLAND FRESHWATER FISH.

By Prof. T. HARVEY JOHNSTON, M.A., D.Sc., etc., and M. J. BANCROFT, B.Sc.

With Plates XLIII – XLVII.

[*Read before the Royal Society of N. S. Wales, December 4, 1918.*]

THE material for this paper was collected during an investigation of the recent epidemic amongst freshwater fish in Central Queensland. We are indebted to several of the officers of the Longreach Shire Council for some of the specimens obtained. All the fish examined were taken in the Thomson River at Longreach, with the exception of one, *Sciœna australis*, which was captured in the Brisbane River in the vicinity of Ipswich. All the specimens have been kindly identified for us by Mr. J. Douglas Ogilby of the Queensland Museum. We have used the classification given by Auerbach ("Die Cnidosporidien eine monographische Studie," Leipzig, 1910).

MYXOSPORIDIA.

Family MYXIDIIDÆ.

MYXIDIUM THERAPON n. sp.

Figs. 1, 9, 12.

Hosts:—*Therapon carbo* Ogilby and McCulloch; and *Therapon hillii* Castelnau.

This parasite was found infesting the gall bladder of both these *Therapons*. Only one specimen of *T. carbo* was secured. Of thirteen examples of *T. hillii*, the common "black bream" or "grunter" of the Thomson River, nine were infected. It apparently has no harmful effect upon its host. When the gall bladder of a parasitised individual is slit open, numerous round filmy pieces of matter float out with the bile. These are the plasmodia. They are of a pale yellowish to green colour, and vary in diameter from 3 to 12 mm. The small forms are young plasmodia and contain no mature spores, while the largest have abundance of them. In life the protoplasm can be distinguished into a clear narrow ectoplasm, about ten micra in width and a coarsely grained endoplasm. When placed in bile, diluted with normal saline, the plasmodia do not seem capable of actually changing their position, but undulations may be seen to travel round the margin of the organism. The plasmodium is very delicate and easily injured. In some cases the bile was swarming with myriads of ripe spores, in other cases of less advanced infection they were much less numerous.

The spore is spindle shaped and sharply pointed at both extremities. The polar capsules are more or less rounded structures lying one at either end of the spore. There are two medianly situated nuclei. Faint longitudinal striations are visible. The average dimensions are:—length of spore $9-10\mu$, breadth 4μ; length of polar capsule $2-3\mu$, breadth $1-2\mu$.

Auerbach[1] has recorded 11 described species of *Myxidium* from fish. They are most commonly found in the gall bladder.

MYXOSOMA OGILBYI n. sp.

Figs. 2, 17.

Host:—The golden perch, *Plectroplites ambiguus* Richardson.

In three out of nine specimens examined tiny white cysts were observed in the white fibrous tissue of the gill arch, usually close to the bases of the filaments. The cysts were quite small, being on the average less than a millimetre in

[1] Auerbach, "Die Cnidosporidien," pp. 170-3, 1910.

diameter; they were not at all abundant—five being the greatest number found on any single gill arch. Sections revealed the structure usually present in a myxosporidian cyst.

The spore is egg-shaped, the anterior end being pointed. There are two polar capsules situated anteriorly. The protoplasmic body contains a single nucleus. The inner margin of the envelope is indented posteriorly. The average dimensions are:—Length of spore $11-13\mu$; breadth $6-8\mu$; thickness 5μ; length of polar capsule $5-6\mu$; breadth of capsule 2μ. An iodinophilous vacuole has not been demonstrated, the lack of this characteristic placing the species in the genus *Myxosoma*. It closely resembles *Myxosoma dujardini*, a European species, from the gills of *Scardinius erythrophthalmus* and *Leuciscus rutilus*, both in shape and size, but is distinguished from it by the presence of the indentations referred to.

We have named the species as a recognition of Mr. D. Ogilby's assistance.

Family MYXOBOLIDÆ.

Myxobolus plectroplites n. sp.

Host:—Golden perch or yellow belly, *Plectroplites ambiguus* Richardson.

Spores were first noticed in a stained smear from the kidney. Cysts were not observed with the naked eye in this or in any other of the nine specimens of perch examined, but in two other cases, however, on careful microscopic examination a few spores were found. On sectioning a piece of kidney known to be infected, a few small cysts about 60μ in diameter were discovered. In two specimens of perch, *Myxobolus*, spores were detected in the gall bladder; these proving to be extremely like those from the kidney. It was only on prolonged examination that the infection of the gall bladder was noticed, hence the percentage infection may be much higher than it appears. This parasite was detected in four out of nine golden perch examined; in two cases in the kidney only, in one case only in the gall bladder; and one instance in both gall bladder and kidney.

In sections of the kidney the cysts are found to lie in the connective tissue of the organ. They are exceedingly small, the following being the measurements of six taken at random:—·036 mm. in diameter; ·024 × ·048 mm.; ·06 × ·04 mm.; ·076 × ·072 mm. (shewn in microphotograph); ·116 × ·084 mm.; ·144 × ·1 mm. The two latter were relatively large cysts. No definite structure could be made out. The spore is a rounded oval, and bears quite a close resemblance to *Myxobolus hylæ*, which we have recently described from the golden frog, *Hyla aurea*. It is, however, slightly shorter, the polar filaments are not so long, while the vacuole is apparently not iodinophilous. The average dimensions are:—Length of spore, $10-12\mu$; breadth of spore $7-8\mu$; length of polar capsule 5μ; breadth of polar capsule 2μ; length of polar filament $30-40\mu$.

Auerbach (pp. 39 – 44) records 28 species of *Myxobolus* from fish, three of which are undescribed. They may occur in practically any organ of the body. Some are found in a great variety of situations within the same host, e.g. *M. pfeifferi* inhabits the intestines, spleen, ovary, muscles and neurilemma (?); whilst others like *M. oculi-leucisci* from the aqueous chamber of *Leuciscus rutilus* are apparently restricted to one organ. They have been rarely recorded from the gall bladder but commonly from the kidney.

HENNEGUYA AUSTRALIS n. sp.

Figs. 4, 5, 11, 14, 16.

Host:—The golden perch, *Plectroplites ambiguus* Richardson.

This parasite was found as tiny rounded white cysts on the gill filaments. In all cases observed, the infection was extremely light. It occurred in four out of nine specimens of perch examined. In sections of an infected filament the cyst was seen to lie embedded in the spongy tissue, and in many cases occupying a relatively large area of the section. The cyst exhibits the usual three well defined layers—the outermost clear ectoplasm, an inner layer of developing spores, while the whole mass of the cyst within this is filled with mature spores. The latter appear to lie in a definite manner, the long axis of the spore commonly being at right angles to the boundary of the cyst, the anterior end of the spore pointing outwards. The spores, then, seem to radiate from the central portion of the cyst.

The spore is greatly elongated, pointed somewhat anteriorly, while the posterior margin of the envelope is drawn out into a long tapering process or tail. When freshly liberated from the cyst, the tail appears single, but the two halves soon separate and usually diverge widely, giving the appearance of a double appendage. At the anterior end of the spore are two polar capsules which lie parallel and quite frequently are of different lengths, in one or two instances of a malformed spore they were seen to lie one behind the other. The posterior end of the spore is occupied by the amœbula containing two nuclei and a small vacuole. The average dimensions are:—Length of spore $11-15\mu$; breadth of spore $3-5\mu$; thickness of spore $3-4\mu$; length of polar capsule $5-6\mu$; breadth of polar capsule $1-2\mu$; length of tail process about 20μ.

Henneguya gracilis n. sp.

Figs. 6, 8, 10.

Host:—Black bream, *Therapon hillii* Castelnau.

This parasite closely resembles the preceding one, but it makes definite narrow pear-shaped cysts in the filaments, these cysts lying transversely, *i.e.* at right angles to the long axis of the filament. The spores are arranged with long axes parallel to that of the cyst. Infection was observed in eight out of thirteen specimens of bream, but only in one case was it at all severe.

The spore is extremely like that of the preceding, but is slightly smaller while the tail is longer in proportion. The average dimensions are:—Length of spore $10-14\mu$; breadth of spore $2{\cdot}5-3\mu$; thickness of spore 3μ; length of polar capsule $5-6\mu$; breadth of polar capsule $1-2\mu$; length of tail process about $20-26\mu$.

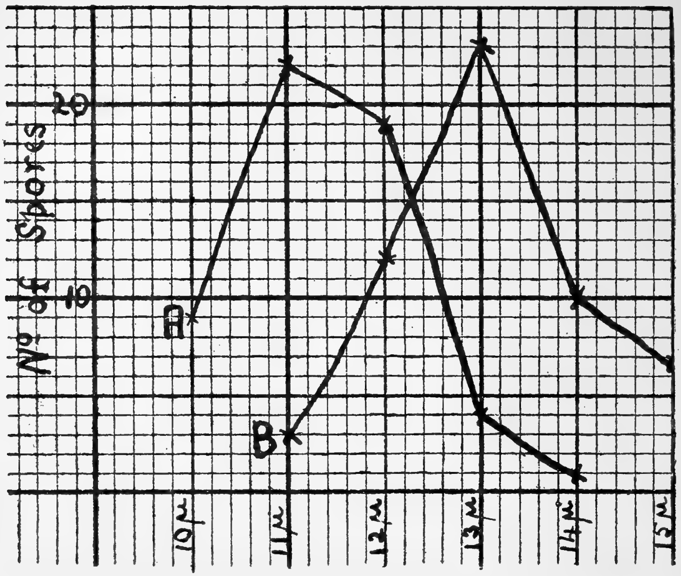
In order to obtain additional evidence, either for or against the view that two distinct species were being dealt with, a fairly large number of spores, taken at random, were drawn with the aid of a camera lucida, and measurements made thereof. The dimensions noted were, length and breadth of spore, and length of polar capsule.

The average dimensions founded on these measurements were:—

Species.	Length of spore	Breadth of spore	Length of polar capsule.
H. gracilis	$11{\cdot}38\mu$	$2{\cdot}74\mu$	$5{\cdot}22\mu$
H. australis	$13{\cdot}1\mu$	$3{\cdot}68\mu$	$5{\cdot}66\mu$

The results of plotting the lengths measured against the number of spores in each case are given below. The empirical mode in the case of *H. gracilis* will be seen to be 11, and in the case of *H. australis* 13. There was not sufficient variation in the other dimensions to render a graphical representation of any value.

Auerbach (1910, pp. 183–186) has recorded 18 species of *Henneguya*, from fish, two of which were undescribed. The various species inhabit almost every organ of the body but are rather more usually found in the ovary, gills and connective tissue.



Length of spore—A. *Henneguya gracilis;* B. *H. australis.*

Henneguya sp.

A number of spores of a *Henneguya* were detected in scrapings of the gill of one out of four specimens of the slender bony bream, *Nematalosa elongata* Macleay. The slide having become mislaid, we are unable to give further particulars.

MICROSPORIDIA.

Pleistophora sciænæ n. sp.

Figs. 7, 13.

The ovary of a single specimen of *Sciæna australis* Gunther,[1] the so-called perch of the Brisbane River, examined by us, was found to contain small white cysts. Each cyst was seen to be filled with myriads of tiny spores. When sections of the infected portion were examined, it was obvious that the parasite had originally taken up its

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[1] Syn. *S. canina* de Vis. See Ogilby Mem. Qld. Mus. 6, 1918, p. 75.

position in the connective tissue covering the ovary, but as growth proceeded, the cyst had come to press down among the developing ova, though it was still surrounded by a hypertrophied layer of this tissue.

The spore is a tiny pyriform structure with a mass of more deeply staining material at the narrower end. The average length is $3-5\mu$, while the breadth is $2-3\mu$. Its morphological characteristics and the formation of an indefinite number of spores relegate this organism to the genus *Pleistophora*.

Host.	Parasite.
Nematalosa elongata	*Henneguya sp.*
Plectroplites ambiguus	*Myxosoma ogilbyi* J. and B.
	Myxobolus plectroplites J. and B.
	Henneguya australis J. and B.
Sciæna australis	*Pleistophora sciænæ* J. and B.
Therapon carbo	*Myxidium therapon* J. and B.
Therapon hillii	*Myxidium therapon* J. and B.
	Henneguya gracilis J. and B.

All figures (1 – 9) on Plates XLIII and XLIV have been drawn to the same magnification, (see scale beside fig. 1). The photomicrographs have not been retouched in any way. References to lettering:—*c*, cyst; *c.t.*, connective tissue surrounding cyst; *d.s.*, developing spores; *ect.*, ectoplasm; *end.*, endoplasm; *g.t.*, gill tissue; *k.t.*, kidney tissue; *ov.*, ovum; *s.*, spores; *s.f.*, skeleton of gill filament.

EXPLANATION OF PLATES.

Plate XLIII.

Fig. 1. Group of spores of *Myxidium therapon*. × 1250.
,, 2. *Myxosoma ogilbyi*. × 1250.
,, 3. *Myxobolus plectroplites*. × 1250.
,, 4. *Henneguya australis*. × 1250.
,, 5. ,, ,, abnormal spores. × 1250.
,, 6. ,, *gracilis*. × 1250.

Plate XLIV.

Fig. 7. Portion of transverse section ovary of *Sciæna* with spores of *Pleistophora sciænæ*. × 1250.

„ 8. Transverse section, gill filament of *Therapon hillii*; with cyst of *Henneguya gracilis*. × 1250.

„ 9. Edge of plasmodium of *Myxidium therapon*. × 1250.

Plate XLV.

„ 10. Portion of gill filament of *Therapon hillii* (stained with hæmatoxylin) showing six pyriform cysts of *Henneguya gracilis*. × 34.

„ 11. Portion of gill filament of *Plectroplites ambiguus* (unstained) showing cyst of *Henneguya australis*. × 35.

„ 12. Portion of plasmodium of *Myxidium therapon*. × 75.

Plate XLVI.

„ 13. Transverse section of ovary of *Sciæna* with cyst of *Pleistophora*. × 72.

„ 14. Transverse section of gill filament *Plectroplites ambiguus*, showing portion of cyst of *Henneguya australis*. × 312.

„ 15. Transverse section of kidney of *Plectroplites ambiguus* with cyst of *Myobolus plectroplites*. × 434.

Plate XLVII.

„ 16. Transverse section of two gill filaments of *Plectroplites ambiguus*, one showing section of cyst of *Henneguya australis*. × 90. No radiating arrangement of spores.

„ 17. Transverse section of portion of gill arch of *P. ambiguus* at base of several filaments—showing two cysts of *Myxosoma ogilbyi*. × 74.

ON THE OCCURRENCE OF THE TERPENE TERPINENE IN THE OIL OF *Eucalyptus megacarpa.*

By HENRY G. SMITH, F.C.S.

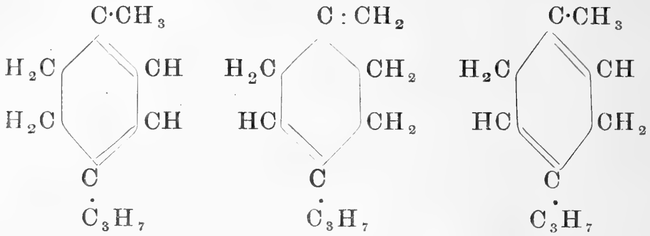
[*Read before the Royal Society of N.S. Wales, December 4, 1918.*]

TERPINENE was first recognised as a definite terpene by Wallach,[1] and has, so far, been detected only in a very few essential oils. It was first discovered by Weber[2] in cardamom oil, and has been recorded as occurring in marjoram oil, dill oil, coriander oil, and a few others. Terpinene is thus rarely found existing naturally, and Gildemeister and Hoffmann[3] have stated "that it may appear doubtful whether this terpene is really found in nature or whether it is formed by the influence of heat during the distillation from other compounds contained in the respective oils." This opinion cannot now be supported in reference to Eucalyptus oils, because if true the terpene would without doubt, have been detected in them before this, seeing that the oils of such a large number of species have now been determined. It must, therefore, be considered as a naturally occurring terpene in some Eucalyptus oils.

Terpinene is formed artificially by the action of alcoholic sulphuric acid on many of the terpenes and terpene derivatives, ordinary turpentine (pinene) being well adapted for the purpose. It may also be prepared by similar means from terpineol, geraniol, dihydrocarveol and cineol. This formation is interesting in this connection as, besides cineol and the terpenes pinene and limonene, geraniol appears to be present also as an ester in the oil of *Eucalyptus megacarpa.*

[1] *Ann. Chem.*, (230) 254 and 260. [2] *Ann. Chem.*, 238, (1887) 107.
[3] "The Volatile Oils," p. 119 (English translation, 1900).

The molecular structures which have been suggested for terpinene are the following, known as α, β, and γ-terpinenes respectively:—



Wallach[1] contends that it has been shown with sufficient clearness that terpinene is a mixture of $\triangle_{1,3.}$ and $\triangle_{1,4.}$ dihydrocymenes, and that it is the former which gives the characteristic nitrosite reaction. A considerable amount of work has been undertaken upon this terpene by Wallach, Semmler, Auwers and others, and both the α, and γ-forms have been synthesised during these investigations.

As terpinene has not, so far, been regenerated from its solid derivative in a pure form, its physical properties cannot be stated with precision, but from the several results obtained with the terpene formed in various ways the following range of figures may be given:—

Boiling point 171 to 181° C.; specific gravity 0·842 at 22° to 0·848 at 18°; refractive index 1·4719 to 1·4789.

The two reactions which largely help to distinguish terpinene from other terpenes are (*a*) the crystallised nitrosite $C_{10}H_{16}N_2O_3$ melting at 155° C., which is formed when the oil is treated with nitrous acid, and (*b*), the comparative ease with which it is destroyed when treated in the cold with Beckmann's chromic acid mixture; this reagent under such conditions has little action upon either pinene, limonene or cineol.

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[1] *Ann. Chem.*, 374, 217.

The pinene in the oil of *E. megacarpa* was shown to be highly lævorotatory, as was also the limonene; dipentene appears also to be present. The cineol content was 30%. It does not appear that the terpinene in this oil can exceed 10%, judging from the results of the distillation and the amounts of other constituents determined.

Although limonene tetrabromide was formed with the oil of the fraction boiling between 170–190° yet the result was not altogether satisfactory, and the compound small in amount. This peculiarity naturally led to further search for the interfering constituent with the resulting detection of the terpinene.

Limonene rarely occurs in eucalyptus oils, and it may be that terpinene will be found more frequently associated with that terpene in the oils of certain species of this group. The formation of terpinene from terpineol through the terpene terpinolene is thus of special interest, because dipentene can also be formed from the same terpineol. Wallach and Kerkhoff[1] found that oxalic acid was a useful reagent by which to prepare terpinolene and then terpinene from terpineol.

E. megacarpa is a Western Australian species, and the oil was forwarded to the Technological Museum for investigation by Mr. C. E. Lane Poole, the Conservator of Forests for that State.

The formation of the terpinene nitrosite.

A portion of the fraction distilling between 170–190° C. was mixed with an equal quantity of petroleum ether and an equal bulk of a saturated solution of sodium nitrite added, and afterwards sufficient glacial acetic acid to decompose the salt. The whole was then allowed to stand on one side. After twenty-four to thirty hours

[1] *Ann. Chem.*, (275), 106.

crystals commenced to form, and increased considerably in amount after two days. The crystals were separated, pressed on porous plate to absorb the liquid products, and purified from a mixture of alcohol and chloroform. The terpinene nitrosite thus formed melted at 155°C. (corrected), and answered to the more easily applied chemical reactions for this substance.

Terpinene nitrosite, which is a more stable substance than the corresponding compound formed with phellandrene, has had two formulæ suggested for it :—

$$C_{10}H_{16}\left\langle\begin{matrix}N{=}O\\ O{-}N{=}O\end{matrix}\right. \quad \text{and} \quad C_{10}H_{15}\left\langle\begin{matrix}N{-}O{-}H.\\ O{-}N{=}O.\end{matrix}\right.$$

but no definite conclusion has yet been arrived at.

Treatment with Beckmann's reagent.

A portion of the fraction boiling between 170 – 190° was repeatedly treated in the cold with small quantities of Beckmann's chromic acid mixture, until the formation of the brown precipitate was less noticeable. The optical rotation of the fraction before treatment was 35·5 degrees to the left, due principally to the limonene. After the first treatment, the optical activity had increased to 36·4 degrees, and after further action reached 36·6 degrees. The substance removed in this way was evidently the inactive terpinene, while the optical activity of the limonene had apparently not been interfered with.

If Wallach's statement that the α-form produces the crystalline nitrosite is accepted, and assuming that the terpene is not a mixture of the α- and γ-forms, then the terpinene in the oil of this Eucalyptus species has the molecular structure *I* above.

E. megacarpa, in the sequence of species, more nearly approaches the first members of the genus, or those with the parallel feathery leaf venation, than the more recent forms. This is also indicated by the principal chemical constituent in the oil being pinene. It is only in the oils of the more recent members of the genus that the terpene phellandrene is found, so that the peculiarity is noticed of terpinene (one of these closely agreeing terpenes) being found at that end of the genus which is more largely represented in Western Australia, while the other terpene (phellandrene) is a characteristic constituent in the oils of the members of the more recent groups of the genus, or those which occur most abundantly in the south-eastern portion of Australia.

ABSTRACT OF PROCEEDINGS

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of New South Wales.

MAY 1st, 1918.

The Annual Meeting, being the three hundred and ninety-sixth General Monthly Meeting of the Society, was held at the Society's House, 5 Elizabeth Street, Sydney, at 8 p.m.

Dr. J. B. CLELAND, President, in the Chair.

Fifty-one members and one visitor were present.

The minutes of the General Monthly Meeting of the 5th December, 1917, were read and confirmed.

The certificates of eleven candidates for admission as ordinary members were read: one for the second and ten for the first time.

Mr. E. CHEEL and Mr. I. ORMSBY were appointed Scrutineers, and Mr. C. HEDLEY deputed to preside at the Ballot Box.

The following gentleman was duly elected an ordinary member of the Society:—

CLYDE DOUGLAS GILLIES, M.Sc., Assistant Lecturer in Biology, the University, Brisbane.

The following gentleman was duly elected an Honorary Member of the Society:—

CHARLES CHILTON, M.A., D.Sc., etc., Professor of Biology at Canterbury College, Christchurch, New Zealand.

The Annual Financial Statement for the year ended 31st March, 1918, was submitted to members, and, on the motion of the Honorary Treasurer, Professor H. G. CHAPMAN, seconded by Mr. R. T. BAKER, was unanimously adopted:—

GENERAL ACCOUNT.

RECEIPTS.	£ s. d.	£ s. d.
To Balance, Cash on hand and at Bank, 1st April, 1917		137 4 8
,, Subscriptions—		
Annual	501 18 0	
Sectional Member	0 10 6	
		502 8 6
,, Rents—		
Offices	347 15 0	
Hall and Library	79 10 0	
		427 5 0
,, Sundry Receipts		7 8 10
,, Government Subsidy for 1917...		399 19 10
,, Clarke Memorial Fund—		
Amounts received to date		200 0 0
		£1,674 6 10

PAYMENTS.	£ s. d.	£ s. d.
By Salaries and Wages—		
Office Salary and Accountancy Fees ...	157 15 0	
Assistant Librarian	48 0 0	
Caretaker	135 10 0	
		341 5 0
,, Printing, Stationery, Advertising, Stamps, etc.—		
Stamps and Telegrams	35 2 6	
Office Sundries, Stationery, etc.	5 18 9	
Advertising	10 16 8	
Printing	33 18 6	
		85 16 5
,, Rates, Taxes and Services—		
Electric Light...	16 5 7	
Gas	5 13 10	
Insurance	25 5 5	
Rates	96 10 0	
Telephone	8 5 7	
		152 0 5
,, Printing and Publishing Society's Volume—		
Printing, etc.	191 2 6	
Book Binding...	18 19 2	
		210 1 8
,, Library—		
Books and Periodicals		13 13 11
Carried forward		802 17 5

Payments—*continued.*	£	s.	d.	£	s.	d.
Brought forward				802	17	6
By Sundry Expenses—						
Repairs...	33	4	3			
Lantern Operator	12	0	0			
Bank Charges	0	12	0			
Sundries	22	11	1			
				68	7	4
,, Clarke Memorial Fund—						
Amount invested in War Loan				200	0	0
,, Building and Investment Fund—						
Amount transferred	350	0	0			
Interest on Mortgage	115	0	0			
				465	0	0
,, Bookbinding Fund				87	10	0
,, Balance—						
Credit Balance at Union Bank of Australia	47	8	11			
Cash on Hand...	3	3	2			
				50	12	1
				£1,674	6	10

Compiled from the books and accounts of the Royal Society of New South Wales, and certified to be in accordance therewith.

HENRY G. CHAPMAN, M.D., *Honorary Treasurer.*

W. PERCIVAL MINELL, F.C.P.A.
Auditor.

SYDNEY 15TH APRIL 1918.

BUILDING INVESTMENT LOAN FUND.

BALANCE SHEET AS AT 31ST MARCH, 1918.

LIABILITIES.	£	s.	d.
Loan on Mortgage—			
Amount due to the Australasian Association Advancement of Science	2,300	0	0
	£2,300	0	0

ASSETS.	£	s.	d.
Commonwealth War Loan	100	0	0
Cash, Government Savings Bank	250	0	0
Balance	1,950	0	0
	£2,300	0	0

STATEMENT OF RECEIPTS AND PAYMENTS, 31ST MARCH, 1918.

	£	s.	d.
To Amount received from General Fund	465	0	0
	£465	0	0

	£	s.	d.
By Interest paid to the Australasian Association Advancement of Science	115	0	0
„ Amount invested in War Loan	100	0	0
„ Balance, Government Savings Bank	250	0	0
	£465	0	0

Bookbinding Fund, 31st March, 1918.

Receipts.

	£	s.	d.
To amount received from General Fund	£87	10	0

Payments.

	£	s.	d.
By War Saving Certificates purchased	£87	10	0

CLARKE MEMORIAL FUND.

Balance Sheet, 31st March, 1918.

Liabilities	£	s.	d.	£	s.	d.
Accumulation Fund—						
Balance as at 31st March, 1917				640	2	3
Additions during the year—						
Interest Savings Bank of N.S.W. ...	5	13	3			
„ Government Savings Bank	4	13	2			
„ Commonwealth Savings Bank	1	3	5			
„ Commonwealth War Loan	18	0	0			
				29	9	10
				£669	12	1

Assets.	£	s.	d.	£	s.	d.
Commonwealth War Loan				600	0	0
Cash Savings Bank of N.S.W.	25	0	0			
„ Government Savings Bank	19	12	1			
„ Commonwealth Savings Bank	25	0	0			
				69	12	1
				£669	12	1

Statement of Receipts and Payments, 31st March, 1918.

Receipts.	£	s.	d.	£	s.	d.
To Balance 31st March, 1917						
Savings Bank of N.S.W.	151	14	2			
Government Savings Bank	48	12	7			
Commonwealth Savings Bank	39	15	6			
				240	2	3
„ Interest to date—						
Savings Bank of N.S.W.	5	13	3			
Government Savings Bank	4	13	2			
Commonwealth Savings Bank	1	3	5			
War Loan	18	0	0			
				29	9	10
				£269	12	1

PAYMENTS.			£	s.	d.	£	s.	d.
By Amount Invested in War Loan	...	...				200	0	0
,, Balances at date—								
Savings Bank of N.S.W. ...	...	...	25	0	0			
Government Savings Bank	...	...	19	12	1			
Commonwealth Savings Bank	...	...	25	0	0			
						69	12	1
						£269	12	1

On the motion of Mr. G. HOOPER, seconded by Mr. A. D. OLLÉ, Mr. W. P. MINELL was elected Auditor for the current year.

A report on the state of the Society's property and the annual report of the Council were read:—

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1916-17.
(1st May to 25th April.)

The Council regrets to report that we have lost by death four ordinary members. Eleven members have resigned. On the other hand, seventeen ordinary members have been elected during the year.

To day (24th April, 1918) the roll of members stands at 317.

During the Society's year there have been eight monthly meetings and nine Council meetings.

Two Popular Science Lectures were given, namely:—

July 19—"The Wonders of Coal Tar," by Professor J. READ, M.A., Ph.D.

September 20th—"Heredity and the Laws of Mendel," by Professor A. ANSTRUTHER LAWSON, D.Sc., F.R.S.E.

Meetings were held throughout the Session by the Sections of Geology, Public Health and Kindred Sciences, Agriculture and Industry.

Twenty-one papers were read at the monthly meetings, and these, with a good number of exhibits, afforded much instruction and interest to members of the Society.

The President announced that the Council had awarded the Clarke Memorial Medal to LEONARD RODWAY, C.M.G., Honorary Government Botanist of Tasmania.

A letter was read from Mrs. A. McLAUGHLIN, thanking the Society for sympathy in the death of her husband.

The following donations were laid upon the table:—290 parts, 12 volumes, 14 reports and two maps.

The President, Dr. J. B. CLELAND, then delivered his Presidential Address.

On the motion of Dr. GREIG-SMITH, a hearty vote of thanks was accorded to the retiring President for his valuable address.

Dr. J. B. CLELAND briefly acknowledged the compliment.

There being no other nominations, the President declared the following gentlemen to be Officers and Council for the coming year:—

President:

W. S. DUN.

Vice-Presidents:

C. HEDLEY, F.L.S.	T. H. HOUGHTON, M. INST. C.E.
R. GREIG-SMITH, D.Sc.	J. B. CLELAND, M.D., Ch.M.

Hon. Treasurer:

Prof. H. G. CHAPMAN, M.D.

Hon. Secretaries:

R. H. CAMBAGE, F.L.S.	J. H. MAIDEN, I.S.O., F.R.S.

Members of Council:

C. ANDERSON, M.A., D.Sc.	F. H. QUAIFE, M.A., M.D.
E. C. ANDREWS, B.A., F.G.S.	HENRY G. SMITH, F.C.S.
D. CARMENT, F.I.A., F.F.A.	C. A. SUSSMILCH, F.G.S.
Prof. C. E. FAWSITT, D.Sc., Ph.D.	H. D. WALSH, B.A.I., M. INST. C.E.
J. NANGLE, F.R.A.S.	Prof. W. H. WARREN, LL.D., Wh.Sc.

The out-going President then installed Mr. W. S. DUN as President for the ensuing year, and the latter briefly returned thanks.

JUNE 5th, 1918.

The three hundred and ninety-seventh General Monthly Meeting was held at the Society's House, 5 Elizabeth Street, at 8 p.m.

Mr. W. S. DUN, President, in the Chair.

Twenty-seven members and one visitor were present.

The minutes of the preceding meeting were read and confirmed.

The certificates of eleven candidates for admission as ordinary members were read: ten for the second, and one for the first time.

Mr. A. B. HECTOR and Mr. A. D. OLLÉ were appointed Scrutineers, and Professor C. E. FAWSITT deputed to preside at the Ballot Box.

The following gentlemen were duly elected ordinary members of the Society:—GEORGE HYSLOP ADAM, Chemist, Electric Light Department, City Council, Sydney; ROBERT HOUSTON BARR, Mechanical Engineer, Australasia Chambers, 2 Martin Place, Sydney; EDWARD ELLIOTT, Chemical Engineer, c/o Reckitts' (Oversea) Limited, Bourke Street, Redfern; ALEXANDER RICHARD ROBY HASSAN, Merchant, c/o Pacific Commercial Company, Pomeroy House, York Street, Sydney; MORGAN JONES JOHNS, M.I.M.E., Chief Engineer of the Mount Morgan Company, Mount Morgan, Queensland; JAMES MATTHEW PETRIE, D.Sc., F.I.C., Research Fellow of the Linnean Society in Bio-chemistry, the University, Sydney; HENRY PRIESTLEY, B.Sc., M.D., Ch M., Lecturer in Physiology in the University of Sydney; FREDERICK WILLIAM STEEL, Chemical Works Manager, c/o General Chemical Company Ld., Parramatta Road, Auburn, N.S.W.; EDWARD NAUNTON WARD, Superintendent, Botanic Gardens, Sydney; EDMOND AUNGER WHITE, Manager of Electrolytic Refining and Smelting Company of Australia Ltd., Port Kembla, N.S.W.

The President announced the deaths of the following members:—Mr. J. BROOKS, Mr. R. H. MATHEWS, Mr. C. H. MYLES and Mr. P. R. PEDLEY. Mrs. BROOKS and Miss MATHEWS wrote thanking the Society for sympathy in their bereavements.

Three volumes, 126 parts, 5 reports and 1 map were laid upon the table.

The President announced that the following lectures would be delivered this Session:—

1. Clarke Memorial Lecture by Professor R. J. A. BERRY, on "Brain Growth, Education and Social Inefficiency."
2. Popular Science Lectures:—"The Planet Mars," by J. NANGLE, F.R.A.S. Some Modern Phases of Agriculture," by H. W. POTTS, F.L.S. "Radium," by S. RADCLIFF, F.C.S.

THE FOLLOWING PAPERS WERE READ:

1. "The Spine Mode of *Centropyxis aculeata* Stein," by C. D. GILLIES, M.Sc.
2. "A new species of Leptospermum and its Essential Oil," by R. W. CHALLINOR, F.C.S., E. CHEEL and A. R. PENFOLD. Remarks were made by Messrs. H. G. SMITH, R. T. BAKER and A. B. HECTOR.
3. "Notes on some Permo-Carboniferous Fenestellidæ (with descriptions of new species)," by C. F. LASERON. Remarks were made by the President.

EXHIBIT:

Mr. D. J. COLLEY sent as an exhibit, a Boulton two-penny piece struck in 1797, being one of two issues struck in order to prove the superiority for coinage work of steam power over horse power.

JULY 3rd, 1918.

The three hundred and ninety-eighth General Monthly Meeting was held at the Society's House, 5 Elizabeth Street, Sydney, at 8 p.m.

Mr. W. S. Dun, President, in the Chair.

Thirty-three members and three visitors were present.

The minutes of the preceding meeting were read and confirmed.

The certificates of two candidates for admission as ordinary members were read; one for the second, and one for the first time.

Mr. J. E. Carne and Mr. S. H. Smith were appointed Scrutineers, and Mr. E. C. Andrews deputed to preside at the Ballot Box.

The following gentleman was duly elected an ordinary member of the Society:—James Laurence Gallagher, Chemist, c/o Lever Bros. Ltd., Balmain, Sydney.

A letter was read from Mr. A. Pedley thanking the Society for sympathy in the death of his brother, Mr. P. R. Pedley.

Mr. E. J. Statham drew attention to the presence of sea-weed and pumice which had been washed ashore near Wollongong early in June, the latter having probably been brought, as on previous occasions, by ocean currents from the New Hebrides.

Fifty-four parts and two volumes were laid upon the table.

THE FOLLOWING PAPERS WERE READ:

1. "A Contribution to a History of the Royal Society of New South Wales (with incidental notes in regard to the history of other New South Wales Societies)," by J. H. Maiden, F.R.S. Remarks were made by Mr. R. H. Cambage, His Honour Judge Docker and Mr. A. B. Hector.

2. "A simple Progressive Tax, and its bearing on the Federal Income Tax and other Acts," by H. S. Carslaw, M.A., Sc.D.

AUGUST 7th, 1918.

The three hundred and ninety-ninth General Monthly Meeting was held at the Society's House, 5 Elizabeth Street, Sydney, at 8 p.m.

Mr. W. S. DUN, President, in the Chair.

Thirty-eight members were present.

The minutes of the preceding meeting were read and confirmed.

The certificates of three candidates for admission as ordinary members were read; one for the second, and two for the first time.

Dr. G. HARKER and Mr. A. A. HAMILTON were appointed Scrutineers, and Mr. J. NANGLE deputed to preside at the Ballot Box.

The following gentleman was duly elected an ordinary member of the Society:—CARL GUSTAF SUNDSTRÖM, Manager of the Federal Match Company, Ltd., 6 Arcadia Road, Glebe Point.

Four volumes, 66 parts, 5 reports, and 1 catalogue were laid upon the table.

THE FOLLOWING PAPERS WERE READ:

1. "On the Technology and Anatomy of some Silky Oak Timbers," by R. T. BAKER, F.L.S. Remarks were made by Dr. R. GREIG-SMITH and Messrs. A. D. OLLÉ, J. NANGLE and A. B. HECTOR.

2. "The Vertical Growth of Trees," by R. H. CAMBAGE, F.L.S. Remarks were made by Messrs. J. H. MAIDEN, R. T. BAKER and A. F. OSBORN.

EXHIBIT:

Mr. J. E. BISHOP exhibited a piece of New Zealand Kauri cut from one of many logs which are said to have been discovered by gum diggers in a bog in which no kauri has grown within the memory of the living men. The manifest faults are not discernible until the logs are cut up. Experienced timber buyers have bought them for sound timber. The Maoris are said to explain the existence of the fallen trees by alleging a cyclone, but the logs do not lie all in the same direction. Another suggestion is that the trees have fallen in an earthquake which has shaken them as a man would shake a buggy whip and thus caused the fractures. The fractures permeate the wood so completely that enough sound timber to make a chair leg could not be got out of a log.

SEPTEMBER 4th, 1918.

The four hundredth General Monthly Meeting was held at the Society's House, 5 Elizabeth Street, at 8 p.m.

Mr. W. S. Dun, President, in the Chair.

Forty-three members were present.

The minutes of the preceding meeting were read and confirmed.

The certificates of three candidates for admission as ordinary members were read: two for the second, and one for the first time.

Mr. G. H. Halligan and Mr. A. B. Hector were appointed Scrutineers, and Mr. C. A. Süssmilch deputed to preside at the Ballot Box.

The following gentlemen were duly elected ordinary members of the Society:—John Anthony Young, Director of Lewis Berger and Sons, (Aust.) Ltd., 16 Young Street, Sydney; Harry Brown Sevier, Manager of Lewis Berger and Sons, (Aust.) Ltd., 16 Young Street, Sydney.

The President announced the deaths of Mr. Hugh Paterson and Mr. T. F. G. Pockley.

Four volumes, 81 parts and 11 reports were laid upon the table.

THE FOLLOWING PAPERS WERE READ:

1. "The Darling Peneplain of Western Australia," by Professor W. G. Woolnough, D.Sc., F.G.S.

2. "Experiments on the behaviour of Iron in contact with Sulphuric acid," by Professor C. E. Fawsitt, D.Sc., Ph.D., and A. A. Pain, B.Sc. Remarks were made by Messrs. F. W. Carpenter and S. Radcliff, Dr. Murphy, Mr. Steel and Judge Docker.

3. "Note on the Resinous Earth occurring at the head of the Nambucca River, N.S.W.," by H. G. Smith, F.C.S. Remarks were made by the President, Messrs. E. Cheel, R. W. Challinor, A. A. Hamilton, and R. T. Baker.

EXHIBITS:

1. Mr. John Barling exhibited a diagram illustrating the rainfall over a period of 70 years at Sydney, Adelaide and Hobart, for 50 years at Brisbane, and 40 years at Port Macquarie. An equalizing line was drawn separating the high from the low-rainfall years, those above and below the line being shown by distinctive colours.

2. Mr. A. B. Hector exhibited some slides to illustrate processes employed in colour photography.

Mr. J. H. Maiden read a note on "Popple or Bopple Nuts" *(Macadamia ternifolia)*. 'Mr. E. Cheel, this Journ. L, xx (1916), gives "Popple Nut" as a New South Wales name for the common Queensland Nut *(Macadamia)*. The nut being so common, and the name being new to me, I instituted enquiries, which had no result until Mr. E. E. Pescott of Melbourne, informed me that the name is a corruption of "Bopple Nut," so called because they are abundant at Bopple Mountain near Gympie, Queensland, where the aborigines used to, and still collect them. They are of course often cultivated now, but they form the basis of an increasing trade from Gympie to many parts of Australia. It will be interesting to those who seek to trace the vernaculars for Australian products, to note that the word has been already corrupted in the second degree, the nuts being often known in Sydney as "Poplar nuts." Mount Bopple is situated on the east side of the North Coast Line, Latitude 25° 47″, Longitude 152° 34″. It is two or three miles westerly from Bauple (another variant) township, and thirty-three miles northerly from Gympie.'

OCTOBER 2nd, 1918.

The four hundred and first General Monthly Meeting was held at the Society's House, 5 Elizabeth Street, at 8 p.m.

Mr. W. S. DUN, President, in the Chair.

Thirty-seven members and two visitors were present.

The minutes of the preceding meeting were read and confirmed.

The certificate of one candidate for admission as an ordinary member was read for the second time.

Dr. H. S. H. WARDLAW and Mr. W. L'ESTRANGE were appointed Scrutineers, and Dr. R. GREIG-SMITH deputed to preside at the Ballot Box.

The following gentleman was duly elected an ordinary member of the Society:—HERBERT J. SULLIVAN, Works Manager of Lewis Berger and Sons (Aust.) Ltd., Rhodes.

The President announced the deaths of Sir PHILIP SYDNEY JONES and Mr. JOHN MCGARVIE SMITH.

Mr. H. J. PATERSON and Dr. F. ANTILL POCKLEY wrote thanking the Society for sympathy in their recent bereavements.

Five volumes, 80 parts and 13 reports were laid upon the table.

THE FOLLOWING PAPER WAS READ:

1. "Acacia Seedlings, Part IV," by R. H. CAMBAGE, F.L.S. Remarks were made by Dr. CLELAND, Professor CHAPMAN and Mr. A. A. HAMILTON.

DISCUSSION—THE TEACHING OF SCIENCE IN SCHOOLS:

The discussion (of which due notice had been given) was opened by Professor C. E. FAWSITT, and contributed to by Dr. J. B. CLELAND, Professr H. G. CHAPMAN, Mr. P. BOARD, Director of Education (a visitor), Mr. A. B. HECTOR, and Dr. R. K. MURPHY. [The discussion will be found printed *in extenso* in "The Scientific Australian" for December, 1918, pp. 36 - 38.]

EXHIBIT:

Mr. A. E. STEPHEN exhibited an interesting sample of cotton from Queensland.

NOVEMBER 6th, 1918.

The four hundred and second General Monthly Meeting was held at the Society's House, 5 Elizabeth Street, at 8 p.m.

Mr. W. S. DUN, President, in the Chair.

Twenty-nine members were present.

The minutes of the preceding meeting were read and confirmed.

The certificates of two candidates for admission as ordinary members were read for the first time.

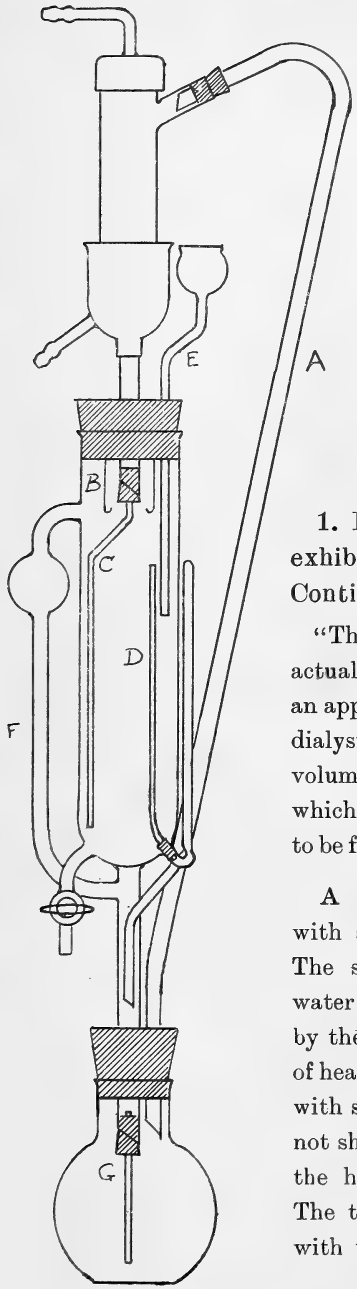
Miss MAY DENIEHY and Mr. G. SYDNEY JONES wrote thanking the Society for sympathy in their recent bereavements.

A letter was read from Major (Professor) David in acknowledgement of his having been awarded the Clarke Memorial Medal, and expressing his appreciation of the Council's action.

Five volumes, 163 parts, 20 reports and one calendar were laid upon the table.

THE FOLLOWING PAPERS WERE READ:

1. "Some Preliminary Investigations on a Bacterial Disease of Tobacco," by G. P. DARNELL-SMITH, B.Sc., F.I.C. Remarks were made by Dr. R. GREIG-SMITH.



2. "Two New Species of Eucalyptus," by R. H. CAMBAGE, F.L.S. Remarks were made by Mr. H. G. SMITH, and Judge DOCKER.

3. "A Note on the Occurrence of Muellerian Ducts in the Male of *Hyla cœrulea*," by T. HARVEY JOHNSTON, D.Sc. and C. D. GILLIES, M.Sc.

EXHIBITS:

1. Dr. H. S. HALCRO WARDLAW exhibited, and read a note on "A Continuous Dialyser."

"The accompanying figure (one-fourth actual size), shows the construction of an apparatus which enables continuous dialysis to be carried out with a limited volume of hot or cold water, and which can be assembled from materials to be found in any chemical laboratory.

A Soxhlet extractor is connected with a flask and a Cribb condenser. The steam produced by boiling the water in the flask is led to the condenser by the tube *A*. A considerable saving of heat is effected if this tube is insulated with sheet asbestos. The dialysing sac, not shown in the figure, is attached to the holder of an inverted gas mantle. The three arms of the holder engage with the wire hooks *B*, inserted into the stopper of the extractor. The sac is made by coating the inside of a test tube with collodion solution and removing the coating when dry. The water from the condenser is led by the tube *C* to the bottom of the extractor. In this way a thorough renewal of the dialysate is ensured, and the dropping of water into the sac is prevented. The liquid in the extractor is maintained at constant level by the tube *D*, which is inserted into the opening of the siphon by means of a piece of rubber tubing. The opening of the thistle funnel *E*, which serves for the admission of liquid, lies below the level of the dialysate. When the water in the flask is boiled, a flow through the dialyser proceeds. Steam passing through the side tube *F*, heats the contents of the dialyser to 60° – 70° C., and maintains the temperature at this level during the course of the dialysis. If the dialysis is to be carried out with cold water, the upper opening of the side tube *F* is plugged, and a tube *G* is inserted into the lower end of the extractor extending below the level of the water in the boiling flask. Access of steam to the contents of the dialyser, either through the side tube or the siphon, is thus prevented, and no heating takes place. An apparatus of the size described will completely dialyse 100 cc. of liquid with a total volume of water of 250 cc., and has been in use in the Physiological Laboratory of the University since 1915."

2. His Honour Judge DOCKER, exhibited a specimen of petrified wood, *Dadoxylon australe*, from Cherry Tree Hill near Capertee.

DECEMBER 4th, 1918.

The four hundred and third General Monthly Meeting was held at the Society's House, 5 Elizabeth Street, Sydney, at 8 p.m.

Mr. W. S. DUN, President, in the Chair.

Twenty-eight members were present.

The minutes of the preceding meeting were read and confirmed.

The certificates of three candidates for admission as ordinary members were read: two for the second, and one for the first time.

Mr. I. ORMSBY and Mr. W. WELCH were appointed Scrutineers, and Mr. J. NANGLE deputed to preside at the Ballot Box.

The following gentlemen were duly elected ordinary members of the Society:—PERCIVAL HINDMARSH, M.A., Student, "Linden Park," Revesby, via Bankstown, JOHN POWELL, Manufacturer (Food Products), 170-2 Palmer Street, Sydney.

The President referred to the fact that since the last General Monthly Meeting, an armistice had been arranged in connection with the war with Germany, and on the motion of the President the following resolution was carried unanimously:—

"That, having in view the successful position reached in the disastrous war in which our Empire and the Allies, after four and a quarter years, have gained such a signal victory, the Royal Society of New South Wales, assembled at its General Monthly Meeting, desires to place on record its profound satisfaction that this great struggle for freedom and liberty had secured what it is hoped will eventually be the world's peace; and it also desires to express its great appreciation of, and deep sense of gratitude for the valuable services rendered to their country, by those of its members who enlisted for Active Service, and while it mourns the loss of those brave ones who made the supreme sacrifice, it offers to the survivors its most cordial greetings and heartfelt congratulations on their Providential deliverance and brilliant success."

On the motion of Dr. CLELAND, seconded by Mr. H. G. SMITH, authority was granted to the Executive Officers to take any action which might seem necessary during the recess, in regard to providing that Germany should make restitution from her own stock of any scientific specimens which may have been destroyed by her action during the war.

Sixty-four parts, six reports and one map were laid upon the table.

THE FOLLOWING PAPERS WERE READ:

1. "On some Australian Cladocera," by Miss MARGUERITE HENRY, B.Sc., (communicated by Professor S. J. JOHNSTON). Remarks were made by Dr. Cleland.

2. "Notes on Eucalyptus (with descriptions of two new species in co-operation with Mr. R. H. CAMBAGE) No. VI.," by J. H. MAIDEN, F.R.S. Remarks were made by the President, Mr. R. H. CAMBAGE and Dr. CLELAND.

3. "Some New Sporozoon Parasites of Queensland Freshwater Fish," by T. HARVEY JOHNSTON, D.Sc., and Miss M. BANCROFT, B.Sc.

4. "On the Occurrence of the Terpene Terpinene in the Oil of *Eucalyptus megacarpa*," by H. G. SMITH, F.C.S. Remarks were made by Messrs. R. H. CAMBAGE, R. W. CHALLINOR, E. CHEEL and J. H. MAIDEN.

EXHIBITS:

1. Mr. J. H. MAIDEN exhibited a copy of the Mendel medal, which was struck in connection with the Fourth International Congress of Genetics, at Paris, in 1911. It was awarded to Mr. H. H. B. BRADLEY, formerly a member of this Society, and it is believed to be the first medal of the kind which has found its way to Australia. Mr. BRADLEY was one of the most scientific plant-breeders in Australia, and contributed a paper entitled "Hybridising at the Antipodes," which was published at page 388 of the report of the Third International Conference of Genetics held in London in 1906.

2. Dr. J. B. Cleland exhibited twigs of a *Dodonœa* from the Pilliga Scrub, whose tops had been cut off by rabbits cleanly and obliquely as with a knife, and mentioned that a number of trees of *Eucalyptus trachyphloia* had been ring-barked by rabbits in the same locality.

3. Dr. Cleland also exhibited the heart and great vessels at its base from a Corella, (*Licmetis nasica* Temm.), said to be 40 years of age. Intense calcification (atheroma) had occurred, as in old age in man, so that the great vessels were rigid and hard. The specimen was kindly secured by Mr. Grant of the Australian Museum.

GEOLOGICAL SECTION.

ABSTRACT

OF

PROCEEDINGS OF THE GEOLOGICAL SECTION.

Monthly Meeting, 8th May, 1918.

Mr. J. E. Carne in the Chair.

Ten members and three visitors were present.

Mr. Carne and Dr. C. Anderson were proposed and elected as Chairman and Honorary Secretary respectively.

EXHIBITS:

1. From the Mining Museum:—(*a*) *Araucarioxylon;* (*b*) Anglesite, Broken Hill, N.S.W.; (*c*) Banded Schist replaced by Rhodonite, Broken Hill; (*d*) Concretionary Marble; (*e*) Siliceous Sinter, Yellowstone Park, U.S.A.

2. Mr. Mathieson, Internal cast of *Atrypa*, Wellington Caves, N.S.W.

3. Acting Professor Cotton, on behalf of Mr. A. R. Pike, exhibited a small diamond from the Gulgong district N.S.W. The interesting feature about the occurrence of this diamond is that it was found in what appears to be a weathered dyke. If this is the case, it is the second record of the finding of a diamond in its matrix in New South Wales, the other being that previously recorded by Mr. Pike from a dolerite dyke near Copeton, Inverell.

4. Mr. W. R. Browne:—Tuffaceous rock which had been observed to be intrusive into claystones in a railway cutting about two and a half miles north of Bredbo, N.S.W. The evidence of intrusion consists of local hardening of the country rock and inclusions of the invaded formations in the igneous material. The name *pyroclastic intrusives*

was suggested to describe igneous rocks of brecciform appearance exhibiting intrusive relations.

5. Dr. C. ANDERSON:—Liesegang figures and photographs of restored Iguanodons in the Brussels Museum.

Monthly Meeting, 14th August, 1918.

Acting Professor COTTON in the Chair.

Five members and one visitor were present.

EXHIBITS:

1. Mr. W. T. WATKIN BROWN:—Crystallised Azurite, Broken Hill.

2. Mr. W. S. DUN:—Mr. W. E. ABBOTT'S book, "Mount Wingen and the Wingen Coal Measures"; only twenty-five copies of this interesting and valuable work have been issued.

3. Dr. C. ANDERSON:—Beryl Crystals from Torrington, N.S.W.

Dr. C. ANDERSON gave a short lecture, "Growth and Solution in Crystals," illustrating his remarks by crystals of Beryl from Torrington, N.S.W., which exhibit well marked hexagonal pits and hillocks on the basal plane. A summary of some of the more important features of growth and solution in crystals was given, and the lecturer discussed the question of the origin of the peculiar markings on the Torrington beryl. The hexagonal pits have their edges parallel to the intersections of the base, and the first order pyramid, and are bounded by planes of this pyramid and the base which forms the bottom of the pits. Other crystals show hillocks similarly oriented, and also bounded by planes of the first order pyramid and the base. These features are regarded as probably due to solution, although it is unusual for faces so produced to be so smooth and well-formed as they are in this case.

The subject was discussed by Acting Professor COTTON, Mr. W. R. BROWNE and Mr. W. T. WATKIN BROWN.

Monthly Meeting, 11th September, 1918.

Mr. R. H. CAMBAGE in the Chair.

Ten members were present.

EXHIBITS:

1. Dr. C. ANDERSON:—(*a*) Wolfram, Butler Tin Mine; (*b*) Quartz crystals, Tingha, N.S.W.

2. Mr. L. F. HARPER exhibited a number of specimens from the Hill End district, N.S.W., and made remarks on the geology and the nature of the reefs. It is considered that rocks of two distinct geological periods are represented in this area, classified provisionally as Ordovician and Devonian. Type rocks of each age were shown, also a specimen of tuff-slate breccia representative of the contact zone between the two geological periods. According to Mr. HARPER, while there are undoubted saddle reefs in the Devonian, the principal auriferous reefs occur either as true bedded veins in the Ordovician rocks, or as irregular makes of quartz and calcite along the contact zone. Samples of each were exhibited, both showing gold freely.

3. Mr. E. J. STATHAM:—(*a*) Waterworn pebbles and (*b*) Aboriginal stone implements from near the Parramatta Reservoir, N.S.W.

Mr. E. J. STATHAM contributed a paper, "The Shell Beach, Bellambi, N.S.W." in which he gave an interesting account of the topography and history of the district. From the existence of a stratified shell and sand deposit on the foreshores, which covers an area of about five acres, and contains numerous shell remains, chiefly gastropods, Mr. STATHAM concludes that the sea must at one time have stood at a higher level, estimated to be twenty-six feet above present high water line when the last stratum of shell was laid. Remarks were made by Mr. HARPER, Acting-Professor COTTON and Dr. ANDERSON.

Dr. A. L. DU TOIT'S reply to Mr. E. F. PITTMAN'S criticism of his paper "The Problem of the Great Australian Artesian Basin," (This Journal, LI, 1917, pp. 135 – 208, *ibid.*, pp. 431 – 434), and Mr. PITTMAN'S rejoinder were read, and remarks made by Acting Professor COTTON and Messrs. HARPER, POOLE, HAMMOND, and CAMBAGE.

Monthly Meeting, 9th October, 1918.

Mr. J. E. CARNE in the Chair.

Ten members and two visitors were present.

EXHIBITS:

1. Acting Professor COTTON:—Slate from Burrinjuck with bands of pyroclastic intrusions.

2. Mr. MATHIESON:—*Cyathophyllum Shearsbyi*, showing budding.

3. Mr. W. R. BROWNE:—(*a*) Slickensided ore, North Mine, Broken Hill; (*b*) Encrusting secondary galena, North Mine, Broken Hill; (*c*) Pyromorphite crystals, Block 14 Mine, Broken Hill.

4. Mr. W. S. DUN:—*Martinia glabra*, Russia, showing spines.

5. Mining Museum:—(*a*) Platinum-bearing diorite, Walhalla, Victoria; (*b*) Wolfram and associated minerals, Bismuth Mine, Torrington; (*c*) Obsidian, Japan; (*d*) Graphic granite, Japan; (*e*) Rich tin ore (60 – 70%), Carpathia Mine, Ardlethan; (*f*) Molybdenite vein in decomposed slate, near Deepwater.

Mr. L. F. HARPER, F.G.S., read a paper "Intake Beds of the Artesian Basin other than those of Mesozoic Age." Mr. HARPER advanced the hypothesis that an appreciable volume of the water contained in the New South Wales

Artesian Basin is absorbed by beds of Permo-Carboniferous and Carboniferous Age. It was pointed out that large areas of these rocks occur along the N.E. side of the basin, and many of them consist of beds of porous sandstone of the former age, and arkose sandstone, equally porous, of Carboniferous age. The Permo-Carboniferous beds have a fairly consistent dip to the west, and it was claimed that water absorbed by them would filter into the artesian basin direct. The Carboniferous rocks are in the form of a series of anticlines and synclines, with a general synclinorium pitching to the west, so that water absorbed by them might also be expected to reach the basin finally. The altitude of a large area occupied by rocks of these ages is as much as 4,000 feet, and it was thought that this would have a favourable influence upon the hydrostatic pressure of the bore water.

The paper was discussed by Acting Professor COTTON, Messrs. POOLE, W. R. BROWNE, and the author.

Monthly Meeting, 11th December, 1918.

Mr. J. E. CARNE in the Chair.

Seven members and two visitors were present.

EXHIBITS:

1. Dr. C. ANDERSON:—Ironstone concretions from Cootawundy, near Wilcannia, Bingara Diamond Fields, and Tambo, Queensland.

2. Mr. C. A. SUSSMILCH exhibited specimens illustrative of his paper.

3. Mr. W. T. WATKIN BROWN showed a new meteorite, found twenty miles from Yenberrie Wolfram Field, Northern Territory. It is a siderite, belonging apparently to the class of Broad Octahedrites and weighing approximately thirty pounds.

4. Mining Museum:—(*a*) recent coral, coloured by carbonate of copper, New Caledonia; (*b*) garnierite, Celebes; (*c*) spheroidal siderite, Mount Elliott Mine, Queensland; (*d*) wind-abraded boulder of quartzite, Broken Hill; (*e*) graphic granite, Silverton Road, Broken Hill; (*f*) faulted and stretched pebbles from boulder clay, Poolamacca; (*g*) phosphate rock, Tennessee.

Mr. C. A. Sussmilch read a paper entitled "Notes on the Geology of the Gloucester District." The paper was discussed by Acting Professor Cotton, Mr. W. R. Browne, Major Walker and the author.

SECTION OF INDUSTRY.

ABSTRACT OF THE PROCEEDINGS

OF THE

SECTION OF INDUSTRY.

Monthly Meeting, 8th April, 1918.

Mr. W. T. Willington in the Chair.

Prof. N. H. Lefroy of the Imperial College of Science and Technology, South Kensington, gave a lecture upon "The Weevil Problem—Its Solution."[1] A series of lantern slides showed the conditions under which wheat had been handled and stacked at various centres before the weevil made its appearance. This was followed by a description of the kinds of insects infecting wheat. The Rice Weevil is most frequently found, then the Grain Weevil, followed by the Grain Borer. They are found in the approximate ratio of 87 : 35 : 24. These are the chief pests, and they are the most troublesome because they pass a portion of their life history within the body of the grain, and cannot be entirely removed by the mechanical process of cleaning which eliminates all the other pests such as the Red Flour Beetle, the Saw Tooth Beetle, Cadelle and the Flat Grain Beetle. The two weevils are most numerous and may be taken as one pest.

The life histories of all these insects were shown upon the screen and described by the lecturer. In the case of the weevils, the life history is completed in from four to eight weeks. Like some other insects they have parasites such as certain chalcid wasps which prey upon them, but

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[1] Reports of the lecture appeared in the *Sydney Morning Herald* and *Daily Telegraph* of April 9th, 1918.

these have very little effect, for in places where they were quite plentiful, the weevils did not seem to have lessened.

Grain with 8% of moisture is proof against weevil, and even with 10% it is fairly safe. Wheat will never absorb more than under 2% of moisture from damp air, even under extreme conditions, so that if it is stacked with 8% of moisture it should be fairly safe from weevil. The trouble is not brought about by moist air, but by water getting at the grain. The weevil multiplies rapidly in grain that has become wetted, and especially after fermentation has set in. In the stacks, there is always some place where through insufficient covering, rain has got to the grain, or where the grain falls from a pierced or burst bag to the ground, and gets damp. The damp grain serves as a breeding centre for the weevil.

Various disinfectants have been tried, but with some the smell is too persistent, and clings to the grain and damages the flour. Others, while destroying external insects, do not affect the grub within the grain. To be of use the disinfectant must not be too volatile, for it requires from 24 to 48 hours to ensure penetration, and yet it must be sufficiently volatile to become dissipated during storage or the subsequent milling. A good disinfectant has not yet been obtained.

The electrical method of endeavouring to destroy them by high voltages was ineffectual, as with a charge of 63,000 volts between two metallic plates, the insects simply stood on end, and when the current was disconnected, they ran off the plate. One cannot get the current to go through the weevils.

The method of destroying them by heat remained. In this connection, it has been found that if the grain is subjected to a temperature of 140° F. for three minutes, all the weevil is killed. The desideratum is to get a machine which will effectively and expeditiously heat the body of the grain to this temperature, so that the pest will be killed and the grain will not be cooked. Most of the machines designed for this purpose depend upon the grain being heated by hot air, and because of the greater specific heat of the grain as compared with air, it has been determined that 1,000 gallons of air are necessary to heat up one gallon of grain. The machine must, therefore, have a large air capacity. Many types of machines have been made by various makers within the last few months, and the principles underlying their mechanics were illustrated by the lecturer with the aid of the lantern. Some, as the Robinson machine, are already treating wheat, others are in the experimental stage.

The following notes were contributed :—

1. "Fixation of Nitrogen by Burchner's Method," by A. R. Penfold, F.C.S. Sodium cyanide is obtained by passing air through retorts containing briquettes made of iron, coke and soda ash.[1]

2. "Castor Oil grown in New South Wales," by W. M. Doherty, F.I.C., F.C.S. Oil of good quality was obtained from locally grown plants.[2]

3. "The Production of Potash," by A. E. Stephen, F.C.S. Attention was called to the necessity for augmenting our supply of potash salts.

4. "Power Alcohol," by Wm. Poole, B.E., M. Inst. C.E. A review of the Report upon Power Alcohol, issued by the Advisory Council of the Institute of Science and industry.

5. "Sources of Alcohol," by E. J. Statham, Assoc. M. Inst. C.E. The advantages of the Lower Hawkesbury as a suitable locality for establishing a factory for the production of alcohol was emphasised.

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[1] Fully reported in *Australasian Manufacturer*, April 27th, 1918.

[2] *Ibid.* April 20th, also *Chem. Eng. and Mining Journal*, June.

6. "Note upon above," by the Hon. Sec. With alcohol at the then contract price of 1/1 per gallon, the price of starch would require to be about ½d. per ℔. This precludes the use of cereals as sources of alcohol.[1]

Monthly Meeting, May 13th, 1918.

Mr. W. T. WILLINGTON in the Chair.

The Chairman gave an address upon "Progress of Manufacture in New South Wales," in which he referred to the early work of the pioneer manufacturers, and discussed the reasons for the slow progress made up to some thirty years ago. Since that time the progress has been of great magnitude, which is the more creditable as the difficulties of establishing industries in a new country, and the competition of outside manufacturers had to be surmounted, while the strong prejudice against locally produced articles had to be overcome. With a small and reducing margin, New South Wales may be accepted as a self supporting community, and should, in the not distant future, be in a position to largely export her manufactures.[2]

The following notes were contributed:—

1. "Report of the Nitrogen Committee," by B. J. SMART, B.Sc. The work may be regarded as a revolution in the attitude of the British Government towards science. Steps have been taken to conserve waste ammonia, to erect plant for the synthesis of ammonia from atmospheric nitrogen, for the oxidation of ammonia to nitrates, and for the production of cyanamide.

2. "The Removal of Rust from Iron Plates," by A. D. OLLÉ, F.C.S. A mixture of two parts of sodium bisulphate and one part of common salt are wetted and applied to the rusty plate; when the plate is clean it is washed with an

[1] *Ibid.* May 4th.
[2] Fully reported in *The Australasian Manufacturers' Journal*, June, 1918, p. 37.

alkaline solution. The efficiency of the method was shown by an exhibit, and confirmed by Mr. B. J. SMART.

3. "The Minimum Effective Quantities of Disinfectants Required for Efficient Fumigation," by R. W. CHALLINOR, F.I.C.,F.C.S. A reference to the work of KINGZETT, BOTTOMLEY and BRIMLEY, indicating the smallest amount of disinfectants required to disinfect a room as indicated by the destruction of *Bac. typhosus.* The note led to an animated discussion in which the following took part; Drs. J. B. CLELAND and R. K. MURPHY, Messrs. B. J. SMART, F. OAKDEN, T. I. WALLAS, S. E. SIBLEY, A. D. OLLÉ, G. I. HUDSON, A. B. HECTOR, and the Hon. Sec.

This being the Annual General Meeting the following business was done:—

Rule—"That the retiring Chairman should be a member of the Committee *ex officio*, for three years." Proposed by Mr. A. B. HECTOR, seconded by Mr. S. E. SIBLEY, and carried.

Rule—"That the Committee consist of seven members, exclusive of *ex officio* members." Proposed by Mr. A. D. OLLÉ, seconded by Dr. GREIG-SMITH, and carried.

Rule—"That the past President of the Society be an *ex officio* member of the Committee." Proposed by Mr. A. F. OSBORN, seconded by Mr. A. D. OLLÉ, and carried.

The Sectional Office-bearers were elected:—Chairman, Mr. W. T. WILLINGTON. Hon. Sec., Dr. R. GREIG-SMITH. Committee—Dr. R. K. MURPHY, Dr. J. D. GRANGER, Messrs. J. NANGLE, A. B. HECTOR, J. HENDERSON, B. J. SMART, and F. W. STEEL.

Monthly Meeting, June 10th, 1918.

Mr. A. B. HECTOR in the Chair.

The following notes were communicated :—

1. "The Toxicity of Wood Alcohol," by R. W. CHALLINOR F.I.C., F.C.S. The manufacture of methyl alcohol was described, and instances were detailed of its poisonous effects when drunk.[1] The paper led to a useful discussion by Prof. C. E. FAWSITT, Messrs. W. POOLE, T. I. WALLAS, F. W. STEEL and the Chairman.

2. "Industrial Betterment," by W. W. L'ESTRANGE. Attention was called to the necessity for considering the comfort and health of the workers when a maximum output is expected, and an excessive turnover of labour is to be minimised.[2] A discussion was contributed by Dr. C. S. WILLIS, Messrs. DARNELL-SMITH, F. W. STEEL, A. D. OLLÉ, T. I. WALLAS, the Chairman and the Hon. Sec.

3. "Industrial Fatigue," by the Hon. Sec. The cause of fatigue was shown to be of nervous origin, the remedy for which was properly proportioned rest periods.[3] The subject was discussed by Dr. C. S. WILLIS, Messrs. A. D. OLLÉ, T. I. WALLAS, DARNELL-SMITH, and the Chairman.

4. "The Bulletins published by the Advisory Council of the Institute of Science and Industry." The Hon. Sec. drew the attention of members to these publications which are sent post free upon request.

Monthly Meeting, July 8th, 1918.

Mr. A. B. HECTOR in the Chair.

Mr. H. B. SEVIER gave a lecture upon "Modern Methods of White Lead Corrosion." After explaining the various methods which have been tried for corroding the lead, the lecturer described the old Dutch method, which with few

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[1] Reported fully in *The Australasian Manufacturer,* No. 120, July 20, also in *Chem. Eng. and Mining Journal,* July.

[2] *Ibid.*, No. 117, June 29th.

[3] *Ibid.*, No. 116, June 22nd, also in *Chem. Eng. and Mining Journal* September.

alterations is in general employment at the present time. The details of the process as conducted at Rhodes near Sydney were given. The main improvements consisted in the corroded lead being manipulated in contact with water and finally with oil. The process is automatic from the time that the corroded buckles are taken from the stoneware pots until the finished white lead in oil is obtained.

Mr. H. J. SULLIVAN continued the lecture, describing the blending of the white lead with pigments, and explaining the research work necessary in a paint factory to maintain and improve the quality of the products. He detailed the methods used in standardising the chemical and physical properties of his firm's products.

The lecture was followed by a discussion, in which the following took part, Dr. J. B. CLELAND, Messrs. WM. POOLE, A. D. OLLÉ, J. A. YOUNG, FINLAY, NEIL, WATT, the Chairman and the Hon. Sec.

Mr. SEVIER invited the members to inspect the works of Messrs. Lewis Berger and Sons at Rhodes, and twenty-five accepted the invitation upon August 13th.

Dr. R. K. MURPHY contributed a note upon Cobalt Plating which of recent years had been suggested as a substitute for nickel plating. The advantages are that iron, steel, and brass can be plated directly and more rapidly than with nickel, the material to be plated does not require the same careful preparation, and the finished surface is harder and does not scratch so easily. The present price for cobalt in Australia, however, would prohibit its general use, but if a demand should arise, the price would probably fall sufficiently to enable it to compete with nickel.

Monthly Meeting, August 12th, 1918.

Mr. W. T. WILLINGTON in the Chair.

Mr. F. OAKDEN gave a lecture upon "Progress in Cement Making." After referring to the increase in the world's production of cement during the last thirty years, the lecturer proceeded to describe the various improvements in the mills for grinding together the chalk and clay, and in the kilns for converting the "slurry" into "slip" and finally into "clinker." The gradual improvements in the kinds of kiln from the primary Bottle type to the Ransome rotary kiln were illustrated by means of diagrams. It was to the invention and improvements in the rotary kiln that made the increased production of cement possible. The evolution of the method of grinding the "clinker" was shown by the changes from the old stone mill to the Krupp combined crushing, pulverising and sifting rotary mill. Emphasis was laid upon the fact that the efficiency of a cement depended largely upon its fine state of division as comparatively large particles are inert and behave like sand.

The lecturer dealt with the varieties of specifications laid down by the various State Governments, and as confusion tended to retard the industry, he suggested that scientists should move in the matter of obtaining a standardisation of the specifications.

Mr. MORRISON followed with a description of the physical properties of cement as indicating its value. He gave the various standards adopted by the New South Wales Government, and the methods used for testing cement. The breaking strength was demonstrated by means of the standard apparatus.

The Chairman in thanking the lecturers, mentioned that the question of standardisation was part of the scheme of the Institute of Science and Industry. A discussion upon the lectures was contributed by Dr. R. K. MURPHY and Mr. W. M. HAMLET.

Monthly Meeting, September 9th, 1918.

Mr. W. T. WILLINGTON in the Chair.

Mr. P. G. L. Law gave an address upon "Some Impressions upon the Conditions of Labour as they exist in America and Australia." Contrary to anticipation the lecturer had found that in the States, education was not as general as in Australia; organisation was on the average not any better, while efficiency taken all round was lower than with us. But there are in America some of the most highly efficient and best organised businesses in the world, and these are showing the way for the others to follow.

There are few organised labour troubles, the workers take individual action, and in some works the average length of service is only six weeks. In 1916, 13,000 men were hired in a Pittsburg establishment to keep up a staff of 1,700. Organisation, industrial welfare and profit-sharing are slowly but effectively reducing this great "turnover" of labour. American employers encourage suggestions from their employees, and are thus developing the constructive faculty which is becoming a trait in the national character.

In the shirt and collar trade, America is ahead in collar-making, because they are able to use machinery which with our smaller market it would not pay to put in. But with standardised articles such as shirts, our labour costs are less than theirs, and we turn out as many per week although we work for 15 hours less. If this can be done with shirts it can also be done with other articles, but the crying necessity in Australia is to have our articles standardised. Why should blankets have blue bands at the ends? The custom neither makes for efficiency in their use nor in their manufacture.

The lecture was followed by a discussion in which Messrs. Loxley Meggitt, F. W. Steel, Napier Thomson, A. A. Hamilton, A. F. Osborn and the Chairman took part.

Monthly Meeting, October 14th, 1918.

Mr. LOXLEY MEGGITT, F.I.C., F.C.S., in the Chair.

Mr. WM. DOHERTY, F.I.C., F.C.S., read a note upon "Iodine in our Seaweed."[1] He had analysed a large variety of Laminaria *(Ecklonia radiata)* obtained near Sydney Heads and found it to contain Iodine 0·06% in the fresh weed, 0.40% in the dry state and 1·5% in the ash. This was equal to 33·6 lbs. per ton of ash. In the discussion contributed by Messrs. S. E. SIBLEY, F. A. RANDLE and J. E. BISHOP, it was pointed out that the world's supply of Iodine was obtained chiefly from Chili, as a byproduct in the production of Nitrate of Soda, and the price was determined by a "ring."

Mr. F. A. RANDLE gave a lecture upon "Modern Illustrative Processes," in which he traced the evolution of book illustration from the invention by the Chinese of fixed type and by the Koreans of moveable type. Line engraving upon wood, the discovery of the use of porous stone in lithography, and other processes were described. The modern photographic methods in black and in colour were given in detail, and were illustrated by examples and by practical demonstrations.

Monthly Meeting, November 11th, 1918.

Mr. W. T. WILLINGTON, O.B.E., in the Chair.

The Chairman announced that news had been received during the last hour, by cable, notifying that the armistice had been signed by the Central Powers. He shortly spoke upon the glorious victory that had been obtained by the armies and navies of the Allies, and asked the members to join in singing "God Save the King." This was followed by cheers for the King and for the heroes who had helped

[1] Reprinted in the *Chem. Eng. and Mining Journal,* November, 1918.

to gain the victory and end the greatest war the world had seen.

The Hon. Sec. congratulated the Chairman upon having received the honour of Officership of the British Empire.

Mr. E. P. FINLEY gave a lecture upon "The Art of the Potter." Denmark imports almost every item of material necessary for the manufacture of porcelain, and yet the Royal Copenhagen Porcelain stands highest to-day in the records of all time. Australia has many of the materials, and there is no reason why it should not produce as fine porcelain as Denmark. A description of the materials used, and the properties which they confer upon the finished porcelain was followed by the details of manufacture. The clay is washed and sifted, the runnings evaporated, then pressed to produce a thin "slip" of uniform consistency, which is worked into various shapes. A demonstration of throwing on the wheel was given by an expert potter, who quickly converted a slab of clay into vessels of diverse shapes. The construction, loading and firing of the kiln, the burning of biscuit ware, and of the glazed shapes was described in detail, and an explanation followed of the composition and chemical action of glazes, and also of the various methods used in applying the design to pieces of decorated ware. To illustrate these processes specimens of Barbotine and Intarsio vases, designed and fashioned by the hands of the lecturer were exhibited, as well as a valuable and beautiful collection of both antique and modern pieces to illustrate the art at various periods.

Monthly Meeting, 9th December, 1918.

Mr. W. T. WILLINGTON, O.B.E., in the Chair.

Mr. A. D. OLLÉ gave a lecture upon "The Vagaries of the Electric Bell," in which the lecturer traversed ground familiar to experienced electricians. The lecturer dealt in detail with the structure and parts of the bell and battery, and gave the conditions that make for good and efficient service.

The zinc should be of drawn, not cast rod, and should be amalgamated. The manganese in the Lelanché cell should be native pyrolusite, and while ammonium chloride is best it could be substituted by sodium chloride. To prevent the evaporation of the ammonium chloride solution, it is desirable to cover the liquid with a mixture of resin 1 part, Venetian turpentine 1 part, and paraffin 2 parts. This has a melting point of 60° C. Good bells, made of 26 silk covered wire, and having platinum points of contact, should be used, and the connecting wires (20 for household use), should be stapled singly. Old Lelanché cells could be revivified by immersion in moderately strong hydrochloric acid, and used up dry cells, could, after puncturing the zinc casing, be utilised as Lelanché cells by immersing in dilute ammonium chloride. Questions were asked by Messrs. F. W. Steel, R. W. Challinor and the Hon. Sec.

Mr. A. B. Hector gave a lecture upon "Business Resonance or Live Wires and Wireless." Beginning with the statement that business is everyone's avocation, the lecturer proceeded to deal with resonance, demonstrating the absorption and emission of sounds of the same pitch by tuning forks. The structure of the ear followed, and emphasis was laid upon the hairs of Corti which, like a row of tuning forks, took up the vibrations transmitted to the lymph by way of the bones from the drum of the ear. The mechanism of receiving and transmitting the sounds to the brain is similar in some respects to the Marconi system of wireless telegraphy, which was described. Resonance is the basis of wireless and business. The business man must become attuned with his customers, and the best way of getting in tune is to sell good articles. He should endeavour to induce the buyer to think as he does. It is also important for the employer and employed to get into intelligent sympathy with each other, and therefore resonating one with the other, for this is the only true way of solving the differences between Capital and Labour.

A good discussion was contributed by Messrs. R. W. Challinor, S. H. Smith, F. W. Steel, A. D. Ollé, Loxley Meggitt, A. A. Hamilton, J. Taylor and the Chairman.

In his reply, the lecturer emphasised the importance of resonance to the teacher, and suggested that it were better to get the best brains to teach the boy to keep him out of jail than to employ the best legal brains to put him there.

The Chairman wished the members the Compliments of the coming Season.

SECTION OF AGRICULTURE.

ABSTRACT OF THE PROCEEDINGS

OF THE

SECTION OF AGRICULTURE.

Monthly Meeting, 13th March, 1918.

Mr. H. W. Potts, Chairman, in the Chair.

An address on "Agricultural Education in England, Canada and Australia Compared," was delivered by the Chairman. The lecture was illustrated with a fine series of lantern slides. The popularity and respect with which agricultural education was received in America, was shown by the fact that in the year 1914 no less than 1,652 students received tuition at the Guelph Agricultural College in Ontario, Canada. Located at this college was Professor Zavitz, who, by selection, has improved cereals, particularly barley, to such an extent that 93% of the barley grown in Canada is bought from the college. In Canada, in 1915, there were 4,552 experiment plots, conducted by private farmers. The exhibits from the different colleges and those from the experiment plots, displayed at the Toronto National Exhibition, were sights never to be forgotten. Although the theoretical training at the college was everything to be desired, there was a decided lack of properly supervised practical training, and this, which occupied five months of the year, had to be received at the hands of the farmers.

Coming to England, the lecturer pointed out the stimulus given to stud-breeding by his late Majesty, King Edward VII. Of late years some fine agricultural colleges had been established at Swanley, Wye, Reading and Cambridge.

At the last named institution Professor BIFFEN was doing excellent work in plant breeding, and arrangements had been made for New South Wales Farrer research scholars to study under him. Speaking generally, public interest in agricultural education in England was far inferior to that in America, but the results from the newly instituted colleges must surely, if slowly, be felt.

The lecturer thought that the development of agricultural education in Australia was encouraging for the future, but needed much more financial backing than it received at present. Hawkesbury Agricultural College carried out a very complete course of instruction for students, and was extremely popular, as shown by the large increase in the number of students during the present year. The sound theoretical training received was supplemented by a complete course of supervised practical instruction.

Monthly Meeting, 14th May, 1918.

Mr. F. B. GUTHRIE in the Chair.

The following officers were elected for the ensuing year:—Chairman—H. W. POTTS, Esq., J.P., Principal, Hawkesbury Agricultural College. Hon. Secretary—E. BREAKWELL, B.A., B.Sc. Committee—Drs. CLELAND and GREIG-SMITH, and Messrs. GUTHRIE, DARNELL-SMITH, STEPHEN, CHEEL, WRIGHT, OLLÉ, SACHS, HINDMARSH, and WARD.

Mr. P. HINDMARSH, M.A., delivered a lecture on the latest researches in "The Inheritance of Fecundity in Fowls." The lecturer dealt with the researches carried out by Dr. PEARL, U.S.A. This investigator claims to have proved that the record of fecundity of a hen taken alone is no guide to the probable egg-production of its daughters. This was shown by the fact that the average winter record of registered hens (Barred Rocks) was 55·89 and that of their daughters 15·29.

Mr. HINDMARSH showed by Mendelian graphical representation how Dr. PEARL proved that fecundity in fowls is inherited, and how pure strains could be determined by the study of pedigree lines. He claims that the study of winter production is the best guide to the innate capacity in regard to fecundity. At that period of the laying cycle the widest difference in fecundity is exhibited. There were three well defined classes in this respect, viz. (1) zero winter production; (2) under 30 (eggs); and (3) over 30. Dr. PEARL claims to have proved (1) that low fecundity may be inherited from the sire or the dam; (2) high fecundity is not inherited by the daughter from the dam; (3) high fecundity may be inherited by the daughter from the sire independent of the dam. The interpretation was based on (*a*) hypothesis of sex as an inherited character on a Mendelian basis; (*b*) the male is the homozygote and the female the heterozygote in respect to sex inheritance, and (*c*) high production was a sex-linked character.

Dr. CLELAND considered it doubtful whether there could be birds with pure maleness or femaleness respectively.

Mr. DUNNICLIFF said that Dr. PEARL'S theory could not be accepted without reservation, because there were limiting factors. The Hawkesbury College Laying Competitions appeared to contradict the principle laid down as regards winter egg production.

Messrs. SHELTON, GUTHRIE and Dr. GREIG-SMITH also spoke.

Monthly Meeting, 9th June, 1918.

Mr. F. B. GUTHRIE in the Chair.

Mr. E. BREAKWELL contributed a note and exhibited "Variations in Saccharine Sorghums." It was pointed out that sorghum is a crop very prone to variation and splitting into types, owing to the facility with which natural crossing was effected. Types could thus be selected, which, if grown so that crossing with other types could be prevented, would remain remarkably true to type. Considerable scope was therefore given to the plant breeder in improving Sorghums by a process of selection.

Mr. DALTON contributed notes and exhibits on two widely distributed plants which had certain economic features. These were *Asclepias physocarpus*, a weed introduced from South Africa, and *Alpinia cœrulea.* The former had a fibre of great tensile strength, with flowering buds filled with a cottony substance. Mr. R. T. BAKER reported that the fibre was superior to that of jute, in having a breaking strain of 28·98 kgs. per sq. mm. as against 23·86 kgs. per sq. mm. for that of jute, and the preliminary testing of this fibre showed promising results.

Alpinia cœrulea was closely related to our ginger of commerce, and still more closely related to *Alpinia nutans*, from which Galangal, a medicinal soporific, was obtained.

Mr. H. W. HAMILTON delivered a lecture on "Birds of the Farm," illustrated with a fine series of lantern slides depicting the habits of the birds, and, in many cases, their protective colouration. The lecturer said that birds could be divided into three groups according to their environment, viz. (1) birds of the field; (2) birds of the water; and (3) birds of the air. The most important birds from the farmer's point of view were the insectivorous birds, including the willie-wagtails, various robins, blue wrens, peewee, magpie, jacky-winter, ibis, jackass and curlew. Amongst the insects destroyed by these birds were codlin moth, blowfly, cutworms, grasshoppers and various scale insects. Investigations carried out in a natural rookery of Ibises, in the Riverina district, showed the presence of 240,000 ibises, and on examining a few specimens, 2,000 immature grasshoppers were found, on an average, in each bird's stomach;

this would mean the destruction of 480,000,000 grasshoppers in a day. Reference was also made to the destruction of small noxious rodent animals, as field mice, bush rats and rabbits, by owls, moreporks and hawks. Immense quantities of guano had accumulated from birds on ocean islands. The lecturer made out a strong case for the better protection of useful bird life in New South Wales. America had societies for this purpose throughout the length and breadth of the land. Although legislation was in force in this State, the laws were often broken with impunity, and the surest way of preserving bird life was to educate the people, such as the Gould League of Bird Lovers was doing.

Mr. GILDER referred to the valuable work Dr. CLELAND was doing in examining the contents of bird's stomachs, with a view towards determining their economic value or otherwise.

Monthly Meeting, 11th July, 1918.

Mr. H. W. POTTS in the Chair.

Mr. SACH read a note on "The Probable Cause of Woodiness in Passion-fruit. He stated that as the result of three years' experience in growing passion vines at his own home in which some vines were completely exposed to the south and south-east winds, and others were completely sheltered, he had come to the conclusion that the deformed fruit on the exposed vines was due to the cold winds. When grown in sheltered situations the fruit was quite normal.

Mr. DARNELL-SMITH thought that cold winds were not the only explanation. In some cases woodiness was due to bad soil, in others to bad pruning. The development of woodiness in passion-fruit was very erratic.

Mr. E. BREAKWELL read a note on "The Cultivation of Grasses and Fodder Plants at Public Schools." Very valuable work was being done in this direction, and the data obtained by the pupils on the growth of our native grasses justified a considerable extension of this work.

Professor KOIDE delivered a most interesting lecture on "Agriculture in Japan." A complete account of this lecture was printed in book form and presented to the Library of the Society.

Monthly Meeting, 13th, August, 1918.

Mr. H. W. POTTS in the Chair.

The President drew the attention of the Section to the very generous action of Mr. SPENCER WATTS, in having printed in excellent form, 75 copies of Professor KOIDE'S paper on "Agriculture in Japan," read at the previous meeting, for distribution amongst members. A very hearty vote of thanks was accorded Mr. WATTS.

Mr. HADLINGTON, Poultry Expert, discussed in detail the advisability of testing Dr. PEARL'S researches on "The Inheritance of Fecundity in Fowls." He pointed out that certain of Dr. PEARL'S conclusions were now being tested at the College, but the results were not yet available. He was doubtful whether high winter production betokened high fecundity. Other features mentioned in Dr. PEARL'S researches also required explanation.

Mr. E. BREAKWELL delivered a lecture on "Experimental Work with Grasses and Fodder Plants," illustrated with lantern slides. The lecturer pointed out that no opportunity was provided until recent years for the testing of native and introduced grasses and fodder plants at the State Experimental Farms. It was shown that very often an introduced grass was particularly valuable, as in the case of Soudan Grass from Northern Africa, and Napier's Fodder Grass from Rhodesia. Although Paspalum had obtained a strong hold on the Northern Rivers, there were other grasses here, Para, Guinea and Rhodes Grass, which could be grown in separate paddocks, and which would provide a more balanced ration than Paspalum alone. In attempting to bring native grasses under cultivation the best results seemed obtainable from the species of those genera of grasses which were native to this country, but which were also found in different parts of the world. This appeared to imply that such grasses were plastic enough in their structure to respond to changed conditions. Many of the native grasses were being tried at Coonamble Experimental Farm to determine the exact changes that take place in the composition and relative sizes of the grasses and herbage, typical of the black soil, (1) when overstocking was indulged in, (2) when grazing was carried out for a certain portion of the year, and (3) when a pasture was protected continually from stock.

Certain native grasses were proving very promising for laying down in cultivated pastures in wheat growing districts. The everlasting or neverfail grasses of the interior, with their wiry curled-up leaves and densely hairy stems, were admirably adapted for hot, scorching winds and baked soils, but were most unhappy when removed to more congenial surroundings. The manner in which native grasses of the interior could stand up to the hot summer conditions was remarkable, and it would be to the nation's permanent loss were such a rich heritage lost or affected by bad management of pastures.

Saltbushes and other native edible trees and shrubs should be developed much more than at present. The Grain Sorghums were also, as a result of selection and acclimatisation, producing most satisfactory results. The practical development of grasses and fodder plants was an important part of the work of the State Agricultural Department.

Monthly Meeting, 11th September, 1918.

Dr. J. B. CLELAND in the Chair.

The report of the sub-committee in connection with the development of horticulture was submitted. It was resolved that a letter be written to the Minister of Agriculture, drawing his attention to the necessity for the establishment of a School of Horticulture, and inviting his assistance in the matter. It was resolved that the Section should offer their services as a sub-committee in order to carry out experiments to test Dr. PEARL's mean hypotheses, the committee to consist of Professor WATT, and Messrs. H. W. POTTS, DARNELL-SMITH, and HINDMARSH.

Mr. E. M. WARD delivered a lecture on "Hybridisation." The lecturer referred to the rapid progress made in the hybridisation of flowering plants and fruits. As far as horticulture was concerned, it was not necessary to have fertility in the hybrid, as a sexual propagation from cuttings or buds could be carried out with the hybrid. This was the case with the beautiful display of Begonia Gloire de Lorraine in one of the Botanic Gardens' houses. Expert plant breeders hybridised to get a break or to obtain the ideal for which they had been seeking. Then by selection and breeding they aimed at fixity of the plant. Crossing different genera or different species led to sterility in the progeny, and seemed impracticable from an agricultural point of view. In the case of graft hybrids, it was only factors like increased vigour, productiveness, or flavour which were influenced by the stock. Mr. WARD showed what could be done by crossing, instancing the Ettersburg strawberry. This was raised by Mr. Etter, of Ettersburg, California. By crossing different species, he produced the Rose Ettersburg with no flavour. Knowing that the common alpine strawberry had a good flavour, he crossed this with the Rose Ettersburg, and as a result produced the famous tree Ettersburg No. 80.

Monthly Meeting, 9th October, 1918.

Mr. H. W. Potts in the Chair.

Mr. P. Gilder opened a discussion on "The Effect of the Stock on the Scion in Fruit Trees." It was pointed out that the value of bud selection was a subject of decided economic importance, and that if all observers would record their impressions on a uniform basis, an extensive collection of data could eventually be made, from which conclusions could be drawn, and this would provide a convenient jumping off ground for systematic inquiry in the future. In discussing in detail the uses of different stocks for different purposes, the lecturer remarked that the universal popularity which Northern Spy possessed as a stock for the apple, in New South Wales and Victoria was somewhat astonishing. This was in spite of the fact that Winter Majetin was considered by some as equal to Northern Spy in respect of blight resistance, and superior to it in respect of Bitter Pit; and at Capertee, New South Wales, Winter Majetin stocks are producing a better development of tree and root system, and greater freedom from other diseases. Again different stocks were used for different soils as in the case of plums and oranges. Certain stocks were also used for dwarfing apples, and the Mahaleb stock for dwarfing cherries.

In investigating the effect of the stock on the scion, one should not lose sight of the factor of bud variation. From such a sport the Washington Navel Orange had originated, and Shamel, the Californian scientist, had shown that great variations existed in the trees propagated by such buds, and that a considerable increase in yield could be obtained by selecting the right types.

Mr. E. BREAKWELL referred to the latest investigations which absolutely proved that alkaloids, like nicotine, could migrate from scion to stock and vice versa.

Mr. STEPHEN referred to personal cases where grafted scions did better than seedlings. The Gravenstein Apple was noted for canker, and the best stock for such an apple should be studied. He thought that this important matter should be brought before the attention of orchardists.

Mr. POTTS referred to the good work America was doing in this connection.

Mr. A. A. HAMILTON thought that trained observers would be necessary before experiments could be properly carried out. It was decided that opinions be obtained through the "Fruit World" from orchardists in regard to this important matter.

Mr. A. D. OLLÉ read a letter from Mr. HUGH DIXSON in regard to Indian Wax Scale. The writer pointed out that he had drawn the attention of the Agricultural Department to the possibility of obtaining a better destructive agent than washing soda. In experiments which he had carried out, he found that the wax constituted one-third the bulk of the whole scale, and it might be just possible that a new source of wax would arise. It was decided to draw the attention of the Agricultural Department to this matter.

Mr. STEPHEN exhibited samples of two varieties of Cotton grown in Queensland, and emphasised the excellent prospects of this industry.

The meeting in November lapsed owing to Armistice celebrations.

Monthly Meeting, 10th December, 1918.

Dr. CLELAND in the Chair.

Mr. A. E. STEPHEN exhibited a soil fungus from the Narara Viticultural Station.

Mr. CHEEL stated that the fungus resembled Blackfellow's Bread, a specimen of which he exhibited.

Mr. STEPHEN'S exhibit consisted of earthy matter, with mycelium interwoven with it, believed to be that of *Polyporus tumulosus.* The sporophores were very rare.

Dr. CLELAND pointed out there was an essential difference between the false sclerotium of the exhibit and the true Blackfellow's Bread; the false sclerotium was a mass of sand and mycelium, with a thin crust of felted mycelium. He had only found two sporophores of this *Polyporus tumulosus*, these occurring about the autumn after heavy rain.

Mr. STEPHEN said that the Superintendent of the Narara Station regarded the soil in which the fungi occur as infertile.

Dr. CLELAND stated that the phenomenon might be similar to the "Fairy Ring," infertility being due to soil moisture being prevented from reaching the surface.

Mr. A. D. OLLÉ exhibited a specimen of *Alyxia buxifolia* from Western Australia. An infusion of the leaves was very commonly used by camel drivers, and on the Western Australian gold-fields as a cure for dysentery. The leaves were supposed to contain coumarin. An infusion of the bark had been used and patented as a "cure-all" on the south coast of New South Wales in 1888, and called the "Physic of the Sea."

Mr. CHEEL advised caution in using the plant internally, as many of the Apocynaceæ contained a milky fluid of a poisonous nature.

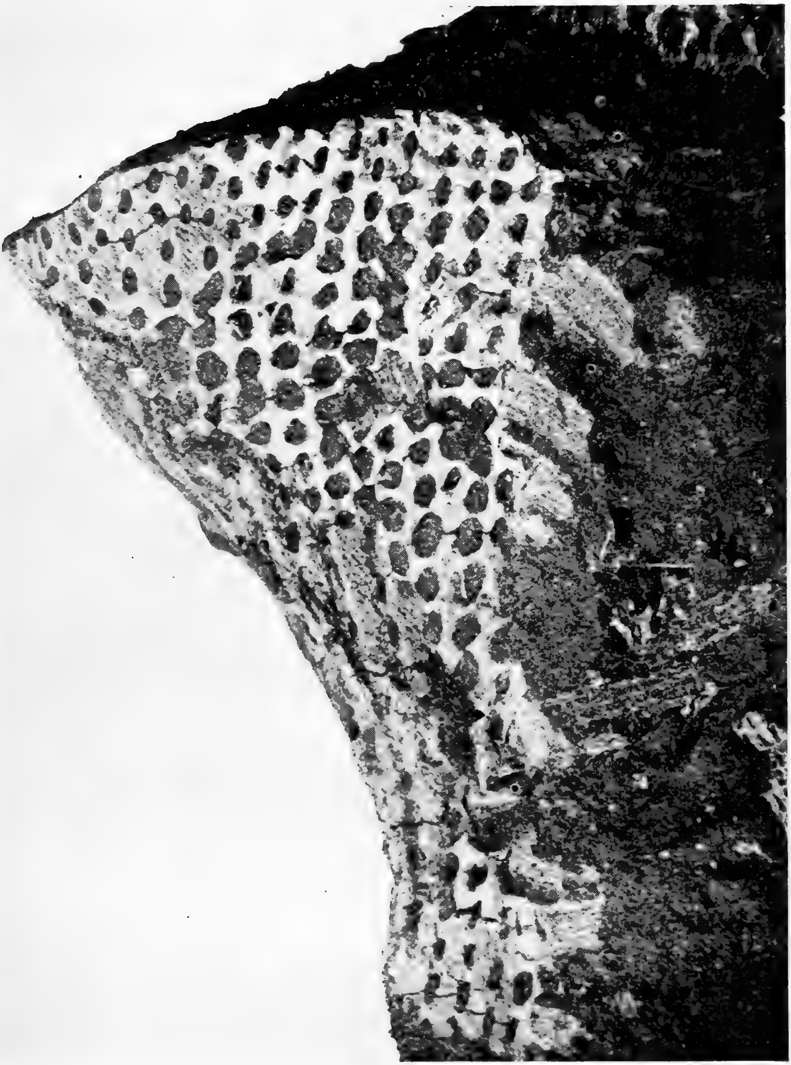
The report of the Sub-committee in devising experiments upon the "Inheritance of Fecundity in Fowls," was then discussed. These experiments, which were outlined in detail, were of special economic importance and would prove or disprove Dr. PEARL'S conclusions.

Mr. HADLINGTON pointed out that, owing to great variations in both Leghorn and Game birds, the work would need to be done in triplicate, and with check experiments also. There were not twelve tested hens available of over 250 egg capacity, and the standard would need to be lowered to 220. He advised that the Department should be asked to carry out experiments to determine, if possible, the manner of transmission of fecundity through the male. The capacity to pick out prepotent animals was, in his opinion, the basis of all breeding.

It was decided that the Experiments Supervision Committee carry out experiments along the lines stated in the report, and that members of the Sub-committee be given the opportunity of making personal observations.

INDEX.

Sydney:
F. W. White, Printer, 344 Kent Street.
1919.



Protoretepora montuosa, sp. nov. × 3.

Fig. 1.

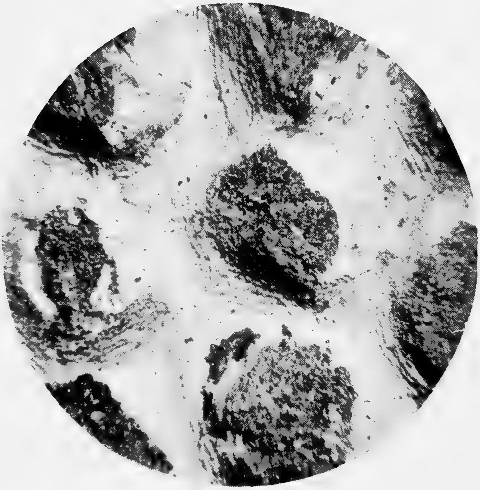


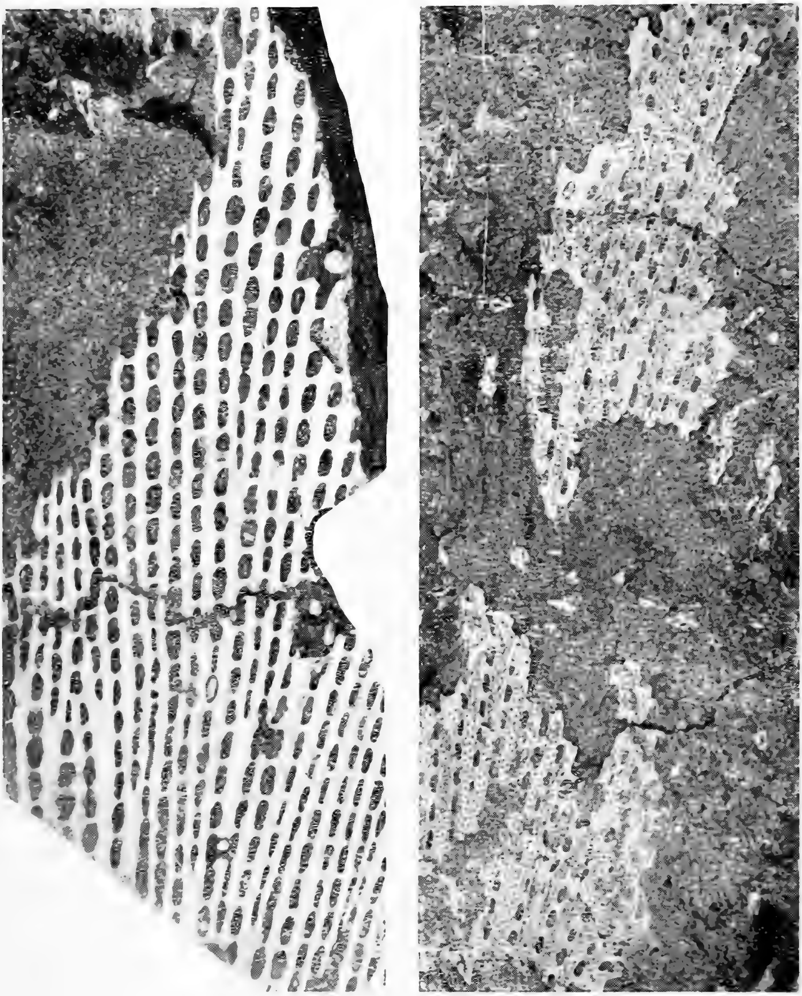
Fig. 2.

Protoretepora montuosa sp. nov. × 20.

Fig. 1. **Phyllopora** or **Protoretepora** sp. indet. × 20.

Fig. 2. **Protoretepora montuosa** sp. nov. × 20.

Protoretepora ampla Lonsdale. × 4.



Polypora pertinax sp. nov. × 3.

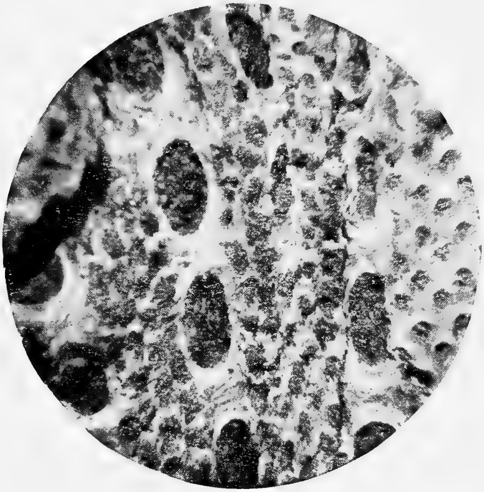


Fig. 1.

Fig. 2.

Polypora pertinax sp. nov. × 20.

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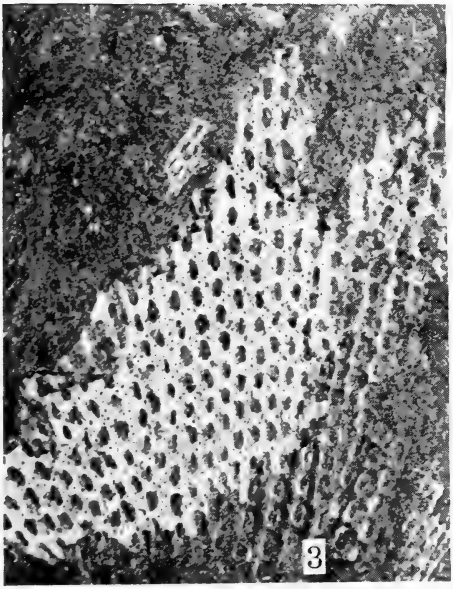
2



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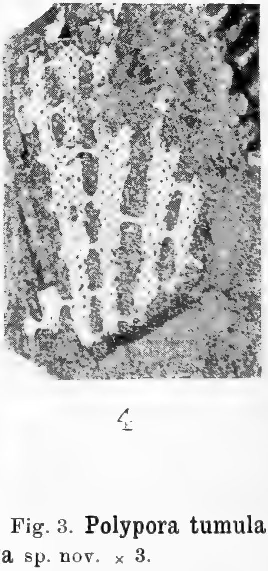


4

Figs. 1 and 2 **Fenestella exserta** sp. nov. × 3. Fig. 3. **Polypora tumula** sp. nov. × 3. Fig. 4. **Polypora virga** sp. nov. × 3.

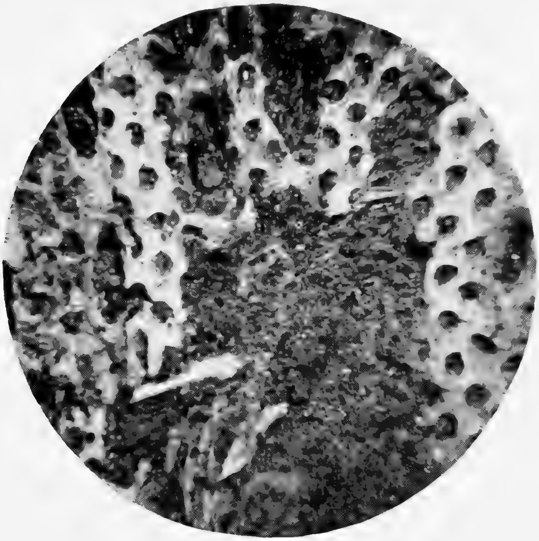


Fig. 1. **Polypora pertinax** sp. nov. × 20.

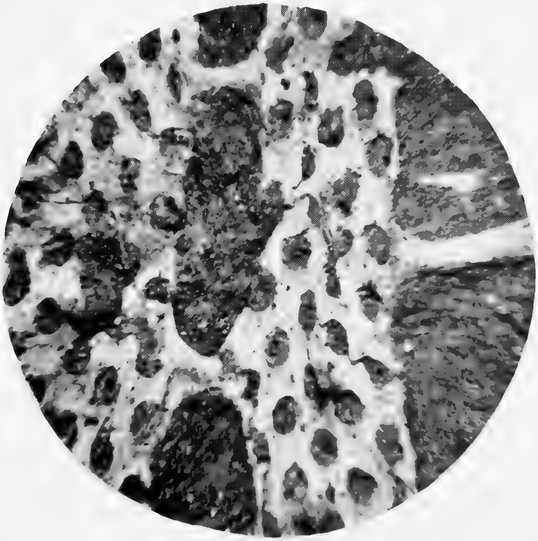


Fig. 2. **Polypora virga** sp. nov. × 20.

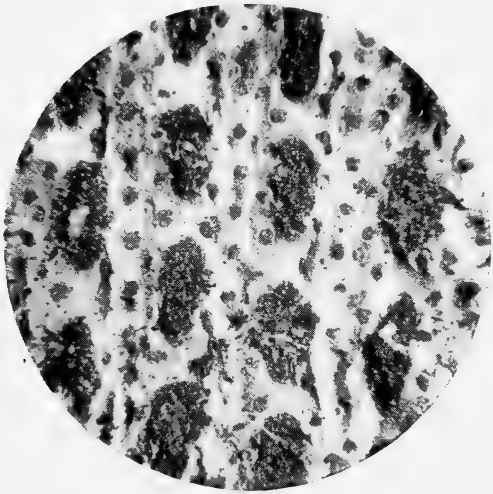


Fig. 1.

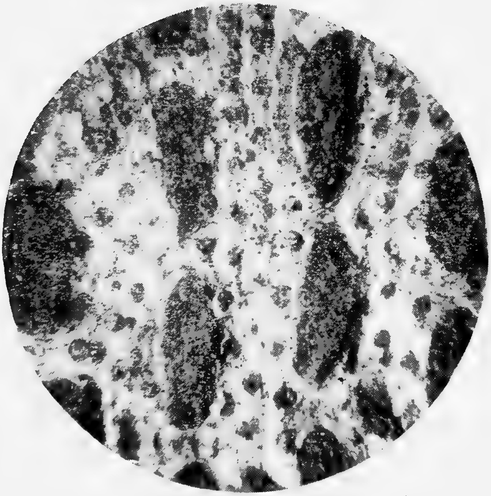


Fig. 2.

Polypora tumula sp. nov. × 20.

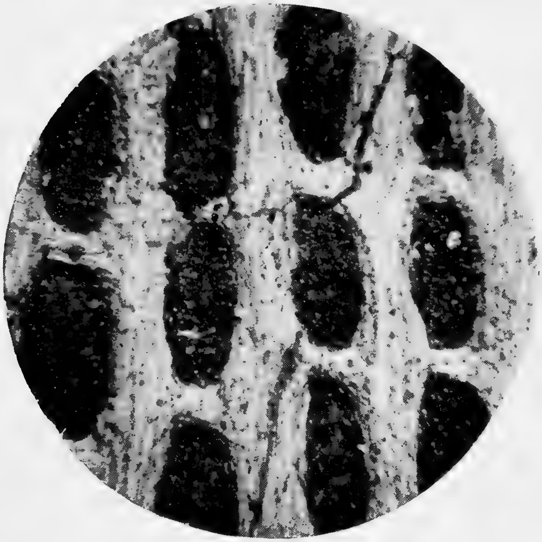


Fig. 1. **Polypora pertinax** sp. nov. × 20.

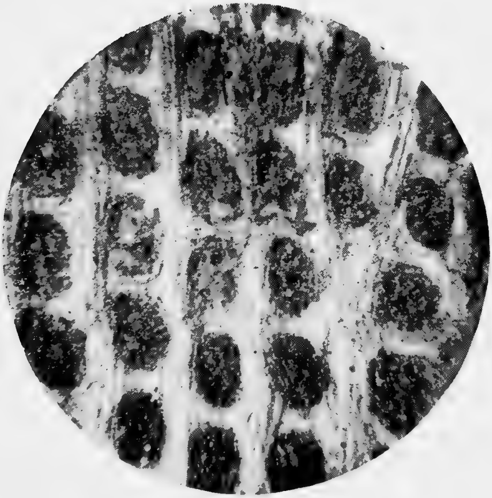


Fig. 2. **Fenestella internata** (?) Lonsdale. × 20.

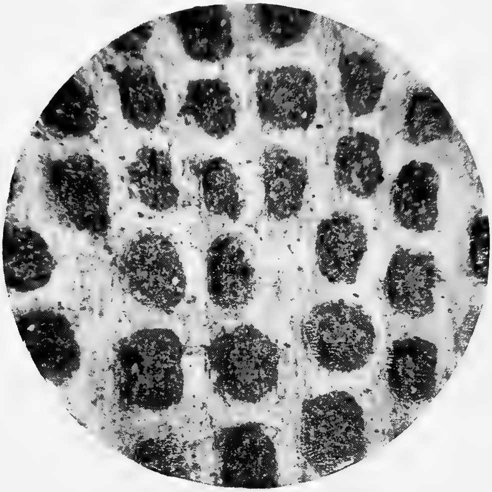


Fig. 1. × 20.

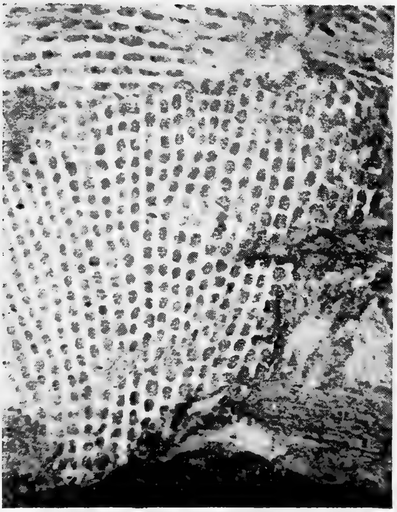


Fig. 2. × 3.

Fenestella internata (?) Lonsdale.

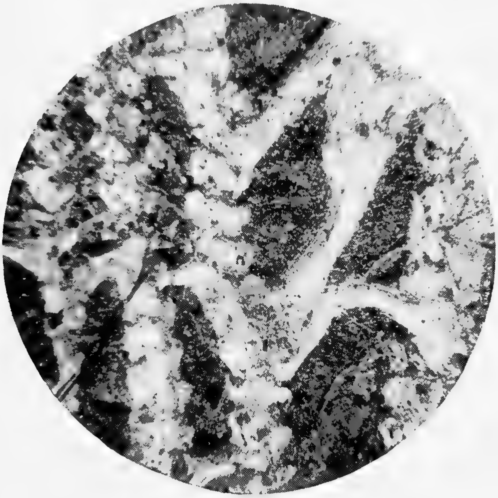


Fig. 1.

Fig. 2.

Fenestella exserta sp. nov. × 20.

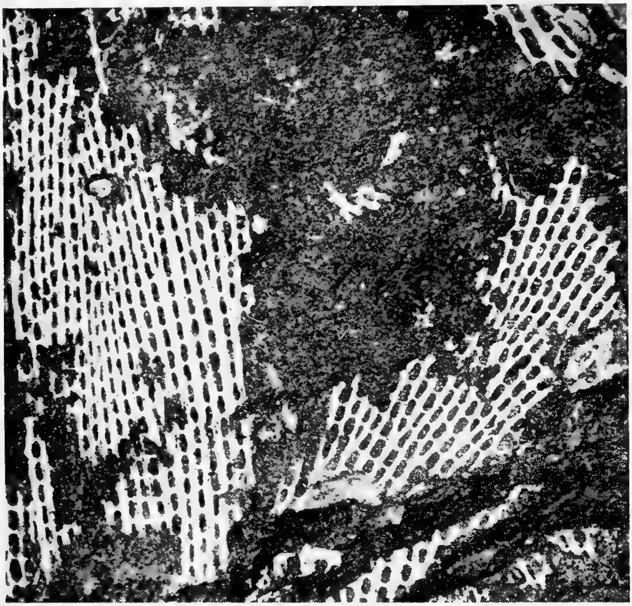


Fig. 1. × 3.

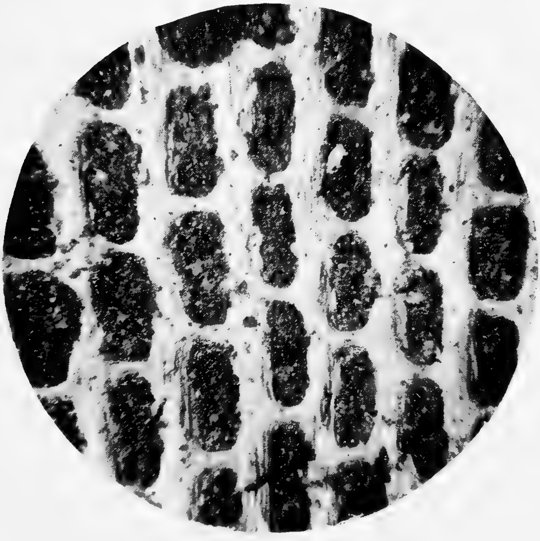


Fig. 2. × 20.

Fenestella fossula Lonsdale.

Fig. 1.

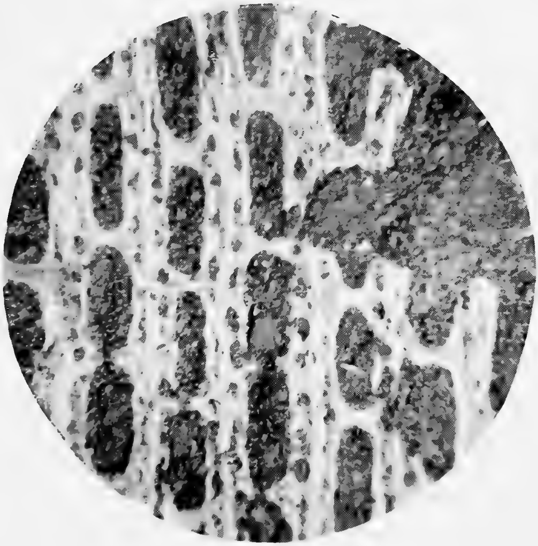


Fig. 2.

Fenestella fossula Lonsdale × 20.

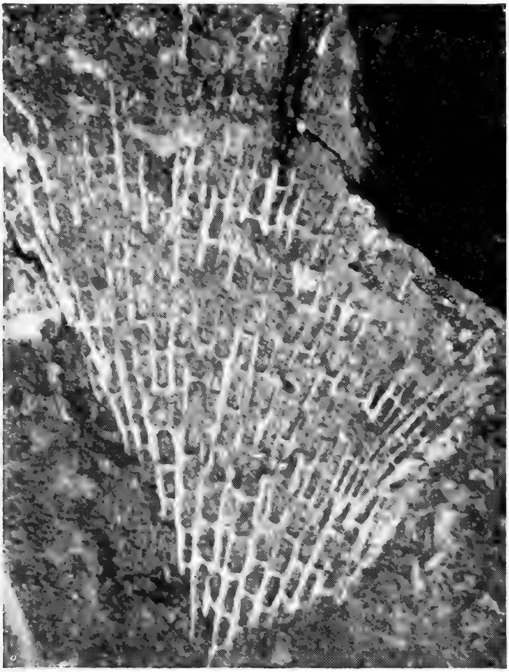


Fig. 1. × 3.

Fig. 2. × 20.

Fenestella cavea sp. nov.

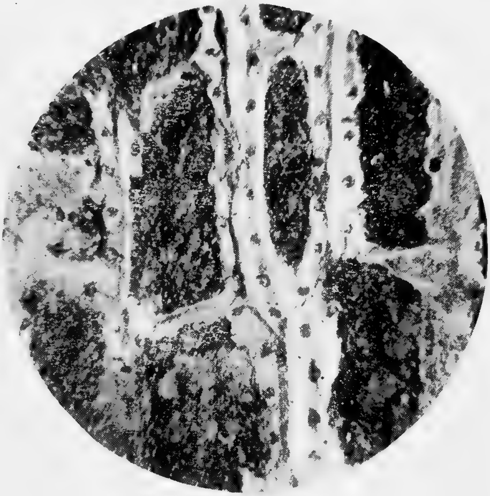


Fig. 1.

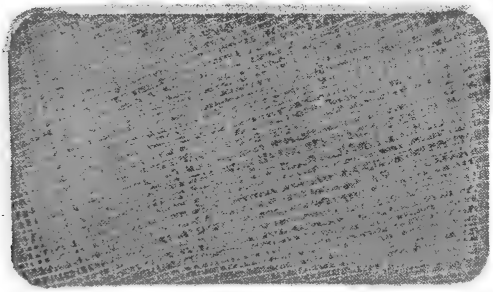
Fig 2.

Fenestella cavea sp nov. × 20.

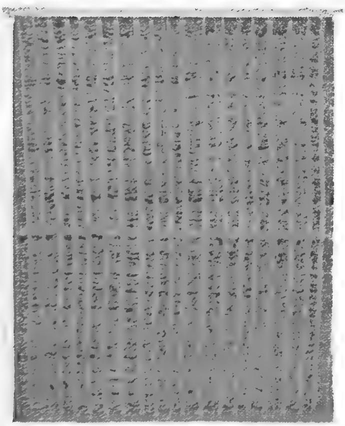
TRANSVERSE SECTIONS OF TIMBER—(Natural size).

Grevillea robusta A. Cunn.

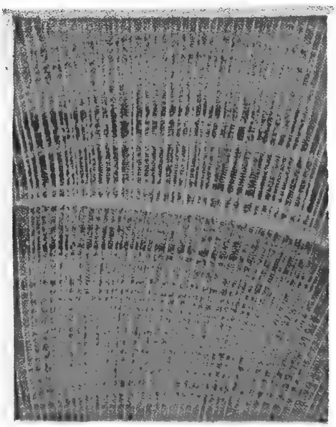
Grevillea Hilliana F.v.M.



Embothrium Wickhami F.v.M.

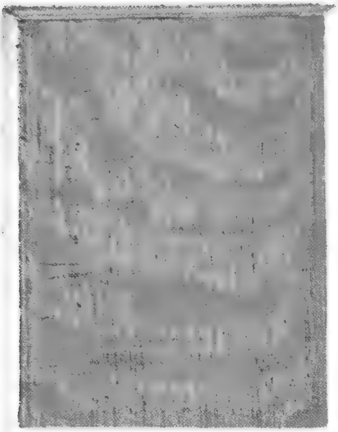


Cardwellia sublimis F.v.M.



Orites excelsa R.Br.

RADIAL SECTIONS OF TIMBER.—(Natural Size).

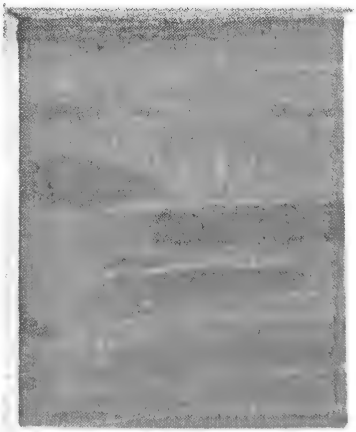


Grevillea robusta A. Cunn.

Grevillea Hilliana F.v.M.

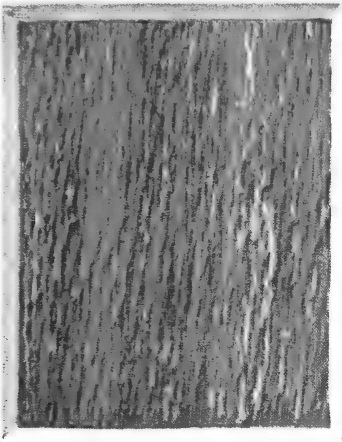
Embothrium Wickhami F.v.M

Cardwellia sublimis F.v.M.

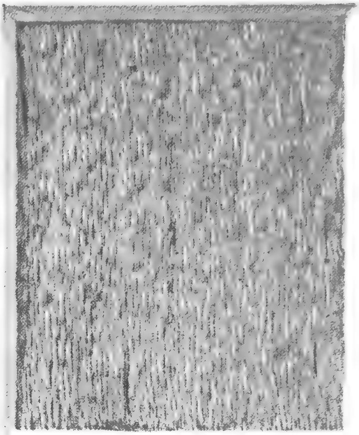


Orites excelsa R.Br.

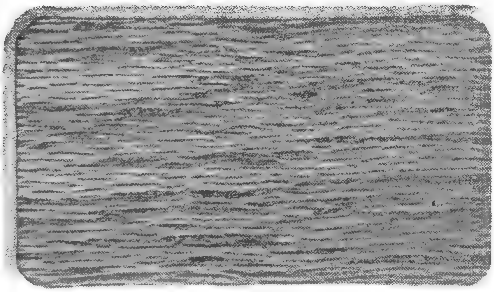
TANGENTIAL VIEW OF TIMBER NEXT TO THE BARK.—(Natural Size)



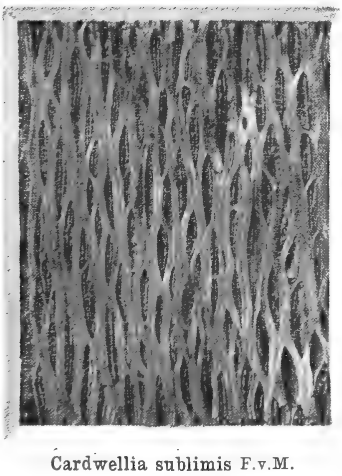
Grevillea robusta A. Cunn.



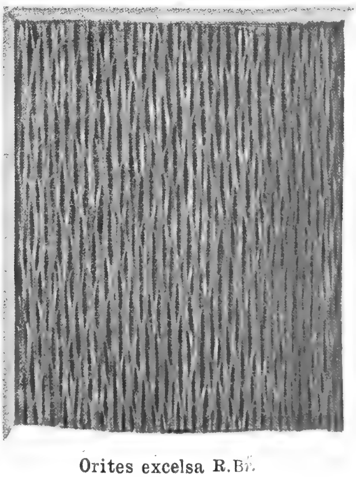
Grevillea Hilliana F.v.M.



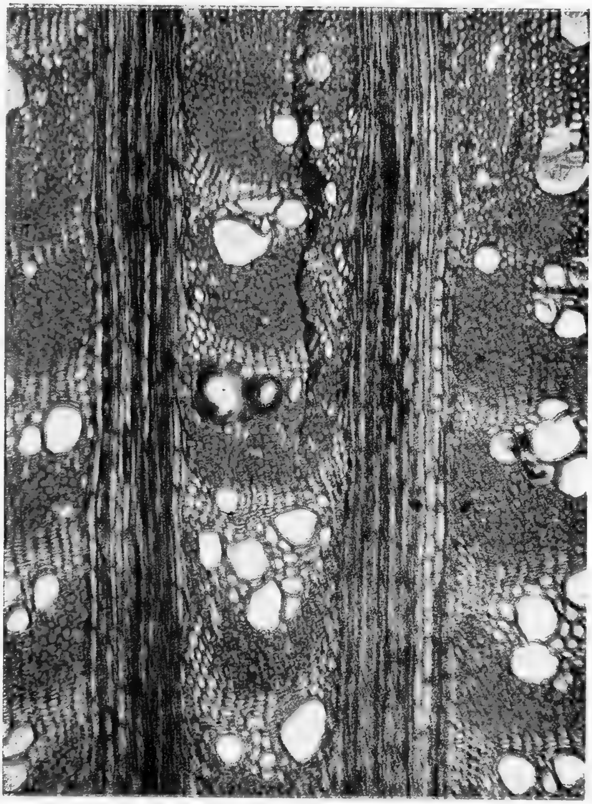
Embothrium Wickhami F.v.M.



Cardwellia sublimis F.v.M.

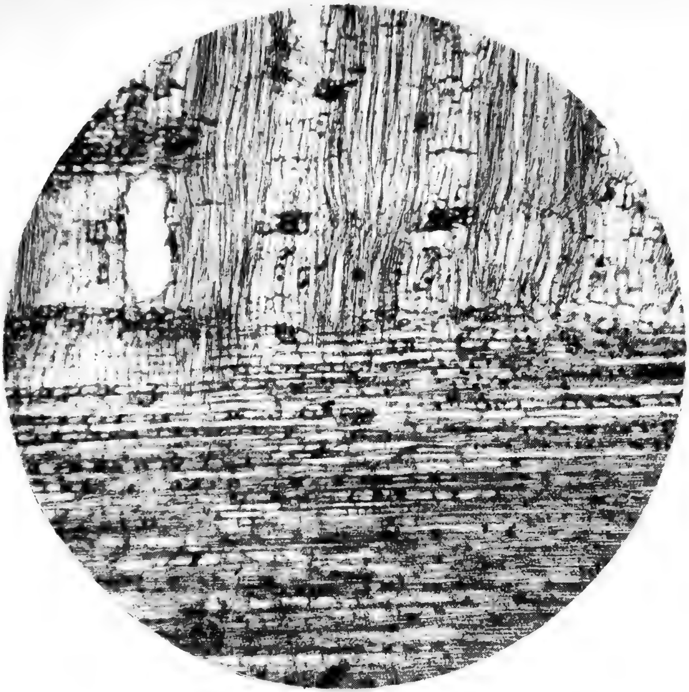


Orites excelsa R.Br.



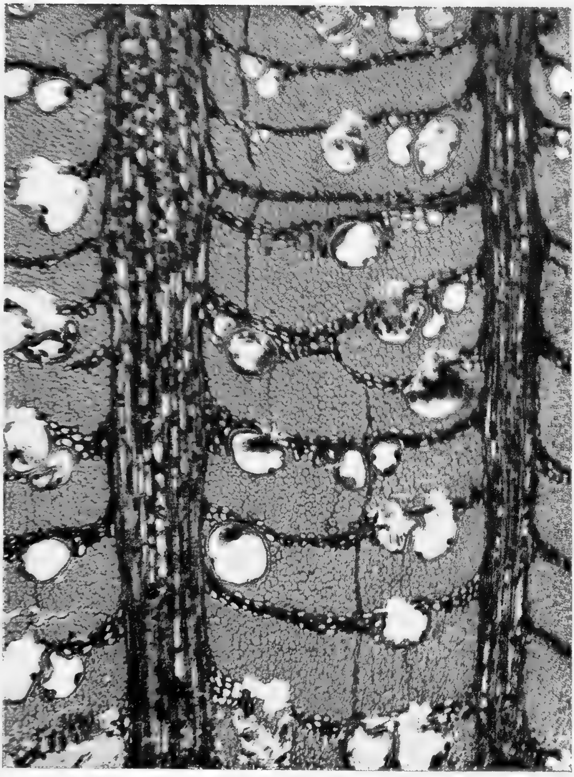
From an Autochrome. By T. C. Roughley.

Grevillea robusta A. Cunn., (Silky Oak)—Transverse section of the timber. × 25. Centre of tree towards the bottom.



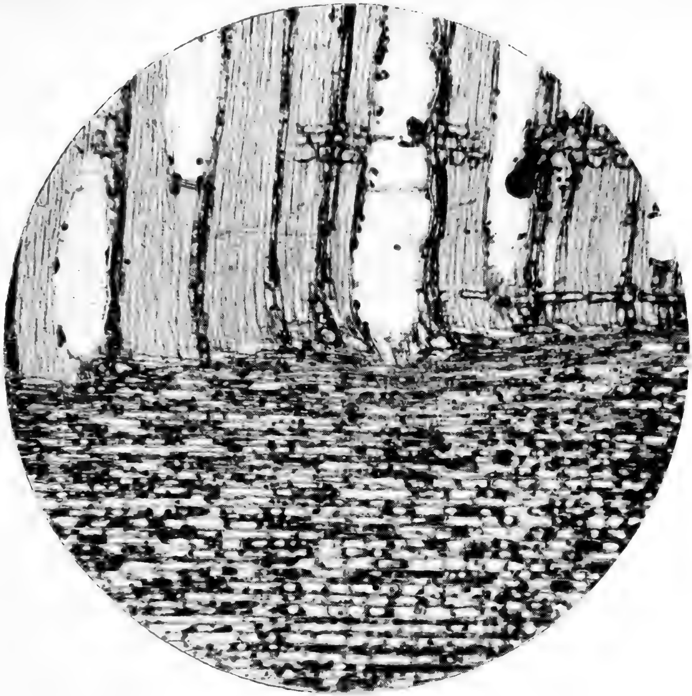
Grevillea robusta—Radial section showing part of multiseriate ray in lower half with a few spherical bodies in the cells; fibres and parenchyma in the upper portion. × 40.

Grevillea robusta—Tangential section showing part of a large multiseriate ray in centre and right and left, cut transversely; fibres and wood parenchyma alternately in other parts, vessel in right top. × 40.



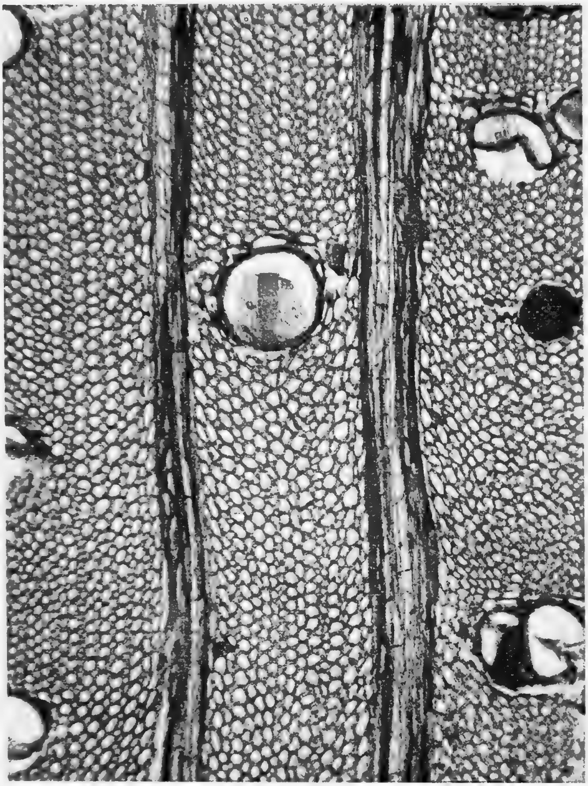
From an Autochrome. By T. C. Roughley.

Grevillea Hilliana F.v.M., (Red Silky Oak).—Transverse section of the timber. × 30. Centre of tree towards the bottom.



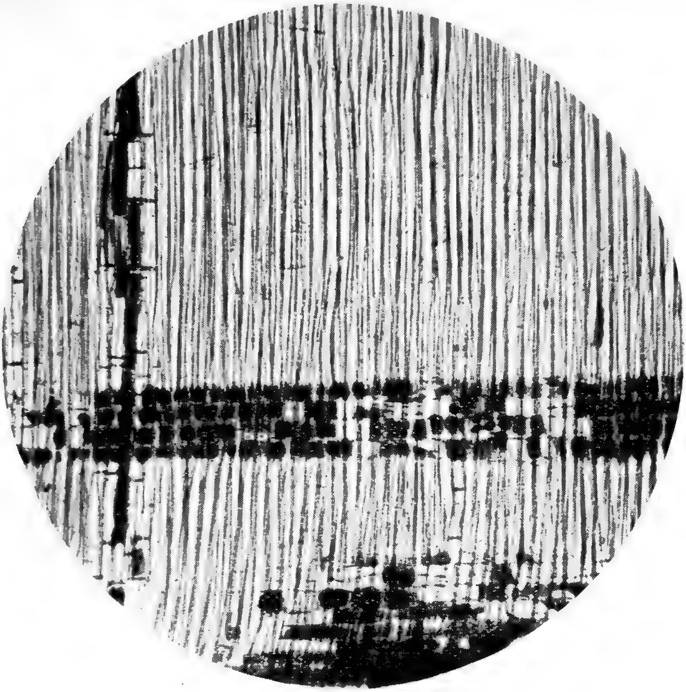
Grevillea Hilliana—Radial section showing part of multiseriate ray in lower half half with coloured globular and amorphous bodies in cells; vessels, fibres and wood parenchyma (black lines) in upper portion. × 40.

Grevillea Hilliana—Tangential section showing parts of 4 multiseriate rays; fibre-bands, and vessels with globular bodies. × 40.

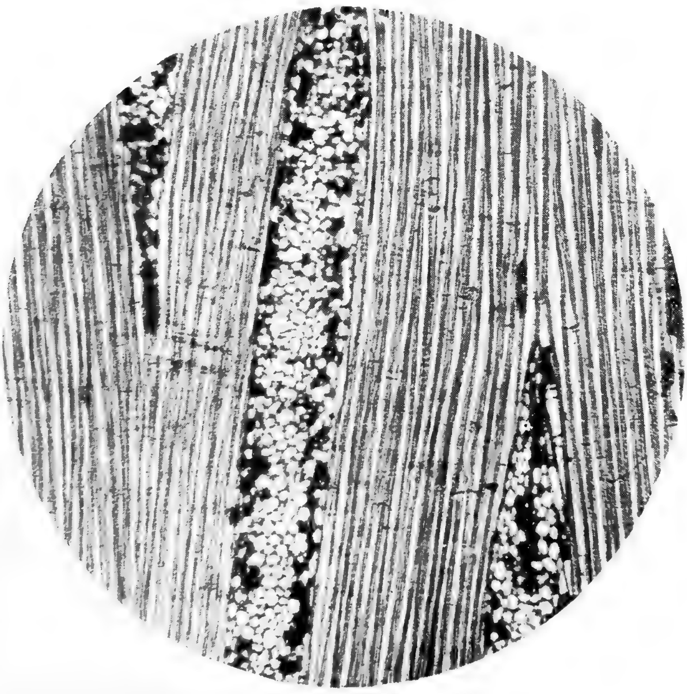


From an Autochrome. By T. C. Roughley.

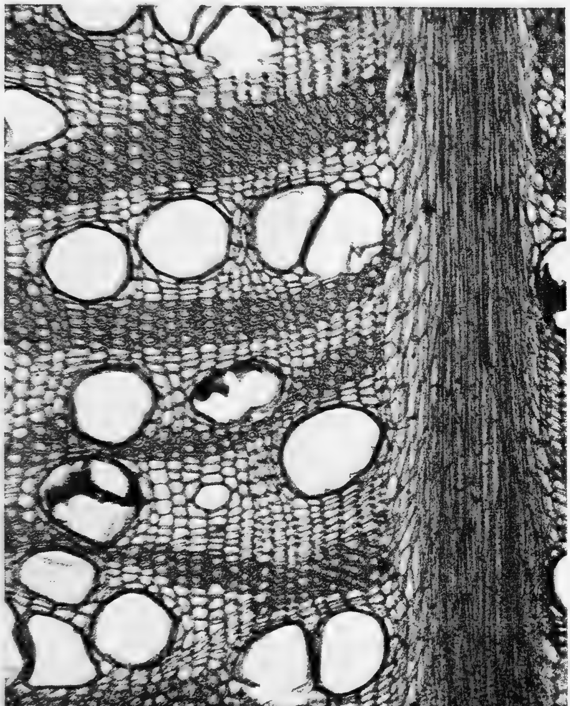
Embothrium Wickhami F. v. M., (Satin Silky Oak).—Transverse section of the timber. × 20. Centre of tree towards the bottom.



Embothrium Wickhami—Radial section showing parts of two rays with dark coloured substance in cells; wood parenchyma towards the left edge also with dark deposit, fibres forming the remaining part. × 40.

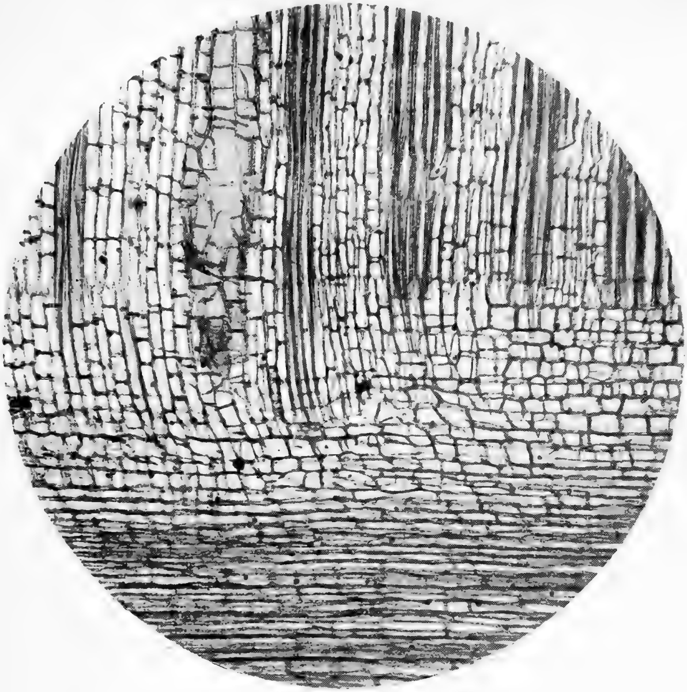


Embothrium Wickhami—Tangential section showing parts of multiseriate rays and masses of fibres. × 40.

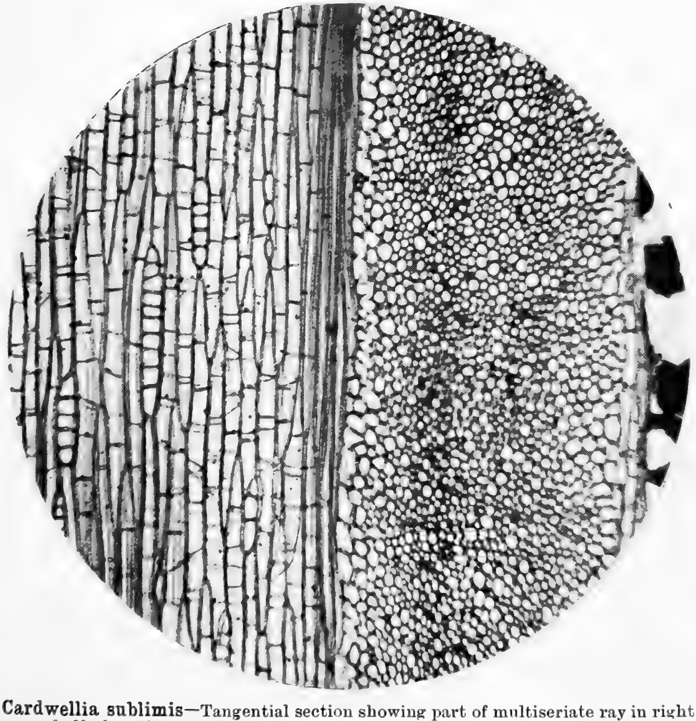


From an Autochrome. By T. C. Roughley.

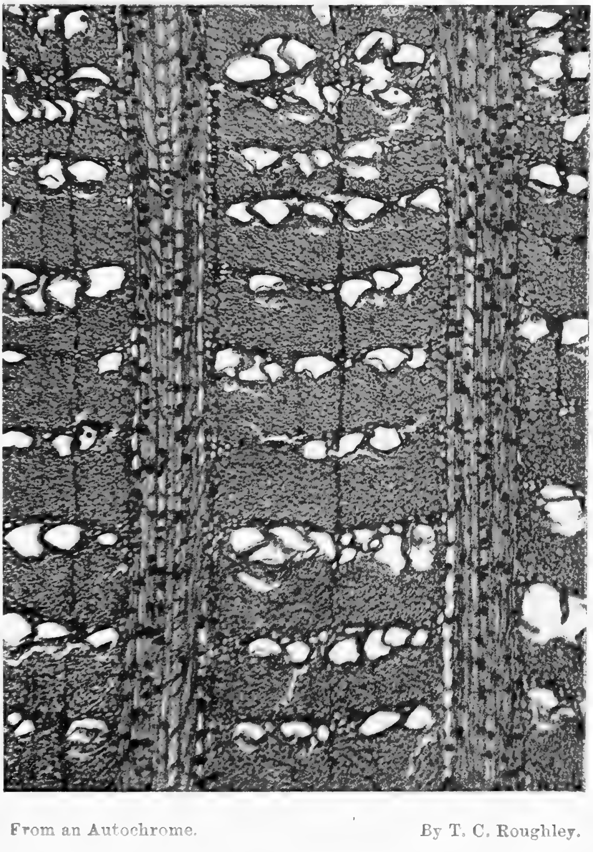
Cardwellia sublimis F v.M., (Bull Silky Oak)—Transverse section of the timber. × 40. Centre of tree towards the bottom.



Cardwellia sublimis—Radial section showing part of multiseriate ray with few minute globular bodies in some of the cells; fibres and wood parenchyma alternately in the upper portion. × 40.

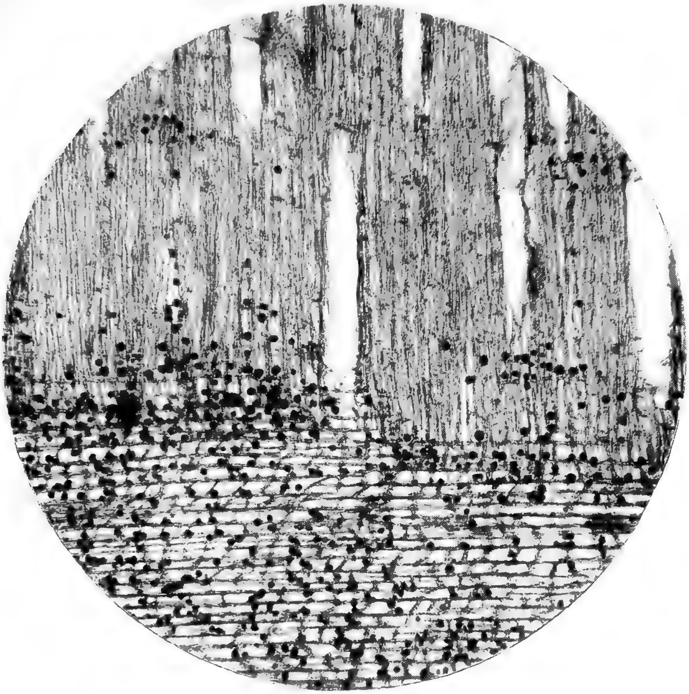


Cardwellia sublimis—Tangential section showing part of multiseriate ray in right half of section; portion of vessel on extreme right; band of fibres in the centre: uniseriate rays and wood parenchyma with small globules in cells, left half of section. × 40.

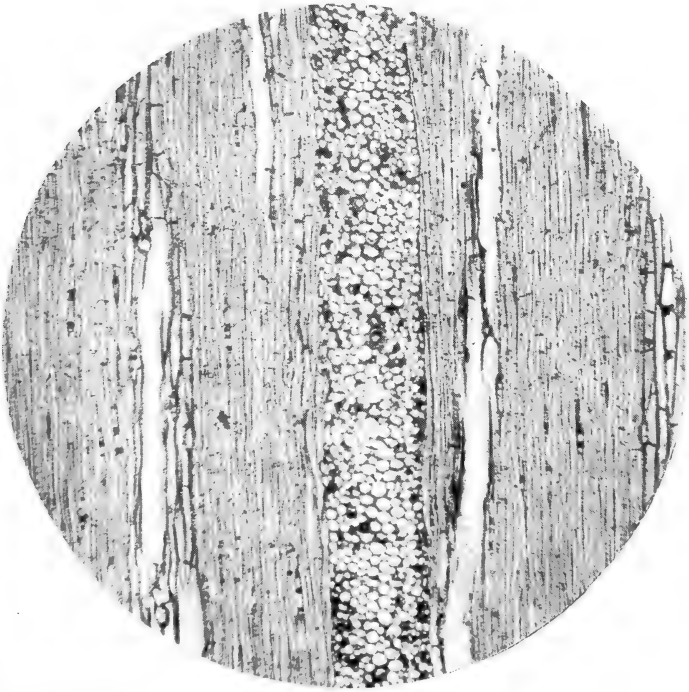


From an Autochrome. By T. C. Roughley.

Orites excelsa R. Br., (Prickly Leaved Silky Oak).—Transverse section of the timber. × 40. Centre of tree towards the bottom.



Orites excelsa—Radial section showing part of multiseriate ray in lower half with red coloured, spherical bodies in the cells; fibres and vessels in the upper portion. × 40.



Orites excelsa—Tangential section showing end-on view of part of multiseriate ray in the centre with two sclerenchyma cells in the middle; fibres; wood parenchyma towards the right, and round the vessel on the left. × 40.

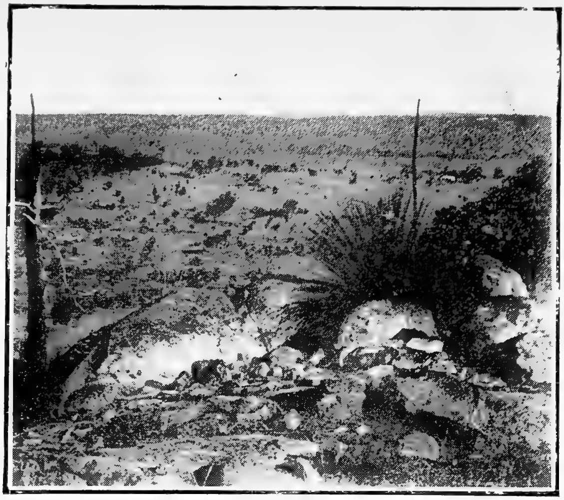


Fig. 1

Fig. 2

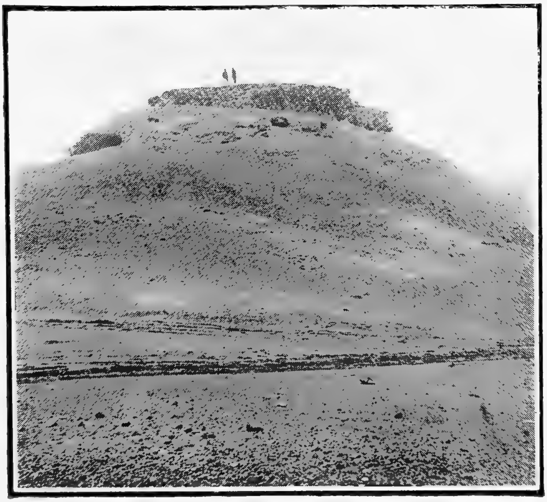
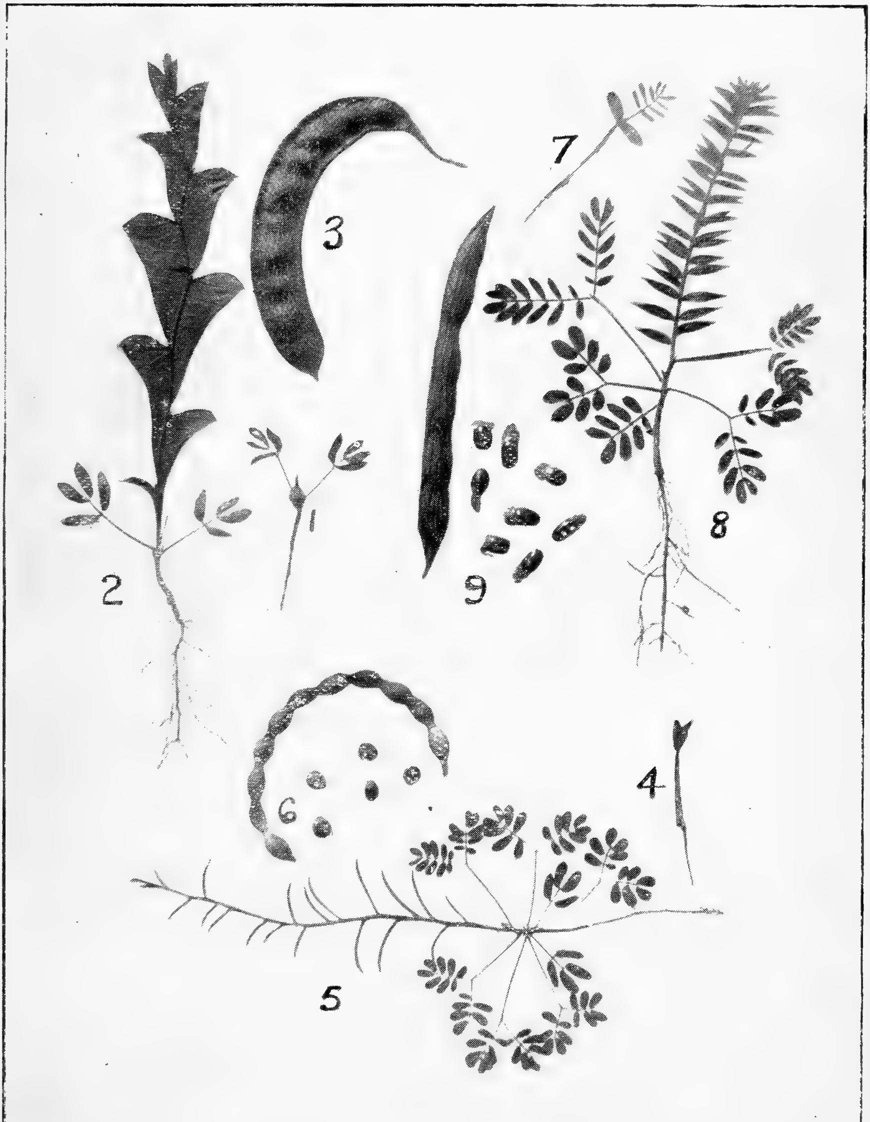
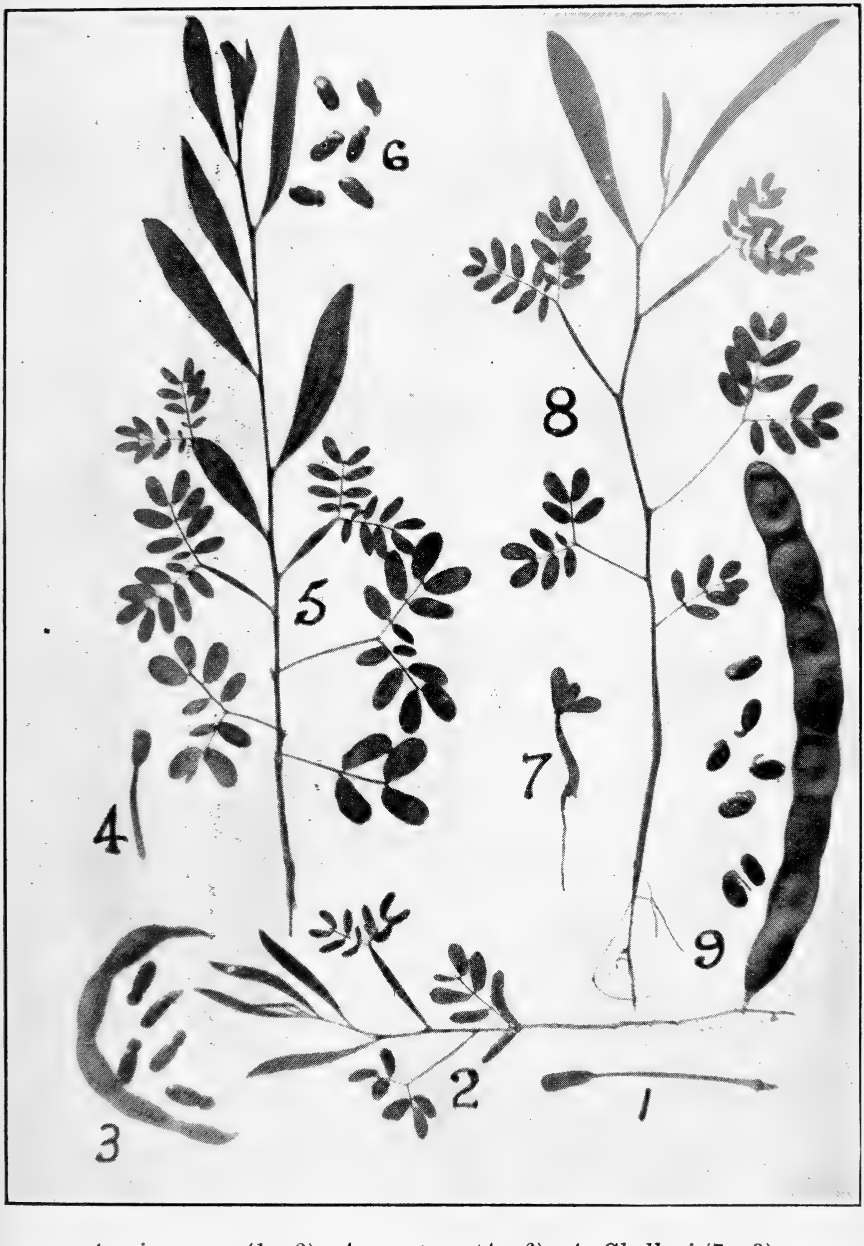


Fig. 3



Acacia alata (1 – 3); *A. continua* (4 – 6); *A. oxycedrus* (7 – 9).

Three-fourths Natural Size.



Acacia aspera (1 – 3); *A. montana* (4 – 6); *A. Chalkeri* (7 – 9).

Natural Size.

Acacia neriifolia.

Slightly over Half Natural Size.

Acacia obtusata (1 – 3); *A. hakeoides* (4 – 6); *A. Howittii* (7 – 9).

Four-fifths Natural Size.

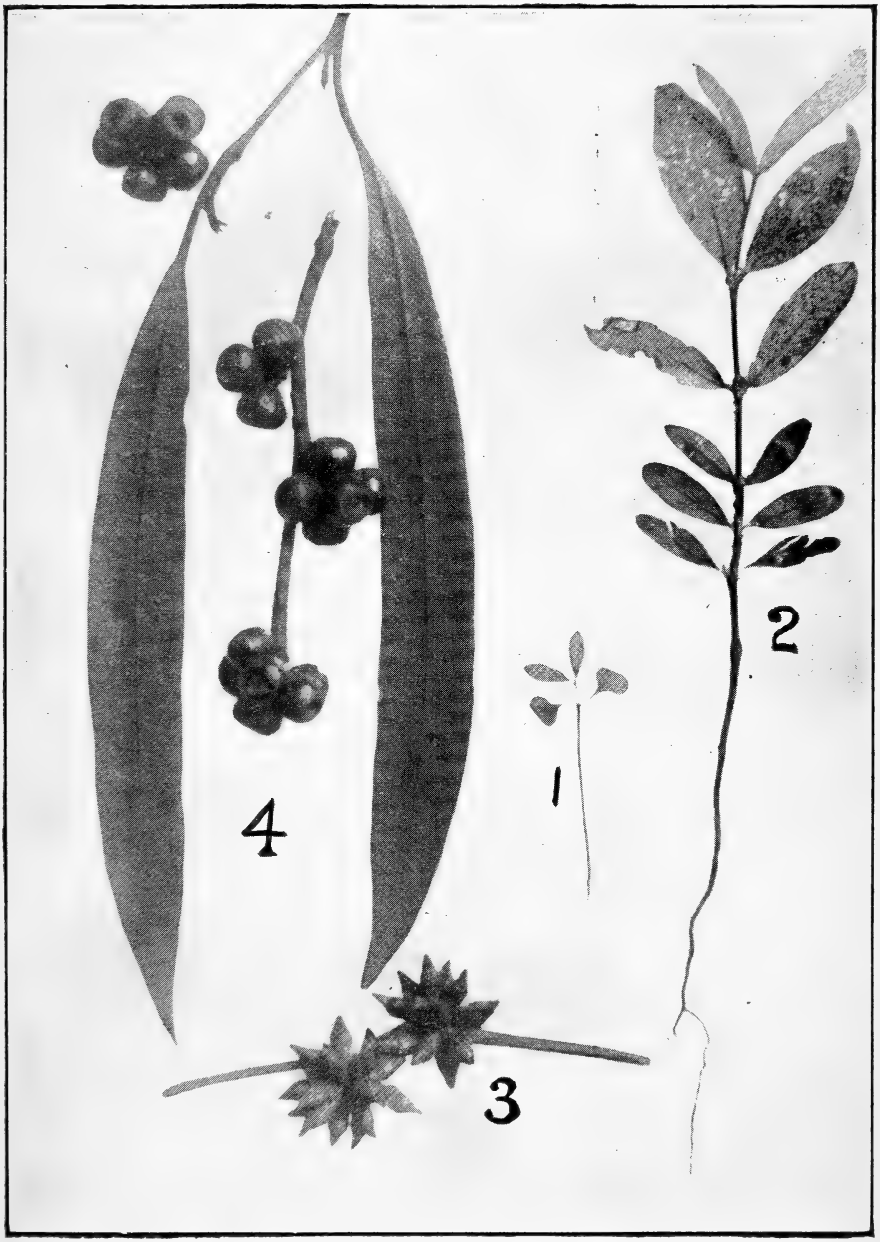
Acacia crassiuscula (1 – 4); *A. spectabilis* (5 – 7).

Two-thirds Natural Size.

Fig. 1.

Fig. 2.

Eucalyptus pumila, n. sp.



Eucalyptus Mitchelli, n. sp.

Eucalyptus Mitchelli, "Willow Gum."

Fig. 1

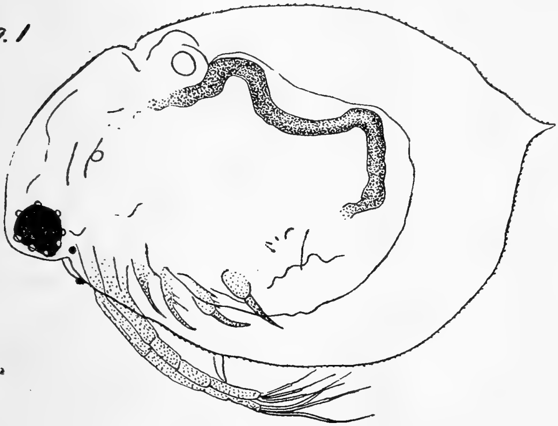


Fig. 2

Fig. 3

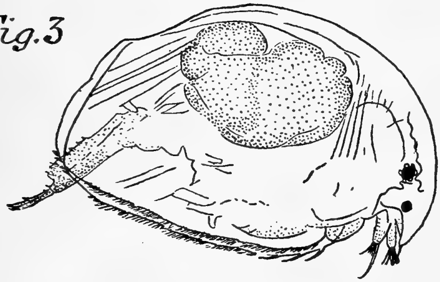


Fig. 4

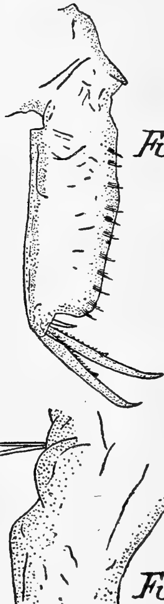
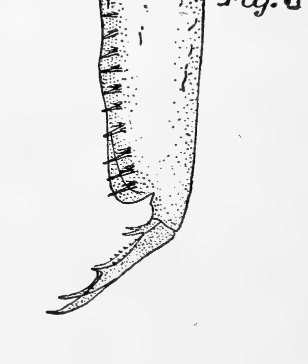


Fig. 5

Fig. 6



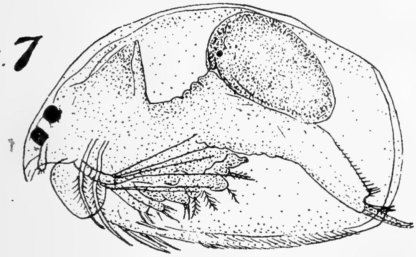


Fig. 7

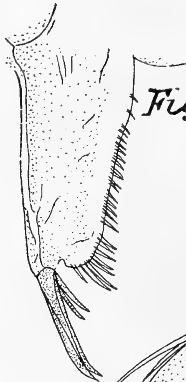


Fig. 8

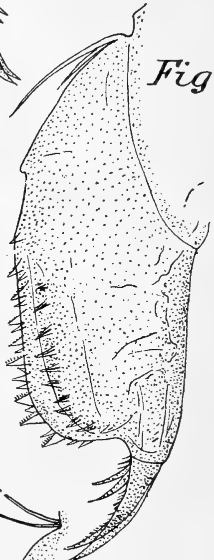


Fig. 10

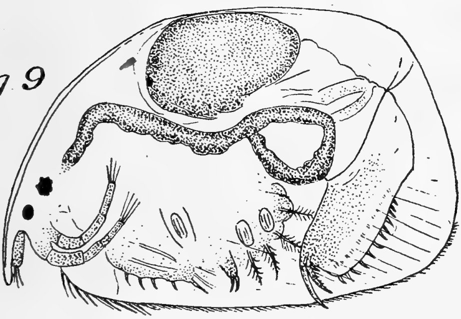


Fig 9

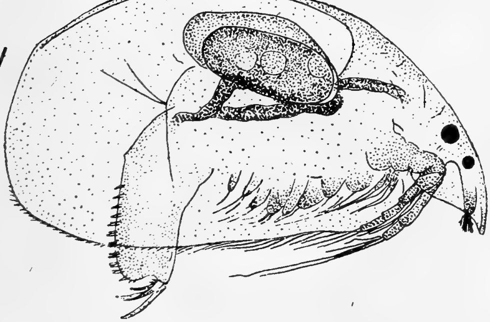


Fig. 11

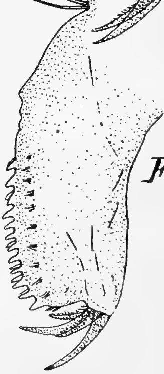


Fig. 12

Fig. 13

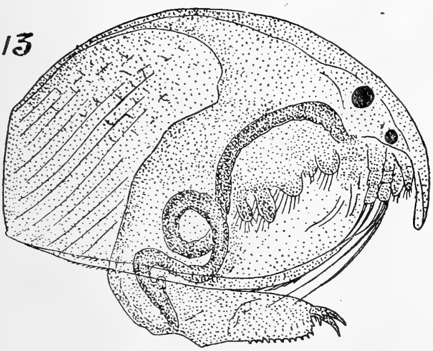


Fig 14.

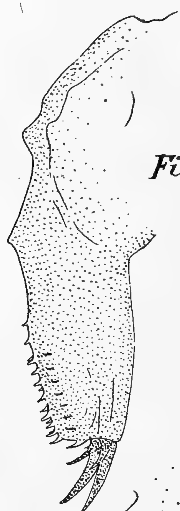


Fig. 15

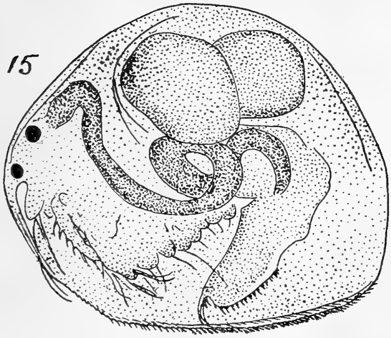


Fig. 16

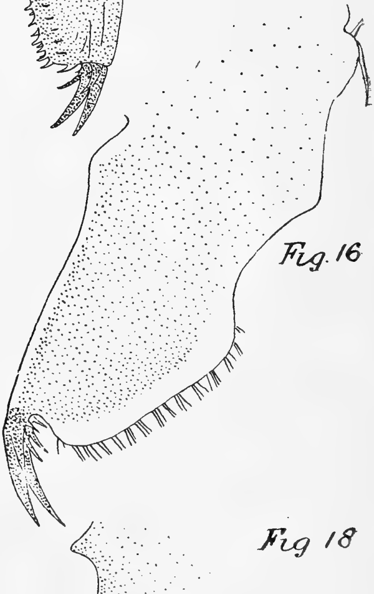


Fig. 17

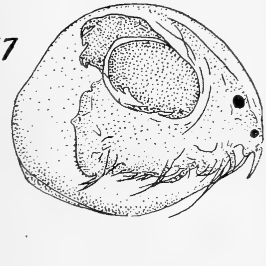
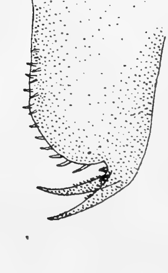
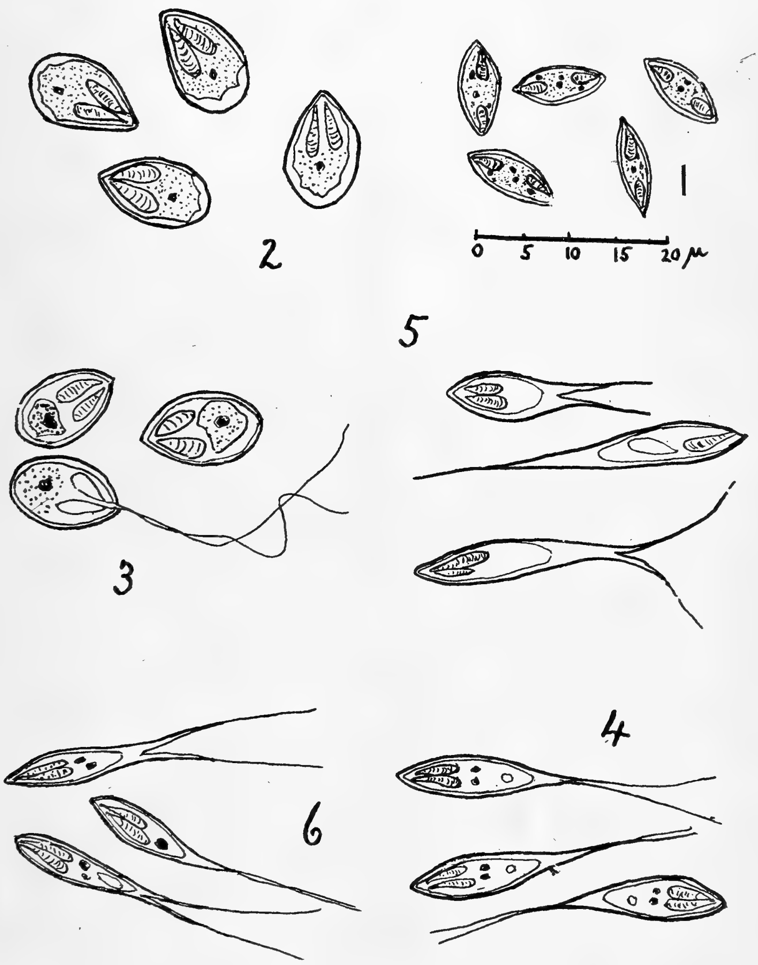


Fig 18

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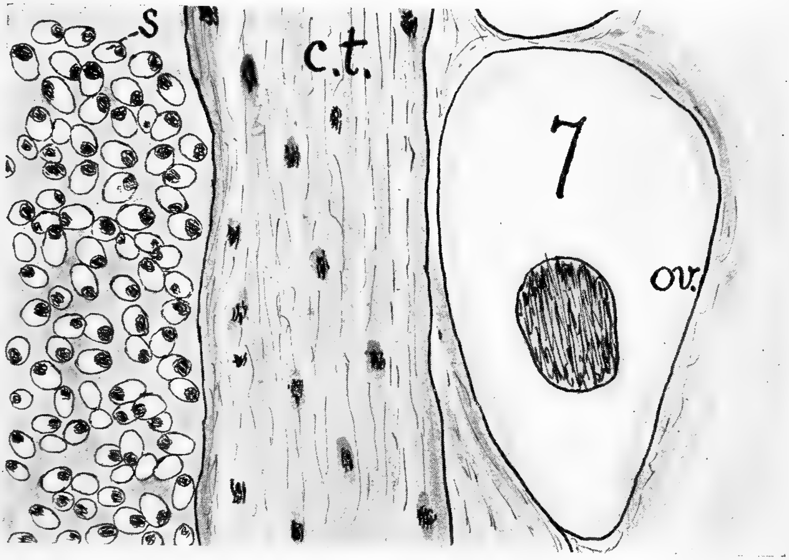
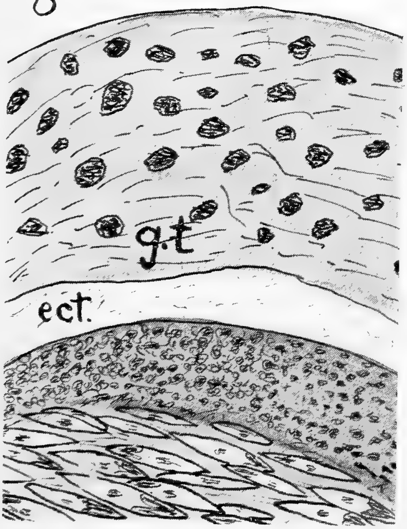
0 5 10 15 20 μ



8



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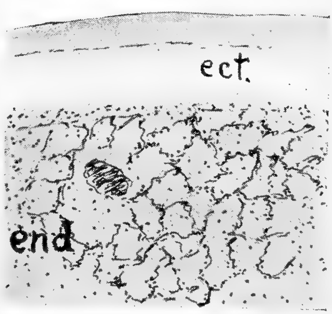

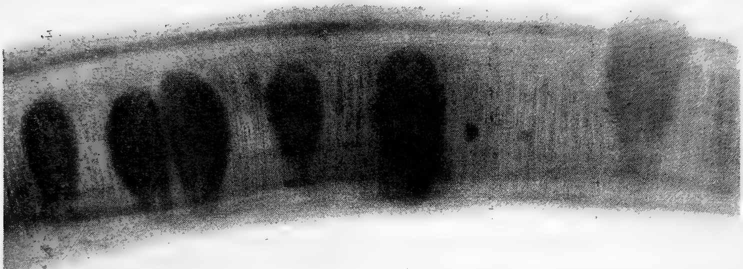

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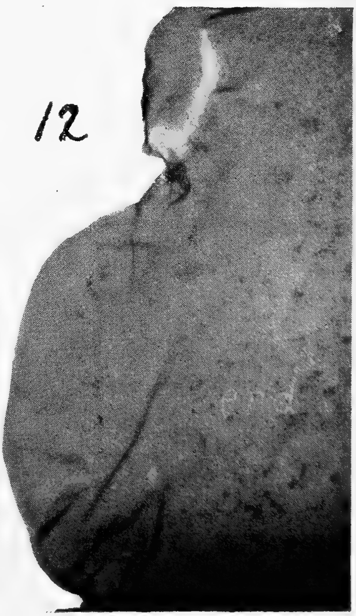

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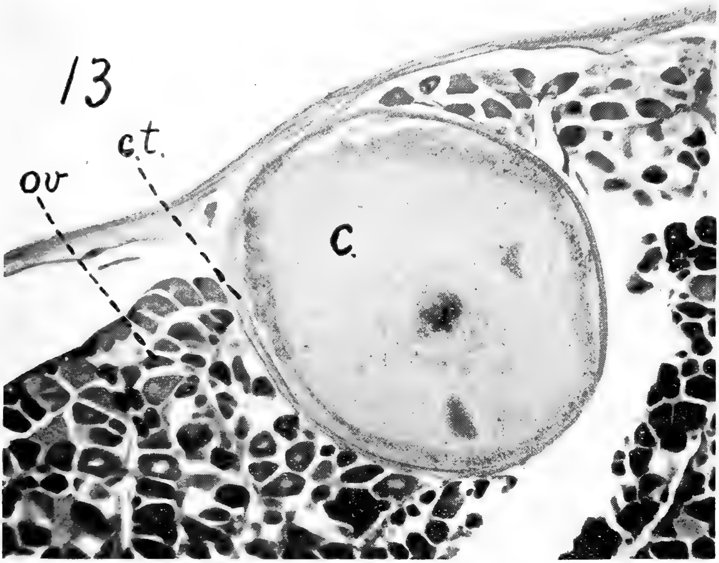
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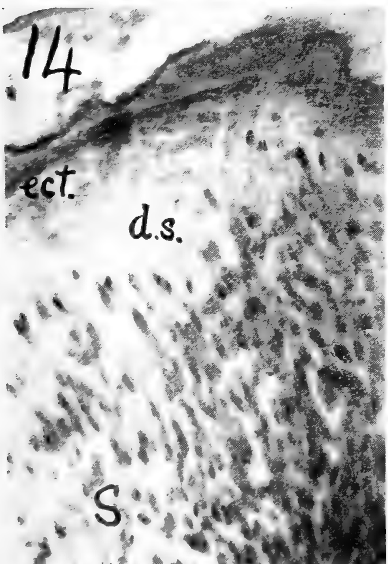
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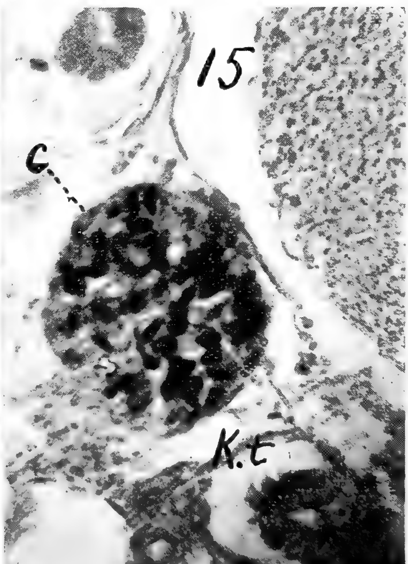
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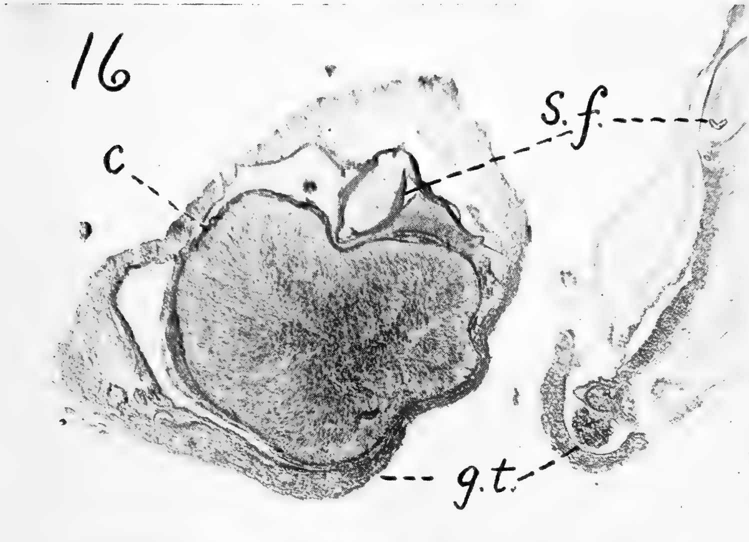
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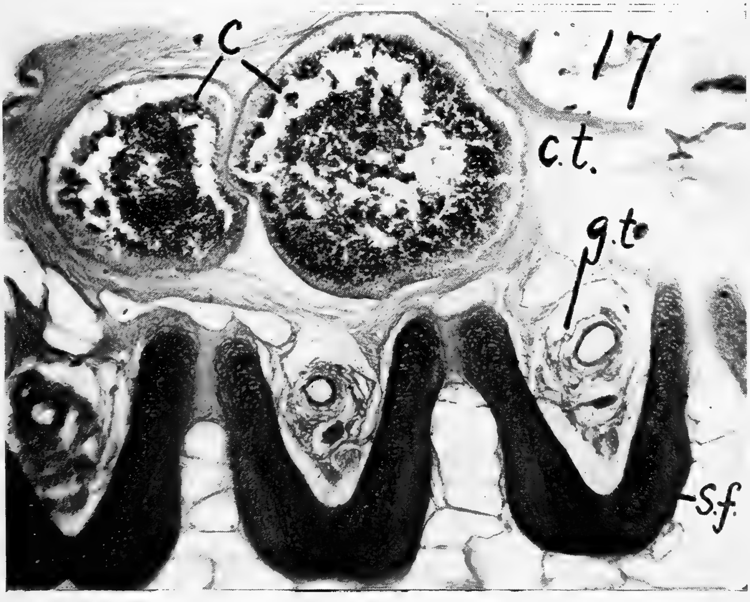
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