# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH AFRICA

VOLUME V.

1915–16.

WITH SIXTY-SIX PLATES.



CAPE TOWN:

PUBLISHED BY THE SOCIETY.

1917.

LONDON:

PRINTED BY ADLARD AND SON AND WEST NEWMAN, LTD.,

BARTHOLOMEW CLOSE, E.C. 1.

# CONTENTS.

## ADDITIONS TO THE LIBRARY DURING 1914.

ADELAIDE.

Royal Society of South Australia.

Transactions and Proceedings, vol. xxxvii.

Memoirs, vol. i., part 4; vol. ii., part 4.

AMSTERDAM.

Koninklijke Akademie van Wetenschappen te Amsterdam.

Proceedings of the Section of Sciences, vol. xvi., parts 1, 2.

BALTIMORE, MARYLAND, U.S.A.

The Johns Hopkins University.

Bulletin of the Johns Hopkins Hospital, vol. xxv., Nos. 275, 276, 277, 278, 279, 280, 281, 282, 283, , 285.

Johns Hopkins University Circular, 1913, Nos. 7, 8, 9.

Johns Hopkins University Studies, series xxxi., Nos. 3, 4; series xxxii., No. 1.

BASEL.

Naturforschenden Gesellschaft in Basel.

Verhandlungen, Band. xxiv.

BERKELEY, CAL., U.S.A.

University of California.

Zoology, vol. xi., Nos. 9, 10, 11, 12, 13, 14, 15; vol. xii., Nos. , , , 4, 5–6, 7, 8; vol. xiii., Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; vol. xiv., No. 1.

Economics, vol. iv., No. 1.

Geology, vol. vii., Nos. 21, 22, 23, 24, 25; vol. viii., Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9.

Botany, vol. vi., Nos. 1, 2, 3, 4, 5.

American Archaeology and Ethnology, vol. x., No. 6; vol. xi., No. 2.

Physiology, vol. iv., No. 19.

Memoirs, vol. iii., "Business Cycles, by Wesley Clair Mitchell."

BERLIN.

Königlich Preussischen Akademie der Wissenschaften.

Sitzungsberichte, 1913, Nos. xli.–xliii., xliv., xlv.–xlvii., xlviii.–xlix., l.–lii., liii.; 1914, i.–ii., iii.–v., vi., vii., viii.–ix., x., xa.–xii., xiii., xiv.–xv., xvi., xvii.–xviii.

Königlich Preussischen Meteorologischen Instituts.

Bericht über die Tätigkeit des Königlich Preussischen Meteorologischen Instituts im Jahre 1913; No. 272.

Veroffentlichungen, No. 273, Beitrage zur Geschichte der Meteorologie, von G. Hellmann, Nr. 1–5.

BERNE.

Schweizerischen Naturforschenden Gesellschaft.

Verhandlungen, 96 Jahresversammlung vom 7–10 September, 1913, in Frauenfeld. 1, Teil, mit Anhang, Nekrologe; 2, Teil.

BOSTON, MASS., U.S.A.

American Academy of Arts and Sciences.

Proceedings, vol. xlix., Nos. 1, 2, 3, 4, 5, 6, 7, , , , 11.

BOULDER, COLORADO, U.S.A.

University of Colorado.

Studies, vol. x., Nos. 3. 4; vol. xi., No. 1.

BRISBANE.

The Queensland Museum.

Memoirs, vol. ii.

BROOKLYN, U.S.A.

The Museum of the Brooklyn Institute of Arts and Sciences.

Science Bulletin, vol. ii., Nos. 1, 2.

BRUXELLES.

Academie Royale de Belgique, Bulletin Classe des Sciences, 1913, Nos. 9–10, 11, 12; 1914, Nos. 1, 2, 3, 4.

Annuaire, 1914.

BUENOS AIRES.

Museo Nacional de Historia Natural de Buenos Aires.

Anales, Tomo xxiv.

Sociedad Physis Para el Cultivo y Difusion de las Ciencias Naturales en la Argentina.

Boletin, Tomo i., No. 5.

BULAWAYO.

Rhodesia Scientific Association.

Proceedings, vol. xii. Containing Papers read during 1912–13.

CALCUTTA.

The Asiatic Society of Bengal.

Journal and Proceedings, vol. viii., No. 11; vol. ix., Nos. 1, 2, 3, 4, 5, 6.

CAMBRIDGE, ENGLAND.

Cambridge Philosophical Society.

Proceedings, vol. xvii., part 4 (Michaelmas Term, 1913); vol. xvii., part 5 (Lent Term, 1914); vol. xvii., part 6 (Easter Term, 1914); vol. xviii., part 1 (Long Vacation, 1914).

CAPE TOWN.

The South African Association for the Advancement of Science.

The South African Journal of Science, vol. x., Nos. 4, 5, 6, 7, 8, 9, 10, 11, 12, , 14; vol. xi., Nos. 1, 2, 3, 4.

The South African Museum.

Annals, vol. ix., part 3; vol. xiii., parts 2, 3; vol. x., parts 7, 8, 9, 10, 11, 12.

CAROTHERS, W. F., HOUSTON, TEXAS, U.S.A.

Carothers Observatory (Private Astronomical).

Bulletin, No. 1.

CHICAGO, U.S.A.

Field Museum of Natural History.

Geological Series, vol. iv., No. 3.

The Wilson Ornithological Club.

The Wilson Bulletin, vol. xxv., No. 4 (85); Index to vol. xxv., 1913; vol. xxvi., Nos. 1 (86); 2 (87); 3 (88).

CINCINNATI, OHIO, U.S.A.

The Lloyd Library.

Bulletin, No. —. Pharmacy Series, No. —.

,, ,, —. Botany Series, No. —.

,, ,, —. Mycological Series, No. —.

Bibliographical Contributions, No. 11, July, 1913; No. 12, October, 1913; No. 13, January, 1914.

Mycological Notes, No. 38.

Synopsis of the Genus Gladoderris, by C. G. Lloyd.

The Cincinnati Society of Natural History.

Journal, vol. xxi., No. 4.

COLUMBIA, MISSOURI, U.S.A.
University of Missouri.
Bulletin, Science Series, vol. ii., No. 3.
Studies, Mathematics Series, vol. i., No. 1.
Bulletin, Science Series, vol. i., No. 6; Non-Technical Lectures, Series I., Mathematical and Physical Sciences: 6, Geology; 8, Experimental Zoology; 9, Evolutional Zoology.

COPENHAGEN.
The Danish Biological Station.
Report to the Board of Agriculture, vol. xxi. (1913).

CORDOBA, ARGENTINA.
Academia Nacional de Ciencias en Cordoba (Republica Argentina).
Boletin, Tomo xix.: Entrega i., 2, 3–4.

DAVENPORT, IOWA, U.S.A.
Davenport Academy of Sciences.
Proceedings, vol. xiii., pp. 1–46.

DECATUR, ILLINOIS, U.S.A.
The American Microscopical Society.
Transactions, vol. xxxii., Nos. 2, 3, 4; vol. xxxiii., No. 1.

DRESDEN.
Vereins für Erdkunde zu Dresden.
Mitteilungen, Band ii., Heft 8, 9.
Mitglieder-Verzeichnis, April, 1914.

DUBLIN.
The Royal Dublin Society.
Scientific Proceedings, vol. xiv. (N.S.), Nos. 8, 9, 10, 11, 12, 13, 14, 15, 16.
Economic Proceedings, vol. ii., No. 7.

EAST LONDON, C.P.
East London Public Library.
Annual Report and Statement of Accounts for the Year ending December 31, 1913.

EDINBURGH.
Royal Physical Society.
Proceedings, vol. xix., Nos. 5, 6.

EDINBURGH—*continued.*

The Royal Scottish Geographical Society.

Magazine, vol. xxx., Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; vol. xxix., 1913, Title-page, Contents and Index.

Royal Society of Edinburgh.

Proceedings, vol. xxxii., part 4; vol. xxxiii., part 4; vol. xxxiv., parts 1, 2.

FRANKFURT AM MAIN.

Senckenbergischen Naturforschenden Gesellschaft in Frankfurt am Main.

Abhandlungen, Band xxxi., Heft 4; Band xxxiv., Heft 4; Band xxxv., Heft 1.

Bericht, xliv., Heft 1, 2, 3, 4.

GALLOWAY, Dr. W., Cardiff.

"Great Colliery Explosions and their Means of Prevention."

GÖTTINGEN.

Königlichen Gesellschaft der Wissenschaften zu Göttingen.

Nachrichten, Geschaftliche Mitteilungen aus dem Jahre, 1913. Erstes (Einziges), Heft.

GRAHAMSTOWN, S. AFRICA.

The Albany Museum.

Records, vol. iii., part 1.

Annual Reports for the Years 1910–13.

HALLE.

Kaiserlichen Leopoldinisch-Carolinischen Deutschen Akademie der Naturforscher.

Leopoldina, Heft xlix. (Jahrg., 1913).

Nova Acta, Band ic., No. 1.

HAMBURG.

Hamburgischen Wissenschaftlichen Anstalten.

Jahrbuch, xxx., Jahrgang, 1912, Beiheft, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.

HOBART, TASMANIA.

Department of Mines, Geological Survey.

Bulletin, No. 14, "The Middlesex and Mount Claude Mining Field"; No. 14, Maps and Sections to accompany Bulletin No. 14; No. 16, "The Jukes-Darwin Mining Field"; No. 16, Maps and Sections to accompany Bulletin No. 16; No. 17, "The

HOBART, TASMANIA—*continued.*

Bald Hill Osmiridium Field"; No. 15, "The Stanley River Tin Field"; No. 15, Maps and Sections to accompany Bulletin No. 15; No. 18, "Geological Reconnaissance of the Country between Cape Sorell and Point Hibbs."

Geological Survey Record, No. 2, "Stichtite, A New Tasmanian Mineral."

INDIANAPOLIS, U.S.A.

Indiana Academy of Science.

Proceedings, 1912.

JANET, Charles.

Le Volvox, 1912.

Sur L'Origine Parthénogénétique du Gamétophyte, 1913.

JOHANNESBURG.

The Geological Society of South Africa.

Proceedings, January–December, 1913, to accompany vol. xvi. of the Transactions; January–June, 1914, to accompany vol. xvii. of the Transactions.

Transactions, vol. xvi., January–December, 1913, pp. 1–164; vol. xvii, January–June, 1914, pp. 1–59.

Union of South Africa, Union Observatory.

Circular, Nos. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21.

LAUSANNE.

Société Vaudoise des Sciences Naturelles.

Bulletin, vol. xlix., Nos. 181, 182, 183,

LAWRENCE, KANSAS.

University of Kansas.

Bulletin, vol. xiv., No. 16, July 1, 1913. Science Bulletin, vol. vi., Nos. 2, 3, 4, 5, 6, 7; vol. xv., No. 2, November 1, 1913; Science Bulletin, vol. vii., Nos. 1–17; vol. xv., No. 9, March 15, 1914; Science Bulletin, vol. viii., Nos. 1–10.

LEIDEN.

Rijks Herbarium.

Mededeelingen, Nos. 15–20 (1913), with Atlas.

LEIPZIG.

Gesellschaft für Erdkunde zu Leipzig.

Wissenschaftliche Veroffentlichungen der Gesellschaft für Erdkunde zu Leipzig, Achter Band, "Reise in Peru und Ecuador, Ausgeführt, 1909, von Wilhelm Sievers."

LEIPZIG—*continued.*

Königlich-Sächsischen Gesellschaft der Wissenschaften zu Leipzig.

Berichte über die Verhandlungen, Math.-Phys., Klasse, 1913, Band lxv., Nos. ii., iii., iv., v.; Band lxvi., 1914, No. i.

Abhandlungen, xxxiii. Bandes, Nos. i. (iv., Abhandlungen), ii.

LIMA, PERU.

Cuerpo de Ingenieros de Minas del Peru.

Boletin, No. 80.

LISBOA.

Sociedade de Geographia de Lisboa.

Boletim, 31 Serie, 1913, Nos. 10, 11–12; 31 Serie, 1914, Nos. 1–2; 32 Serie, 1914, Nos. 3–4, 5–6, 7–8.

Instituto de Anatomia.

Archivo, vol. i., No. 2 (1913–14).

LONDON.

The Royal Anthropological Institute of Great Britain and Ireland.

Journal, vol. xliii., 1913, July to December; vol. xliv., 1914, January to June.

Royal Observatory, Greenwich.

Cape Astrographic Zones, vol. i., Catalogue of Rectangular Coordinates and Diameters of Star-Images derived from Photographs taken at the Royal Observatory, Cape of Good Hope. Commenced under the direction of Sir David Gill, K.C.B., LL.D., F.R.S., etc., formerly H.M. Astronomer at the Cape. Completed and prepared for press under the supervision of S. S. Hough, M.A., F.R.S., H.M. Astronomer at the Cape. With a Preface by Sir David Gill. Zone, 41°.

British Museum (Natural History).

Catalogue of the Plants collected by Mr. and Mrs. P. A. Talbot in the Oban District, South Nigeria.

Special Guide No. 6, Guide to the Exhibition of Specimens illustrating the Modification of the Structure of Animals in Relation to Flight.

Catalogue of the Lepidoptera Phalaenae in the British Museum, vol. xii., Plates cxcii.–ccxxi.; vol. xiii., Plates ccxxii.–ccxxxix.

Royal Botanic Gardens, Kew.

Bulletin of Miscellaneous Information, 1913.

Royal Astronomical Society.

Monthly Notices, vol. lxxiv., Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9; vol. lxxv., No. 1.

Memoirs, vol. lx., parts 3, 4.

LONDON—*continued.*

The Royal Colonial Institute.

"United Empire," The Royal Colonial Institute Journal, vol. v. (N.S.), Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.

"Our Just Cause. Facts about the War for Ready Reference."

Index to vol. iii.

Index to vol. iv.

Year Book, 1914.

The Royal Society of London.

Proceedings, Series A, vol. lxxxix., Nos. 612, 613, 614; vol. xc., Nos. 615, 616, 617, 618, 619, 620, 621, 622, 623, 624; Series B, vol. lxxxvii., Nos. 594, 595, 596, 597, 598, 599, , , , 603.

Geological Society of London.

Quarterly Journal, vol. lxix., part 4, No. 276; vol. lxx., part 1, No. 277; part 2, No. 278; part 3, No. 279.

List of the Geological Society of London, June 30, 1914.

Geological Literature added to the Geological Society's Library during the year ended December 31, 1912.

The Institution of Civil Engineers.

Minutes of Proceedings, with other selected and abstracted papers, vol. cxciii., 1912–13, part 3; vol. cxcix., 1912–13, part 4; vol. cxcv., 1913–14, part 1; vol. cxcvi., 1913–14, part 2.

Charters, Supplemental Charters, By-Laws, and List of Members, I., July, 1914.

International Catalogue of Scientific Literature.

A, Mathematics, 11; B, Mechanics, 11; C, Physics, 11; D, Chemistry; E, Astronomy, 11; F, Meteorology, 11; G, Mineralogy, 11; H, Geology, 11; J, Geography, 11; K, Palaeontology, 11; L, General Biology, 11; M, Botany, 11; N, Zoology, 11; O, Anatomy; P, Anthropology, 11; Q, Physiology, 10; R, Bacteriology, 10.

The Royal Geographical Society.

Journal, vol. xliii, Nos. 1, 2, 3, 4, 5, 6; vol. xliv., Nos. 1, 2, 3, 4, 5, 6.

The Linnean Society of London.

Journal, Botany vol. xl., Nos. 275, 276, 277, 278; vol. xli., Nos. 279, 280, 281, 282, 283, 284; vol. xlii., Nos. 285, 286, 287.

Journal, Zoology, Vol. xxxi, Nos. 203, 204, 205, 206, 207, 208; vol. xxxii., Nos. 211, 212, 213, 214, 215, 216, 217, 218.

Catalogue of Current Mathematical Journals, etc. With the names of the libraries in which they may be found. (Compiled for the Mathematical Ascociation.)

LONDON—*continued.*

The Zoological Society of London.

Proceedings, 1913, part 4, pp. 861–1104; 1914, part 1, pp. 1–226; 1914, part 2, pp. 227–490.

Transactions, vol. xx., parts 5, 6, 7, 8, 9, 10.

Report of the Council and Auditors for the year 1913.

Royal Meteorological Society.

Quarterly Journal, vol. xl., Nos. 169, 170, 171, 172.

List of Fellows, March 2, 1914.

"War and Peace" (monthly magazine), vol. i., Nos. 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15.

Messrs. Iliffe & Son.

The Motor Cycle, vol. xii., No. 571; vol. xiii., Nos. 597, 608.

The Autocar Imperial Year Book, 1914.

MANCHESTER.

The Manchester Geographical Society.

Journal, vol. xxix., parts 1 and 2, 1913; vol. xxix., parts 3 and 4, 1913.

Manchester Literary and Philosophical Society.

Memoirs and Proceedings, 1913–14, vol. lviii., parts 1, 2.

MANILA, P. I.

The Bureau of Science, Manila, P. I.

The Philippine Journal of Science.

Section "A," Chemical and Geological Sciences, and the Industries, vol. viii., Nos. 3, 4, 5, 6; vol. ix., Nos. 1, 2, 3.

Section "B," The Philippine Journal of Tropical Medicine, vol. viii., Nos. 5, 6; vol. ix., Nos. 1, 2, 3, 4.

Section "C," Botany, vol. viii., Nos. 5, 6; vol. ix., Nos. 1, 2, 3.

Section "D," General Biology, Ethnology, and Anthropology, vol. viii., Nos. 4, 5, 6; vol. ix., Nos. 1, 2, 3.

Bulletin of the Philippine Library, vol. ii., Nos. 3, 4, 5, 6, 7, 8, 9, , 11, 12; vol. iii., No. 1.

Twelfth Annual Report of the Bureau of Science, Philippine Islands, for the year ending June 30, 1913.

Division of Mines. The Mineral Resources of the Philippine Islands for the year 1912.

MELBOURNE.

Australian Association for the Advancement of Science.

Report of the Fourteenth Meeting, held at Melbourne, 1913, vol. xiv.

Royal Society of Victoria.

Proceedings, vol. xxvi. (N. S.), part 2.

Melbourne—*continued.*

Public Library, Museums, and National Gallery of Victoria.

Report of the Trustees for 1913.

National Museum, Melbourne.

Memoirs, No. 5.

Mexico.

Sociedad Cientifica "Antonio Alzate."

Memorias y Revista, tomo xxxii., Nos. 7 and 8, 9 and 10; tomo xxxiii., Nos. 1, 2, 3, 4, 5, 6, 7 and 8, 9 and 10.

Observatorio Meteorologico Magnetico Central de Mexico.

Boletin Mensual, 1913, Enero, Febrero, Marzo, Abril, Mayo, Junio.

Minneapolis, Minn., U.S.A.

Minnesota Academy of Science.

Bulletin, vol. v., No. 1.

Missoula, Montana, U.S.A.

University of Montana.

Bulletin, Register, 1910–11; Register, 1911–12; Register, 1913–14; Montana High School Debating League, 1911; University Extension Work for 1911–12; Ninth Annual Interscholastic Meeting, 1912; Forestry Announcement, 1912–13; Summer School Announcement (Preliminary), 1913; Summer School Announcement, 1913; Biological Station, 1913; Short Course in Forestry, 1911.

Montevideo.

Republica Oriental del Uruguay.

Anos 1909–10, Anuario Estadistico de la Republica Oriental del Uruguay, tomo i., con varios datos de 1911.

Moscou.

Société Impériale des Naturalistes de Moscou.

Bulletin, Année, 1913, Nos. 1–3.

München.

Königlich Bayerischen Akademie der Wissenschaften.

Abhandlungen, xxvi., Band 7, 8, 9, 10, Abhandlung.

Abh. d. ii., Kl.–2, Suppl.–Bd. 10, Abh.; Abh. d. ii., Kl.–3, Suppl.–Bd. 2, Abh.; Ahb. d. ii., Kl.–4, Suppl.–Bd. 3, Abh.

Sitzungsberichte-math.-phys., Kl.

Jahrg., 1913, Heft iii.

Register, zu den K. Bayer Akademie der Wissenschaften, 1807–1913.

Maritzburg, Natal.

Natal Museum.

Annals, vol. iii., part 1, September, 1914.

Nantes.

Société des Sciences Naturelles de l'Ouest de la France.

Bulletin, Troisième Série, tome ii., 3 et 4 Trimestres, 1912; Troisième Série, tome iii., 1 Trimestre, 1913; tome iii., 2 Trimestre, 1913; tome iii., 3 et 4 Trimestre, 1913.

New Orleans, La., U.S.A.

Louisiana State Museum, New Orleans, U.S.A.

Fourth Biennial Report of the Board of Curators, April 1, 1912, to March 31, 1914.

New York, U.S.A.

New York Academy of Sciences.

Annals, vol. xxiii., pp. 1–75, 77–83, 85–143; vol. xxiv., pp. 1–17; 19–22, 23–38, 39–113, 115–170.

American Geographical Society.

Bulletin, vol. xlv., No. 12; vol. xlvi., Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.

Index to vol. xlv.

Ottawa, Canada.

Department of Mines, Geological Survey.

Victoria Memorial Museum, Bulletin, Nos. 1, 2.

Geological Survey, Memoirs, Nos. 20E, 23, 29E, 43, 44, 22, 41, 54, 32, 52, 19, 47, 39, 40.

Guide Books, Nos. 1 (2 parts), 2, 3, 4, 5, , , 8 (3 parts), 9, 10.

Prospector's Handbook, No. 1.

Summary Report for the Calendar Year 1912, with Map 92A.

The Royal Society of Canada.

Proceedings and Transactions, Third Series, vol. vii., 1913.

Transactions, Series III., Sections i., ii., iii., iv.

Paris.

La Feuille des Jeunes Naturalistes.

Nos. 517, 518, 519, 520, 521, 522, 523, 524.

Philadelphia, U.S.A.

The Academy of Natural Sciences.

Proceedings, vol. lxv., part 2, April–August, 1913; vol. lxv., part 3, September–December, 1913.

The American Philosophical Society.

Proceedings, vol. lii., Nos. 210, 211, 212.

Pretoria.

Union of South Africa. Mines Department. Geological Survey.

Sheet No. 2 (Pienaars River) (New Series), with Supplement to the Explanation of the Sheet.

Annual Reports for 1913, part 5, Geological Survey.

Transvaal Museum.

Annals, vol. iv., part 3, 4.

Rio de Janeiro.

Ministerio da Agricultura, Industria e Commercio.

Monographias do Servico Geologico e Mineralogico do Brasil, vol. i.

Roma.

Reale Accademia dei Lincei.

Atti Della Reale Accademia dei Lincei, Rendiconti—Classe di Scienze Fisiche, Matematiche e Naturali, vol. xxii., 2 Sem., Fasc. 10, 11, 12 ; vol. xxiii., 1 Sem., Fasc. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 ; 2 Sem., No. 1.

Rendiconti, Classe di Scienze Morali, Storiche e Filologiche, Serie Quinta, vol. xxii., Fasc. 7–10, 11–12, e Indice ; Serie Quinta, vol. xxiii., Fasc. 1–2.

Rotterdam.

De Nederlandsche Entomologische Vereeniging.

Tijdschrift voor Entomologie, Deel lxvi., Vierde Aflevering ; Supplement.

Deel lxvii., Eerste Aflevering ; Tweede Aflevering.

Entomologische Berichten, Deel iv., Nos. 73–78.

San Francisco.

California Academy of Sciences.

Proceedings, Fourth Series, vol. ii., part 1, pp. 1–132, 133–202 ; vol. iii., pp. 265–390, 391–454 ; vol. iv., pp. 1–13, April 9, 1914.

St. Louis, Mo., U.S.A.

Washington University.

Studies, vol. i., part 1, No. 2 (Series iv., vol. i., No. 3) ; vol. i., part 2, No. 2 (Series iv., vol. i., No. 4).

St. Petersburg.

L'Academie Imperiale des Sciences de St.-Petersbourg.

Bulletin, 1913, Nos. 17, 18 ; 1914, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.

STOCKHOLM.

Kungl. Svenska Vetenskapsakademiens.

Handlingar (Memoires), Bd. 50, Nos. 2, 3, 4, 5, 6, 7, 8, 9.

Arkiv för Matematik, etc., Bd. 8, Hafte 3–4; Bd. 9, Hafte 1-2.

Arkiv för Kemi, etc., Bd. 4, Hafte 6; Bd. 5, Hafte 1–2.

Arkiv för Botanik, Bd. 12, Hafte 3–4; Bd. 13, Hafte 1.

Arkiv för Zoologi, Bd. 8, Hafte 1.

Arsbok, Year 1913.

Meddelanden Fran K. Vet. Akad. Nobel Institut, Bd. 2, Hafte 3, 4.

Svensk Naturskyddsbibliografi, 1910–12.

Les Prix Nobel en 1912.

SYDNEY, NEW SOUTH WALES.

The Linnean Society of New South Wales.

Proceedings, vol. xxxviii., part 3, No. 151; part 4, No. 152; vol. xxxix., part 1, No. 153.

The Australian Museum.

Records, vol. x., Nos. 7, 8, 9, 10.

Special Catalogue, No. 1, vol. iv., part 4.

Memoir IV. Scientific Results of the Trawling Expedition of H.M.C.S. *Thetis* off the Coast of New South Wales in February and March, 1898, part 18, Title Pages, Contents and Index.

The Royal Zoological Society of New South Wales.

The Australian Zoologist, vol. i., part 1.

Royal Society of New South Wales.

Journal and Proceedings, vol. xlvii., part 2 (1913); vol. xlviii., part 1 (1914).

The University of Sydney.

Calendar for the Year 1914.

Bibliographical Record of the University of Sydney, 1851–1913.

New South Wales, Department of Mines, Geological Survey.

"The Great Australian Artesian Basin and the Source of its Water," by E. F. Pittman, A.R.S.M.

TOKYO.

The Imperial Academy.

Proceedings, vol. i., No. 3.

Memoirs, Section II., vol. i., No. 1.

Asiatic Society of Japan, Keio University, Tokyo.

Supplement to vol. xli.

Topeka, Kansas.

The University Geological Survey of Kansas.

Bulletin, No. 1.

Torino.

Reale Accademia delle Scienze di Torino.

Atti, Classe Fisiche, Matematiche e Naturali, vol. xlix., Disp. 8, 9, 10, 11, 12, 13, 14, 15, 1913–14.

R. Osservatorio Astronomico di Torino.

Osservazioni Meteorologiche fatte nell' anno 1913. All' Osservatorio della R. Universita di Torino.

Musei di Zoologia ed Anatomia Comparata della R. Universita di Torino.

Bollettino, vol. xxviii., 1913, Nos. 665 to 679 inclusive.

Toronto.

The Canadian Institute.

Transactions, vol. x., part 1, No. 23.

Year Book for the Session 1912–13.

Urbana, Illinois, U.S.A.

Illinois State Laboratory of Natural History.

Bulletin, vol. ix., Articles Nos. 11, 12, Contents and Index; vol. x., Articles Nos. 1, 2, 3, 4, 5.

"Fresh Water Fishes and their Ecology."

Uppsala.

Linnës Föreläsningar ofver Djurriket. Med Understöd af Svenska Staten för Uppsala Universitet (Einar Lönnberg).

Zoologiska Bidrag Fran Uppsala (Zoologische Beiträge aus Uppsala), A. Wiren, Band 1, 1911–12; Band 2, 1913.

The Geological Institution of the University of Upsala.

Bulletin, vol. xii.

Washington, U.S.A.

Smithsonian Institution. United States National Museum.

Contributions from the United States National Herbarium, vol. xvi., parts 10, 11, 13; vol. xvii., parts 4, 5; vol. xviii., parts 1, 2.

Reprints from the Proceedings of the United States National Museum, Nos. 2029, 2033, 2018, 2024, 2031, 2035, 2037, 2039, 2041, 2043, 2048, 2045, 2046, 2050, 2052, 2054, 2056, 2058, 2061.

Bulletin, Nos. 71, 83, 71 (part 4); 86, 87, 50 (part 6); 85.

WASHINGTON, U.S.A.—*continued.*

Proceedings of the United States National Museum, vols. xli., xliv., xlv., xlvi.

Annual Report of the Smithsonian Institution for 1912.

U.S. Department of Agriculture.

Bulletin of the Mount Weather Observatory, vol. vi., parts 2, 3, 4; vol. .

Contents and Index of vol. v.

Weather Map of the Northern Hemisphere and Daily Weather Map for January 1, 1914.

Department of Commerce. U.S. Coast and Geodetic Survey.

Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory near Honolulu, Hawaii, 1911 and 1912, by Daniel L. Hazard.

Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, 1911 and 1912, by Daniel L. Hazard.

Results of Observations made at the United States Coast and Geodetic Survey Magnetic Observatory at Sitka, Alaska, 1911 and 1912, by Daniel L. Hazard.

Terrestrial Magnetism. Results of Magnetic Observations made by the United States Coast and Geodetic Survey between July 1, 1911, and December 31, 1912, by R. L. Faris. Special Publication, No. 15.

Department of Commerce.

Scientific Papers of the Bureau of Standards. No. 213, Critical Ranges $A_3$ and $A_2$ of Pure Iron, by G. K. Burgess and J. J. Crowe. (Reprinted from Bulletin, vol. x.)

WIEN.

K. K. Naturhistorischen Hofmuseums.

Annalen, Band xxvii., No. 4.

K. K. Zentral-Anstalt für Meteorologie und Geodynamik.

Jahrbucher, Jahrgang, 1911. Neue Folge. Band xlviii.

WIESBADEN.

Nassauischen Vereins für Naturkunde.

Jahrbucher, Jahrgang 66.

ZURICH.

Vierteljahrsschrift der Naturforschenden Gesellschaft in Zurich.

Jahrgang 58, 1913: Drittes und viertes Heft.

Jahrgang 59, 1914: Erstes und zweites Heft.

# MINUTES OF PROCEEDINGS

OF THE

# ROYAL SOCIETY OF SOUTH AFRICA.

---

## Report of the Hon. General Secretary for the Year Ending December 31, 1914.

Six Ordinary Meetings, the Annual and the Anniversary Meetings, were held during the year, and the following papers were read:

"Note on a Theorem of Ph. Gilbert, regarding the Differentiation of a Special Jacobian," by T. Muir.

"Note on Rosanes' Functions, resembling Jacobians," by T. Muir.

"The Triple Stellar System $\zeta$ Virginis and $\Sigma$ 1757," by R. T. A. Innes.

"A Curious Mosquito," by G. A. H. Bedford.

"On the Porosity of the Rocks of the Karroo System," by A. L. du Toit.

"A Note on the Temperatures of the Air observed at Mochudi," by J. R. Sutton.

"Properties of Pfaffians and their Analogues in Determinants," by T. Muir.

"The Secular Variation of the Magnetic Elements in South Africa during the Period 1900–1913," by J. C. Beattie.

"A Proof by Elementary Methods, without Complex Quantities, that every Algebraic Function (with Real Coefficients) has Factors of the Form $x^2 - vx + q$ ($p.q.$ real)," by W. N. Roseveare.

"On Malet's Proof that every Equation has Roots, Real or Imaginary, Equal in Number to its Degree," by W. N. Roseveare.

"Note on Palaeolithic Implements of Large Size found in the Precincts of Capetown City," by L. Péringuey.

"Note on Grooved Stone Slabs, used by the Strand-looper-San Aboriginals," by L. Péringuey.

"On the Anatomy of *Ozobranchus branchiatus* and its Position in the Class Hirudinea," by E. J. GODDARD.

"Preliminary Investigation of the Deterioration of Maize Infected with *Diplodia Zeae* (Schw.), Lev.," by PAUL A. VAN DER BIJL.

"The Morphology of the Tadpole of *Xenopus laevis*," by T. F. DREYER.

"A Morphological Study of *Strongylus Douglasi*, Cobbold," by RAFFAELE ISSEL.

"On the Interpretation of the Electrocardiogram," by W. A. JOLLY.

"On the Crystallography of Anatase Crystals in the Auriferous Conglomerate of the Witwatersrand," by W. VON BONDE.

"Note on the Product of a Special $n$-line Determinant by its Central Minor of the $(n$-$4)$th Order," by THOMAS MUIR.

"The Great Dyke of Norite of Southern Rhodesia—Petrology of the Selukwe Portion," by A. E. V. ZEALLEY.

"The Mosses of South Africa," by HORACE A. WAGER.

"A Mesostoma from Bloemfontein (*M. Karrooense*, n. sp.)," by T. F. DREYER.

"Note on Hesse's Generalisation of Pascal's Theorem," by THOMAS MUIR.

"Herpetomonidae found in *Scatophaga Hottentota* (Diptera) and *Chamaeleon pumilus* (Lacertilia)," by H. BAYON.

"Some New South African Aloes," by J. B. POLE-EVANS.

"Optical Illusions," by TH. WASSENAAR.

"On the Space-Lattice of Liquid Crystals," by J. S. V. D. LINGEN.

The Society has awarded, on the recommendation of the General Committee, for Grants-in-Aid of Research, the following grants: £100 to J. C. BEATTIE for the prosecution of Magnetic Work in the Eastern Province, in German South-West Africa, and in Rhodesia; £40 to A. L. DU TOIT for the comparative study of the Geological Formations in Australia and South Africa; £100 to F. W. FITZSIMONS for expenses connected with the further excavation of a site where fossil human remains have been found; £50 to Miss M. WILMAN for copying bushman paintings and making rubbings of engravings.

During the past year further progress has been made with the cataloguing of the Society's library.

The publications of the undermentioned Societies have been examined and catalogued, and communications are proceeding with the Societies regarding filling up of blanks.

American Geographical Society.
Missouri Botanical Garden.
University of Missouri.
University of Okhlahoma.
Washington University, St. Louis.

Brooklyn Institute of Arts and Sciences.
Texas Academy of Science.
Davenport Academy of Natural Sciences.
Illinois State Laboratory of Natural History.
American Academy of Arts and Sciences.
Louisiana State Museum.
Field Columbian Museum, Chicago.
Colorado College, Colorado Springs.
University of Colorado, Indiana State, Department of Geology.
Indiana Academy of Sciences.
Johns Hopkins University.
Johns Hopkins Hospital.
American Microscopical Society.
Academy of Natural Sciences of Philadelphia.
California Academy of Sciences. (Bulletin—Proceedings—Sections of Botany—Zoology—Geology—Math.-Phys.—Memoirs, etc.)
University of California. (Sections of Zoology—Economics—Physiology—Geology—Botany—Amer. Archae. and Ethnology.)
University of Kansas.
New York Academy of Sciences.
American Philosophical Society.
Bureau of Science, Philippine Islands.

The annual increase of volumes in the library has rendered additional accommodation urgently necessary.

Vol. IV, Parts 1 and 2, of the Society's Transactions have been issued during the year.

The number of Honorary Fellows is 4; Fellows, 52; Members, 168.

The Society regrets to have to record the death, since the 1914 Anniversary Meeting, of the Right Hon. Lord de Villiers, Fellow, and of G. T. Amphlett, L. MacLean, E. H. V. Melvill, and Sir A. E. Thomson, Members of the Society.

---

## Anniversary Meeting.

The Anniversary Meeting of the Society was held on Wednesday, April 21st, 1915, at 8.15 p.m., in the Board Room of the South African Association Church Square, Capetown.

The President, Dr. L. Péringuey, was in the Chair.

The Report of the Hon. General Secretary was submitted and adopted.

The Report of the Hon. Treasurer was submitted and adopted.

# TREASURER'S ACCOUNT FOR THE YEAR ENDING DECEMBER 31, 1914.

## Receipts.

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| To Balance in Bank as per Pass Book ... ... | | | | 103 | 16 | 6 |
| ,, Subscriptions received in 1914: | | | | | | |
| for two years before 1911, 1 Country Member ... ... ... ... ... | 2 | 0 | 0 | | | |
| for 1911, 1 Country Member ... ... | 1 | 0 | 0 | | | |
| for 1912, 1 Fellow at £2, 2 Town Members at £2, 4 Country Members at £1 | 10 | 0 | 0 | | | |
| for 1913, 5 Fellows at £2, 5 Town Members at £2, 12 Country Members at £1 | 32 | 0 | 0 | | | |
| for 1914, 43 Fellows at £2, 48 Town Members at £2, balance 1 Town Member £1 18s., 84 Country Members at £1, balance 1 Country Member 17s. 6d., balance 1 Country Member 18s. 6d. ... | 269 | 14 | 0 | | | |
| for 1915, part 2 Fellows 4s., 5 Country Members at £1, part 1 Country Member 1s. ... ... ... ... ... | 5 | 5 | 0 | | | |
| | | | | 319 | 19 | 0 |
| ,, Entrance Fees received, 11 new Members | | | | 11 | 0 | 0 |
| ,, Part Government Grant, 1914–5 ... ... | | | | 300 | 0 | 0 |
| ,, Sales of Publications ... ... ... | | | | 17 | 4 | 1 |
| ,, Interest on Fixed Deposit in Standard Bank, 1913–14 ... ... ... ... | | | | 32 | 0 | 0 |
| ,, Gift from Miss Lloyd ... ... ... | | | | 4 | 16 | 0 |
| ,, Sale of Binding Cases ... ... ... | | | | 0 | 9 | 9 |
| | | | | £789 | 5 | 4 |

## Expenditure.

| | £ | s. | d. |
|---|---|---|---|
| By Publications ... ... ... ... ... ... | 219 | 6 | 3 |
| ,, Freight, Insurance, Landing Charges, etc. ... ... | 10 | 11 | 3 |
| ,, Research Grants and Expenses, less refund unexpended balances ... .. ... ... ... | 259 | 10 | 4 |
| ,, Cost of Stamps on retaining £800 for one year on Fixed Deposit, Standard Bank ... ... ... | 0 | 4 | 0 |
| ,, Payment in connection with Grant to Professor Pearson for Botanical Exploration in Namaqualand | 0 | 12 | 6 |
| ,, Compilation for International Scientific Catalogue of Papers ... ... ... ... ... ... ... | 25 | 0 | 0 |
| ,, Clerical Assistance in year and work in Library ... | 55 | 0 | 0 |
| ,, Local Printing and Stationery ... ... ... ... | 33 | 18 | 10 |
| ,, Postage and Petties, less Petty Cash returned by Mr. H. E. Wood, Johannesburg ... ... ... | 36 | 0 | 7 |
| ,, Bank charges for Commissions, Ledger Fee, Deposit Book, less Commissions paid by Members .. ... | 1 | 10 | 5 |
| ,, Hire of Rooms for Meetings and Caretaker, part 1913 and 1914 ... ... ... ... ... ... ... | 7 | 17 | 6 |
| ,, Engrossing on Fellows' Book ... ... ... ... | 2 | 10 | 0 |
| ,, Purchase Volumes from Government Stationery Department ... ... ... ... ... ... ... | 3 | 13 | 6 |
| ,, Cash, Entrance Fees, received 1914, put into Post Office Savings Bank ... ... ... ... ... | 11 | 0 | 0 |
| ,, Share of Expenses in entertaining Members of British Association ... ... ... ... ... ... | 5 | 13 | 0 |
| ,, Balance in Bank as per Pass Book ... ... ... | 116 | 17 | 2 |
| | £789 | 5 | 4 |

## ASSETS AND LIABILITIES AS AT DECEMBER 31, 1914.

| Assets. | £ | s. | d. |
|---|---|---|---|
| Money at Standard Bank on Fixed Deposit at 4 per cent. | 800 | 0 | 0 |
| Money in Post Office Savings Bank, Life Subscriptions and Entrance Fees ... ... ... ... ... ... | 125 | 0 | 0 |
| Money in Post Office Savings Bank, at call, with interest to March 31st, 1914 ... ... ... ... ... | 400 | 3 | 1 |
| Balance in Standard Bank, as per Pass Book ... ... | 116 | 17 | 2 |
| Petty Cash in hands of Hon. Secretary ... ... ... | 3 | 4 | 0 |
| Arrears of Subscriptions, as in Statement for 1913, due at beginning of 1914, £77, less £43 paid in year and £8 struck off as irrecoverable ... ... ... ... | 26 | 0 | 0 |
| Arrears of 1914 Subscriptions ... ... ... ... | 57 | 0 | 0 |
| | £1,528 | 4 | 3 |

| Liabilities. | | | | £ | s. | d. |
|---|---|---|---|---|---|---|
| Subscriptions, whole or in part, received for 1915 ... | | | | 5 | 5 | 0 |
| Balance Grant to Professor Pearson for Botanical Exploration in Namaqualand ... ... ... ... | | | | 57 | 15 | 6 |
| Balance of Research Grants voted 1914: | | | | | | |
| Dr. J. C. Beattie (whole grant) | £100 | 0 | 0 | | | |
| Miss M. Wilman (half grant) | 25 | 0 | 0 | | | |
| | | | | 125 | 0 | 0 |
| Balance from 1912 Conversazione carried forward towards the expenses of future Conversazione in Capetown ... | | | | 7 | 4 | 0 |
| | | | | £195 | 4 | 6 |

LAWRENCE CRAWFORD, Hon. Treasurer.

We have audited the accounts and checked the vouchers of the Royal Society of South Africa for the year 1914, and find the same, to the best of our belief, correct.

J. HALM.
W. H. LOGEMAN.
February 10, 1915.

The following were elected Members of Council for the year 1915:

| | |
|---|---|
| Dr. L. Crawford. | Dr. R. A. Lehrfeldt. |
| Dr. E. J. Goddard. | Dr. L. Péringuey. |
| Dr. J. K. E. Halm. | Dr. W. F. Purcell. |
| Dr. W. A. Jolly. | Dr. J. R. Sutton. |
| Dr. C. F. Juritz. | Sir A. Theiler. |
| Mr. F. E. Kanthack. | Dr. A. Marius Wilson. |

Dr. L. Péringuey was elected President.

Dr. L. Crawford, Hon. Treasurer.

Dr. W. A. Jolly, Hon. General Secretary.

The President then gave an Address, entitled "The Bushman as a Palaeolitic Man."

---

## Ordinary Monthly Meeting.

An Ordinary Meeting was held on April 21st, after the Anniversary Meeting.

The President was in the Chair.

The Minutes of the Ordinary Meeting held on October 21st, 1914, were confirmed.

Mr. Th. Wassenaar was elected a member.

Dr. A. D. Ketchen and Dr. Hugh Smith were nominated for election as members.

The following papers were read:

1. "Some Notes on the South African Erysiphaceae," by Ethel M. Doidge, communicated by Dr. Pole-Evans.

The paper consists of notes on the South African representatives of the "powdery mildews." These cause a number of widely-distributed and more or less destructive diseases of plants in this country; but they are not easily identified owing to the almost invariable absence of perithecia.

The species occurring in South Africa are enumerated, and a list given of the specimens contained in the Union Mycological Herbarium, Pretoria.

Two new specimens of the genus Uncinula are described.

2. "Geitsi Gubib, an old Volcano," by A. W. Rogers.

A geological description is given of Geitsi Gubib, a ring-shaped mountain in German South-West Africa, rising about 5,200 feet above sea-level, and a conspicuous object from the railway north of Keetmanshoop. The description is based on notes taken during a stay by the author of two days on the mountain, and on the examination of the rocks brought away.

---

ORDINARY MEETING.

An Ordinary Meeting was held on Wednesday, May 19th, 1915, at 8.15 p.m., in the Board Room of the South African Association, Church Square, Capetown.

The President, Dr. L. PÉRINGUEY, took the Chair.

The Minutes of the previous meeting were confirmed.

Mr. R. RAY, B.Sc., was nominated for membership.

Dr. A. D. KETCHEN and Dr. HUGH SMITH were elected members.

Sir KENDAL FRANKS subscribed the Obligation in the Charter Book as Fellow of the Society.

The following communications were made:

"The Equivalent Mass of a Spring Vibrating Longitudinally," by ALEXANDER BROWN.

The paper deals with the allowance to be made for the mass of a spring when a weight attached to it is oscillating under gravity and the tension of the spring. The fraction one-third of the spring's mass is correct for great added weights; for very small weights the fraction is a little over two-fifths. The variation of this fraction is considered theoretically, and data supplied to give its value for any weight. Experiments are described confirming the theoretical results.

"The Occurrence of Dinosaur Bones in Bushmanland," by A. W. ROGERS.

Dinosaur bones were found in a well in Bushmanland at 112 ft. below the surface. The well is in an old valley cut in gneiss and filled in with local *débris*. It seems probable that the climate became dry while the dinosaurs lived there, and that since then the valley has been steadily filled up.

"Description of the Dinosaur Bones from Bushmanland," by S. H. Haughton.

The bones discovered by Dr. Rogers consist of a maxillary tooth and portions of the hind limbs and caudal vertebra of a medium-sized Ornithopodous Dinosaur. They are described under the name *Kangnasaurus Coetzeei* n. g. et sp., which is shown to have affinities with *Camptosaurus* and its allies, and with *Mochlodon* and *Hypsilophodon*. The form is certainly younger than *Camptosaurus*, but no estimate of its exact age is given, the evidence being considered to be too insufficient.

"The Coccidæ of South Africa," by CHAS. K. BRAIN.

The paper, which is the first contribution to a Catalogue of the Coccida of South Africa, deals with five sub-families, viz.: *Pseudococcinae, Orthe siinae, Coccinae, Monophlebinae*, and *Margarodinae*. Sixty-three species and two varieties are described, of which number thirty-two are here dealt with for the first time.

"A Note on the Molecules of Liquid Crystals," by J. S. v. D. LINGEN.

The object of the paper is to show the effect of bi-prisms on the Lane spots. Experiments carried out with prisms of NaCl show that the spots are "fluted," and that the central spot is elliptic instead of circular. Sixty degrees and 179 degrees bi-prisms show this phenomenon, especially when they are rotated through a small angle.

"On the 'Lines' within Röntgen Interference Photographs," by J. S. v. d. Lingen.

The author holds that these lines are due to the ruptured surface, which will most probably resemble an echelon grating. Sodium Chloride, Quartz, Silicon, and Magnesium Hydroxide photographs are described. These show "irregular spots" under certain conditions.

---

Ordinary Meeting.

*June* 16, 1915.

The President, Dr. L. Péringuey, was in the Chair.

The Minutes of the previous Meeting were confirmed.

The following nominations for membership were intimated: Mr. L. Simons, B.Sc., Mr. F. Brinsley, M.Sc., and Mr. C. S. Grobbelaar, M.A. Proposed by Dr. E. J. Goddard, seconded by Dr. B. St. J. v. d. Riet.

Miss E. M. Doidge, D.Sc., F.L.S, and Mr. J. A. v. d. Bijl, M.A., F.L.S. Proposed by Sir A. Theiler, seconded by Dr. C. F. Juritz.

Mr. R. Ray, B.Sc., was elected a member.

The following communications were made:

"Osteology of Palaeornis, with other notes on the genus." By R. W. Shufeldt. Communicated by Dr. L. Péringuey.

A description is given of one of the most abundant parrots of India—*Palaeornis torquatus*, or the Ring-parrot—so named for the reason that in the adult a ring or collar forms a part of the plumage of the neck. It is a species long known to many in the Indian Empire, where it is represented as the vahana or "vehicle" of Kama, one of the gods of the Hindus. Kama corresponds to our Cupid, or rather the classic Eros, symbolising Love These birds, for there are several species of them, are supposed to have been known to the Greeks and Romans, but they were not considered as a subfamily of parrots until so founded in 1825 by Vigors, who gave them the name of *Palaeornithinae*.

"Note on apparent Apogamy in *Pterygodium Newdigatae*." By Miss A. V. Duthie.

This paper deals with a cleistogamous variety of the South African Orchid *Pterygodium Newdigatae* and is of special interest because cleistogamy, rare enough among Orchids, appears here to be accompanied by apogamy.

Sections of the ovary and column at various stages of development show no trace of pollen tubes. The gland-like "pollen masses," which remain permanently embedded in the tissue of the rostellum arms, do not appear to develop beyond the mother cell stage.

"A Record of Plants collected in Southern Rhodesia." By FRED EYLES.

This record includes representatives of 160 Families, 869 Genera, and 2,397 Species, besides 112 Varieties.

The flowering plants are arranged on Dr. Engler's system as set out in the *Genera Siphonogamarum* of Dr. C. G. de Dalla Torre and Dr. H. Harms, 1900–1907.

The ferns and fern allies are arranged in accordance with the system of Engler and Prantl, as shown in the Check List of Flowering Plants and Ferns of the Transvaal and Swaziland by J. Burtt-Davy and Mrs. Pott, 1911.

With regard to the lower cryptogams, the arrangement is that of Strasburger's Text Book of Botany, 1903.

Description of: (1) a simple apparatus for finding "g"; (2) a simple apparatus for standardising a given Vibrator. By J. S. v. d. LINGEN.

The discussion on this communication was postponed until the next meeting of the Society.

---

ORDINARY MEETING.

*July* 21, 1915.

The President, Dr. L. PÉRIGUEY, was in the Chair.

The Minutes of the previous Meeting were confirmed.

Mr. J. FIGDOR, L.D.S., was nominated for memberhip.

The following were elected to membership:

Mr. L. SIMONS, B.Sc., Mr. F. BRINSLEY, M.Sc., Mr. C. S. GROBBELAAR, M.A., Miss E. M. DOIDGE, D.Sc., F.L.S., and Mr. J. A. v. d. BIJL, M.A., F.L.S.

The following communications were made:

"Exhibition and Description of a New Type of Fossil Reptile from the Karroo." By S. H. HAUGHTON.

"Note on Conus Shells illustrating Variation in Markings." By K. H. BARNARD.

"Discussion of: (1) Simple Apparatus for finding 'g'; (2) Simple Apparatus for Standardising a given Vibrator." By S. J. v. d. LINGEN.

"Note on Astronomical Photometry." By J. K. E. HALM.

"The Electromotive Changes accompanying Activity in the Mammalian Ureter." By W. A. JOLLY.

## Ordinary Meeting.

*August* 18, 1915.

The President, Dr. L. Péringuey, was in the Chair.

The Minutes of the previous Meeting were confirmed.

Mr. F. W. Pettey and Mr. J. Figdor, L.D.S., were elected to membership.

The following communications were made:

"The Growth Forms of Natal Plants." By J. W. Bews. (Communicated by Prof. H. H. W. Pearson.)

The author gives a detailed description of his work on the growth forms of Natal plants. The investigation of the growth forms of plants in relation to their environment is being recognised as a very important, if not the most important, branch of Plant Ecology. The study of the various plant communities and their determination by the environmental factors presents a more general aspect of the subject, and has hitherto perhaps on the whole received more attention from plant ecologists, though, of course, it includes a certain amount of the study of the separate growth forms. It is, however, in the more detailed study of the "epharmony" of the species of plants that a deeper insight is gained into the cause and effect relationship existing between the environment and plant life.

"The South African Rust Fungi." 1. The Species of Puccinia on Compositae." By I. B. Pole-Evans.

Descriptions and accompanying notes are given of the species of Puccinia, based mainly upon material which the author and his colleagues have collected during the past ten years in South Africa, and which is now represented in the Mycological Herbarium of the Union of South Africa at Pretoria.

The material has been collected primarily with the object of elucidating the life-histories of the various rusts which are so destructive to many of our economic crops, and it is hoped that the descriptions of these parasites, of which this is the first instalment, may promote a more widespread interest in this group of plants and may be the means of adding considerably to our present very imperfect knowledge of these fungi.

"Heating and Cooling Apparatus for Röntgen Crystallographic Work." By J. Steph. v. d. Lingen.

The apparatus described has been devised by the author in order to facilitate the work of those who wish to carry on research on the determination of the energy of an atom at zero temperature and at very high temperatures. The energy of atoms and its relation to temperature is one of the many problems of modern physics. Since the publication of de Bye's extension of Von Laue's theory of Röntgen interference, several experiments have been performed with a view to determine, firstly, the validity of de Bye's theory, and secondly, the variation of atomic energy due to "heat motion."

In the discussion following upon this communication it was pointed out that the only reason why important work of this description is not being prosecuted in South Africa is the lack of available funds.

On the motion of the President, seconded by Prof. L. Crawford, the Society resolved to record its belief that it is highly desirable that research of this kind should be carried on in South Africa, and that the requisite financial support ought to be made available.

---

## Annual Meeting.

*September* 15, 1915.

The President, Dr. L. Péringuey, was in the Chair.

It was announced that no nominations to Fellowship had been made this year, and the attention of members was directed to the rule that names of candidates for Fellowship must be proposed prior to the first day of May.

---

## Ordinary Meeting.

*September* 15, 1915.

The President was in the Chair.

The Minutes of the Ordinary Meeting held on August 18th ere confirmed.

On the motion of the President, seconded by Dr. Marius Wilson, the Society expressed its sense of the loss sustained through the death of Dr. J. Medley Wood, one of the Fellows of the Society, and its sympathy with his relatives.

The President gave notice of the Election of the Council, President and Officers for 1916.

The following communications were made:

"South African Perisporiales: 1. Perisporiaceae." By Miss Ethel M. Doidge.

The Perisporiaceae and allied fungi are very plentiful in South Africa especially in forest regions and in warm districts with a fairly plentifu rainfall. The specimens in the Union Mycological Herbarium are mostly from the Woodbush forests in the Zoutpansberg, from the Knysna and from the coast regions of Natal; there is also a fair sprinkling from other parts of the coast and from Natal as far inland as Pietermaritzburg. The Middle and High Veld of the Transvaal are only represented by a single specimen, a species of *Dimeriella* collected at Bandolier Kop.

All that is known of the South African Perisporiales up to the present is comprised in diagnoses and descriptions of fungi collected by Professor MacOwan and Dr. J. Medley Wood, and in a few descriptions of fungi more recently collected and published in the Annales Mycologici and elsewhere.

All the earlier work was done in the Grahamstown District and the Coast Region of Natal, so that a large part of the Union was left totally unexplored so far as this group was concerned.

"The Arrangement of Successive Convergents in Order of Accuracy." By Alexander Brown.

One of the most important uses of Simple Continued Fractions is for the solution of the problem to find the fraction whose denominator does not exceed a given integer, which shall most closely approximate to a given number commensurable or incommensurable. A practically complete solution was provided by Lagrange in 1769 in his paper "Sur la Resolution des Equations Numériques" in the Mémoires de l'Académie royale des Sciences et Belles-Lettres de Berlin.

His results give the fraction nearest in defect and the fraction nearest in excess satisfying the conditions. He does not, however, consider the question of deciding which of these two fractions is nearest in absolute value to the given number. The author gives a proof of the rule and a method of arranging the convergents in one set so as to show the nearest in defect, the nearest in excess, and the nearest in absolute value satisfying the stated condition.

"The Use of a Standard Parabola for Drawing Diagrams of Bending Moment and of Shear in a Beam Uniformly Loaded." By Alexander Brown.

The important stresses in a uniform continuous beam are the Shear and the Bending Moment; they are best shown in the form of graphs where length along the beam is taken as abscissa and the required function as ordinate.

---

## Ordinary Meeting.

*October* 20, 1915.

The President, Dr. L. Péringuey, was in the Chair.

The Minutes of the Ordinary Meeting held on September 15th, 1915, were confirmed.

Mr. Montagu Price was nominated for membership.

The President gave notice of the election of the Council, President, and Officers, and announced the Council's recommendation to the Society as Members of Council for 1916 of the following seven members of the existing Council:—L. Crawford, J. K. E. Halm, W. A. Jolly, C. F. Juritz, L. Péringuey, Sir A. Theiler, and A. Marius Wilson; and the following five Fellows:—J. C. Beattie, G. S. Corstorphine, C. P. Lounsbury, S. Schonland, and B. St. J. v. d. Riet.

The Council further recommended L. Péringuey as President, L. Crawford as Hon. Treasurer, and W. A. Jolly as Hon. General Secretary.

Exhibits:

Mr. J. S. v. d. Lingen exhibited to the Society: (1) a new form of protective cloak of rubber and lead to be worn when work is being undertaken with X rays; (2) Apparatus in which liquid air is employed for cooling crystals; and (3) Heating Apparatus for the study of liquid crystals.

Dr. L. Péringuey exhibited stone implements found together with remains of extinct animals in South Africa, and sketched the probable ancestry of Man in South Africa in view of the recent discovery of fossilised human remains.

The following communications were read:

"Description of a South African Species of Pelodrilus." By E. J. Goddard and C. S. Grobbelaar.

This is the first record of the genus Pelodrilus, an Oligochaete worm, in South Africa. The specimens were obtained from Sneeuw Kop, near Wellington, at a height of about 4,500 feet. The species has the generic characters of other species. The genital pores were distinctly made out. The occurrence in South Africa is interesting, as the genus has a distribution restricted to the Antarctic region.

"Preliminary Note on Ancient Human Skull-remains from the Transvaal." By S. H. Haughton.

A description is given of the skull-remains found at Boskop, Transvaal, and of the manner of their occurrence. The remains consist of the greater part of the skull-cap, a temporal bone, and a portion of the lower jaw. Unfortunately, no estimate can be given as to their age. The bones are considerably fossilised, and were found embedded in a sub-soil which overlay and partially consisted of the lateritic "ouklip" characteristic of some parts of the Transvaal.

Examination of the skull-cap shows that it is the longest known, with the exception of that of La Chapelle-aux-Saints. Its greatest affinities are with the skulls of the Cro-Magnon type—a Negroid type which lived in Southern Europe after that of Neanderthal. The back of the skull is considerably elongate, a feature displayed both by the Neanderthal man and the Cro-Magnon man, while the forehead and anterior half of the skull agree with the Cro-Magnon and Bantu types, and not at all with the Neanderthal. The temporal bone is somewhat primitive in its characters, and seems to indicate a somewhat more degraded type than does the skull-cap: a semblance which may just possibly be due to sex. The lower jaw is comparatively small and akin in character to that of the Bantu or Bushman type. The details of the various bones are briefly discussed, and figures are given to indicate the relations of the skull-cap to other types. Fragments of limb-bones found in the neighbourhood of the skull-cap are described by R. B. Thomson as human. These comprise portions of the shafts of the left ulna and radius, of the left tibia and fibula, and two portions of the right femoral shaft. Stones which were supposed possibly to bear traces of human workmanship are stated by L. Péringuey not to be artefacts.

In the discussion which followed upon this communication, Dr. Péringuey said:—

Mr. Haughton has told you of a few fragments of sandstone with angular borders found partially encased in laterite in the excavation carried to a depth of nearly 8 feet over an area of about 25 square yards around the spot which was pointed out to him as being directly over the original position of the skull-cap of the Boskop man.

A superficial examination was sufficient to reject most specimens as not being artefacts. Two which were thickly coated with the ferruginous matrix, with ends only partly showing, were very carefully developed, with the result that I can ascribe to them nothing but a natural origin. Man's hand had no share in the shaping.

One of these pseudo implements has truly a facies approximating to that of an artefact, but if shaped by man the median ridge of the upper face should be sharp, whereas it is rounded and not continuous in the original. This is the only piece that might be taken as simulating a long flake, but it is an accidental simulation.

However much I regret that no lithological evidence be forthcoming in connection with the find of the Boskop man, I find it impossible to consider any of the fragments of stone found in the breccia as being artefacts.

To anyone having, as you have before you, the casts of most of the pre-historic human skulls known hitherto, it is obvious that the skull of the Boskop man, incomplete as it is, does not belong to the type of the Neanderthal.

That it has strong primitive characters is patent, but that these affinities are with the La Chapelle man is disproved by Mr. Haughton's explanation. Rather does most of the evidence tend to prove that these unfortunately somewhat scanty remains belong to a type characterised in European pre-historic deposits by the man and woman of Cro-Magnon.

That the Boskop man is ancient seems to admit of no doubt; but how ancient he is unfortunately we are unable to say. Geologically it is extremely difficult to make any correlation between the superficial deposits of South Africa and the glacial, inter-glacial and post-glacial beds of Europe, so that any statement as to the contemporaniety of the Boskop and Cro-Magnon men would be merely a hazard.

If, however, the two are contemporaneous, they may have evolved quite apart from each other; because when once man—no longer ape-man—has reached the stage represented, say, by the La Chapelle man, the variation in the species must perforce have brought out several types which may possibly have been contemporaneous in a geological sense, and yet separated from each other geographically; and the separation and lack of intercourse would help to crystallise the peculiarities exhibited in the various regions.

No palaeontologist can very well accept any other view, and on this assumption we arrive at the conclusion that in those far-off days there arose an autochthonous African man of the species "Sapiens"—of which this Boskop skull may be a relic.

On the other hand, if the Cro-Magnon and Boskop men were not contemporaneous, the two types are still sufficiently close to suggest that the one may be related to the other. If this be so, migration of the earlier type must have taken place, *i.e.*, migration from Europe into South Africa, or *vice versâ*. It is impossible to state which was the earlier until further evidence concerning such a migration is obtained, either by fresh discoveries on the time of march between the two places, or by a closer correlation of the superficial deposits of the two regions.

A slightly-fossilised human jaw (exhibited by Mr. Haughton) shows strong affinities with the Bush type of the Kalahari, and throws little light on the origin of the Boskop man. But it is of great importance, as bearing on the great antiquity of the Bush race, which, although not comparable, to my thinking, with the much earlier stage of the Boskop man—I should probably say "woman"—is connected with an Aurignacian culture, an advanced culture, of which I gave you proofs in my last Presidential Address. No remains of the Aurignacian man, fossilised as this jaw proves to be, has, so far as I know, been found as yet.

And thus we have in South Africa, now, two relics—which will play a very important part in the chronology of the human race.

"The Elastic Arch continuous over Several Spans, capable only of Small Rotary Motions at the Supports." By A. N. Henderson; communicated by Professor A. E. Snape.

"The Heating Co-efficients of Rheostats and the Calculation of Resistances for Currents of Short and Moderate Duration." By H. Bohle.

"Further Magnetic Observations in South Africa during the years 1914–1915." By J. C. Beattie.

The declination, dip and horizontal intensity are given for 27 stations, including two repeat stations in the Free State, Transvaal and Cape Provinces. The methods and instruments used are the same as in previous work of this nature in South Africa.

"True Isogonics and Isoclinals for South Africa for the Epoch July 1st, 1913." By J. C. Beattie.

The results at about 700 stations have been reduced to this epoch from observations at about 40 repeat stations fairly distributed over the greater part of the region. The greater number of the observations were made in 1903 and 1909, and the stations occupied are in the Cape, Free State, Natal, and Transvaal Provinces, in Damaraland, Southern Rhodesia, Northern Rhodesia, the Bechuanaland Protectorate, and Portuguese East Africa.

The westerly declination has decreased in the ten years 1903–1913 by about $1\frac{1}{2}$ degrees in the west, and 2 degrees in the east. In the same period the southerly dip has increased by approximately 1 degree in the east and $1\frac{1}{2}$ degrees in the west.

"Descriptions of some New Aloes from the Transvaal." By I. B. Pole Evans.

The paper describes the following six new species of Aloes: *A. verecunda, A. Simii, A. Barbertoniae, A. Petricola, A. sessilifolia,* and *A. Thorncroftii.*

"A New Harmonic Analyser." By J. T. Morrison.

In many physical researches, especially in the domain of meteorology, it is necessary to inquire whether a fluctuating quantity, such as atmospheric pressure, daily or monthly rainfall and the like, shows signs of regular periodic variations, and the necessary operations are performed mechanically by the harmonic analyser described.

# EXTRACTS FROM REPORTS OF RECIPIENTS OF GRANTS IN AID OF RESEARCH.

## *Extract from Miss D. F. Bleek's Report.*

I beg to report that I have this year been enabled by the balance of the grant made me by your Society in 1911 to take another trip into the Kalahari to obtain more material for the study of the Bushman language.

On June 15th I left for Kanye in the Betshuanaland Protectorate. There I spent a few days making preparations, in which I was much assisted by the Rev. Williams. On June 23rd I set out by ox-wagon for the desert, accompanied by Miss Vollmer of Wynberg. We followed the trade route towards the west, passing Kooi and Legombe, and made our headquarters at Kakong, as we found there a large group of Bushmen, or Masarwa as they are called in this part of the country. Kakong is in the Kalahari on the road to Lehutitu, and has good wells; hence it is the gathering-place of many kinds of natives. The Masarwas lived by themselves outside the villages of the Betshuana and the Bakalahari, in tiny bush huts scattered over the country. Each family has a hut or a couple of huts. The young girls walk several miles daily to get water from the wells, which they carry in ostrich eggshells slung in a skin. The men, though supposed to be the servants of certain Betshuanas, do little work for their masters. They spend most of their time trapping small game. Their families live on the meat obtained thus, on roots and berries collected by the women, and such small quantities of meal as they can buy with the skins of the game.

The men were willing to come to the wagon daily, but expected gratuities for doing so, as did their masters for allowing them to come. Some of the women and girls came also.

I took photographs of all, singly and in groups, also dancing. A good many of the negatives have not turned out well. However, I have sufficient photographs to show the type of native.

I also took measurements of several Masarwas of either sex for Dr. Péringuey of the South African Museum, who had provided me with proper measuring instruments and helped the expedition in many ways.

The Masarwa is not a pure Bushman; there is evidently a fairly large admixture of Bantu blood in the race. Some individuals show this far more than others. I only saw two or three who might have been mistaken for the purer race found further south. In general appearance the Masarwa strongly resemble the Bushmen of the Nossop; but they are a distinct tribe, acknowledging no relationship to the Nossop people, and speaking a separate language.

The study of the language was the chief object of the journey, and I am glad to say that I obtained a large number of words and phrases sufficient to establish the position of Masarwa among the Bushman languages and dialects. It is most like the speech of the Nossop Bushmen, yet so different that I doubt any person of the one race understanding a person of the other.

Two dialects of Masarwa came to my notice—one spoken in Kahia, and one used by a man from the Molepolole territory. The tribe seems to be spread over the country north of the Malopo and west of Lehutitu up to about the 22nd or 23rd degree of latitude. This statement is based on information gathered from the natives themselves and from traders.

### *Extract from Miss A. W. Tucker's Report.*

I enclose with the report of my second Ethnological Expedition a detailed account of my expenditure on the actual expedition.

In carrying out my work I was aided by funds from the Royal Society, the South African Association for the Advancement of Science, and the Witwatersrand Council of Education, and in March of last year I was elected Croll Scholar of the South African College in Cape Town.

On May 3rd, 1913, I set out for Cape Town, where I made all my purchases for camping in Walfish Bay and German South West. Thence I proceeded overland to Springbok in Little Namaqualand to interview the ex-captain of the Bondelzwarts, and their leader in the late war against the Germans, Abram Morris. Their information was the more interesting in that the Bondelzwarts tribe is one of the oldest in Great Namaqualand, though since the German-Hottentot war it has practically ceased to exist as a separate tribe. Later on in Keetmanshoop I had an opportunity of interviewing some other of their chief men, but found that they could add but little to my knowledge; indeed Abram Christian's words proved to be quite true, that all who knew anything of the tribal customs had perished in, or soon after the war.

From Springbok I went to Walfish Bay, where I spent three months among the Topnaars, in many respects the most interesting of all the surviving tribes of Hottentots. The Topnaars dwell among the sand dunes of Walfish Bay and subsist upon the fruit of the Naras, a cucurbitaceous plant which grows only in this region. The fruit, which is a melon, is extremely nutritious and luscious, so that as long as it is in season the natives do not trouble about any other food. The territory inhabited by this tribe is dreary in the extreme, and for a people devoid of proper homes and with insufficient clothing it is very unhealthy, owing to the rapid changes of temperature, the violent winds which bring clouds of dust, and the heavy, damp fogs at night. It is little wonder, then, that the people are saturated with disease and are in every sense degenerate.

Their pastoral habits have been almost entirely abandoned since the German occupation of Great Namaqualand, as the boundary between British and German territory cuts right through their original tribal grounds, and they can no longer wander where they will. Thus the whole tribe has been reduced to the condition of the Strandloopers of early Dutch times.

In spite of such unpromising material and such dismal surroundings, my best results were obtained in Walfish Bay.

It is very probable that the Topnaars broke away from the main stream of Hottentot migration southwards many centuries ago. As they wandered southwards with their flocks they came upon these Naras fields, where food was to be had six months in the year for the simple picking of it. Yielding to the temptation, they remained in the neighbourhood of Walfish Bay in the desert coastal zone. For years they must have been isolated, and when other people broke in upon them it was American and English sailors who were hunting whales along the West Coast.

The coming of the white man was the beginning of their ruin, but their degeneration has been unaccompanied by much contamination of tribal custom. It has become gradually laxer and less complicated, and tribal lore less rich ; but what there is is pure. Hence I was able to make a fairly complete study of their social and tribal organisation, their sociology, and partly too of new aspects of their religious and magical beliefs.

Law and government could not be studied here, as the tribe has been too long under English influence and jurisdiction. I therefore went inland to Berseba, in German South West, where the Gai Khauas, a tribe which originally inhabited the Tulbagh district in the Cape Colony, and migrated across the Orange River after 1809 when chieftainship was abolished by the British, still nominally retain their old tribal organisation and are governed by their own laws under their own captain. The tribe is unfortunately not pure, as many of the families were bastardised before ever they crossed the river. Their customs are therefore much modified by Dutch influence, and great caution has to be used in coming to any conclusions regarding their own original culture. However, I gained many new lights upon their culture here.

All the other tribes which originally inhabited German South West are now disintegrated, and the whole people is fast degenerating and becoming bastardised. Unlike the Bushman, who died out pure, the Hottentot is disappearing only to leave a rapidly increasing tainted population of bastards behind him. Indeed, among children under ten I had the greatest difficulty in obtaining any pure specimens of their race. White blood is always traceable somewhere in the parentage.

Old people of any intelligence are few, and they alone know anything of tribal lore. The Hottentot himself says he has been absorbed into a new condition of things, and it takes him all his time to keep abreast of the tide.

An onlooker sees that he is not keeping abreast, and never will, for all his struggle.

The material for further investigation is thus no longer to be had, and I had perforce to be content with the remnants I had been able to gather. On some lonely farm, perhaps, an old man or an old woman may still be able to add to the collected facts, but the time for further systematic scientific work is past.

*Extract from Mr. G. Arnold's Report.*

I applied for the grant so that with its aid I might be able to travel to Capetown and Durban, partly to collect the Formicidae of those parts, and partly to examine the collections of the South African Museum, and to make use of the scientific library of the latter institution, with a view to publishing a monograph of the Formicidae of the South African Region. This monograph will be published in the Annals of the South African Museum, and the first part of the work is already in the hands of the printers. I shall send you copies of the parts as they appear, to be laid before the Society.

I wish once again to thank the Society for the grant, without which the progress of the work would have been greatly delayed.

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH AFRICA.

---

VOLUME V.—PART 1.

1915.

---



CAPE TOWN:
PUBLISHED BY THE SOCIETY.

1915.

[Price 12s.

# CONTENTS

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH AFRICA.

VOL. V.


---

## THE GREAT DYKE OF NORITE OF SOUTHERN RHODESIA: PETROLOGY OF THE SELUKWE PORTION.


By A. E. V. Zealley, A.R.C.S., F.G.S., of the Geological Survey of Southern Rhodesia.



(Communicated by permission of the Secretary, Department of the Administrator, Southern Rhodesia.)

(With Plates I.–IV.)

(Read September 16, 1914.)


### I.—Introductory.

The following paper is based upon work done in 1911–12 whilst mapping geologically the country around Selukwe.

The large intrusion for which the name "Great Dyke of Norite" was suggested by the present writer in a preliminary description (*Report of the Director, Geological Survey*, 1911, p. 13), stretches across the area mapped for some 30 miles from north-north-east to south-south-west. It continues onwards in both directions with the characters described below, and, as shown by F. P. Mennell ("Geological Structure of Southern Rhodesia," 1910, *Q.J.G.S.*, vol. lxvi., pp. 371–372), extends for some 300 miles nearly throughout the Territory, maintaining the width of outcrop (about 4 miles) seen at Selukwe and elsewhere. North of the Zambezi similar rocks have not been described, but south of the Limpopo in the Transvaal precisely similar rocks belonging to the Bushveld Laccolite are well known, and will be referred to below.

That the intrusion maintains in other districts the chief characters described below is borne out by P. A. Wagner ("The Geology of a Portion of the Belingwe District of Southern Rhodesia," *Trans. Geol. Soc. S. Africa*, vol. xvii., p. 49, 1914), who describes similar rocks to those encountered at Selukwe. Further, precisely similar rocks have been collected at Umvukwe (Gwebi), Makwiro, Rhodesdale, and other places situated on the Great Dyke, by G. N. Blackshaw, H. B. Maufe, F. P. Mennell, W. Torrance, and the present writer.

## II.—Distribution and Field Relations.

In the area examined the intrusion averages some 3 miles wide, but varies from $2\frac{1}{2}$ to rather more than 4 miles. As will be seen from the accompanying map (Plate I), it trends north-north-east to south-south-west, and its trend and average width are maintained north and south of the portion mapped.

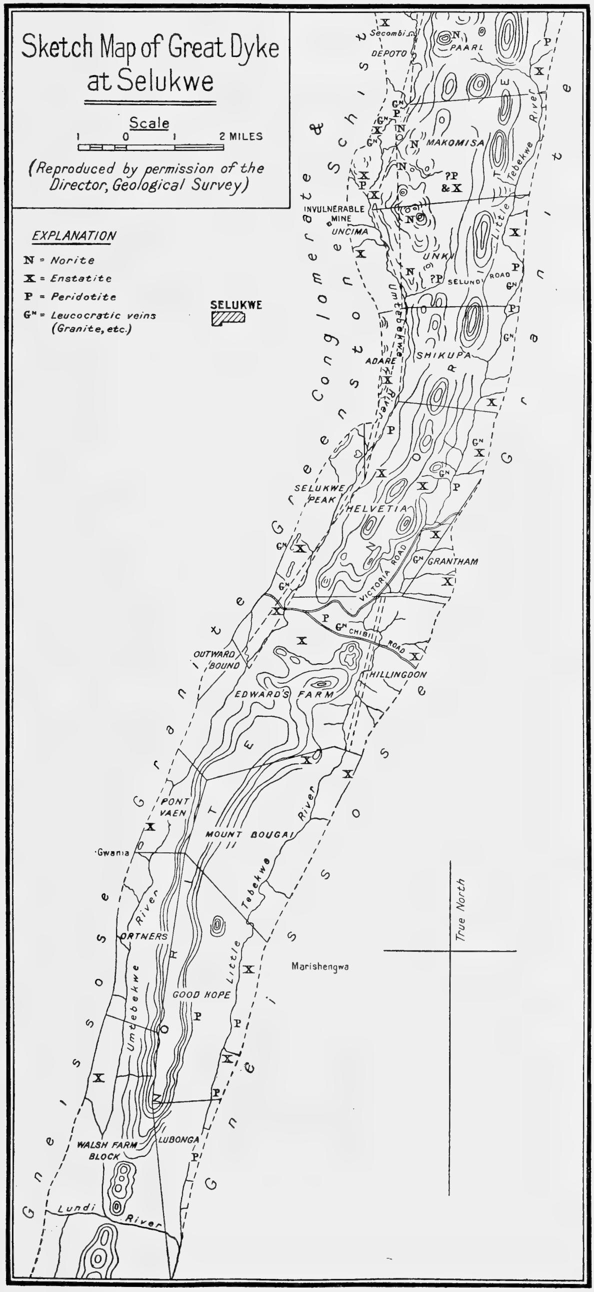
Its margins are usually parallel to one another. They are gently sinuous with here and there conspicuous bulges, a concavity in one margin as a rule is reflected as a convexity in the other. A well-marked constriction occurs on Helvetia and Adare farms where the intrusion truncates the schists which are striking obliquely at it.

The Great Dyke has intruded into the Granite and along the junction of that intrusion with the schistose series (the Greenstone Schists, Banded Ironstone, and Conglomerate).

Along its eastern margin the intrusion is continuously in contact with the granite-gneiss with one exception, namely, on Hillingdon farm, where a narrow arm of Greenstone Schists, etc., formerly extending from Adare farm, has been cut through, and has left fragments in the Great Dyke. On the west in the northern part of the area, however, the intrusion is continuously in contact with the schists which are metamorphosed by it. The Great Dyke, therefore, in this northern part has intruded along the former junction of the granite with the schists. The banding of the granite on the western margin of the intrusion near the Lundi and Amapongokwe rivers strikes diagonally at the margin of the latter.

Two rivers, the Umtebekwe and Little Tebekwe, flow along the marginal portions of the Great Dyke from north to south. This is a common feature of the topography produced by the intrusion. The streams originally cutting across the mass at right angles, as most of them still do, are being diverted by reason of the easily eroded nature of the Great Dyke, and now tend to flow within it parallel to its sides.

The tributary spruits flowing into the two main rivers at Selukwe in a few places afford sections of the contact of the intrusion and the Gneissic granite. In two instances (on Makomisa and Unki farms) tributaries




West, Newman proc.

upon reaching the Great Dyke turn at right angles to their normal course to flow along the contact for short distances. In these places the pyroxenite shows a rude cross-jointing perpendicular to the edge, making horizontal pillars weathering into rude spheroids. The granite-gneiss is exposed as a smooth highly-inclined surface, indurated but not visibly recrystallized. In places along the edges the granite appears to have been considerably baked and now stands out as hills. This is well brought out by Wagner's mapping in the Belingwe district (see map, *ibid.*).

Perhaps the most striking feature of the Great Dyke at Selukwe is the high degree of differentiation which the magma has undergone.

The dominant rock types which make up the intrusion are felspar-rich norite, enstatitite, and enstatite peridotite. These outcrop in elongated strips or wedges parallel to the edges of the intrusion, the less basic types, which are also the finest textured, forming the innermost strips. The less basic portion forms high ground; of such nature is the large rectilinear range, the Selundi range, which forms throughout the area the central part of the Great Dyke. The least basic type of rock (granite), present as dykes and bosses in the marginal portions of the intrusion, stands out too in the form of walls and hummocks.

The more basic parts of the intrusion, on the other hand, form low ground, although this is not true of the Great Dyke in some other parts of Rhodesia. The two rivers above mentioned have almost invariably carved their present courses in the most basic rock types that are present.

Certain quite subordinate types (websterite, granite, etc.) are apparently distributed at random, and occur in small bosses and veins.

At Selukwe the dominant types outcrop with a striking bilateral symmetry.

The two sides of the intrusion show several differences: there appears to be more peridotite and less felspathic pyroxenite on the east than there is on the west side, whilst websterites were only discovered on the west side.

The rocks are entirely free from foliation, banding, or streakiness. They are fresh—generally ideally so—but the peridotites are to some extent serpentinized, and locally small portions of the enstatitite have gone to a bastite-like mineral. A stratiform appearance is to be observed in several places, one type of rock sharply demarcated from another will show a kind of bedding plane, the one type shelving under the other; such planes usually dip to the west.

## III.—Habit.

The boundaries of the various types have not been mapped, but a generalized plan of the distribution in a representative section (probably no two sections are alike) at Selukwe may be represented thus :—

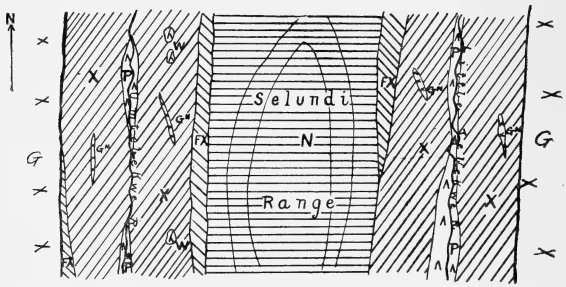



Fig 1.—Diagrammatic Plan of Distribution of Rock Types in Great Dyke at Selukwe.

N = Felspar-rich norite. X = Enstatitite. FX = Felspathic enstatitite. P = Peridotite. W = Websterite. $G^N$ = Granite and pegmatite. *G* = Granite-gneiss country.

Such a plan admits of at least two interpretations as to the habit of the intrusion. An intrusion made up of rocks outcropping in this manner may be a dyke or a sill ; if the former, the distribution of the rocks within the intrusion may be represented thus :—

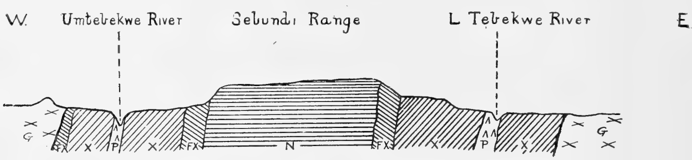



Fig. 2.—Diagrammatic Section across Great Dyke at Selukwe.

Both explanations have been offered, and a third theory is suggested by P. A. Wagner (see below) that the intrusion may be a laccolite.

F. P. Mennell states (*loc. cit.*, p. 372) that the intrusion "is almost certainly a gently inclined sheet injected along a line of weakness, which is probably a thrust-plane."

The present writer (*loc. cit.*, p. 13) suggested in describing the Selukwe section of the intrusion that it was a dyke.

P. A. Wagner in his instructive paper describes (*loc. cit.*, p. 49) and gives a figure of a very clear section of a bedded arrangement of alternate layers of the peridotite and pyroxenite gently dipping to the south-south-east ; such structures occur in several sections to the west of the centre line of the intrusion. He further states (p. 51) that "The exact nature of the Great Dyke is by no means clear. In the bed of the Umgezi river, which is fairly deeply incised, pink granite is exposed for a distance of fully a quarter of a mile beyond the line of contact between granite and pyroxenite on the western portion of the farm Umgezi. This circumstance, taken in conjunction with the fact that in the western half of the intrusion at any rate the dip of the layers of pyroxenite and peridotite appears everywhere to be to the south-south-east, suggests that the Dyke is in reality a huge sill dipping at a low angle to the south-south-east. This view, however, receives no support whatsoever from the relationship between pyroxenite and granite along the eastern margin of the intrusion or from the relationship between pyroxenite and norite on the Springs and Sandeman's farm, for the contact between the last-mentioned rocks appears to be vertical, and to the writer it appears more probable that in the area under review the Great Dyke is of the nature of a very elongated laccolite. Further investigation, however, is urgently needed on this point."

It is advisable therefore to state fully the evidence obtained at Selukwe with a view to substantiating or otherwise the opinion of the present writer.

It may be pointed out that in general the intrusion has many of the characters of the dyke; thus its rectilinearity of outcrop, the parallelism of its sides and fairly constant width (which is small in comparison with its longitudinal extension), together with the symmetrical disposition of the variations, indicate a dyke rather than a sill or laccolite.

It must be admitted, however, that the Selukwe portion is poorly exposed. The junctions of one rock with another are rarely seen, and the actual edge of the intrusion was only visible in five or six exposures, and these with one exception (Gwania) are on the eastern side.

Each of these exposures of the edge of the intrusion is steeply inclined or vertical, and there was no modification of the rock noted that is indicative of slow cooling; this fact is often interpreted in favour rather of the dyke habit than of the inclined sheet or laccolite. Several of these edge exposures exhibit indications of a rude horizontal pillar structure.

No V-ing of the edges was detected either up or down in the stream sections either on the east or the west (but in this connection it must be stated that the method of simple plane-tabling in an area where exposures are infrequent and the topography inaccurately represented on the map used is not to be expected to afford the indications named). Further, although the norite appears to be confined to the high ground and the pyroxenite to the low ground, in both instances the opposite obtains and indicates vertical junctions of the two rocks. Thus in several places the Tebekwe rivers expose on the one bank a continuous cliff of norite and on the other nothing but pyroxenite. And in the hilly ground on Adare farm pyroxenite (which forms the edge of the intrusion and is seen in the river-bed) occurs high up in the hills and at an appreciably greater height than the lowest of the norite exposures a quarter of a mile away opposite the hills. Again it must be remembered that this deeply dissected hilly ground in the schists alongside the intrusion nowhere was found to expose Great Dyke rocks such as would be the case if the intrusion were a gently dipping sheet. Neither is there any evidence of a fault along the western edge subsequent to the intrusion.

In the Selukwe section the arrangement of the variations is bilaterally symmetrical, the least basic rock lying in the middle (excepting the granite veins and bosses which are confined to the marginal basic portions). Close examination shows this differentiation to be quite sharp.

The regular arrangement does not, however, always hold good. The long central mass of felspar-rich norite gives place here and there (where the surface level becomes low) to the more basic types which then occupy the whole width of the intrusion. Very occasionally also the felspar-rich norite occurs in isolated, irregular, rounded outcrops, perhaps as small bosses. This latter habit may indeed be extended to the whole of the centrally placed norite; that is, it may be one of a series of very much elongated bosses.

Perhaps the chief difficulty encountered in the Selukwe area against regarding the intrusion to be a dyke is that, as in the Belingwe portion described by Wagner, there are in several places exposures which show bedded structure and interbedded arrangement of the different rock types. Thus: (1) Below the Victoria road drift in the Umtebekwe a small cliff in the river bank exposes peridotite with pyroxenite beneath, the rocks having a small easterly dip. The exposure suggests a series of parallel sheets. (2) A mile north of the Victoria road drift in the Little Tebekwe a bed of serpentine several feet thick, lying in enstatitite, similarly has an easterly dip. (3) The chromite seams on Good Hope dip at small angles (12°–25°) ? eastwards. (4) It is commonly to be noted in small exposures that the rocks have a sort of bedded or horizontally jointed structure. Further, the Selundi range where broad has the appearance of a general gentle slope to the north-west. It is to be noted here also that the small boss-like bodies of websterite breaking abruptly through the pyroxenite commonly weather with a horizontal stratiform structure, as also do the rounded bodies of granitic rock.

It is not inconceivable perhaps that this bedded arrangement of the peridotite and pyroxenite might be formed here and there during the slow cooling of a fluid magma of a dyke undergoing differentiation in place. Such might be produced by the progressive differentiation of that portion of the magma parent of the two rock types and the action of gravity upon the products, or by the injection of one differentiate into the other.

It must be conceded by most petrologists that the layers of chromite described below are the result of differentiation in place and segregation of matter contained in the surrounding rocks. If layers of chromite rock are thus produced and constituted gently dipping layers alternating with peridotites, why not peridotites and pyroxenites too?

It seems to the author that such a process might have given rise to the condition admirably represented by Wagner (*loc. cit.*, figure, p. 50), where a series of alternating layers of peridotite and pyroxenite are overlaid by a "bed" of harzburgite. The draining off of the pyroxenes from a harzburgite magma would produce peridotite and pyroxenite, which it might be expected would settle into a position perpendicular to the sides of the intrusion.

There is no evidence of uplift of the rocks or disturbance of the foliation alongside the intrusion in the Selukwe portion such as would be expected if the intrusion were a laccolite.

The parallelism of the "Um Vimeela" Norite Dyke of Wagner (*loc. cit.*, p. 52) (inferred to be genetically related to the Great Dyke) not only in the Belingwe area but northwards in the Selukwe and Gwelo areas is a fact of some significance to be noted here.

## IV.—Petrography.

The petrology of the Great Dyke at Selukwe is extremely interesting. The examination of the intrusion, however, both in the field and laboratory, has not been carried out in sufficient detail to permit the settlement of many points. The field evidence is often disappointingly meagre.

It has already been stated that the intrusion is made up of several very well-marked types of rock which are abnormal in composition. The differentiation of the parent magma has taken place to a remarkably complete degree. Thus quartz veins form one extreme and chromite seams the other.

The differentiation resembles that of the Bushveld complex of the Transvaal in many respects (see Molengraaff, *Bull. de la Soc. Géol. de France,* 4me, serie, tome 1, p. 48, 1901; F. H. Hatch, *Trans. Geol. Soc. S. Af.*, vol. vii., p. 1, 1904, and Hatch and Corstorphine, *The Geology of South Africa*, 2nd ed., Macmillan, 1909, pp. 208–18).

Considering the Selukwe part of the intrusion as exposed *en masse* the minerals are as follows: A largely preponderant amount of enstatite, considerably less but next in abundance being felspar (usually bytownite), a fair to somewhat small amount of olivine and of monoclinic pyroxene (largely non-aluminous), still less mica and very little iron ore, traces of soda-lime felspars and quartz. Enstatite is ubiquitous, so also are bytownite, diopside, and pyrites, but less prominently, the last named being in very small amount.

The rocks are divisible chiefly into two well-marked types, namely felspar-rich norite and enstatitite. A subordinate type intermediate between these two exists in felspathic enstatitite, which contains from 10–15 per cent. of felspar, whilst a fourth type, also subordinate and the most basic of the intrusion, is enstatite-peridotite.

A fifth type occurring in isolated bosses of small extent is a pyroxenite composed of orthorhombic and monoclinic pyroxenes and agreeing with the American websterites, whilst a sixth type also strictly subordinate to the main types and occurring in veins and bosses, is a peculiar granite representing a very acid phase of the magma; it is associated in some instances with norite-pegmatite.

Quartz veinlets and chromite seams are respectively the most acid and basic modifications of the intrusion, whilst norite, picrite, lherzolite, olivine gabbro, and felspar-rich gabbro are local variations of one or other of the above-mentioned types.

Enstatite-bearing olivine serpentine and bastite-rock are respectively altered forms of the peridotites and enstatitites.

The rocks of the Great Dyke in the area examined may therefore be grouped as follows in decreasing order of extent:—

| | | |
|---|---|---|
| Roughly equal | Felspar-rich norite<br>Enstatitite | Dominant types in very large amount. |
| Ditto | Felspathic enstatitite<br>Enstatite-peridotite | Subordinate types in fair quantity. |
| | Granite<br>Websterite | Subordinate residual types in veins and bosses in small quantity. |
| | Picrite<br>Norite<br>Lherzolite<br>Olivine gabbro<br>Felspar-rich websterite<br>Felspar-rich gabbro<br>Norite pegmatite<br>Quartz-felspar veins<br>Chromite-olivine seams | Variational and residual types in very small amount. |
| Enstatite-bearing olivine serpentines<br>Bastite-rock | | Altered rocks. |

*Felspar-rich Norite* (see Plate III, figs. 1–3).—This rock constitutes the central part of the intrusion and solely forms the long Selundi range, a thickly wooded rectilinear range a mile to two miles wide. This forms one continuous flat range from the Walsh farm Block to Edward's farm, where there is a gap in the hills occupied by pyroxenite and peridotite. From Helvetia farm northwards the range is more rugged. It narrows on Shikupa farm and on Unki splits into two arms, the easternmost continuing as a strong feature of peaked hills, but the western arm, owing to interruptions of peridotite and pyroxenite in the low ground, becomes very broken for a few miles until on Paarl it reunites with the eastern arm and continues northwards again as a wide flattish-topped range.

The range is bounded on either side by the enstatite-pyroxenites.

In very few instances small detached bodies of the felspar-rich norite may be noted. There are small boss-like bodies lying in enstatitite at the foot of the Selundi range on Ortner's farm and in the large vlei in the middle of the Great Dyke east of the Wanderer Mine.

The rock usually weathers into small round blocks, but the summits of the hills show huge jointed blocks and occasional crags.

The rock is a very characteristic type. It is medium- to somewhat coarse-grained, granitic textured, and mottled grey and white. The constituents are easily recognized in hand specimens. They are a white or glassy striated felspar generally exhibiting crystalline form (short striated laths) with interstitial pale leek-green or grass-green and brownish semitransparent pyroxenes, which in most specimens are typically of irregular shape, being interstitial to the felspar, but in other rocks of a more granular nature it forms well-shaped prismatic crystals, and in still others (see Plate III, fig. 3) strikingly poikilitic on a small scale. The constituents are almost invariably evenly distributed, but in some places they are irregularly segregated and poikilitic, somewhat as in certain of the Canadian anorthosites (see figure, Adams, *Geological Survey, Canada, Annual Report*, vol. viii., 1895, p. 104 J). A red-brown mica and pyrites (pyrrhotite, pyrite, and chalcopyrite) are fairly constant accessories occurring in small quantities. The sulphides are never in idiomorphic crystals, but like the pyroxene are interstitial to the felspar. There is no doubt in the writer's mind as to the sulphide being an original constituent of the rock. A trace of green hornblende was noted in one slide and minute quantities of calcite, zoisite, chlorite, bastite, and magnetite in others.

The felspar ranges from basic labradorite to acid anorthite, but usually is bytownite or labradorite, a small quantity of less basic felspar (? andesine) is also present in some rocks. The felspar (see Plate III, fig. 1) averages 70 per cent. of the volume of the rock, but ranges from 64–75 per cent. as determined by Sorby's method [drawing on squared paper with camera lucida several fields of a thin section, the outlines of the dark constituents being represented. The percentage then computed by counting the squares enclosed by the outlines and afterwards cutting out and weighing. The felspar was estimated by difference]. Both rhombic and monoclinic pyroxenes are present. The relative proportions of these vary; in many rocks the monoclinic pyroxene is more abundant than the rhombic species, and in places excludes the latter; moreover there are two monoclinic species. They are all very pale coloured to almost colourless in thin sections, the diopside in some rocks is diallagic.

The specific gravity of five representative specimens of this type gave the values: 2·86, 2·87, 2·88, 2·89, 2·91. These exceed the figures for anorthosite (2·70) (*ibid.*, Adams, 131 J), but on the other hand are low for a typical norite (2·97).

In the text-books the definition of norite as regards the relative amounts of pyroxenic constituents to the felspar and to one another is somewhat conflicting. It is variously stated that a norite contains plagioclase and pyroxene in about equal amounts and rhombic pyroxene is the principal pyroxenic constituent, or that an appreciable amount, or an equal amount of rhombic pyroxene makes the rock a norite rather than a gabbro, whilst the anorthosites are very low in pyroxenes, frequently containing not more than 5 per cent.

The rock type under consideration, therefore, whilst approaching the anorthosites is still nearer to the norites (or to the gabbros). And interpreting the definition of norite broadly, together with a consideration of the other parts of the intrusion in which rhombic pyroxene is so strongly represented, it is perhaps preferable to regard the type as a whole a felspar-rich norite. Individual specimens nevertheless, according to their mineralogical composition, may be designated felspar-rich gabbro.

Locally the amount of pyroxene appears to increase considerably until the rock may be a typical norite, when the pyroxenes are idiomorphic.

*Enstatitite* (see Plate III, fig. 4).—This remarkably persistent rock occupies the low-lying broad basic margins of the Great Dyke continuously throughout the area mapped. It is probably the predominant type. A precisely similar rock is described by F. H. Hatch ("The Geology of the Marico District, Transvaal," *Trans. Geol. Soc. S. Af.*, vol. vii., pp. 4–5, 1904).

In the Selukwe area it forms low ground, which, were it not for the stream sections, affords but few exposures. Occasionally it forms the flanks of the Selundi range extending well up the slopes. The two rivers, Umtebekwe and Little Tebekwe, flow along the pyroxenite margins, which have an average width of about three-quarters of a mile, but may be considerably more or less; nowhere does the rock form the whole width of the intrusion as it does in the Belingwe portion (*loc. cit.*, Wagner, map) and north of the Selukwe district.

The rock not uncommonly forms small kopjes 20–50 feet high, composed of coarse blocks and rounded slabs; such are seen near the Victoria road drift across the Little Tebekwe river (see Plate II, fig. 2). Elsewhere the rock disintegrates into coarse enstatite sand. Exceptionally it is observed to alter, notably along prominent joints and alongside the granitic veins for a few inches to two feet on both sides, to a pale pistachio-green bastite rock, which retains the form of the mineral and the structure of the original rock, but is soft (H = 1·5), and has sp. gr. 2·74. These and other characters suggest that the altered mineral is the variety of bastite called phästine.

Usually the rock is coarser grained than are the other parts of the complex, but it varies from coarse, even-textured, granular, to fine, compact. Its colour is typically deep olive-green, but ranges from dark brown-green to grey-green. The grains of mineral composing the rock are equidimensional hypidiomorphic to idiomorphic. Some specimens have crystals ½–1 centimetre long arranged parallel to one another. In it segregation veins of fine- and coarse-grained enstatite occasionally occur.

The rock consists essentially of rhombic pyroxene (enstatite), Plate III, fig. 4, with but minute proportions of the following accessory minerals: Basic felspar, monoclinic pyroxene (W. A. Humphrey, "The Geology North of Zeerust," *Transv. Geol. Survey, Expl. of Sheet No.* 9 (*Marico*), p. 25, refers to the presence of diallage in the pyroxenites of the Bushveld laccolite), brown mica, olivine (rarely), pyrite, chromite, and micropegmatitic quartz and orthoclase. By increase of the accessory plagioclase and monoclinic pyroxene the rock grades respectively into the felspathic enstatitite type (Plate III, fig. 5) and to felspathic websterite (Plate III, fig. 6).

The strongly pleochroic red-brown mica, the pyrite, and the basic felspar are fairly constant accessories; the latter mineral fills the minute angular spaces between the enstatite crystals, thereby permitting the idiomorphism of the pyroxene. The enstatite in thin section is extremely pale-coloured, but exhibits faint pleochroism, pale pink to pale green.

The specific gravity of this rock is 3·29 to 3·30.

The Great Dyke enstatitite, but for the minute quantity of accessory minerals, is precisely similar to that of the Marico district, Transvaal, described by J. A. L. Henderson (*Transvaal Norites, Gabbros, and Pyroxenites*, London, Dulau & Co., 1898, pp. 38–41), who considers the rock to be "an extreme modification of a norite." It also appears to be exactly similar to the enstatite-pyroxenite of Vaalkop (Transvaal) described by H. Kynaston (*Trans. Geol. Soc. S. Af.*, vol. viii., p. 57).

*Felspathic Enstatitite* (Plate III, fig. 5).—This type is chiefly limited to the flanks of the Selundi range, but it also occurs along the extreme edge of the intrusion in a few places, *e.g.* near Secombi's Kraal to the north-west, about 1½ miles south of the Victoria road drift across the Umtebekwe river, and east of the Little Tebekwe river on Makomisa farm. The rock appears to form long, narrow, wedge-shaped masses a few hundred yards wide.

The rock presents characters similar to those of the last-described type, but it is typically rather finer grained, and its felspar content (labradorite-bytownite) ranges from 10 to 20 per cent. Its specific gravity is slightly lower (3·22). The felspar is interstitial to the enstatite crystals, and contiguous particles of the formal mineral may be in optical continuity over a centimetre or more.

The accessory minerals of the felspathic enstatitites are as follows: Monoclinic pyroxenes, micropegmatitic quartz and felspar, red-brown mica, pale green mica, pyrite, chromite, bastite, and chlorite; all these occur in minute quantities only. The same minerals are present in the felspathic websterite.

By increase of the pale green monoclinic pyroxene, which is a fairly constant accessory, the rock passes into an interesting variety approaching websterite. This may be called felspathic websterite or pyroxene-rich norite (Plate III, fig. 6). Such a rock exposed for a width of about 150 feet in the foothills of the Selundi range, a mile or so north of Secombi's Kraal and in a similar position north-east of the Invulnerable Mine, is exactly like the felspathic enstatitite excepting for the large diopside diallage crystals developed in it These have very irregular outlines, but tend to be idiomorphic; they stand out prominently from the finer grained enstatite-felspar-matrix on weathered surfaces, and are up to 3 centimetres in size. The two pyroxenes would appear to be in about equal proportions, whilst a third pyroxene (a monoclinic variety) is also present. The felspar (bytownite-anorthite) occupies from 10 to 15 per cent. of the volume of the rock, and encloses the fine-grained idiomorphic pyroxenes poikilitically.

*The Peridotites and Picrites.*—Like the felspathic enstatitite, the peridotites (Plate IV, fig. 1) appear to be confined to long, narrow, wedge-shaped masses, which die out in the pyroxenites to mere strings and veins. They afford outcrops from 50 to 100 yards wide, but in places the width may considerably exceed this, whilst they may be up to a couple of miles long. Usually the rock is only seen in the beds and banks of the Umtebekwe and Little Tebekwe rivers, where it weathers spheroidally, but it outcrops in the large vlei between the two arms of the Selundi range on Unki farm and again in the gap in the Selundi range on Edward's farm, through which the Victoria road passes. These poorly resistant olivine rocks thus outcrop in the low ground only. They are exposed in the following places: Near the junction of the Little

Tebekwe and the Lundi rivers and northwards on Lubonga, Good Hope and Mount Bougai farms, in the Chibi road drift across the Little Tebekwe river, south of the Selundi road drift across the same river, east of the Little Tebekwe river near the boundary of Paarl and Pink Un farms, in the Umtebekwe near the north-east beacon of Selukwe Peak, and on Depoto and the northern part of Uncima farms. The peridotites are never in contact with the felspar-rich norite, but have pyroxenites on both sides. In one or two places they may form the actual margin of the Great Dyke, *e.g.* on Paarl and Depoto farms; but this is doubtful. They are thus regarded as direct separations from the second rock magma alluded to below (the hypothetical enstatite picrite), and indeed the picrites of the Great Dyke, which are here only found grading into the peridotites, may perhaps be regarded as residual parts of the hypothetical magma which thereby would become no longer hypothetical.

The peridotites are largely typical harzburgites (saxonite or enstatite-peridotite). The enstatite-peridotite serpentine from the Marico district (Vaalkop), described by H. Kynaston (*loc. cit.*, p. 58), is similar in all respects to many of those of the Great Dyke. They are rather coarse-grained, dark brown or greenish to nearly black rocks, consisting essentially of olivine and enstatite in roughly equal proportions, although, in many instances, the olivine is in excess of the pyroxene, and rarely may be almost the sole constituent, when the rock becomes a dunite; whilst in other instances the enstatite is largely in excess of the olivine, when the rock may be called an olivine-bearing enstatitite.

The olivine forms granular, equidimensional, rounded hypidomorphic grains (Plate IV, fig. 1), which in thin section are nearly colourless and usually remarkably fresh. Whether fresh or serpentinized they contain a very small amount of iron ore (magnetite). The enstatite is characteristically poikilitic, *i.e.* interstitial to the olivine, and forms large rounded individual patches, optically continuous over 3 or 4 centimetres, thereby imparting the characteristic lustre-mottling to the rock; the porphyritic nature is more complete in some specimens than in others, *i.e.* there are fewer inclusions of olivine. In some rocks these large poikilitic enstatites are so close together that a relatively small amount of olivine ground-mass exists. The name "harzburgite porphyry," used by Wagner (*loc. cit.*, p. 51), is an apt one for these rocks. The enstatite is pale green to dark brownish in the hand specimens, but in thin section is nearly colourless. Dark red-brown mica is a constant accessory, it also encloses the olivine poikilitically. Chromite, felspar, monoclinic pyroxene, and magnetite are the other accessories; whilst serpentine, bastite, chlorite, and magnesite are alteration products. The felspar is much altered, and together with the monoclinic pyroxene (pale green diallage), occurs interstitially in very small and irregularly distributed particles; the latter mineral also forms interlamellar growths with the enstatite. Chromite is characteristically associated with the brown mica, and occurs in small rounded or perfect crystals; it is abundant in places, and tends to segregate into patches and well-defined thin seams seldom more than 6 or 8 inches thick, from which the olivine and the enstatite are partially or totally excluded. These seams are further described below.

An interesting variety of harzburgite occurring in the Little Tebekwe river west of Marishengwa may be mentioned here. It consists of large (1·5 centimetres), closely set poikilitic enstatites lying in an olivine-chromite base, the two minerals being in almost equal proportions. The olivine is medium-grained (1–2 millimetres), granular and free from chromite inclusions; whilst the chromite forms a finely (0·25–0·5 millimetre) crystallized interstitial aggregate. The enstatite individuals have included chromite, olivine, and brown mica.

Locally the peridotites are much serpentinized, but even then the enstatite present has remained almost unaltered. These serpentines are well represented east of the Victoria road drift across the Umtebekwe river.

By increase of monoclinic pyroxene and felspar at the expense of olivine the peridotite in several places grades insensibly into picrite. This may contain up to 20 per cent. of felspar, although usually the proportion appears to be considerably less. The rhombic pyroxene has largely given place to a monoclinic species.

The picrite does not occur without peridotite. The former is merely a facies of the latter or *vice versa*, and is apparently of much more limited occurrence. The picrites are coarse-grained rocks, in appearance closely resembling the peridotites, but always showing their felspar conspicuously, giving the rock a speckled appearance, whilst they are less commonly poikilitic than the peridotites, chiefly by reason of the failure of enstatite to assume a prominent proportion. The mica, however, and, in some specimens, the felspar show poikilitic structures.

A typical specimen with sp. gr. 3·01 was found to consist essentially of olivine, diopside diallage, basic felspar (about 20 per cent.), and red-brown mica in decreasing order of abundance, with small quantities of enstatite, chromite, and magnetite.

*The Websterites* (Plate IV, figs. 2 and 3).—This rock type is limited to small boss-like bodies from a few yards in diameter to perhaps 150 feet. They lie entirely in the basic margins of the intrusion and chiefly in the enstatitite, but also in the coarse-grained websterite near Secombi's Kraal, and in the felspathic enstatitite. It is probable that the rock represents a differentiation product of the hypothetical enstatite picrite partial magma, the opposite differentiation being lherzolite, which is, however, scarcely represented in that part of the intrusion examined.

Some ten or twelve of these small masses were observed, chiefly in the Umtebekwe valley, where they are well represented at the foot of the Selundi range north of Secombi's Kraal, on Depoto farm, and on Makomisa farm.

In all these places the websterite forms small rocky hillocks 12 feet or less high, but up to 60–70 feet; some of them weather with stratiform appearances.

As might be expected from their mode of occurrence, the websterites exhibit considerable differences mineralogically, but texturally they are all alike, namely, very fine-grained and saccharoidal. The grains are nearly equidimensional in general, but occasionally small patches or streaks of coarser grain are present. Their colour is dark grey to sage-green. The structure (especially of those which contain a fair amount of felspar) —the norite and gabbro (Plate IV, figs. 4 and 5)—closely resembles that of the Saxon "granulites." Their specific gravity is high (3·24–3·28).

In the typical websterite (Plate IV, fig. 2) enstatite and diopside are the essential constituents and are in about equal proportions, the rhombic pyroxene rather exceeding the monoclinic species. Both minerals are nearly colourless in thin section, and form a mosaic of irregular rounded indented granules. The minutest quantity of interstitial plagioclase is the only other constituent.

Varieties containing other minerals approach lherzolite (when accessory olivine is present), (Plate IV, fig. 3), norite or felspathic enstatitite (when diopside is lacking), (Plate IV, fig. 4), or olivine-enstatite gabbro (when olivine and plagioclase are largely present and rhombic pyroxene is an accessory in very small amount), (Plate IV, figs. 5 and 6). This last-named rock is an interesting one. It forms a small outcrop on the east bank of the Umtebekwe river near the Victoria road. It lies in enstatitite and serpentine, and is a fine-grained granular dark grey rock with specific gravity 3·10, and composed of the following minerals in decreasing order of abundance, finely granular labradorite-bytownite usually untwinned; pale grey-green, slightly pleochroic diopside diallage, allotriomorphic and poikilitic; colourless olivine containing rather much fine dusty magnetite and minute round inclusions of felspar; pleochroic enstatite in irregular growths partly or completely surrounding the monoclinic pyroxene and in places joining up six or eight diopside and olivine grains into a small cluster. The micro-photograph (Plate IV, fig. 6) is taken in such a position between crossed nicols as to show the narrow rims of rhombic pyroxene surrounding extinguished grains of monoclinic pyroxene.

*The Chromite Seams.*—These were found only in one place, namely, in the centre of Good Hope farm, about half a mile west of the Little Tebekwe river. An unusually wide stretch of harzburgite occupies the greater part of the flat and gently rising ground from the river to the foot of the Selundi range. The olivine in the rock is decomposed at the surface for a few feet, rendering it soft, laminated, and friable, but where the river has cut through this surface layer the rock is remarkably fresh and scarcely affected by serpentinization. The chromite occurs as a series of some half-dozen gently inclined bedded veins or seams averaging a few inches in thickness and not exceeding 14 inches. Their trend is parallel with that of the Selundi range. The seams were not observed to exceed 100 yards in length, and they are mostly much less than this. Some have flat surfaces, others are corrugated.

The veins consist entirely of chromite in some instances; in others a greater or lesser admixture of one or more of the following minerals is present with the chromite: Olivine, magnesite, magnetite, and enstatite. The chromite is always well crystallized, commonly forming an even granular aggregate of fairly equidimensional grains about a millimetre in diameter, in other specimens forming a fine aggregate of well-shaped crystals averaging half a millimetre.

Olivine is commonly present in hypidiomorphic crystals interspersed evenly and forming some 20–30 per cent. of the volume of the rock. In such outcrop specimens the olivine is decomposed to a pale brown serpentine containing very little magnetite, or to a whitish pseudomorph containing rather abundant minute grains of magnetite. In other rocks in which the olivine predominates and forms a rather coarse aggregate with interstitial chromite, magnesite may become a prominent constituent in the form of minute anastomosing veins. This alteration and replacement has proceeded so far in some instances as to form a white black-speckled rock consisting entirely of magnesite and chromite, the latter mineral being embedded in the former, which forms crusts round the chromite crystals. The magnesite is intermixed with opal in some instances.

It may be noted here that veins of impure siliceous (opaline) magnesite also occur in various places in the enstatite pyroxenites, and it is believed may attain considerable dimensions in other districts.

In some of the chromite seams massive amorphous magnetite is present. Enstatite is less common.

In places the chromite seams are bounded by two flat surfaces which sharply demarcate the seams from the harzburgite country. In other parts only one flat surface is present, and the other side of the seam grades somewhat rapidly into ordinary harzburgite free from chromite. The evidence obtained makes it fairly certain that the above described chromite rocks may be regarded as ultra-basic segregations of the Great Dyke magma.

*The Granite Veins and Norite Pegmatites.*—A type of rock very commonly found in the form of narrow veins and small lenticular bosses in the basic margin of the Great Dyke is one which may be termed granite. The rocks of the different bodies vary considerably, a felspar quartz biotite rock is perhaps the commonest; other types devoid of ferromagnesian minerals are strictly aplites and pegmatites, and even pegmatite quartz-veins when they consist entirely of quartz; still another type which may be called norite-pegmatite consists of very coarse aggregates of bastite and felspar.

The injections generally have their length parallel, or nearly parallel, to the margins of the Great Dyke, but they may take any direction, for instance, in the centre of Edward's farm alongside the Victoria road granite veins have intruded at right angles to the length of the Great Dyke.

These veins and lenticles appear to be the latest phase—a residual leucocratic differentiation of the Great Dyke magma. They intrude into the pyroxenites and peridotites, but are generally in the former. Although in places the veins strike almost at right angles to the felspar-rich norite, they are never traceable into that portion of the Great Dyke. And although distributed throughout the basic parts of the Great Dyke these curious granite bodies tend to be distributed in groups over a small area.

During the preliminary examination of the district it was thought that the granite veins in the Great Dyke might be the representatives of a granite later in date than the Great Dyke, rather than leucocratic modifications of the norite, but subsequent detailed work has led to the conclusion that this is not so, but that they belong to the Great Dyke itself, *i.e.* are part of its magma. The facts which lead to that conclusion are as follows:—

1. Although the veins are numerous and generally very close to and even at the edge of the intrusion, and although in places they strike straight at its edge, they are never traceable into the granite and other rocks into which the Great Dyke has intruded. This fact and the conclusion drawn therefrom are borne out by Wagner (*loc. cit.*, p. 51) in the Belingwe section of the Great Dyke.

2. The rocks of the veins, although varying considerably in texture and mineralogical composition, do not resemble any of the pegmatite, aplite, or felsite veins of the Granite, but are mostly characteristically different.

3. The bastite-felspar rocks (norite pegmatite) are found to be part of and to grade into the granite veins in the Great Dyke.

4. The veins are generally parallel to the trend of the intrusion as are the other component parts of the latter.

The veins vary from an inch or so to 10 or 12 feet wide, and average 3 feet. Their length is very variable; generally they are quite short—50 feet or so—but some are more than half a mile long. They usually pursue a perfectly straight course, but in some instances suddenly bend at

2

right angles for a short distance. They rarely ramify. Wherever it is possible to estimate they are vertical, and weather out as vertical wall-like bodies which are very much rectangularly jointed. The lenticular-shaped bodies are fairly numerous, but fewer than the veins. They are up to several hundred feet in greatest length, their greatest width commonly being half their length. They narrow out at their extremities to a few feet. They often possess a horizontal bedded structure, probably due to jointing.

The whole of most bodies and the central parts of nearly every one are composed of a uniformly fine-textured holocrystalline granite, which has a characteristically granular structure. This rock is composed essentially of felspar, quartz, and biotite. Accessory sphene is present in some; and chlorite, zoisite, kaolin, and sericite are alteration products. Quartz is generally subordinate to felspar. Biotite is commonly abundant, but in some rocks is absent. The felspars tend to be idiomorphic, and in some rocks are porphyritic; they are chiefly acid plagioclases, but lime-free felspar is probably common, whilst basic andesine to labradorite is present to a small extent.

The mica is strongly pleochroic—deep foxy brown to golden-yellow. It is poorly crystallized and forms irregular ragged crystals and aggregates intergrown with both felspar and quartz. It is altering to chlorite.

The aplite veins resemble the granite, but many have knots of quartz, and some, patches of felspar and quartz graphically intergrown.

The quartz veins are only a few inches wide, and are composed of nearly black quartz with a curious platy structure. Felspar is present in some, when the vein becomes a pegmatite, but is completely absent in others. In some instances quartz occupies the sides of a small 6-inch granite vein, and in places may occupy nearly the complete width of the vein.

The norite pegmatite occurs typically as a marginal facies of the granite veins. The rock is coarse-grained, in places very coarse. The structures presented are diverse and change rapidly. Coarse granular, coarse pegmatitic, fine pegmatitic, and even graphic structures obtain. The rock is composed essentially of white felspar and a pistachio-green laminated scaly bastite pseudomorphous after rhombic pyroxene; milky quartz is an important constituent in some parts, but is generally absent, chloritized biotite is also present in some specimens. The bastite pseudomorphs are more or less idiomorphic towards the felspar, in places forming crystals 8–10 centimetres long by 2–3 centimetres across; many of these crystals are skeletal and remarkably intergrown in a graphic manner with quartz and felspar. The bastite pseudomorphs further present a remarkable character in being partially composed of dark green fibrous strongly pleochroic amphibole. The amphibole forms a minutely narrow continuous border around the bastite crystals, but also occurs in the interior of some such bordered crystals as rod-like lamellar intergrowths, in other parts where the rock is comparatively fine-grained (dark constituents one-tenth the above dimensions) and very quartzose, it occupies the whole crystal, the central bastite being more or less absent. It is probable that the presence of amphibole is due to a change in this residual magma, quartz and hornblende being produced instead of felspar and rhombic pyroxene already begun, but it might also (but less likely) be the result of primary pneumatolytic replacement of the rhombic pyroxene, the action taking place chiefly from the margin of the crystals and proceeding inwards. The process would naturally be more complete where the rock is fine-grained. Subsequent to the formation of amphibole, however brought about, the remaining rhombic pyroxene has altered to bastite.

An interesting example of these granite veins is exposed in the Little Tebekwe river about a mile south of the Selundi road drift. A prominent vein trending north and south is traceable for about two-thirds of a mile. It crosses the river diagonally and forms a vertical cliff on one bank for some distance. The vein lies in enstatitite, which is altered to a bastite rock for some 4 to 6 inches (less commonly to 2 feet) alongside the vein, probably by percolating water at the junction. Along its course the vein widens and narrows, in places almost dying out but widening again to 10 or 12 feet in a few yards. Its greatest width is perhaps some 9 feet, the greater part of which consists of a highly jointed, fine-grained homogeneous granular felspar-quartz-biotite rock—practically a granite. This is centrally placed. Both sides are bounded by a coarse norite pegmatite, respectively from 9 inches to 2 feet wide, sharply demarcated from the fine granitic central part in some instances, but gradually merging into it in others. This pegmatite consists of coarsely crystallized bastite and white felspar ; in places one side is coarse, the other fine-grained. At one end the vein consists of a foot or less of this coarse norite pegmatite, which rapidly expands to nearly 2 feet and becomes relatively fine-grained (the dark mineral is amphibole with less chloritized mica and the rock has the appearance of a coarse diorite). Continuing on the rock again changes, this time into a coarse quartz-felspar pegmatite in which little or no ferromagnesian mineral is present and the quartz and felspar are partly micrographic. Succeeding this again comes the fine biotite granite which typically occupies the central part of the vein as above mentioned (small patches, spots, and streaks of the coarser norite pegmatite are contained in this portion of the vein in some places). Farther along it forms a chain of lenticles which seem to die out completely for a few yards between the expansions. The surrounding enstatitite contains small seams and veinlets of a soft rather asbestiform mineral, which is probably a form of bastite.

Pebbles of a remarkable porphyritic rock occur rather abundantly in two places in the Umtebekwe river, but the rock was not found *in situ*. This consists of a fine-grained pale grey-green pyroxene-felspar ground-mass, in which are embedded large perfectly idiomorphic white felspar crystals up to several inches in size. The rock probably belongs to the Great Dyke.

## V.—Conclusions.

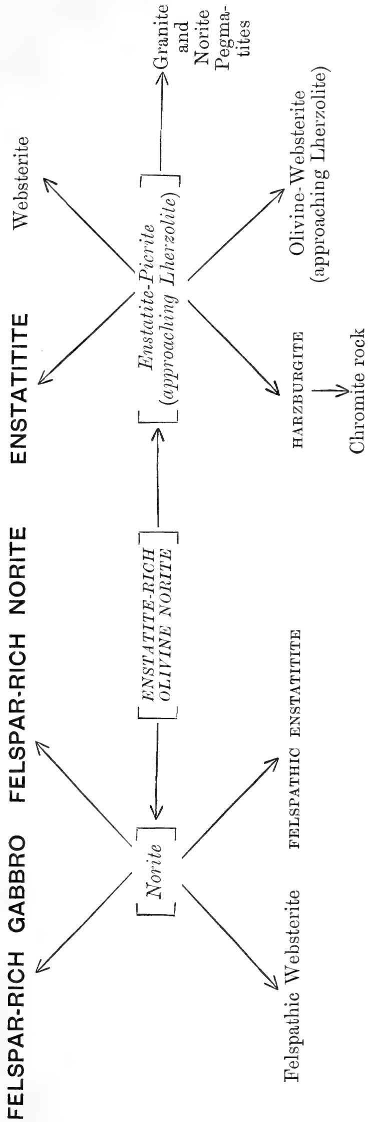
The evidence obtained during the examination of the Selukwe section with regard to the habit of the intrusion is meagre, in large part negative and to some extent contradictory, and it must be borne in mind that the habit may be disguised in several respects and probably cannot be made out as a whole from the examination of a portion. Other districts may afford definite evidence from which conclusions on the point may be drawn with greater certainty. It is thought, however, that at Selukwe the balance of the evidence is in favour of the intrusion having the dyke habit, but that it is likely to be a dyke with rather marked hade. It is therefore proposed to retain the name "Great Dyke" for the present.

As regards the mineralogical composition, texture, and distribution and proportions of minerals in the several rock types, remarkably stable conditions appear to have been reached before consolidation of the component parts into which the magma split. Thus throughout the intrusion the rocks are evenly medium to somewhat coarse-grained, and the constituent minerals are fairly evenly distributed through the rock, even in cases where there is but 10 to 15 per cent. of one of the essential constituents. The rock types further are sharply differentiated; it is exceedingly rare for one type to grade into another.

The intrusion is built up of a consanguineous series, but with the evidence at present available the matter does not permit full discussion of the origin and differentiation; nevertheless it may be useful to consider the facts ascertained in detail and attempt to draw conclusions from them.

The differentiation does not appear to have been one simple gradual operation. It is assumed that the parent magma split into two partial magmas, one with olivine and little felspar, the other without olivine and with much felspar, but both with enstatite; the less basic magma came to occupy a central position. Each of these partial magmas it is assumed again separated into portions respectively rich in, and comparatively poor in, enstatite. The extremes are a non-felspathic peridote enstatite rock and a non-peridotic felspar pyroxene rock.

The following diagram shows hypothetically the origin and relationships of the types.


FELSPAR-RICH GABBRO
FELSPAR-RICH NORITE
ENSTATITITE
Websterite
Norite
ENSTATITE-RICH OLIVINE NORITE
Enstatite-Picrite (approaching Lherzolite)
Granite and Norite Pegmatites
Felspathic Websterite
FELSPATHIC ENSTATITITE
HARZBURGITE
Chromite rock
Olivine-Websterite (approaching Lherzolite)

The position of the granite in the table is very uncertain.

All the types mentioned are present in the Great Dyke, but the primary (enstatite-rich olivine norite) and secondary (norite and enstatite picrite) magmas are only represented by small amounts which may perhaps be regarded as residua. These latter, together with certain of the secondary subordinate differentiations (websterite and granite) occur in the form of small bosses and veins. The dominant secondary differentiations (enstatitite and felspar-rich norite and gabbro) occur in large parallel-sided bodies extending, generally speaking, from end to end of that portion of the Great Dyke examined. The subordinate secondary differentiations, harzburgite and felspathic enstatitite, occur in elongated wedges.

Broadly speaking, therefore, the parent magma has separated into two dominant types in about equal proportions and two subordinate ones as follows:—

Dominant.

Bytownite-diopside-enstatite rock containing 30 per cent. pyroxenes and 70 per cent. felspar.

Enstatite rock containing 90 per cent. pyroxenes and 10 per cent. felspar.

Subordinate.

Enstatite-bytownite rock containing 80 per cent. pyroxenes and 20 per cent. felspar.

Olivine-enstatite rock containing 50 per cent. pyroxenes and less than 5 per cent. felspar.

If these be considered from mineralogical data to be complimentary and co-ordinate derivatives of the original magma, the latter would seem to have been of norite composition—an enstatite-rich olivine norite, that is, a basic magma rather than an ultra-basic one, which the large amount of ferromagnesian minerals would at first sight lead one to infer. But the complex is apparently abnormal mineralogically, being notably rich in rhombic pyroxene and somewhat deficient in felspar.

Chemically the complex would seem to be a fairly normal basic one so far as its roughly calculated silica content (about 51 per cent. $SiO_2$) is concerned, but it would seem to be unusually rich in magnesia, normal to high in lime, but deficient in alumina and poor in iron. This is expressed in the following table, which is an attempt to indicate the relative amounts of principal minerals in the complex:—

| | |
|---|---|
| Excessive amount of rhombic pyroxene | Slightly high silica, high magnesia. |
| Somewhat small amount of olivine | |
| Moderate to rather small amount of bytownite | |

| | |
|---|---|
| Very small quantities of aluminous pyroxenes and mica ........ Moderate to rather small amount of bytownite ......... Moderate to rather small amount of non-aluminous monoclinic pyroxene .......... | Medium to low alumina, normal to high lime. |
| Very small amount of the iron ores chromite, pyrite, and magnetite ........ Poorness of iron in the basic silicates olivine, rhombic pyroxene, and monoclinic pyroxene ........ Rather small amount of olivine ........ | Low iron. |

The differentiation of the magma has resulted chiefly in the separation of the lime from the magnesia, the iron accompanying the magnesia, whilst the silica content was not so greatly affected by differentiation (it became four or five points higher in the femic part of the intrusion because of the enstatite). Thus the inner part of the intrusion probably contains about 49 per cent. $SiO_2$, about 7 per cent. MgO, and rather more than 15 per cent. CaO, and the outer portions of the intrusion (pyroxenite and peridotite) about 53 per cent. $SiO_2$, more than 30 per cent. MgO, and probably less than 5 per cent. CaO. Combining these figures broadly to include the whole of this section of the intrusion, the approximate average composition as regards silica, magnesia, and lime would appear to be respectively 52 per cent., 18 per cent., and 10 per cent.*

* Since this paper was written the Government agricultural chemist, Mr. G. N. Blackshaw, has kindly permitted the author to have the figures of three partial chemical analyses of Great Dyke rocks made in the agricultural laboratory for the purpose of an important investigation of the Great Dyke soils, which is being conducted by Mr. Blackshaw. The analyses are here quoted, and for them the author desires to acknowledge his indebtedness to Mr. Blackshaw.

"Fused with Sodium Carbonate.

| | Serpentine. No. 432. Per cent. | Enstatitite. No. 795. Per cent. | Norite. No. 1022. Per cent. |
|---|---|---|---|
| Insoluble matter after fusion ............ | 51·50 | 52·70 | 46·04 |
| Ferric oxide and aluminium oxide...... | 12·85 | 15·90 | 28·98 |
| Loss on ignition ........................... | 6·70 | 0·12 | 0·21 |
| Calcium oxide, CaO ........................ | 1·45 | 2·90 | 14·66 |
| Magnesium oxide, MgO .................. | 27·53 | 28·52 | 7·13 |

Soda, etc., not determined."

No. 432.—From Lalapanzi. A coarse-grained pale sage-green rock made up of enstatite largely altered to bastite. The only other constituents noted are a little interstitial felspar and some iron oxide. A little olivine serpentine may be present. The rock is an altered enstatitite. Not examined microscopically.

No. 795.—From well near homestead on N. St. Quintin's farm, "Cringleford," Makwiro. A medium-grained dark olive-green rock made up of enstatite and felspar with a trace of monoclinic pyroxene. The felspar, which is interstitial to the well crystallized enstatite, is rather too abundant for an enstatitite, and the rock is probably better classed

Although therefore the complex is of norite aspect, its estimated composition indicates affinities with the picrites.

The age of the intrusion is unknown, but it is post-Granite and probably pre-Dolerite-Dyke, since several dykes of doleritic rocks having affinities with the Dolerite Dykes rather than with any other rock group in the Selukwe area have intruded into the Great Dyke. F. P. Mennell (*A Manual of Petrology*, Chapman and Hall, London, 1913) also states (p. 152) that the Great Dyke is pierced by dolerite dykes. B. Lightfoot (*Bulletin No.* 4, *Geol. Survey S. Rhodesia*, 1914, pp. 13 and 14) describes a norite in the Wankie district of post-Archæan pre-Karroo age, which he parallels lithologically with the Great Dyke. He suggests the probability of the Great Dyke being of pre-Karroo age. Lithologically the Great Dyke bears a very strong resemblance to the basic portion of the remarkable Bushveld Igneous Complex of the Transvaal, which is regarded as having intruded between the Transvaal and Waterberg Systems at a period posterior to the deposition of the Lower Waterberg. It is not unlikely that the Great Dyke is of the same age, and the suggestion of Mr. Lightfoot above noted is in accordance with this conjecture.

with the felspathic enstatitites. The felspar probably is about 15 per cent. of the volume of the rock. Not examined microscopically.

No. 1022.—Taken 150 yards from Little Tebekwe, at Victoria road drift, Selukwe. A medium-grained felspar-rich norite, sp. gr. 2·88, consisting of about two-thirds by volume of labradorite-bytownite and one-third diopside and enstatite (together). A trace of pyrites, brown mica, bastite, and (?) zoisite. The diopside is more abundant than the enstatite.

Fig. 1.—Selundi Range and Umtebekwe Valley (in distance) from Wolfshall Road.

Fig. 2.—Selundi Range and Umtebekwe Valley near Victoria Road Drift.
Pyroxenite kopje at left in foreground. Norite range and gap occupied by pyroxenite and serpetine.

West, Newman proc.

# PLATE III.

## DESCRIPTIONS.

Fig. 1.

*Felspar-rich Norite.*

Slide 467.
Magnification 6·6.
Ordinary light.
Sp. gr. 2·91.

Minerals: bytownite.
diopside.
enstatite.

(Minerals apply to Figs. 1 and 2.)

Fig. 2.

*Felspar-rich Norite.*

Slide 76.
Magnification 6·6.
Polarized light.
Sp. gr. 2·87.

Fig. 3.

*Poikilitic felspar-rich Gabbro.*

Slide 420.
Magnification 14.
Ordinary light.
Minerals: bytownite.
diopside (poikilitic).
Sp. gr. 2·90.

Fig. 4.

*Enstatitite.*

Slide 422.
Magnification 6·6.
Polarized light.
Minerals: enstatite.
interstitial labradorite.
Sp. gr. 3·30.

Fig. 5.

*Felspathic Enstatitite.*

Slide 71.
Magnification 6·6.
Polarized light.
Minerals: enstatite.
bytownite.
diopside (interstitial).
micrographic quartz and felspar (in SW. corner).

Fig. 6.

*Felspathic Websterite.*

Slide 475.
Magnification 6·6.
Polarized light.
Minerals: enstatite.
two monoclinic pyroxenes (a large diopside in E. field),
bytownite.
Sp. gr. 3·22.

Fig. 1

Fig. 2

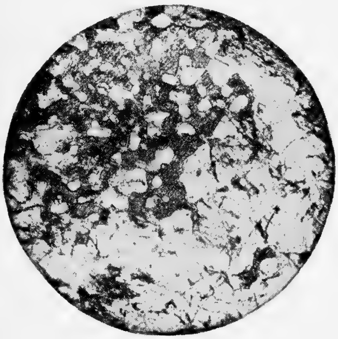


Fig. 3

Fig. 4

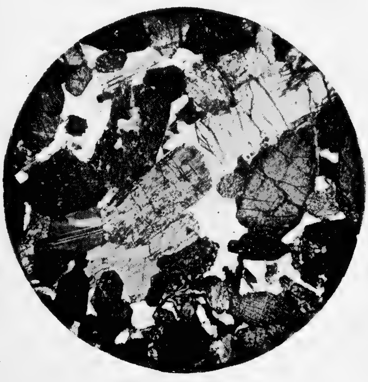


Fig. 5

Fig. 6

West, Newman proc.

# PLATE IV.

## DESCRIPTIONS.

Fig. 1.

*Harzburgite.*

Slide 461.
Magnification 6·6.
Polarized light.
Minerals: Olivine lying in a large enstatite crystal.
Sp. gr. 2·93.

Fig. 2.

*Websterite.*

Slide 474.
Magnification 14.
Ordinary light.
Minerals: diopside.
enstatite.
olivine (trace).
Sp. gr. 3·25.

Fig. 3.

*Websterite near Lherzolite.*

Slide 476.
Magnification 14.
Polarized light.
Minerals: enstatite.
diopside.
olivine.
Sp. gr. 3·24.

Fig. 4.

*Norite.*

Slide 463.
Magnification 14.
Ordinary light.
Minerals: rhombic pyroxene (pleochroic)
basic plagioclase.
Sp. gr. 3·03.

Fig. 5. Fig. 6.

*Olivine-enstatite-Gabbro.*

Slide 442 (same field and position).
Magnification 14.
Ordinary light. Polarized light.
Minerals: diopside.
basic plagioclase.
olivine.
enstatite (forming narrow rims round diopside grains).
Sp. gr. 3·10.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

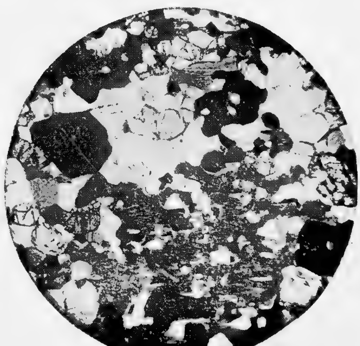


Fig. 6

West, Newman proc.

# DESCRIPTIONS OF SOME NEW ALOES FROM THE TRANSVAAL.

By I. B. Pole Evans, M.A., B.Sc., F.L.S.

(With Plates V.–XV.)

Burtt-Davy * in his First Check-List of the Flowering Plants and Ferns of the Transvaal and Swaziland, published in May, 1912, records some seventeen species of *Aloe* from the above regions. Of these only five species, namely, *A. castanea*, *A. cinnabarina*, *A. Dyeri*, *A. Peglerae*, and *A. transvaalensis* may be looked upon as peculiar to the Transvaal; the rest have a fairly wide distribution throughout South Africa.

Of the former, *A. cinnabarina*, Diels, which is only recorded from the Transvaal † is at present unknown to me, while of the latter it is very doubtful whether *A. lineata*, Haw., occurs in the Transvaal or Swaziland, for plants which have been mistaken for this species from these regions prove to be entirely different, and are described in the present paper as *Aloe Pretoriensis*.

## Aloe longibracteata, spec. nov.

Transvaal.

(Plate V.)

*Aloe longibracteata,* Pole Evans; species nova affinis *A. affinis*, Berg., sed foliis copiose maculatis triangulariis et erectis, longissimis bracteis differt.

*Herba* succulenta, acaulis. Folia 21–33 dense rosulata, valde patentia, apice frequenter sicca et recurvata, triangulari-lanceolata, 9–20 cm. longa et 9–11 cm. lata, carnosissima, supra subcanaliculata, obscure viridia vel rubescentia, striata maculisque magnis albidis oblongis saepe

* *Annals of the Transvaal Museum*, May, 1912, pp. 134–5.

† A. Berger in "Engl. Planzenreich. Liliac. Asphodel-Aloin," p. 271.

confluentibus et irregulariter transverse fasciation seriatis picta, subtus convexa, pallide glauco-viridia immaculata, ad margines sinuato-dentata et linea distincte cartilaginea cincta, dentibus corneis deltoideis apice brunneis validis 6–7 mm. longis et ca. 9–12 mm. inter se distantibus armata.

*Inflorescentia* ca. 80 cm. alta, scapus infra medium ramosus, ramis 2–3 erectis ad basim bracteis ca. 10–11 cm. longis suffultis; racemi elongatis, densi, 25–30 cm. longi; bracteae lanceolato-lineares, subulato-acuminatae 45–47 mm. longae; pedicelli 15–17 mm. longi, flaviusculi.

*Perianthium* rubicundum, 40 mm. longum, basi manifeste globoso-inflatum et 9 mm. diam., supra ovarium distincte constrictum, levissime decurvatum et faucem versus ampliatum; segmenta oblonga et libera per 15–17 mm.; genitalia brevissime exserta.

*Capsula* oblongo-cylindracea, subtrigona, 23–27 mm. longa et 13–16 mm. diam., grisea; pedicelli fructiferi 25–27 mm. longi, erecti; semina oblonga, triquetra, auguste alata, griseo-brunnea, 5 mm. longa.

This plant was collected by myself near Lydenberg in the Transvaal in May, 1914. It occurs in open grass country at an altitude of 5,000–6,000 ft., and flowers from June to July.

It is characterized by its robust spreading leaves, dichotomously branched inflorescence, erect racemes, and extremely long bracts. The bracts at the base of the branches are remarkable in that they attain a length of 10–11 cm. Those in the lower portion of the racemes are from 45–47 mm. long while those in the upper portion measure 25 mm.

The flowers are a rich strawberry-pink (R.C.S.).*

This Aloe would appear to be closely related to *A. affinis*, Berg., which also occurs in the same locality, but it differs from it in possessing shorter and more triangular leaves which are conspicuously spotted. Moreover, the leaves of *A. affinis* are distinctly erect, whereas those of *A. longibracteata* are almost always horizontal. The inflorescence usually bears 2 or 3 erect branches which spring from below the middle of the peduncle, while those of *A. affinis* arise well above the middle.

The brightly coloured racemes make it a distinct and attractive ornamental plant.

**Description.**—*Herb* succulent, stemless. Leaves 21–33 in a dense rosette, spreading, frequently withered at the apex and recurved, triangular-lanceolate, 9–20 cm. long and 9–11 cm. broad, very fleshy, channelled above, convex below, upper surface dark green or reddish with numerous pale green to whitish stripes or spots, which are irregu-

* **N.B.**—(R.C.S.) refers in all cases to colours taken from Ridgway's "Color Standards and Color Nomenclature," Washington, 1912.

larly interrupted and by which irregular transverse bands are produced, lower surface light green or glaucous, indistinctly lineate, margins wavy with a distinct brown cartilaginous border, and beset with short deltoid horny teeth which are 9–12 mm. apart, brown, and 6–7 mm. long.

*Inflorescence* about 80 cm. high, branched below the middle, branches 2–3, erect, subtended at the base by bracts 10–11 cm. long, racemes elongated, densely flowered, 25–30 cm. long; bracts 45–47 mm. long, lanceolate-linear, subulate-acuminate; pedicels 15–17 mm. long, rather yellowish.

*Perianth* strawberry-pink (R.C.S.), 40 mm. long, distinctly inflated at the base and 9 mm. diam., then clearly constricted above the ovary, very slightly decurved and swollen towards the mouth, lobes long and free for 15–17 mm., paler in colour at the margins, yellowish inside.

*Style* and *stamens* very slightly exserted.

*Capsule* oblong-cylindrical, 3-angled, 23–27 mm. long and 13–16 mm. diam., greyish; pedicels 25–27 mm. long, erect.

Seeds oblong, 3-winged, wings narrow, greyish-brown, 5 mm. long.

### Aloe Pienaarii, spec. nov.

Transvaal.

(Plates VI. and VII.)

*Aloe Pienaarii*, Pole Evans; species nova, *A. abyssinica*, Lam., simillima, et certe ad sectionen hanc spectat, sed bracteae multo magiores, distincte cuspidatae, et perianthium non basi stipitatum.

*Herba* succulenta acaulis. *Folia* 35–60, dense rosulata, erecta, leviter apice recurvata, lanceolata-ensiformia, laete rufo-viridia vel caerulea, 60–80 cm. longa et basi 12–15 cm. lata, ad margines aculeis parvis deltoideis castaneis 2 mm. longis et 5–7 mm. inter se distantibus armata.

*Inflorescentiae* 2–3 ex eadem rosula, copiose paniculata-ramosae, erectae, 1·25–1·65 m. altae, ramis ca. 8 arcuato-erectibus basi bractea deltoideo-acuminata suffultis; racemi cylindrico-conici, densiflori, circ. 25–35 cm. longi, floribus primum coccineis apice viridulis, deinde expansis lutescentibus; bracteae initio dense imbricatae deinde pedicellos amplectentes, late ovato-acuminatae, plurinervae, 20 mm. longae et 11 mm. latae; pedicelli erecto-patentes, 15–20 mm. longi, viridio-coccini.

*Perianthium* 35–38 mm. longum, subtrigona-cylindraceum, segmenta exteriora vix tubo breviora, libera, acuta, interiora obtusiora, leviter apice recurva, lateralia conniventia faucem angustam erectam formantia; genitalia vix exserta.

*Capsula* perianthio sicco involuta, cylindraceo-trigono, lignosa, 20 mm. longa; semina fusca, irregularia, anguste alata, 4–5 mm. longa.

This Aloe was collected by Mr. P. J. Pienaar at Smit's Drift in the neighbourhood of Pietersburg, Transvaal, in January, 1914. A number of plants were obtained for the Union Buildings' grounds, and they flowered profusely from May to July. This species is found most commonly on and around the isolated granite kopjes of the Pietersburg district. It also occurs in the open flat country.

It rather resembles *A. abyssinica* in habit and general appearance, and must, I think, be referred to Berger's *Tropicales*, although the bracts are much larger than those which are found in this group, in fact the bracts at the tips of the racemes are one of the most conspicuous features of the inflorescence.

The unopened flowers are scarlet (R.C.S.) tipped with green. As soon as the stamens are exserted, the colour of the perianth changes from scarlet to citron-yellow from the apex downwards; the base of the perianth, however, usually retains its scarlet hue.

It makes a very showy and attractive plant and remains in flower from 2–3 months.

**Description.**—*Herb* succulent, stemless. *Leaves* 35–60 in a dense rosette, erect, slightly recurved towards the apex, lanceolate-ensiform, reddish green or bluish, 60–80 cm. long and 12–15 cm. broad at the base, beset along the margins with small chestnut-coloured deltoid thorns 2 mm. long and 5–7 mm. apart.

*Inflorescences* 2–3 from the same rosette, copiously panicled, erect, 1·25–1·65 metres high, with about 8 arcuate-erect branches subtended at the base with deltoid-acuminate bracts; racemes cylindrical-conical, densely flowered, about 25–35 cm. long, flowers at first scarlet greenish at the tips, becoming yellow when open; bracts at first densely imbricate afterwards embracing the pedicels, broadly ovate-acuminate, many-veined, 20 mm. long and 11 mm. broad; pedicels erect-spreading, 15–20 mm. long, greenish scarlet.

*Perianth* at first scarlet (R.C.S.) tipped with green, later changing to a citron-yellow (R.C.S.) 35–38 mm. long, somewhat 3-angled and cylindrical, outer segments shorter than the inner, free, acute, inner segments more obtuse, slightly recurved at the apex, the two lateral ones becoming compressed towards the apex so as to close the mouth of the tube.

*Style* and *stamens* just exserted, anthers grenadine red (R.C.S.) at first, flame scarlet (R.C.S.) when open, style and filaments bright chalcedony yellow (R.C.S.), filaments flattened and wing-like 2–2½ mm. broad.

*Capsule* enveloped with the dry perianth, cylindrical-trigonous, woody, 20 mm. long; seeds darkish, irregular, narrowly winged, 4–5 mm. long.

## Aloe Wickensii, spec. nov.

Transvaal.

(Plates VIII. and IX.)

*Aloe Wickensii*, Pole Evans; species nova, distincta et pulcherrima, *A. Pienaarii* valde affinis, sed inflorescentiae rami magis patentes et pauciores multo sunt; flores etiam distincte cylindrico-carinati.

*Herba* succulenta, acaulis. *Folia* 40–50, dense rosulata lanceolata-ensiformia, erecta, sensim incurvata pallide glauco-viridia, 50–70 cm. longa et basi 10–13 cm. lata, planiuscula, subtus convexa, ad margines aculeis parvis circ. 2 mm. longis deltoideis atris 6–8 mm. inter se distantibus armata.

*Inflorescentiae* saepe 2–4 ex eadem rosula, patentes; scapus lateraliter, compressus, nudus, plerumque ramis 2 lateralibus instructus; rami arcuato-erecti, sursum bracteis pallide brunneis scariosis laete ovato-acuminatis muniti; racemi densiflori, conico-cylindrici, 17–20 cm. longi; bracteae laete ovato-cuspidatae, 20 mm. longae et 13 mm. latae; pedicelli erecto-penduli, 28–32 mm. longi, viridis.

*Flores* juniores clausi primo laete rubri, deinde viridio-lutei, demum expansis luteis.

*Perianthium* cylindrico-carinatum, 35 mm. longum; segmentis exterioribus liberis, 2 superis apice recurvis et breviores ceteris, interioribus apice rufo-brunneis; genitalia demum paullo exserta.

*Capsula* perianthio sicco involuto, oblonga-cylindracea, subtrigona, 20 mm. longa; semina irregularia anguste alata, fusca, 4–5 mm. longa.

This is one of the handsomest Aloes known to me. It was collected by Messrs. Wickens and Pienaar in M'Phathlele's Location in the Northern Transvaal, in January, 1914.

Specimens were brought to Pretoria and the plants flowered in July, 1914.

In general appearance and habit of growth this Aloe closely resembles *A. Pienaarii* from the same locality, but it is more commonly found on gentle slopes in bush country, although it may frequently occur in open ground along with *A. Pienaarii.*

When the plants are not in flower, those of *A. Wickensii* can be distinguished from *A. Pienaarii* by their paler green leaves which are distinctly incurved.

The inflorescence differs markedly from that of *A. Pienaarii.* It is much less branched and much more open. As a rule there are not more than two lateral branches, whereas in *A. Pienaarii* there are usually about eight, some of which may again be branched. The racemes also are shorter and more conical than in *A. Pienaarii.* The flower-buds are at first morocco-red (R.C.S.), they then turn a dull green-yellow (R.C.S.) and finally the open flowers become a bright lemon chrome (R.C.S.). The perianth differs from *A. Pienaarii* in being distinctly carinate; it is about 7 mm. diam. towards the base and 13 mm. diam. at the widest portion.

**Description.**—*Herb* succulent, stemless.

*Leaves* 40–50 in a dense rosette, lanceolate-ensiform, erect, distinctly incurved, pale glaucous green 50–70 cm. long and 10–13 cm. at the base, rather flat, convex below, beset at the margins with small deltoid thorns about 2 mm. long, black, and about 6–8 mm. apart.

*Inflorescences* often 2–4 from the same rosette, spreading; scape laterally compressed, naked, with usually two lateral branches; branches arcuate-erect, clothed with pale brown scariose broadly ovate-acuminate bracts; racemes densely flowered, conical cylindrical, 17–20 cm. long; bracts and tinged with red towards the base; the young buds distinctly globular; bracts scariose, pellucidate, 5–6 mm. long, ovate-cuspidate, reflexed; pedicels recurved 3–4 mm. long.

*Perianth* 35 mm. long, cylindrical-ventricose, very shortly stipitate; outer segments free for 15–17 mm., obtuse, recurved at the apex, 3–5-nerved; inner segments obtuse, recurved, tipped with auburn (R.C.S.), with 3 green nerves. *Stamens* projecting 11 mm. beyond the perianth and slightly recurved, the exposed portion of the filaments chestnut-brown to black; anthers mars orange (R.C.S.).

*Style* stout, strongly recurved, pale sulphur-yellow (R.C.S.).

*Capsule* shortly stipitate, oblong-ovoid, 25 mm. long and 13 mm. broad.

### Aloe globuligemma, spec. nov.

Transvaal.

(Plates X. and XI.)

*Aloe globuligemma*, Pole Evans; species unica, certe ad sectionem *Pleurostachyarum* pertinet et affinis est *A. secundiflorae*, Engl., sed differt acaulescente et globuligemmis.

*Herba* succulenta, acaulis. *Folia* 16–23 dense rosulata erecto-patula, lanceolato-ensiformia sensim attenuata, apice recurvata, glauca, immaculata, basi planiuscula superne canaliculata, 45–50 cm. longa et basi 8–9 cm. lata, ad margines linea tenui cartilaginea cincta dentibusque parvis deltoideis instructa, pallidis brunneis 1½–2 mm. longis et ca. 8–9 mm. inter se distantes. *Inflorescentia* valde ramosa, circ. 60 cm.–1 m. alta; pedunculus robustus, glaucus, nudus; rami 5–7 horizontaliter-oblique patentes, basi bracteis parvis deltoideo-acutis vacuis muniti; racemi densiflori 22–40 cm. longi; flores secundi, omnessursum spectantes versus centrum inflorescentiae simulae leviter deflexi, junioribus clausis rubris, expansis sulphureis basi rubro-tinctis; juniores gemmae distincte globulae; bracteae scariosae, pelludidae, 5–6 mm. longae, ovato-cuspidatae, reflexae; pedicelli recurvi, 3–4 mm. longi.

*Perianthium,* 25 mm. longus, cylindrico-ventricosum, brevissime stipitatum; segmenta exteriora 15–17 mm. longa, obtusa, apice leviter recurvata, 3–5 nervia; interiora apice fusca, trinervia.

*Filamenta* per 11 mm. exserta et leviter recurvata. *Stylus* valida et valde arcuato-recurvatus.

*Capsula* breviter stipitata, oblonga-ovoidea, 25 mm. longa et 13 mm. lata.

This remarkable Aloe was collected by Messrs. Wickens and Pienaar in M'Phathlele's Location in January, 1914.

Specimens brought to Pretoria flowered towards the end of July and during August of this year.

The plant occurs in vast numbers in a very gregarious manner in open sandy stretches. It is not uncommon to find long, continuous belts of thickly crowded plants extending for two to three hundred yards in length.

In the early stages of development the racemes are conspicuously furnished with widely separated spherical to globular flower-buds which develop with considerable slowness. The unopened flowers are a rich nopal red (R.C.S.) tinged with green at the tips; as soon as they open the flowers become a sulphur-yellow (R.C.S.).

I think this *Aloe* must be referred to Berger's *Pleurostachyae,* and it would appear to show some relationships with *A. secundiflora,* Engl.

**Description.**—*Herb* succulent, stemless.

*Leaves* 16–23 in a dense rosette, erect-spreading, lanceolate-ensiform, distinctly attenuated, recurved at the apex, glaucous, unspotted, somewhat flar at the base canaliculate above, 45–50 cm. long, and 8–9 cm. broad at the base; margins cartilaginous, wavy and toothed; teeth standing out at right angles to the margins, deltoid, recurved, pale brown, $1\frac{1}{2}$–2 mm. long and about 8–9 mm. apart.

*Inflorescence* very branched, about 60 cm.–1 metre high; peduncle stout, glaucous, naked; branches 5–7 spreading horizontally to obliquely, with a few small deltoid-acute empty bracts at the base; racemes densely flowered 22–40 cm. long; flowers secund, all pointing upwards the centre of the inflorescence and at the same time slightly deflexed, unopened flowers nopal red (R.C.S.), green at the tips, sulphur-yellow (R.C.S.) when expanded and tinged with red towards the base; the young buds distinctly globular; bracts scariose, pellucidate, 5–6 mm. long, ovate-cuspidate, reflexed; pedicels recurved 3–4 mm. long.

*Perianth* 25 mm. long, cylindrical-ventricose, very shortly stipitate; outer segments free for 15-17 mm., obtuse, recurved at the apex, 3–5-nerved; inner segments obtuse, recurved, tipped with auburn (R.C.S.); with three green nerves. *Stamens* projecting 11 mm. beyond the perianth and slightly recurved, the exposed portion of the filaments chestnut-brown to black; anthers mars orange (R.C.S.).

*Style* stout, strongly recurved, pale sulphur-yellow (R.C.S.).

*Capsule* shortly stipitate, oblong-ovoid, 25 mm. long and 13 mm. broad.

## Aloe Pretoriensis.

Transvaal.

(Plates XII. and XIII.)

*Aloe Pretoriensis*, Pole Evans, in Gard. Chron., 1914, vol. lvi., pp. 105–6; affinis *A. arborescentis*, Mill., sed non frutescente, foliis multo rigidioribus et inflorescentia altissima copiose ramosa differt.

*Truncus* simplex, brevis, interdum 1 m. altus, 8–12 cm. diam.

*Folia* numerosa, 30–60 dense rosulata, arcuato-erecta, 30–65 cm. longa et basi 3–7 cm. lata, 8–10 mm. crassa, lanceolata et sensim acuminata, supra planiscula leviter canaliculata versus apicem, subtus convexa, pallida viridia vel glauca, ad margines pungentibus corneis aculeisque deltoideis apice curvatus, rubris, 3–4 mm. longis et circa 10–17 mm. distantibus instructa.

*Inflorescentiae* circa 2–3·5 m. altae; scapus validus, basi nudus, plerumque ramos 2–8 emittens, rami erecto-patentes, basi deltoideo-ovatis bracteis suffulti; racemi conico-cylindracei, 15–50 cm. longi, densi, laxius floribus pendulibus; bracteae ovato-deltoideae, plurinerviae, 15–20 mm. longae et 10–12 mm. latae; pedicelli 20–25 mm. longi.

*Perianthium* cylindraceum, medio paullum ampliatum et versus faucem leviter compressum, laete rubrum, 40–43 mm. longum, segmenta libera, apice viridio-luteola; filamenta stylusque breviter exserta, viridio-luteola, antherae rubro-brunneae.

*Capsula* perianthio sicco involuta, cylindracea, subtrigona, 15–18 mm. longa et circa 6 mm. lata, grisea; pedicelli fructiferi 25–30 mm. longi, erecti; semina parva, angustissime triquetra fusca, 2–4 mm. longa.

Although this plant does not possess the shrubby or arborescent habit of Berger's *Arborescentes*, the characters of the inflorescence and flowers plentifully show that its relationships lie with *Aloe pluridens* and *A. arborescens*.

The stem is very rarely branched and seldom exceeds a foot or two in height. It is usually covered with the dried or charred remains of the old leaf bases.

The leaves are stiffer than those of *A. pluridens* or *A. arborescens*, and lack their falcate character. The reddish thorns which beset the margins of the leaves are also more robust and pungent than those which occur in *A. pluridens* or *A. arborescens*.

The tall branched inflorescence forms the most striking feature of the plant, and when one compares it with that of *A. lineata*, which is unbranched and differs in many other important respects, it seems almost incredible that *A. Pretoriensis* should have been mistaken by so many botanists for *A. lineata*, as has been done.

This handsome plant occurs on the northern slopes of the hills around Pretoria, and is especially abundant on Meintjes Kop, where and when in bloom it attracts large numbers of brightly coloured sunbirds. It is also found near Lydenberg, at Barberton, and along the foot of the Lebombo range of mountains.

It usually flowers in May.

**Description.**—*Stem* short, sometimes reaching 1 metre in length and 8–12 cm. in diam.

*Leaves* numerous 30–60 in a dense rosette, arcuate-erect, 30–65 cm. long, 3–7 cm. broad at the base, 8–10 mm. thick, lanceolate and distinctly acuminate, flat above, slightly canaliculate towards the tip, convex below, light green or slightly glaucous armed along the margin with sharply pointed red, horny prickles, which are 3–4 mm. long and 10–17 mm. apart. Tips of most of the older leaves withered and reddish in colour.

*Inflorescence* 2–3·5 metres long; peduncle stout and branched, from 2–8 branches, erect-patent, subtended by deltoid-ovate bracts at the base; racemes conical-cylindrical 15–50 cm. long, dense, with loosely pendulous flowers, floral bracts ovate-deltoid, many-veined, at first densely imbricate, 15–20 mm. long and 10–12 mm. broad; pedicels 20–25 mm. long.

*Perianthium* cylindricum, slightly swollen towards the middle and tapering towards the tip, rich peach red, 40–43 mm. long, segments free, yellowish green at the tips.

*Anthers* and style shortly exserted, filaments and style greenish yellow, anthers reddish brown.

*Capsule* enwrapped with the dry perianth, cylindrical, 3-angled, 15–18 mm. long and about 6 mm. broad, greyish; fruit-bearing pedicels 25–30 mm. long, erect.

*Seeds* small, very narrowly 3-winged, dark, 2–4 mm. long.

### Aloe aculeata.

Transvaal.

(Plates XIV. and XV.)

*Aloe aculeata*, Pole Evans; species distincta et nobilissima. *A. rubroviolaceum*, Schweinfurth, valde accedit, sed caulis multo brevior, folia aculeata, bracteae parviores et breviores.

*Caulis* plerumque brevis, robustus, interdum 1·00 m. altus, simplex. *Folia* numerosa, dense rosulata, erecto-incurvata, lanceolata-ensiformia, sensim attenuata apice corneo pungente, 45–60 cm. longa et basi 7·5–11 cm. lata, 15–17 mm. crassa, ad margines aculeis cornicis rubro-brunneis 10–20 mm. remotis armata, supra concaviuscula, apicem versus subcanaliculata et paucibus dentibus similibus ubique spinoso-tuberculata.

*Pedunculus* validus, simplex vel furcatus, lateraliter compressus, superne numerosis bracteis vacuis deltoideis latis vestibus, plerumque 2–3 ramis, arcuato-erectis; racemi 30–60 cm. longi et ca. 7 cm. lati, multiflori, densi, floribus primum laeta luteo-coccinis, deinde expansis lutescentibus; bracteae rubro-brunneae, deltoides-acutae 11 mm. longae et 7–8 latae; pedicelli 3 mm. longi.

*Perianthium* 34–38 mm. longum, citro-luteum, ventricoso-cylindraceum; segmenta exteriora basi per 14–16 mm. connata, lineari-lanceolata, trinervia, interiora latiora et vix obtusiora apice brunneae. *Filamenta* robusta, per 15 mm. exserta brunnea. *Stylus* longius flavidus.

*Capsula* cylindraceo-trigona, 14–18 mm. longa et 8–10 mm. diam., grisea; semina triquetra, anguste alata, fusca, 4 mm. longa.

This handsome Aloe undoubtedly belongs to Berger's *Principales*, and the characters of the inflorescence and flowers suggest a close relationship with *A. rubroviolacea*, Schweinfurth, although the bracts are much smaller and shorter than in *A. rubroviolacea*.

This Aloe was collected by Messrs. Pienaar and Wickens in the Zoutpansberg in the Northern Transvaal in January, 1914, and specimens which were brought to Pretoria flowered the following May.

The plants occur in open bush veld country, and when in flower form a very attractive feature of the vegetation. The upper part of the racemes with unopened flowers is a bright orange-scarlet, while the open flowers lower down are a bright lemon-yellow.

Sometimes the peduncle is unbranched, especially in the younger plants, but more commonly there are from 1–3 upright branches, in some cases as many as five branches.

When in flower it makes a very handsome ornamental plant.

**Description.**—*Stem* usually short, sometimes as much as 1 metre in height, unbranched.

*Leaves* numerous, in a dense rosette, erect-incurved, lanceolate-ensiform, distinctly attenuated, terminating in a sharp thorn, 45–60 cm. long, and 7·5–11 cm. broad at the base, 15–17 mm. thick, the margins beset with conical reddish-brown thorns 5–6 mm. long and 10–20 mm. apart, somewhat concave above, channelled towards the apex and with a few similar thorns especially in the median line, convex below and more thickly studded with thorns.

*Peduncle* stout, simple or branched, laterally compressed, clothed with numerous broad deltoid bracts, usually 2–5 branches, arcuate-erect; racemes 30–60 cm. long and about 7 cm. broad, clothed at the base with dry empty scariose bracts, dense, many-flowered, upper part of raceme with unopened buds bright orange-scarlet; bracts maroon-claret brown (R.C.S.), deltoid-acute 11 mm. long, and 7–8 mm. broad; pedicels 3 mm. long.

*Perianth* 34–38 mm. long, cylindrical-ventricose, lemon-yellow (R.C.S.); outer segments united for 14–16 mm. from the base, linear-lanceolate, with 3 green or orange veins and tipped with brown, inner segments lighter in colour, more obtuse with chestnut-brown tips. *Stamens* and *style* protruding 15–17 mm. beyond the perianth, filaments stout, coloured auburn (R.C.S.); anthers bright orange chrome (R.C.S.), dark brown at the back, style lemon-yellow.

*Capsule* cylindrical trigonous, 14–18 mm. long and 8–10 mm. diam., greyish; seeds triquetrous, narrowly winged dark, 4 mm. long.

## EXPLANATION OF PLATES.

### PLATE V.

ALOE LONGIBRACTEATA.

FIG.
1. Two plants in flower showing typical branching of inflorescence.
2. Portion of raceme showing the long bracts.
3. Flowers in different stages of development.

1 & 2 much reduced; 3 natural size.

### PLATE VI.

ALOE PIENAARII.

1. Plants flowering near Smit's Drift.
2. Plants in flower showing branching inflorescence, and prominent bracts in the racemes.
3. Inflorescence.

All much reduced.

### PLATE VII.

ALOE PIENAARII, *continued.*

1. Flowers at different stages of development.
2. Portion of raceme, showing characteristic appearance of bracts.

1 natural size; 2 slightly reduced.

### PLATE VIII.

ALOE WICKENSII.

1. Plants near Chunie's Poort.
2. Plant in flower at M'Phathlele's Location.

Both reduced.

### PLATE IX.

ALOE WICKENSII, *continued.*

1. Flowers at different stages of development.
2. Inflorescence, showing typical mode of branching.

1 natural size; 2 much reduced.

### PLATE X.

ALOE GLOBULIGEMMA.

1. Plants at M'Phathlele's Location.
2. Inflorescence.

Both much reduced.

## PLATE XI.

ALOE GLOBULIGEMMA, *continued.*

FIG.
1. Portion of raceme showing globular buds.
2. Portion of raceme at later stage of development.
3. Flowers at different stages of development.

1 & 2 slightly reduced; 3 natural size.

## PLATE XII.

ALOE PRETORIENSIS.

1. Plants on Meintjes Kop.
2. Plant flowering near Lydenburg.

Both much reduced.

## PLATE XIII.

ALOE PRETORIENSIS, *continued.*

1. Portion of leaf.
2. Flowers at different stages of development.
3. Raceme.

1 slightly reduced; 2 natural size; 3 much reduced.

## PLATE XIV.

ALOE ACULEATA.

1. Plants near Smit's Drift.
2. Plant near Meintjes Drift showing typical inflorescence.
3. Plants showing dense racemes and thorny leaves.

All much reduced.

## PLATE XV.

ALOE ACULEATA, *continued.*

1 & 2. Flowers at different stages of development.

Both natural size.

Fig. 1.

I. B. Pole Evans photo. Fig. 2. Fig. 3. West, Newman proc.

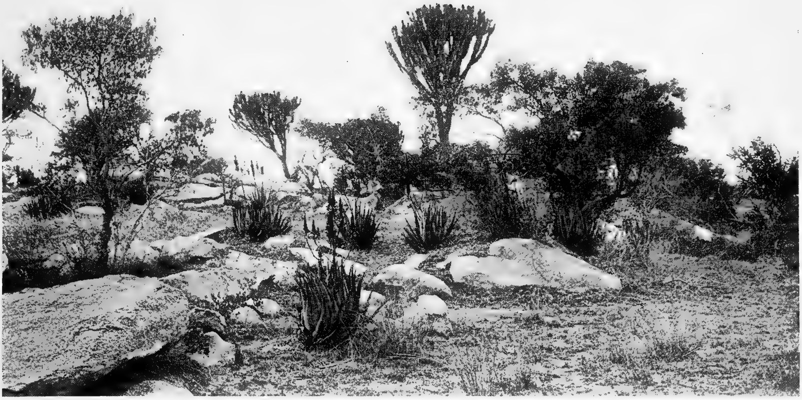
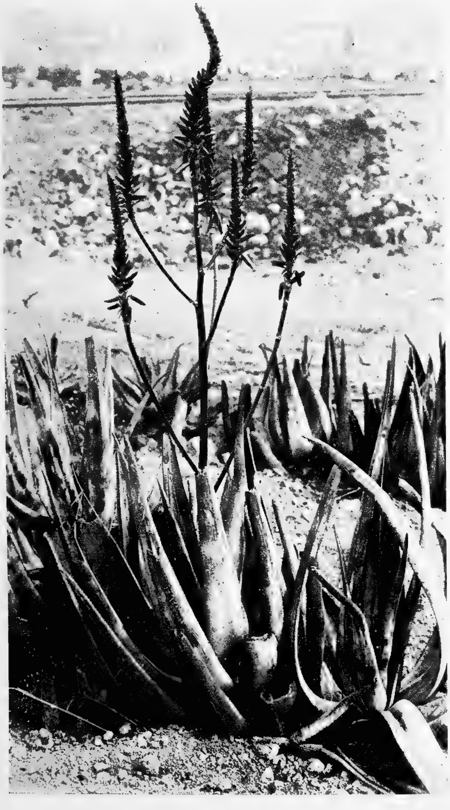


Fig. 1.



I. B. Pole Evans photo. Fig. 2. Fig. 3. West, Newman proc.

Fig. 2.

Fig. 1.

I. B. Pole Evans photo. West, Newman proc.

Fig. 1.

I. B. Pole Evans photo. Fig. 2. West, Newman proc.

Fig. 2.

Fig. 1.

I. B. Pole Evans photo.

West, Newman proc.

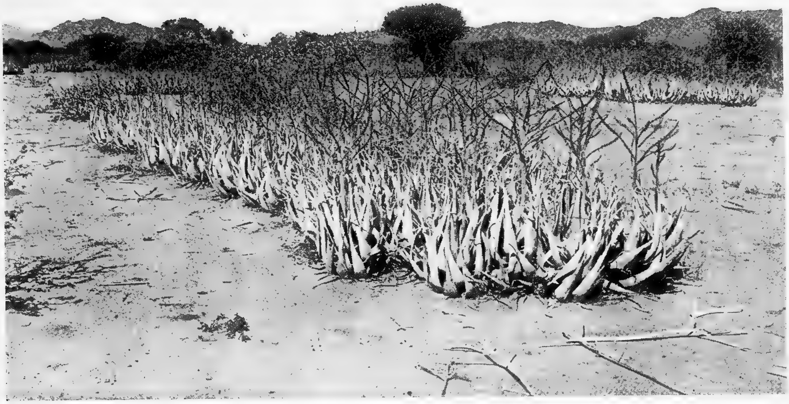


Fig. 1.

I. B. Pole Evans photo.

Fig. 2.

West, Newman proc.

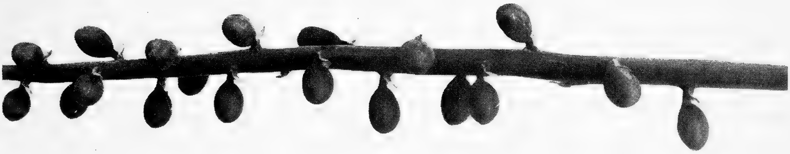


Fig. 1.

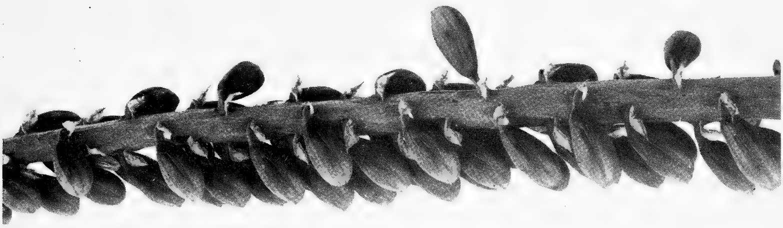


Fig. 2.

I. B. Pole Evans photo. Fig. 3. West, Newman proc.

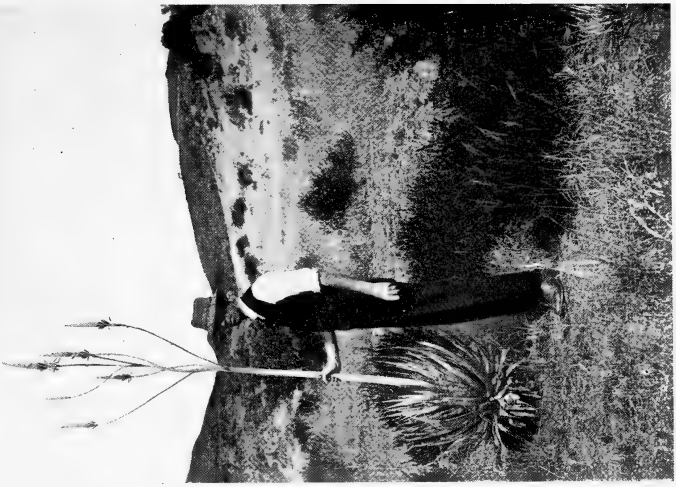


Fig. 2.

Fig. 1.

I. B. Pole Evans photo.

West, Newman proc.

Fig. 3.

Fig. 2.

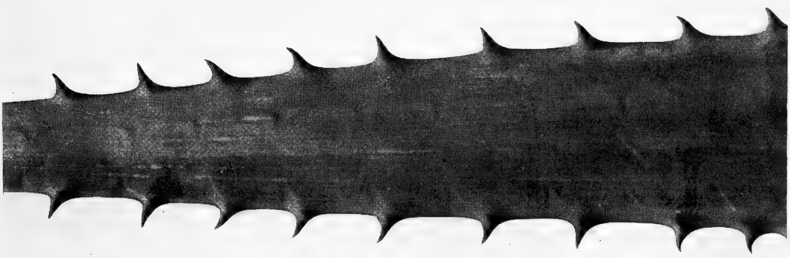


Fig. 1.

I. B. Pole Evans photo. West, Newman proc.

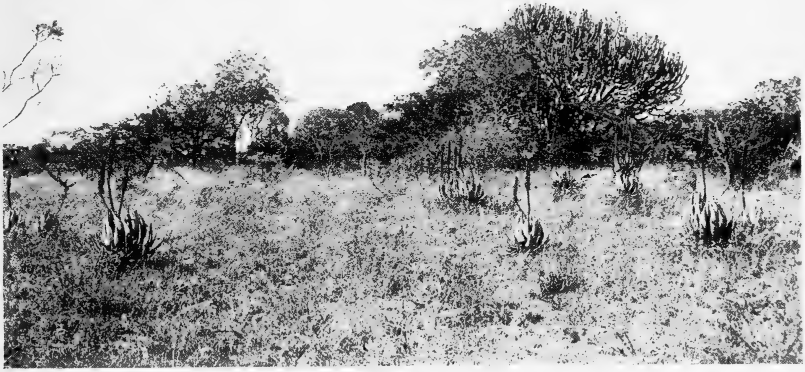
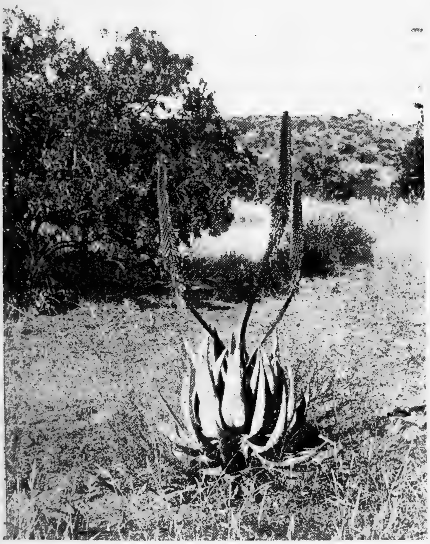
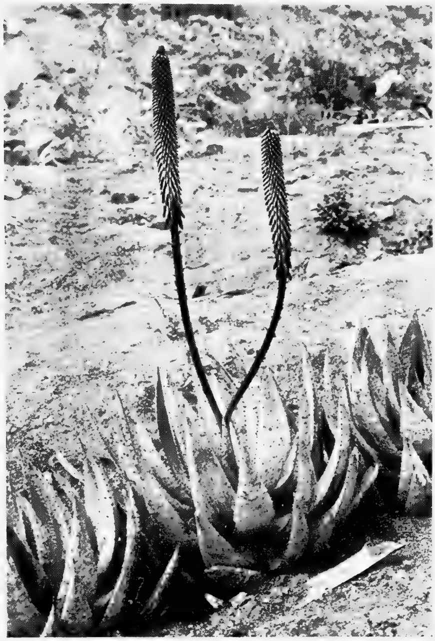


Fig. 1.





I. B. Pole Evans photo. Fig. 2. Fig. 3. West. Newman proc.

Fig 2.

Fig. 1.

I. B. Pole Evans photo. West, Newman proc.

# NOTE ON HESSE'S GENERALIZATION OF PASCAL'S THEOREM.

By Thomas Muir, LL.D.

(Read September 16, 1914.)

1. Having appended an additional column and an additional row, namely,

$$\alpha_1,\alpha_2,\ \ldots,\ \alpha_n,0 \quad \text{and} \quad \beta_1,\beta_2,\ \ldots,\ \beta_n,0$$

to the matrix of the determinant $|u_{1n}|$, Hesse* denoted by $[\alpha, \beta]$ the determinant of the matrix thus resulting; and if the matrix of $[\alpha,\beta]$ were similarly bordered by

$$\gamma_1,\gamma_2,\ \ldots,\ \gamma_n,0,0 \quad \text{and} \quad \delta_1,\delta_2,\ \ldots,\ \delta_n,0,0$$

the determinant of the resulting matrix he denoted by

$$[\alpha\gamma,\beta\delta].$$

With the help of this notation a number of interesting identities were then established, and these he utilized for the purpose of proving an important extension of Pascal's theorem.

2. The last of the identities reached by him was

$$|u_{1n}|\cdot\left\{[\epsilon\zeta]\,[\alpha\gamma,\beta\delta] + [\epsilon,\beta]\,[\alpha\gamma,\delta\zeta] + [\epsilon,\delta]\,[\alpha\gamma,\zeta\beta]\right\}$$

$$= \begin{vmatrix} [\alpha,\beta] & [\alpha,\delta] & [\alpha,\zeta] \\ [\gamma,\beta] & [\gamma,\delta] & [\gamma,\zeta] \\ [\epsilon,\beta] & [\epsilon,\delta] & [\epsilon,\zeta] \end{vmatrix}; \qquad \text{(Z)}$$

and, it being important for him to know whether the cofactor of $|u_{1n}|$ on the left was equal to 0, he satisfied himself that it was so when $n$ is 1, and merely added that the same mode of proof would *not* suffice when $n>1$. Something more definite than this being desirable, the present note takes the matter up at the point where Hesse left it.

* *Abhandl. . . . bayer. Akad. d. Wiss.*, xi. (1872), pp. 177–192.

In order to make a fair start the reader may assure himself of the truth of (Z) by observing that the cofactor of $[\varepsilon,\zeta]$ on the right is

$$\begin{vmatrix} [\alpha,\beta] & [\alpha,\delta] \\ [\gamma,\beta] & [\gamma,\delta] \end{vmatrix} ;$$

that this is a two-line minor of the adjugate of $[\alpha\gamma,\beta\delta]$; that, further, it is that particular minor which corresponds in position with the minor of zero-elements in $[\alpha\gamma,\beta\delta]$: and that therefore by a theorem of Jacobi's it is equal to $[\alpha\gamma,\beta\delta]$ multiplied by the complementary of the said minor of zero-elements, namely, by $|u_{1n}|$: and, finally, that this agrees with what we see on the left.

3. The cofactor of $|u_{1n}|$ in (Z) is readily recognized to be a sum of products of pairs of determinants, the first factor of each product being of the $(n+1)$th order and the second factor of the $(n+2)$th order. This suggests the possibility of the cofactor being representable as a determinant of the $(2n+3)$th order; and without much difficulty such is found to be the case. Thus, taking $n=4$ merely for shortness' sake in writing, and keeping an eye on the first of its three product-terms, namely,

$$[\varepsilon,\zeta] \cdot [\alpha\gamma,\beta\delta],$$

we form a determinant of the 11th order having $[\varepsilon,\zeta]$ for its first five-line coaxial minor and having $[\alpha\gamma,\beta\delta]$ for its last six-line coaxial minor, the only change in form being that the row of $\beta$'s and the row of $\delta$'s in the latter are transferred from the end to the beginning. Turning next to the second product, namely,

$$[\varepsilon,\beta] \cdot [\alpha\gamma,\delta\zeta],$$

we see at a glance that not only it but also $[\varepsilon,\delta] \cdot [\alpha\gamma,\zeta\beta]$ is provided for by merely appending to the five-line coaxial minor a row of $\beta$'s and a row of $\delta$'s, prefixing to the six-line coaxial minor a row of $\zeta$'s, and filling all the remaining vacant places with zeros. The result of this is

$$\begin{vmatrix}
u_1 & u_2 & u_3 & u_4 & \varepsilon_1 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
v_1 & v_2 & v_3 & v_4 & \varepsilon_2 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
w_1 & w_2 & w_3 & w_4 & \varepsilon_3 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
x_1 & x_2 & x_3 & x_4 & \varepsilon_4 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\
\zeta_1 & \zeta_2 & \zeta_3 & \zeta_4 & \cdot & \zeta_1 & \zeta_2 & \zeta_3 & \zeta_4 & \cdot & \cdot \\
\beta_1 & \beta_2 & \beta_3 & \beta_4 & \cdot & \beta_1 & \beta_2 & \beta_3 & \beta_4 & \cdot & \cdot \\
\delta_1 & \delta_2 & \delta_3 & \delta_4 & \cdot & \delta_1 & \delta_2 & \delta_3 & \delta_4 & \cdot & \cdot \\
\cdot & \cdot & \cdot & \cdot & \cdot & u_1 & u_2 & u_3 & u_4 & \alpha_1 & \gamma_1 \\
\cdot & \cdot & \cdot & \cdot & \cdot & v_1 & v_2 & v_3 & v_4 & \alpha_2 & \gamma_2 \\
\cdot & \cdot & \cdot & \cdot & \cdot & w_1 & w_2 & w_3 & w_4 & \alpha_3 & \gamma_3 \\
\cdot & \cdot & \cdot & \cdot & \cdot & x_1 & x_2 & x_3 & x_4 & \alpha_4 & \gamma_4
\end{vmatrix} .$$

By adding the first four rows one by one in order to the last four rows, and then subtracting the 6th, 7th, 8th, 9th columns from the first four columns in similar fashion, this is readily transformed into

$$\begin{vmatrix} u_1 & u_2 & u_3 & u_4 & \varepsilon_1 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ v_1 & v_2 & v_3 & v_4 & \varepsilon_2 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ w_1 & w_2 & w_3 & w_4 & \varepsilon_3 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ x_1 & x_2 & x_3 & x_4 & \varepsilon_4 & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \zeta_1 & \zeta_2 & \zeta_3 & \zeta_4 & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \beta_1 & \beta_2 & \beta_3 & \beta_4 & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \delta_1 & \delta_2 & \delta_3 & \delta_4 & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \varepsilon_1 & u_1 & u_2 & u_3 & u_4 & \alpha_1 & \gamma_1 \\ \cdot & \cdot & \cdot & \cdot & \varepsilon_2 & v_1 & v_2 & v_3 & v_4 & \alpha_2 & \gamma_2 \\ \cdot & \cdot & \cdot & \cdot & \varepsilon_3 & w_1 & w_2 & w_3 & w_4 & \alpha_3 & \gamma_3 \\ \cdot & \cdot & \cdot & \cdot & \varepsilon_4 & x_1 & x_2 & x_3 & x_4 & \alpha_4 & \gamma_4 \end{vmatrix},$$

which is seen to break up into

$$\begin{vmatrix} u_1 & u_2 & u_3 & u_4 \\ v_1 & v_2 & v_3 & v_4 \\ w_1 & w_2 & w_3 & w_4 \\ x_1 & x_2 & x_3 & x_4 \end{vmatrix} \cdot \begin{vmatrix} \cdot & \zeta_1 & \zeta_2 & \zeta_3 & \zeta_4 & \cdot & \cdot \\ \cdot & \beta_1 & \beta_2 & \beta_3 & \beta_4 & \cdot & \cdot \\ \cdot & \delta_1 & \delta_2 & \delta_3 & \delta_4 & \cdot & \cdot \\ \varepsilon_1 & u_1 & u_2 & u_3 & u_4 & \alpha_1 & \gamma_1 \\ \varepsilon_2 & v_1 & v_2 & v_3 & v_4 & \alpha_2 & \gamma_2 \\ \varepsilon_3 & w_1 & w_2 & w_3 & w_4 & \alpha_3 & \gamma_3 \\ \varepsilon_4 & x_1 & x_2 & x_3 & x_4 & \alpha_4 & \gamma_4 \end{vmatrix}.$$

Further, the seven-line determinant here, by having its first column made the last and its 1st, 2nd, 3rd rows the 7th, 5th, 6th respectively is seen to be the bordered determinant which Hesse would have denoted by

$$[\alpha\gamma\varepsilon, \beta\delta\zeta].$$

Our final result thus is

$$[\varepsilon,\zeta]\,.\,[\alpha\gamma,\beta\delta] \;+\; [\varepsilon,\beta]\,.\,[\alpha\gamma,\delta\zeta] \;+\; [\varepsilon,\delta]\,[\alpha\gamma,\zeta\beta] \;=\; |u_{1n}|\,.\,[\alpha\gamma\varepsilon,\beta\delta\zeta] \qquad \text{(I)}$$

4. By transposition of the column of $\varepsilon$'s with the column of $\alpha$'s and the changing of signs throughout, (I) takes the form

$$|u_{1n}|\,.\,[\alpha\gamma\varepsilon,\beta\delta\zeta] \;=\; [\alpha,\beta]\,.\,[\gamma\varepsilon,\delta\zeta] \;+\; [\alpha,\delta]\,.\,[\gamma\varepsilon,\beta\zeta] \;+\; [\alpha,\zeta]\,.\,[\gamma\varepsilon,\beta\delta],$$

and is then seen to be the second of a series of identities of which Hesse gave the first, namely,

$$|u_{1n}|\,.\,[\alpha\gamma,\beta\delta] \;=\; [\alpha,\beta]\,.\,[\gamma,\delta] \;-\; [\alpha,\delta]\,.\,[\gamma,\beta].$$

Further, it should be noted how the dropping of $\epsilon$ and $\zeta$ in the second makes the first a quasi-deduction from it.

Taking an additional column of $\eta$'s and an additional row of $\theta$'s we doubtless would find that

$$|u_{1n}|\cdot[\alpha\gamma\epsilon\eta,\beta\delta\zeta\theta] = \left.\begin{matrix}[\alpha,\beta]\cdot[\gamma\epsilon\eta,\delta\zeta\theta] - [\alpha,\delta]\cdot[\gamma\epsilon\eta,\beta\zeta\theta] \\ + [\alpha,\zeta]\cdot[\gamma\epsilon\eta,\beta\delta\theta] - [\alpha,\theta]\cdot[\gamma\epsilon\eta,\beta\delta\zeta]\end{matrix}\right\}.$$

5. Returning now to Hesse's identity (Z) and using the result of § 3 we obtain

$$|u_{1n}|^2\cdot[\alpha\gamma\epsilon,\beta\delta\zeta] = \begin{vmatrix}[\alpha,\beta] & [\alpha,\delta] & [\alpha,\zeta] \\ [\gamma,\beta] & [\gamma,\delta] & [\gamma,\zeta] \\ [\epsilon,\beta] & [\epsilon,\delta] & [\epsilon,\zeta]\end{vmatrix}. \qquad \text{(II)}$$

This is the second identity of another series, the first of which is

$$|u_{1n}|\cdot[\alpha\gamma,\beta\delta] = \begin{vmatrix}[\alpha,\beta] & [\alpha,\delta] \\ [\gamma,\beta] & [\gamma,\delta]\end{vmatrix},$$

the first identity of both series being in fact the same. The third identity, we may be sure, is

$$|u_{1n}|^3\cdot[\alpha\gamma\epsilon\eta,\beta\delta\zeta\theta] = \begin{vmatrix}[\alpha,\beta] & [\alpha,\delta] & [\alpha,\zeta] & [\alpha,\theta] \\ [\gamma,\beta] & [\gamma,\delta] & [\gamma,\zeta] & [\gamma,\theta] \\ [\epsilon,\beta] & [\epsilon,\delta] & [\epsilon,\zeta] & [\epsilon,\theta] \\ [\eta,\beta] & [\eta,\delta] & [\eta,\zeta] & [\eta,\theta]\end{vmatrix};$$

and by way of verification we note that the expanding of the determinant on the right in terms of the elements of its first row and their complementaries gives

$$\begin{matrix}[\alpha,\beta]\cdot\left|[\gamma,\delta]\ [\epsilon,\zeta]\ [\eta,\theta]\right| - [\alpha,\delta]\cdot\left|[\gamma,\beta]\ [\epsilon,\zeta]\ [\eta,\theta]\right| \\ + [\alpha,\zeta]\cdot\left|[\gamma,\beta]\ [\epsilon,\delta]\ [\eta,\theta]\right| - [\alpha,\theta]\cdot\left|[\gamma,\beta]\ [\epsilon,\delta]\ [\eta,\zeta]\right|,\end{matrix}$$

which by the use of (II) becomes

$$|u_{1n}|^2\cdot\left\{\begin{matrix}[\alpha,\beta]\cdot[\gamma\epsilon\eta,\delta\zeta\theta] - [\alpha,\delta]\cdot[\gamma\epsilon\eta,\beta\zeta\theta] \\ + [\alpha,\zeta]\cdot[\gamma\epsilon\eta,\beta\delta\theta] - [\alpha,\theta]\cdot[\gamma\epsilon\eta,\beta\delta\zeta]\end{matrix}\right\}$$

and thus reproduces the identity at the end of § 4.

6. The four-line determinant

$$\left|[\alpha,\beta]\ [\gamma,\delta]\ [\epsilon,\zeta]\ [\eta,\theta]\right|$$

expanded in the preceding paragraph is manifestly a compound determinant with elements of the $(n+1)$th order, and it is not difficult to see that the said elements are minors of $[\alpha\gamma\epsilon\eta,\beta\delta\zeta\theta]$, which is a determinant of the $(n+4)$th order. Further, a little examination shows that they are the minors in that determinant which are complementary to the principal minors of the array

$$\begin{matrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0. \end{matrix}$$

It is therefore interesting to inquire what would happen if we made the bordered determinant $[\alpha\gamma\epsilon\eta,\beta\delta\zeta\theta]$ a perfectly general determinant, substituting

$$\begin{matrix} u_{1,n+1} & \cdots & u_{1,n+4} \\ \cdots\cdots & \cdots & \cdots\cdots \\ u_{n,n+1} & \cdots & u_{n,n+4} \end{matrix}$$

for the bordering columns, and

$$\begin{matrix} u_{n+1,1} & \cdots & u_{n+1,n+4} \\ \cdots\cdots & \cdots & \cdots\cdots \\ u_{n+4,1} & \cdots & u_{n+4,n+4} \end{matrix}$$

for the bordering rows and the array of zeros. The left-hand side of the identity would then be

$$|u_{1n}|^3 . |u_{11}u_{22} \ldots u_{nn}u_{n+1,n+1} \ldots u_{n+4,n+4}|,$$

and the four-line compound determinant on the right would be

$$\begin{vmatrix} |u_{11} \ldots u_{nn}u_{n+1,n+1}| & \cdots & |u_{11} \ldots u_{nn}u_{n+1,n+4}| \\ \cdots\cdots & \cdots & \cdots\cdots \\ |u_{11} \ldots u_{nn}u_{n+4,n+1}| & \cdots & |u_{11} \ldots u_{nn}u_{n+4,n+4}| \end{vmatrix}.$$

On inspection of these we readily perceive not only that the identity still holds, but that it may be viewed as simply an "extensional" of the truism

$$|u_{n+1,n+1} \ldots u_{n+4,n+4}| = \begin{vmatrix} u_{n+1,n+1} & \cdots & u_{n+1,n+4} \\ \cdots\cdots & \cdots & \cdots\cdots \\ u_{n+4,n+1} & \cdots & u_{n+4,n+4} \end{vmatrix}.$$

The same "extensional" will be found arrived at by a different path in 1881 on page 4 of vol. xxx. of the *Transac. R. Soc. Edinburgh.*

CAPETOWN, S.A.
*August* 25, 1915.

# ON THE SPACE-LATTICE OF LIQUID CRYSTALS.

BY J. STEPH. VAN DER LINGEN.

## INTRODUCTION.

During the past two years numerous experiments have shown that solid crystals cause interference phenomenon when Röntgen rays are passed through them, and that the positions of maximum interference in the pattern depend upon the direction of transmission of the rays through the crystals, that is, they are dependent on the space-lattices of the crystals.*

Liquid crystals, according to O. Lehmann, only have space-lattices when they are polyhedral in form, similar to solid polyhedral crystals, and when thin layers of the crystalline solution are placed between similar crystalline plates, each of which must have the same orientating effect on the molecules of the solution.

In the second case the structure of the space-lattice is not necessarily the same as in the first case. If these solutions are placed between amorphous plates (glass plates) or dissimilar crystalline plates, then the effect of these plates on the molecules causes the solution to become pseudo-isotropic. In this case only the principal axis of the molecules lies in a fixed direction; the secondary axes lie in all directions.

The principal axis is the axis round which the molecules are most easily rotated. According to O. Lehmann, it is perpendicular to the plane of the molecules, which are in all probability disc-shaped.

When ordinary light is transmitted through such a pseudo-isotropic liquid crystalline layer, then it causes the same optical effects as a uniaxial crystal cut perpendicular to its optic axis.

The question now arises, "Do changes in the molecules themselves cause the different forms of crystals of the same substance, or do aggregations of a different order of the same unchangeable molecules cause the

* W. Friedrich, P. Knipping, and M. Laue, Münch. Sitzber., 1912, p. 303; M. Laue and F. Tank, Ann. d. Phys. (4), 41, 1003, 1913; W. H. and W. L. Bragg, Proc. Cambridge Phil. Soc., 17, 43, 1913; T. Terada, Tôkyô Math. Phys. Soc., 7, 60, 1913.

different forms?" Are chemical and physical properties dependent on the aggregation of molecules in a substance, or are they dependent upon a change in the structure of the molecule itself?

The conceptions of O. Lehmann, which he explained fully in numerous works,* are in direct contradiction to the theory that molecules do not change their structures whether the substance be gaseous, solid, anisotropic, or amorphous, so much so that W. Nernst denies the existence of liquid crystals.†

This theory of the "identity" of molecules, which is based on Avogadro's law, is forced to accept that any change in the space-lattice of a crystal must cause a change in the properties of the crystal such as melting-point, solubility, and vapour pressure. As these changes are not brought about by a plastic deformation of crystals it must be accepted, on this theory, that no change has taken place in the space-lattice of the crystals whether they are solid or liquid crystals.‡ Consequently the pseudo-isotropic structures of liquid crystals cannot exist.

The pseudo-isotropic layers, which are obtained when the solutions are placed between glass plates, and which may be retained by the influence of a magnetic field,§ when no other force affects the molecules, must have a space-lattice.

D. Vorländer believed that this had been definitely proved by his experiments when he had examined such layers in convergent light.|| His results, however, are also in accordance with Lehmann's theory of liquid crystals.

The object of my experiments was to determine whether these pseudo-isotropic solutions of crystalline substances have a space-lattice or not. If there be a space-lattice then they must cause interference phenomenon when Röntgen rays are passed through them.

In order to find such an effect substances whose molecules could be influenced by a magnetic field were used.

In this case, according to Lehmann, only the principal axis of the molecules has a fixed direction, viz. parallel to the lines of force, and the subordinate axes may lie in any direction, hence the theory of Röntgen-ray interference phenomenon cannot predict any definite pattern, except that the points on the pattern must trace out symmetrical conic sections. This will be the case if there is a space-lattice, according to Vorländer.

* See O. Lehmann, Die neue Welt der flüssigen Kristalle, Leipzig, 1911. For a full list see "Verzeichuis sämtlicher Veröffentlichungen var Dr. Otto Lehmann," Fr. Vieweg und Sohn, Braunschweig.

† W. Nernst, Theoretischen Chemie, 7th Edition, 1913, p. 666.

‡ Compare G. Tammann, Zeitsch. f. Electrochem., 1912, p. 587.

§ O. Lehmann, Phys. Zeitsch., 13, 550, 1912.

|| D. Vorländer, Zeitsch. f. phys. Chem., 61, 166, 1907; D. Vorländer and H. Hanswaldt, Acta nova, Halle, 90, 1909.

### The Apparatus.

In order to heat the substance to a fixed temperature a pair of copper spirals were constructed out of two copper cylinders and four copper cylinders.

As these substances had to be placed in a magnetic field equal lengths of copper wire were wound round the coils, so that the current passed in opposite directions round them. This avoided the turning moment of the magnetic field on the spirals (Fig. 1).

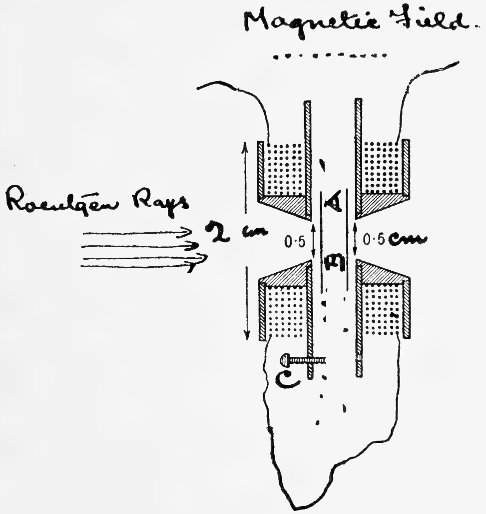



Fig. 1.

BA. The layer of liquid crystals between the glass plates. ½ mm. thick.
C. Clamping screw.

Between these spirals the substance experimented on is enclosed between two thin glass plates, which are kept in position by means of three screws which clamp the spirals together.

The temperature of the substance between the glass plates was determined by means of a sensitive thermocouple, whose junction just touched the glass plates.

The object of the thermocouple is more to keep the temperature constant than to measure its actual value.

In order to pass a beam of Röntgen rays through this layer of crystalline solution a cylinder similar to that used by Friedrich and Knipping was used. The openings in the diaphragms were 5 and 3 cm. respectively. This cylinder was placed in front of the crystalline solution, and two photographic films (at a distance of 3·5 cm.) behind it. This is to avoid "faults" and spots of the films in case they are not perfect.

The spirals were clamped between the pole pieces of a Max Kohl electromagnet, after some wadding had been glued on the conical pole pieces in order to avoid heating them.

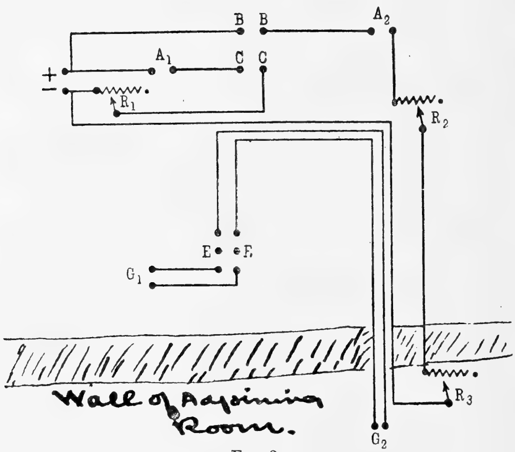



Fig. 2.

$A_1$ and $A_2$. Ampmeters.
$G_1$ and $G_2$. Galvanometers.
$R_1$, $R_2$, and $R_3$. Variable resistances.
BB. Terminals of heating coils.
CC. Terminals of electromagnets.
EE. Terminals of thermocouple.

A good microscope with Nicols was fixed on to a brass holder, which rested on the coils of the electromagnet.

When the microscope with its holder is placed over the magnet, then the pole pieces were between the objective and the object table; thus the solution between the spirals could be examined without any trouble.

During the time of exposure the microscope is removed and the whole of the apparatus covered in between sheets of lead so that only radiations which had passed through the solution could reach the films.

The electrical connections were according to Fig. 2. The galvanometer $G_2$ and resistance $R_3$ were placed in an adjoining room in order to protect the experimenter from the rays, and yet enable him to regulate the temperature of the solution.

## Method of Experiment.

The field strengths of the electromagnets, when the spirals are between the poles, was determined by means of a standard Bismuth spiral. These were recorded for various readings of $A_I$.

Next the deflections of $G_I$ and $G_2$ were recorded for various temperatures after the thermocouple had been standardized.

A rubber ring of 1 cm. diameter was cut at a point and then placed on a clean glass plate-object; cover slides 0·17 mm. thick and 18 mm. square were used. A small quantity of the substance is then carefully powdered and placed inside the ring, and covered with a similar glass plate. The whole is then carefully placed between the spirals so that the cut in the ring is uppermost. The junction of the thermocouple is then placed in position. The spirals are then placed between the pole pieces of the electromagnet and clamped in position. The microscope is focused on the substance. The substance is then heated by passing a current through the coils of the spiral. On melting air-bubbles are expelled through the opening in the rubber ring by gently screwing and unscrewing the spirals.

Observations on a layer of ½ mm. thick of Paraazoxyanisol gave the following results :—

This substance, which was not chemically pure, became amorphous at 124°. The magnetic field has no visible influence on it. At 122° crystalline drops commence to appear. These flow together, and soon fill the whole field of vision with a crystalline solution. When the magnetic field is put on the axes of these spherical liquid crystals all turn in one direction, so that they become parallel to a fixed direction. The crystalline solution, when the magnetic field is off, appears like a network of dark stripes which move about. When the magnetic field is put on they disappear rapidly. The solution then appears to have the same effects optically as a crystal cut perpendicular to its axis. This can be seen by means of the Nicols which are in front of and behind this crystalline layer.

At 118° the stripes become broader and shaded at their sides; these vanish rapidly when a field of 3,000 Gauss is put on.

At 104° the stripes only disappear slowly in a field of 5,000 Gauss.

At 92° the substance begins to solidify. The magnetic then has only a partial effect on the substance. It appears as if the crystals are then plastic. The edges only show a slight change in colour when a strong magnetic field is put on.

At 90° the substance is solidified: the magnetic field has no influence on it. These observations were made during the gradual cooling of the substance.

Similar observations were made on the rotation of the axis of spherical crystals and crystalline solutions of Paraazoxyphenetol with a trace of olive oil; on Anisaldazin with olive oil and piperin; and also on Paraazoxyanisol with olive oil. The results agree with those obtained by O. Lehmann.*

## Röntgen Rays and Liquid Crystals.

Paraazoxyanisol was heated until it became amorphous. It was then allowed to cool gradually in a magnetic field of 5,000 Gauss.

The object of this was to see whether the principal axes remained parallel to the magnetic field, or whether they changed during the process of solidification. If they remain fixed then the interference pattern must show radial lines on the films.

After an exposure of four hours one film was removed and developed. It clearly showed interference phenomenon but no symmetry at all. The pattern obtained is similar to those of Hupka † in his experiments on microcrystalline substances.

The second film was developed after an exposure of eight hours, and also showed the same unsymmetrical interference points on the film.

From these results we conclude that the axes did not remain fixed when the substance was allowed to solidify in this magnetic field. This could also be seen on microscopic examination of the layers.

Secondly, we see that such layers do cause interference phenomenon which is not absorbed by the glass plates.

The same layer was then heated up to 118° in a magnetic field of 5,000 Gauss, and carefully observed for half an hour by means of the microscope. The temperature was kept constant by observing the deflection of $G_1$, which was kept constant by regulating the current through the spirals by means of $R_2$.

As no change was observed the microscope was removed, the cylinder with diaphragms placed in front of the solution, two films behind the solution, and the whole covered in with lead sheets. $G_2$ was switched and the temperature regulated by $R_3$.

After an exposure of eight hours the first film was developed. It showed no trace of interference phenomenon. Only dispersion of the rays could be observed, viz. an enlargement of the central spot which is due to direct transmission of the rays.

* O. Lehmann, Phys. Zeitsch., 13, 550, 1912.
† E. Hupka, Phys. Zeitsch., 14, 623, 1913, fig. 3.

The second film was developed after an exposure of sixteen hours. It also showed no trace of interference phenomenon. Only an increase in the dispersion—which is probably not due to the solution—could be observed.

In an experiment with Paraazoxyphenetol and a trace of olive oil no interference pattern was obtained after an exposure of twenty hours. On examining the solution microscopically the oil could be seen collected in small globules on the glass plates. On switching the magnetic field off the stripes reappeared between these globules.

These experiments show that crystalline solutions of Paraazoxyanisol and Paraazoxyphenetol with olive oil have no space-lattice.

In connection with this work I wish to express my sincere thanks to Professor Max von Laue, Institut international de physique Solvay, and to the Kgl. Preussischen Akademie der Wissenschaften for their aid in carrying out this work.

# NOTE ON THE MOLECULES OF LIQUID CRYSTALS.

By J. Steph. van der Lingen.

In an earlier communication it was shown that pseudo-isotropic layers of certain liquid crystalline substances have no space-lattice in spite of the fact that such layers showed the same optical properties as uniaxial crystals cut perpendicular to their optic axis. When the substance is placed between glass plates then the arrangement of the molecules is probably as indicated as in Fig. 1*a* where the layer is not thin. That is, only the molecules near the surfaces of the glass are parallel to the glass; those farther off are not affected by the glass plates. In Fig. 1*b* all the molecules are parallel to the glass plates. In this case all the principal axes of the molecules are perpendicular to the plates. Such layers behave (optically) like uniaxial crystals cut perpendicular to the optic axis.

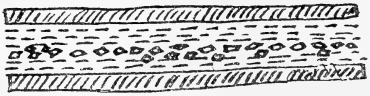


Fig. 1*a*.

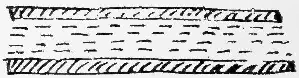


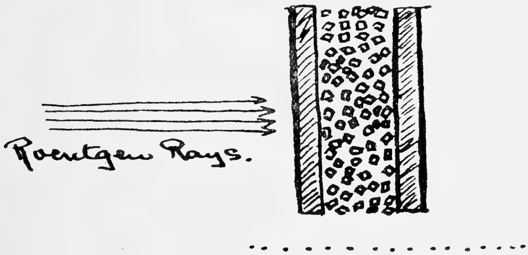
Fig. 1*b*.

If a thin layer be placed in a magnetic field, then the molecules near the surface of the plates will not be completely orientated on account of the influence of the glass plates, which is at right angles to the magnetic force. In thicker layers the majority of the molecules will be perfectly orientated by magnetic fields : the unorientated portion being negligible in comparison with the orientated portion.

In strong magnetic fields the planes of the molecules are perpendicular to the lines of force, hence in the experiments on pseudo-isotropic layers the rays passed perpendicularly to the optic, *i.e.* magnetic, axis of the molecules. (See Fig. 2.)

If the molecules themselves are crystals then photogram of their space-lattice cannot be obtained in this way on account of the fact that there is always a possible translation of the molecules, and more especially because only one axis remains in a fixed direction. Under such conditions the dispersion will be equal in all directions.*

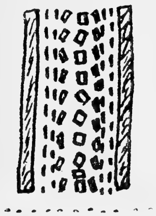
In a series of later experiments the same substance (paraazoxyanisol) was placed between two pieces of thin mica. The object of these experiments was to find whether the molecules of the liquid substance




Magnetic Field.

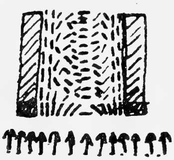
FIG. 2.

will assume a space-lattice under the influence of the neighbouring molecules of mica. Observations on the substance in a magnetic field showed that the orientating power of the mica sheets is much greater than of glass plates. A much greater magnetic field is required to



Magnetic Field.

FIG. 3*a*.—Vertical Section.



Magnetic Field.

FIG. 3*b*.—Horizontal Section.

orientate the molecules. The available field of 6,000 gauss does not cause complete orientation, whereas 3,000 gauss cause an apparently complete orientation when the substance is placed between glass plates. On using thicker layers the substance shows that there is a magnetic

* If we assume that $\Sigma I\omega$ round the magnetic axis is zero where I and $\omega$ is not zero.

rotation within the mass, but that those molecules, which are near the surface resist a rotation most forcibly. This is represented in Figs. 3*a* and 3*b*.

Similar experiments were made on the effects of celluloid. Its effects are not so well marked as that of mica.

When the celluloid becomes plastic it seems to have an effect opposite to that of glass. The optic axis of the molecules is rotated in the same way as a weak magnetic force would act on it. The central part of the layer seems amorphous.

These experiments show that different substances have different influences on the neighbouring molecules of liquid crystals.

# A MESOSTOMA FROM BLOEMFONTEIN (*M. KARROOENSE*, n. sp.).

By T. F. Dreyer, B.A., Ph.D.

(Read September 16, 1914.)

About a dozen specimens were collected in a small temporary pond on clay soil on the hill behind the Grey University College. The pond is always contaminated with cattle droppings.

As long as the pond contains water it is regularly visited every week, but although this has been done for the last two years, the worms have only been found once—in May, 1914. They were all more or less congregated together in one part of the pond, and were all actively producing spermatozoa; a few had no eggs in the uteri, but most had from one to four reddish-brown "winter-eggs" in each uterus.

The worms measured (preserved in $HgCl_2$): Length up to 10 mm.; breadth 4·5 mm. A typical specimen was 9·5 long by 4 broad, with the genital aperture 4·5 from the anterior end (6, Fig. 1) and 5 from the posterior end; with the mouth (5) 2 mm. anterior to the genital aperture.

The outline of the preserved specimen is shown in Fig. 1; the anterior end is squarish on account of the sucker (4 in A—A, Fig. 1) being retracted. On the dorsal surface in the anterior region there are two sharply defined ridges (1, Fig. 1). Laterally the body is expanded into two flaps which tend to curl upwards, especially in the posterior region.

The pharynx is of the type called *rosulatus;* the excretory system resembles closely that of *M. ehrenbergii*, except that the "oral" cup is not well defined; there are two eyes with black pigment which, in sections, is seen to be prolonged into the mesenchym as fine strands; the colour is dirty yellowish white with the region of the gut dirty brown owing to the secretions of the vitellaria and of the endoderm cells; the ectoderm is densely packed with rhabdites; the cerebral ganglion is produced backwards into a pair of ventral and a pair of lateral nerve chords; there is no otocyst.

The reproductive system, which is of prime importance for the classification, is described in greater detail.

The testes lie in the lateral flaps (3, Fig. 1), thus laterally to the vitellaria. In whole mounts it can easily be observed that each testis is divided into a pre-pharyngeal and a post-pharyngeal portion, thus resembling *Mesostoma lingua;* but a reconstruction of serial sections shows that each of these two testicular portions is again subdivided irregularly; Fig. 2 shows the pre-pharyngeal portion of the left testis with the vasa efferentia marked $x$. The vasa efferentia of each side join a longitudinal vas deferens, which, near the opening of the vitelline ducts

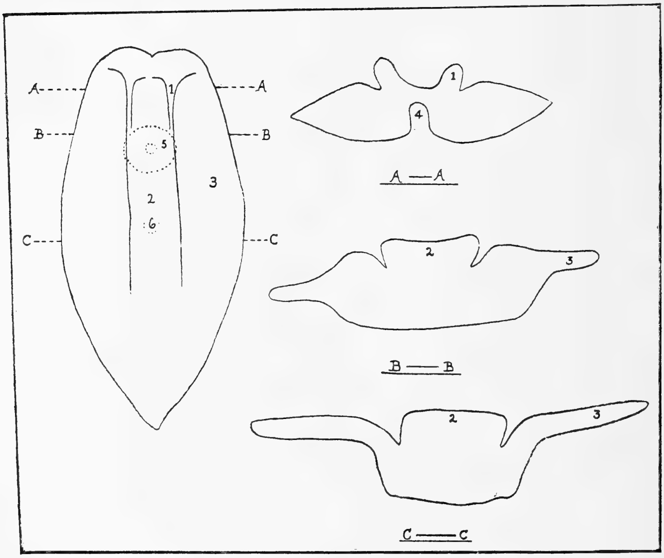



Fig. 1.—Outline of body seen from dorsal surface with three sections through AA, BB, and CC. 1 = dorsal ridge; 2 = median portion of body, around gut; 3 = lateral flaps; 4 = sucker; 5 = pharynx and mouth; 6 = genital aperture.

(12, Fig. 3), is connected to a vessel running forwards and meeting a similar vessel just before opening into the vesicula seminalis; there is therefore no seminal duct, the two vasa deferentia only combining just as they enter the vesicula. The vesicula opens into the "granular" vesicle (3, Fig. 3), which contains the "granular" glands in it, the lumen for the passage of the seminal fluid being restricted to a narrow tube on the inner side. In the figure the penis is shown retracted within its sheath, so that the cuticular valve-like point (6) of the penis seems to lie within the penis; 5 is the cavity of the penis sheath.

The single ovary (7) lies on the side just above the end of the uterus; the oviduct has two muscular portions (8 and 9), to which I shall return later, and an enormous receptaculum seminis (10) filled with spermatozoa. The hinder portion of the receptaculum is embedded in the ventral part of the post-pharyngeal gut. The vitellaria lie dorsal to the whole of the gut and are in the form of two sets of anastomosing tubes; from each of these a number of minute ducts open into the two lateral vitelline ducts which

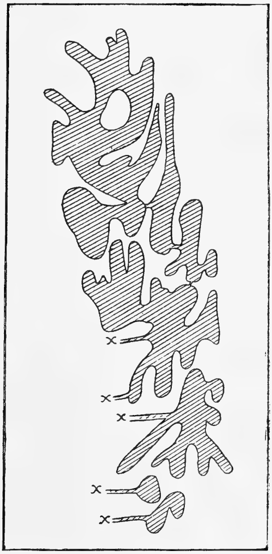



Fig. 2.—Reconstruction of the pre-pharyngeal portion of the left testis. $x$=vasa efferentia.

lie close to the lateral vasa deferentia, and which open into the oviduct at 12, Fig. 3. The common duct (14) receives accessory female ducts (13); these lie in two groups ventral to the ductus communis and open by a pair of ducts, but some of the oligo-cellular glands also open independently into the ductus communis. Further forwards the duct enlarges to form a vagina (15), which has a thick sheath of circular muscles and thinner outer sheath of longitudinal fibres; the vagina in both the specimens cut serially contains a ball of spermatozoa. There are two uteri (22) which open posteriorly into the atrium (18); the uterine ducts are glandular and the secretion is poured into the uteri. In one of the two cut specimens there is a distinct dorsal outgrowth (19) from the atrium; it is in the position of the bursa copulatrix of other species, but in the present species it is lined by the same tall glandular cells which line the rest of the

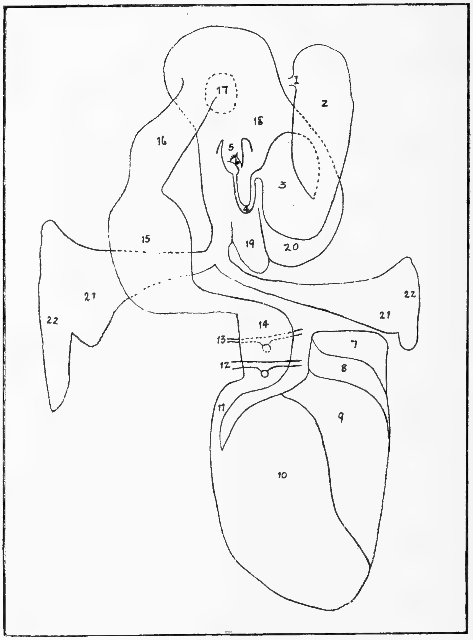



Fig. 3.—Reconstruction of the genitalia. 1 = opening of the two vasa deferentia; 2 = vesicula; 3 = "granular" vesicle; 4 = ductus ejaculatorius; 5 = cavity of penis-sheath; 6 = chitinous end of penis; 7 = ovarium; 8 and 9 = muscular part of oviduct; 10 = receptaculum; 11 = oviduct; 12 = vitelline ducts; 13 = accessory female glands; 14 = ductus communis; 15 = vagina; 17 = common genital aperture; 18 = atrium; 19 = vestigeal bursa (?); 20 = atrium, in which lies the base of the penis; 21 = uterine glands; 22 = uteri.

atrium, and it moreover has no muscle fibres surrounding it; also there is a vagina; so the outgrowth (19) is clearly not a functional bursa, although it may possibly represent a vestigeal bursa.

In the above there are several points worth noting.

Firstly, although the whole organization of the animal indicates a close relationship with *Mesostoma lingua*, it possesses a vagina, the absence of which is one of the diagnostic features of the family Typhloplanidae; and in connection with the presence of a vagina goes the absence of the bursa, which is typically present in the genus *Mesostoma*. The points of resemblance between the present animal and other *M.* spp. are, however, so numerous that it would be folly to establish a new family to receive it; the only correct course is to drop "vagina absent" from the diagnostic characters of the Typhloplanidae in future.

Secondly, although the structure (7) is that of a typical ovarium, and has the position of that organ as it is in other *M.* spp. (e.g. *M. productum*), I have failed to find the oviducal lumen through the muscular portions (8 and 9). The portions marked 8 and 9 are round tubes with muscle fibres, arranged from right to left, completely blocking their lumina. Also, the secretion of the uterine glands (21) is suspiciously like that found in the eggs, so that I am half inclined to believe that, although the "*vitellaria*" described above have the histological structure of such organs as described for other *Planaria* (Schneider, "Lehrbuch der Histologie"), they may be germaria, perhaps even ovaria; the body (7) would then be a gland of unknown function. Anyway, the reproductive organs of *Rhabdocoelida*, as also of the present species, need "intra-vitam" study before we can be clear as to the part which the numerous kinds of glands play in reproduction.

In conclusion, I may mention that two other Typhoplanidae have been recorded from Africa (according to von Graff in "Das Tierreich": Turbellaria II. Rhabdocoelida, 1913):—

1. P. 461, *Mesopharynx otophora* (Schmarda), from Stellenbosch.
2. P. 292, *Mesostoma lacteum* (Neppi), from fresh water near Gara Mulata, Ost Afrika.

# *HERPETOMONIDAE* FOUND IN *SCATOPHAGA HOTTENTOTA* AND *CHAMAELEON PUMILUS.*

By H. Bayon.

(Read September 16, 1914.)

In December, 1912, I noticed numerous flagellate micro-organisms in a smear taken from the hind-gut of a specimen of *Scatophaga hottentota* caught on Robben Island. The slide was dried, fixed in absolute alcohol and stained with Eosine-azur. The flagellates were then seen to belong to the genus *Herpetomonas.* They presented the usual elongated shape, with a flagellum attached to the protozoon by a short, intra-cellular portion. The short, rod-like kinetonucleus was usually found half-way between the trophonucleus and the flagellar ("anterior") end of the parasite. The kinetonucleus was separated from the flagellum by an interval of about 2 $\mu$. No undulating membrane could be detected.

Biflagellate forms (Prowazeks *Herpetomonas* type) were also observed, apparently as a stage of commencing division. Moreover single, non-flagellate, rounded individuals, with a trophonucleus and kinetonucleus (blepharoplast), in addition to all the morphologically intermediate conditions between the latter and the usual elongated, flagellate *Herpetomonas;* such transitory forms corresponding to the three stages described by Patton as preflagellate, flagellate, and post-flagellate.

The length of the body of the flagellate stages varies between 25 and 45 $\mu$. The width is not usually less than 2 or more than 5 $\mu$. In specimens which were fixed in a straight line the flagellum could be seen to be about one and a half times the length of the body proper.

Rounded, non-flagellate stages varied from 5 to 8 $\mu$ in diameter. The size of the trophonucleus was relatively constant in all specimens observed, irrespective of their stage and can be stated to correspond to 4 $\mu$.

All measurements were taken on the fixed and stained slide. This protozoon corresponds in type to the genus *Herpetomonas* (Leptomonas) especially the species *H. muscae domesticae* Burnett. Its host in this case is the common "blind-fly" on Robben Island.

A year later, in December, 1913, I found in the cloaca of a *Chamaeleon pumilus*,* also on Robben Island, numerous flagellate parasites belonging to the same genus, and possibly of an identical or allied species. Several smears were taken, fixed for ten seconds in Osmic acid fumes, then thirty minutes in absolute alcohol and stained according to Giemsa.

These specimens appear to be broader, blunter, and somewhat shorter than the *Herpetomonas* found in *Scatophaga hottentota*. The trophonucleus stains a clear, light purple hue, the kinetonucleus is sharply defined as a compact, short rod, generally placed transversely to the length of the protozoon. Its position is generally half-way between trophonucleus and the flagellar end. In some instances, especially in pear-shaped stumpy flagellate forms, the kinetonucleus has moved up so as to separate from the trophonucleus only by a space not superior to 3 $\mu$. In single specimens the kinetonucleus appears to be slightly curved with its concavity facing the flagellum and a faint, vacuole-like clear space can be detected between this structure and the basal granule of the flagellum. Some of the flagella appear, moreover, to be covered by a sheath or slight membrane which encloses them to the point where they enter the cytoplasm.

Dividing and biflagellar forms are not rare in the specimens examined. Multiplication takes place by binary fission of the long flagellate stages. When the process of fission is very active, the resulting flagellates are long and very thin, so that in an unfixed specimen they dart about in the fluid like spirilla; the nucleus appears also to be reduced in size and is hardly distinguishable.

Development of non-flagellate rounded forms appears to take place by the production of a thin, short flagellum, which increases in length and thickness, whilst the body of the protozoon gets longer and thinner, the kinetonucleus moving towards the flagellar end in the process, till it reaches its usual midway position.

Though in single instances rounded forms were noticed which appeared to be devoid of a blepharoplast, still no *Leishmania*-like stages could be detected in the cells of the epithelial lining of the cloaca. Smears from the liver and spleen also gave a negative result from this point of view.

Measurements: Length of flagellate bodies, 25 to 75 $\mu$; breadth, 2 to 10 $\mu$; diameter of trophonucleus, 2·5 to 4 $\mu$.

Though slight differences in size and appearance are noticeable in these *Herpetomonads* from different sources, still they certainly are not more marked than those found in samples taken from the same artificial culture of *Leishmania* at a few days' interval, therefore it does not seem advisable at the present stage of our knowledge to postulate two distinct species of protozoa. It does not seem excluded that a chamaeleon can

* Kindly identified by Dr. Péringuey, of the South African Museum, Capetown.

get infected through swallowing a fly containing *Herpetomonidae* in its gut. It is usually admitted that flies infect each other by the contaminative or "casual" method, *i.e.* by ingesting faeces containing encysted protozoa of the *Herpetomonas* group. The same is considered to hold good for similar parasites found in fleas and lice.

*Herpetomonidae* have so far only been known to occur as harmless parasites in arthropods, and as pathogenic micro-organisms in mammals. Therefore the presence of these protozoa in *Chamaeleon pumilus* deserves some attention, for it may yet prove to be a biological transitional stage or condition. Cultural tests and animal experiments appear to show that the *Leishmania* bodies found in human beings suffering from kala-azar and Oriental sore and also in naturally infected dogs in Mediterranean countries are but resting stages or encysted forms of *Herpetomonidae*.

In the present instance we may have been able to observe a more or less permanent stage in the cycle of evolution from the saprozoic existence in arthropods such as the fly and true parasitism in a warm-blooded animal, by adaptation to an apparently harmless residence in the cloaca of a cold-blooded vertebrate.

# TRANSACTIONS,

OF THE

# South African Philosophical Society.

---

The following volumes have been published:—

| VOL. | | PUB. | s. | d. |
|---|---|---|---|---|
| | Part 1 | 1878 | | |
| | Part 2 | 1879 | 2 | 6 |
| | Part 3 | 1880 | 2 | 6 |
| | Part 1 | 1881 | 5 | 0 |
| | Part 2 | 1881 | 2 | 6 |
| | Part 3 | 1882 | 2 | 6 |
| | Part 1 | 1884 | 2 | 6 |
| | Part 2 | 1885 | 10 | 0 |
| | Part 1 | 1887 | 2 | 6 |
| | Part 2 | 1888 | | |
| | Part 1 | 1889 | | |
| | Part 2 | 1893 | 2 | 6 |
| | Part 1 | 1890 | 2 | 6 |
| | Part 2 | 1892 | 2 | 6 |
| | Part 1 | 1893 | 10 | 0 |
| | Part 2 | 1896 | 20 | 0 |
| | Part 1 | 1893 | 2 | 6 |
| | Part 2 | 1896 | 5 | 0 |
| | Part 1 | 1897 | 5 | 0 |
| | Part 2 | 1898 | 7 | 6 |
| | Part 1 | 1897 | 13 | 0 |
| | Part 2 | 1898 | 7 | 6 |
| | Part 3 | 1899 | 7 | 6 |
| | Part 1 | 1900 | 12 | 6 |
| | Part 2 | 1900 | 12 | 6 |
| | Part 3 | 1901 | 7 | 6 |
| | Part 4 | 1902 | 12 | 6 |

| VOL. | | PUB. | s. | d. |
|---|---|---|---|---|
| XII.— | (Pp. 1–560) | 1901 | 25 | 0 |
| | (Pp. 561–896) | 1902 | 14 | 0 |
| | (Pp. 897–920) | 1903 | 2 | 0 |
| XIII.— | (Pp. 1–288) | 1904 | 12 | 6 |
| | (Pp. 289–546) | 1907 | 8 | 6 |
| | (Pp. 547–752) | 1908 | 10 | 0 |
| XIV.— | Part 1 | 1903 | 5 | 6 |
| | Part 2 | 1903 | 8 | 6 |
| | Part 3 | 1903 | 11 | 0 |
| | Part 4 | 1903 | 3 | 0 |
| | Part 5 | 1904 | 8 | 0 |
| XV.— | Part 1 | 1904 | 8 | 6 |
| | Part 2 | 1904 | 3 | 6 |
| | Part 3 | 1904 | 17 | 0 |
| | Part 4 | 1905 | 7 | 6 |
| | Part 5 | 1905 | 12 | 6 |
| XVI.— | Part 1 | 1905 | 10 | 0 |
| | Part 2 | 1905 | 10 | 6 |
| | Part 3 | 1906 | 5 | 0 |
| | Part 4 | 1906 | 15 | 0 |
| | Part 5 | 1907 | 3 | 6 |
| XVII.— | Part 1 | 1907 | | |
| | Part 2 | 1908 | | |
| XVIII.— | Part 1 | 1907 | 9 | 0 |
| | Part 2 | 1908 | 12 | 0 |
| | Part 3 | 1907 | 4 | 6 |
| | Part 4 | 1909 | 7 | 0 |

Copies may be obtained from the Honorary Secretary of the Royal Society of South Africa; or from Messrs. Wm. Wesley & Son, 28, Essex Street, Strand, London.

*Members of the Society may obtain the publications, from the Hon. Secretary only, at half of the above prices.*

Part 1 of vol. I., Part 2 of vol. IV., Part 1 of vol. V., and vol. XVII. are out of print.

TRANSACTIONS

ROYAL SOCIETY OF [illegible]

[illegible]

# TRANSACTIONS

OF THE

# [illegible] SOCIETY OF SOUTH AFRICA.

VOLUME V.—PART 2.

1915.

CAPE TOWN:

PUBLISHED BY THE SOCIETY.

1915.

(Price [illegible].)

# CONTENTS.

# THE *COCCIDAE* OF SOUTH AFRICA.—I.

By Chas. K. Brain, M.Sc. (Birm.), M.A.
*Division of Entomology, Pretoria, South Africa.*

## CONTENTS.

## INTRODUCTION.

*Material and Acknowledgments.*—The material studied for this work is contained in the Coccid Collection of the Division of Entomology of the Union of South Africa. It comprises a large number of exceedingly interesting specimens, many of which were collected by Chas. P. Lounsbury and Claude Fuller when Government Entomologists of Cape Colony and Natal respectively. In addition there are many other specimens which have been collected by nursery or port inspectors or by other members of the staff.

A few Rhodesian specimens are also included. Rupert W. Jack, Government Entomologist of Southern Rhodesia, has kindly promised to send others, and the descriptions of these, together with Mr. Jack's notes on the species, will be included in this paper.

I am particularly indebted to the Chief of the Division, Chas. P. Lounsbury, for the privilege and opportunity of working over the collection and for numerous valuable records made during the past eighteen years.

To Claude Fuller, Assistant Chief of the Division, I tender my thanks for most able and willing assistance in a multitude of ways.

The Entomologist of the Cape Province, Chas. W. Mally, has taken a great interest in the work, and has supplied a large amount of useful material, collected either by himself or by his assistant, C. P. van der Merwe.

Albert Kelly, who has charge of the nursery inspection work in the Union, has submitted a large number of interesting specimens, and I am especially indebted to him for his most valuable records of host-plants.

The other members of the staff have also given willing assistance. As the collector's name is given with each species I must ask them to accept this reference as the grateful acknowledgment of my appreciation.

*An Explanation.*—The literature dealing with the *Coccidae* is, unfortunately, very scattered, and a large number of the older papers, which contain original descriptions, are practically unobtainable.

In South Africa those interested in this group are obliged to rely almost entirely upon their own personal collection of Coccid literature, and the number of entomologists now in the country feel the necessity for a descriptive catalogue of all the species of scale insects known to occur here.

To fulfil this purpose I feel that such a catalogue should be sufficiently comprehensive to obviate the necessity of constantly referring to other papers on the group, and for this reason I propose to include several sections which have already been treated by previous workers.

The arrangement of Subfamilies does not follow the plan usually adopted, nor is it chosen to illustrate possible phylogenetic relationships. Owing to experiments now being conducted for the control of mealy-bugs, I was asked to deal with this Subfamily (*Pseudococcinae*) first. I have also included the *Ortheziinae*, *Coccinae*, *Monophlebinae*, and *Margarodinae* because they resemble mealy-bugs—in some measure at least—in some stage of their existence. Thus, the *Ortheziinae* and *Coccinae* always resemble the *Pseudococcinae* more or less closely; this is also true of the *Monophlebinae* during their early stages, and the adult ♀ ♀ of *Margarodes*, after leaving the cysts, simulate subterranean mealy-bugs.

*Types.*—I wish to emphasize the desirability of establishing an Imperial Collection of *Coccidae* similar to the U.S. National Collection at Washington D.C.

I feel that the needs of workers in the Colonies at least demand the centralization of as many types as possible in London. They should be deposited in the British Museum (Natural History), where they would be properly stored and safeguarded, and at the same time be available for all purposes within the usual restricted sphere of type material of all kinds.

All necessary arrangements might well be left to the Imperial Bureau of Entomology.

The Imperial Collection should not be restricted to types alone, but should contain specimens of all the *Coccidae* of the different Colonies, determined by recognized authorities. This would involve the duplication of many species, but the collection would be all the more valuable, as it would illustrate the slight variations—which do occur—due to local conditions.

## SIGNIFICANCE OF TERMS AS GENERALLY USED IN DESCRIPTIONS OF *COCCIDAE.*

**Adult** : the stage when an insect is sexually mature and ready to reproduce normally.

**Anal lobes** : or caudal lobes : a pair of prominent rounded or conical processes, situate one on each side of the anal opening as in the *Pseudococcinae.*

**Anal plates** : a pair of small triangular processes forming a valve-like covering over the anal opening in the *Lecaniinae.*

**Anal ring** : a chitinous ring encircling the anal opening.

**Antenna -ae** : two, jointed, sensory organs, borne, one on each side of the head, commonly called "feelers."

**Antennal chart** : a curve plotted to indicate the range of variation in the lengths of the antennal segments.

**Antennal formula** : an enumeration of the antennal joints in the order of their length, beginning with the longest and bracketing together those of the same lengths.

**Anterior** : in front.

**Apodema** : a conspicuous transverse band of chitin crossing the thorax in front of the scutellum in the male.

**Apodous** : without legs.

**Apterous** : without wings.

**Article** : a joint or segment.

**Atrophied** : wasted away ; unfit for use.

**Canaliculate** : channelled, longitudinally grooved, with a deeper concave line in the middle.

**Carina** : a keel or ridge.

**Castaneous** : chestnut-brown.

**Cauda** : the tail ; any process resembling a tail.

**Caudal** : pertaining to the posterior or anal extremity.

**Caudal process** : the conical projection, or tail of *Ceroplastes* spp., usually visible in the denuded insect only.

**Cephalic** : belonging or attached to the head ; directed towards the head.

**Chitin** : the material forming the hard parts of an insect's body.

**Chitinized** : hardened by chitin.

**Cicatrix** : a scar.

**Circumgenital glands** : small circular glands with an excretory orifice at the tip, disposed in groups about the genital orifice in *Diaspinae.*

**Coccineous** : cochineal red.

**Common** : of frequent occurrence.

**Conjunctiva** : the membrane uniting the abdominal or antennal sclerites or segments.

**Conspicuous** : striking ; easily seen at a glance.

**Costal margin** : the anterior margin of a wing.

**Coxa -ae** : the basal segment of the leg, by means of which it is joined to the body.

**Cribriform plates** : densely chitinous pitted plates which occur on the dorsal surface of some of the *Asterolecaniinae.*

**Denuded** : naked ; refers to Coccids freed from their waxy coverings.

**Dermal** : relating to the skin.

**Dermal glands** : hypodermal unicellular glands which secrete wax, setae, spines, etc.

**Digitules** : appendages on the feet of *Coccidae.*
**Dimerous** : composed of two pieces.
**Distal** : that part of a joint farthest from the body.
**Dorsal** : of or belonging to the upper surface.
**Dorsal scale** : that part of the covering scale of the *Diaspinae* that lies above the insect as opposed to the ventral scale which completes the puparium below.
**Ecdysis -es** : the process of casting the skin ; moulting.
**Exuviae** : the discarded skins cast at the periodical moults (ecdyses).
**Facets** : areas or lens-like divisions of the compound eye.
**Falciform** : curved like a sickle.
**Femur -ora** : the thigh ; usually the stoutest segment of the leg, articulated to the body through trochanter and coxa, and bearing the tibia at its distal end.
**Ferrugineous** : rusty red-brown.
**Filiform** : thread-like.
**Fimbriate** : applied to a margin or process which is fringed or finely divided.
**Fulvous** : tawny; light brown with much yellow ; nearly orange.
**Funicle** : the long terminal joint of the larval antennae of *Diaspinae.*
**Fuscous** : dark brown ; approaching black.
**Geniculate** : knee-jointed ; abruptly bent in an obtuse angle.
**Genital spike** : the sheath of the penis, which in the male of *Diaspinae* takes the form of a long mucronate spike.
**Gland pore** : the external opening through which a gland empties its secretions.
**Gland spines** : spiny appendages, each of which is supplied with a single gland whose opening is at the tip.
**Grouped glands** : circumgenital glands.
**Halteres** : a pair of small organs which replace the hind wings in the males of *Coccidae,* and in the two-winged flies (*Diptera*). In the *Coccidae* they take the form of a strap-shaped, or somewhat clubbed basal part with one or more long, stout, hooked bristles at the extremity.
**Honey-dew** : a sweet, viscid substance excreted by *Coccidae* and some other homopterous insects.
**Imago** : the adult or sexually developed insect.
**Inarticulate** : not jointed or segmented.
**Infuscated** : smoky grey-brown, with a blackish tinge.
**Instar** : the period or stage between moults in a larva.
**Invagination** : a pouch or sac formed by an infolding or indrawing of the outer surface.
**Lac** : a mixture of resinous or waxy substance produced as a protective covering by certain *Coccidae.*
**Lamella** : a thin plate.
**Line** : as a term of measurement is one-twelfth of an inch.
**Lobe** : any prominent rounded process ; the rounded prominent processes on the margin of the pygidium of the *Diaspinae.*
**Lobule** : one of the two distinct parts of which a lobe is sometimes composed.
**Mentum** : the lower part of the mouth, which in the *Coccidae* takes the form of a conical process channelled on its upper surface to receive the rostral setae or sucking-tube.
**Mesosternum** : the underside or breast of the mesothorax.
**Mesonotum** : the upper surface of the second or middle thoracic ring.
**Mesotarsus** : the tarsus of the middle leg.
**Mesothorax** : the second or middle thoracic ring ; bears the middle legs and the front wings.
**Micron** : the unit of microscopic measurement = 0·001 mm., represented by the sign $\mu$ (i e. 1$\mu$ = one-thousandth part of 1 mm., or approximately 1/25,000 inch).

**mm** : = millimetre : 0·001 metre = 0·039 of an inch : roughly 25 mm. are counted to an inch in measuring insects.
**Mode** : in tabulating measurements is that class which occurs most often.
**Moniliform** : beaded like a necklace.
**Mucronate** : terminating in a sharp point.
**Mycetom** : that mass of tissue which contains symbiotic organisms.
**Oblong** : longer than broad.
**Obovate** : inversely egg-shaped ; the narrow end downwards.
**Ocelli** : the simple eyes as opposed to compound eyes.
**Olivaceous** : with a tinge of olive-green.
**Opaque** : without lustre ; not transparent.
**Operculum** : lid, cover, or covering flap ; generally used to denote the anal covering in the *Lecaniinae.*
**Ovum, Ova** : an egg, eggs.
**Oviparous** : egg-laying.
**Ovoviviparous** : when young are produced by the adult ♀ from eggs which are hatched within her body. (In *Coccidae* such a ♀ is quite commonly spoken of as "viviparous").
**Parastigmatic glands** : small, circular glands sometimes present round the spiracles.
**Parthenogenesis** : reproduction without intervention of a male.
**Pellicles** : the exuviae or cast skins. More particularly applied to the hardened larval skins attached to the scale of the *Diaspinae.*
**Piceous** : pitchy black.
**Plates** : the flattened, fimbriated or spine-like marginal processes of the pygidium in *Diaspinae.*
**Pore** : any small round opening on the surface.
**Posterior** : hinder or hindmost ; opposed to anterior.
**Process** : a prolongation of the surface, margin or an appendage ; any prominent portion of the body not otherwise definable.
**Produced** : drawn out, prolonged.
**Protuberance** : any elevation above the surface.
**Proximal** : that part of an appendage nearest the body ; opposed to distal.
**Pseudo-** or **pseud-** : as a prefix means false, or merely resembling.
**Pupa** : the intermediate stage between larva and adult.
**Puparium** : as used for *Coccidae* refers (*a*) to the covering case of the male before it emerges as a winged insect, and (*b*) the covering scale formed by the *Diaspinae.*
**Pygidium** : the compound terminal segment of the *Diaspinae* and *Conchaspinae.*
**Pyriform** : shaped like a pear.
**Reticulate** : like network.
**Retracted** : drawn back ; opposed to prominent.
**Rimose** : full of cracks.
**Rugose** : wrinkled.
**Scale** : a general term to distinguish *Coccidae* ; the puparium of *Diaspinae* ; the waxy covering of the male *Lecaniid.*
**Sclerite** : any piece of the body wall bounded by sutures.
**Scutellum** : a conspicuous shield-shaped piece on the dorsal surface of the metathorax of male *Coccidae.*
**Secretion** : matter produced by the various glands of the body. More particularly the waxy, powdery, fibrous, or cottony substances of which the coverings of *Coccidae* are composed.
**Secretionary** : consisting of secretion.
**Seta -ae** : a pointed bristle or long stiff hair.
**Sordid** : (of colour) dirty, dull.

**Species** : a succession of individuals similar in appearance, structure, and habit, mating freely and producing young which themselves mate freely and bear fertile offspring resembling each other and their parents.

**Spine** : a sharp process.

**Spinose** : **Spinous** : **Spined** : set with thorns.

**Spiracles** : the respiratory orifices.

**Squames** : see **Plates.**

**Stigmata** : the spiracles.

**Stoma -ata** : a breathing pore : = stigma.

**Symbiosis** : a life relationship existing between different kinds of animals or plants, or between animals and plants ; true symbiosis is where both parties to the relation benefit.

**Synonym** : a name erroneously applied to a species or genus that has been previously named and described.

**Tarsal** : relating to the tarsi or feet.

**Tegument** : a covering surface or skin.

**Tenent hair** : specialized hair for clinging or clasping.

**Terminal** : situated at the tip or extremity; opposed to basal.

**Test** : the secretionary covering of *Coccidae*, especially such as is waxy, horny, or glassy.

**Testaceous** : dull yellow-brown.

**Trachea -ae** : the spirally ringed breathing tube or tubes of insects.

**Translucent** : semi-transparent ; admitting the passage of light but not of vision.

**Translucid** : clear ; transparent enough to be seen through.

**Transparent** : so clear as not to obstruct vision.

**Trochanter** : the small joint connecting the femur with the coxa.

**Ungual** : relating to the claw.

**Venter** : under surface ; opposed to dorsum.

**Viviparous** : applied to insects which bear living young.

**Vulva** : the sexual orifice of the female.

**Wax glands** : small circular glands concerned in the secretion of waxy substances ; present on the pygidium as circumgenital glands and round the spiracles as parastigmatic glands ; occurring in other parts of the body in various families.

## METHODS AND TECHNIQUE.

The methods of preparation of Coccids for study vary considerably, according to the purpose of the study, and also with the previous training of the student. The personal equation enters largely, as it does into all research, so that the final methods employed depend upon the results of personal experiment and experience. For this reason it is advisable to indicate merely, in a general way, the lines of procedure; and to leave details to the individual worker.

The process of determination should begin at the time of collection of material, and the following points should all receive due attention:—

(*a*) Host-plant: name if possible. If the plant is not known sufficient material should be obtained for determination, and wherever possible an attempt should be made to secure flowers or fruit and a typical twig with leaves. Position of insects on the plant and habits; whether clustered or solitary; whether on branches only or on leaves and fruit; whether more common on underside of leaves, etc.

(*b*) The insect itself: general colour impressions; distribution on plant; whether ♂ puparia are associated with the females or clustered on some other part of the plant. If males are not observed, and ♂ puparia not found, search should be made on fallen leaves, etc., round about. The ♂ puparia of Mammoth Scale are found on fallen leaves beneath the trees which bear the females. The males of *Aspidoproctus mirabilis*, and *tricornis*, which are closely related scale insects common in some parts of South Africa on thorn-trees, have never been observed.

(*c*) Care of material collected. Specimens should be collected to illustrate the life-history as far as possible. Young and male forms should be obtained whenever possible. Each twig bearing specimens should be wrapped separately in soft paper to prevent the insects from being crushed or unduly rubbed, and particularly to retain larvae, males, or parasites which may emerge before the material is studied in the laboratory. It is highly important that an adequate amount of material should be collected when found. It is a great mistake to think that because a certain insect is very plentiful at one time that it can always be obtained when required.

(*d*) The approximate size of adult insects; the presence or absence of secretionary covering, ovisac, etc.; the nature of secretion, colour, distribution on body, etc.; the colour of the body denuded; the colour of legs and antennae, if present; the length and nature of caudal, lateral, or dorsal filaments; the nature of the integument at maturity; the presence or absence of a covering scale; the size, colour, shape, and nature of covering scale if present the position and nature of the exuviae; the colour of the living insect without the scale.

After the above observations are complete, and notes have been made, specimens should be cleared and mounted for more detailed study.

The microscopic characters of the *Coccidae* which are utilized for the determination of species are found in the exoskeleton. In order to render this transparent it is necessary to get rid of the soft body contents, but at the same time to retain the chitinous skin of the insect, with its appendages, hairs, and spines in as perfect a condition as possible. The easiest method is to treat the specimens with a strong solution of caustic potash (KOH) or caustic soda (NaOH) which dissolves all the soft parts, but does not dissolve chitin. If used hot, or boiling, this solution acts more quickly than when cold. Small specimens, such as the armoured scales, are generally sufficiently transparent after boiling from 5 to 10 minutes in a 20 per cent. solution of KOH. Larger insects, such as mealy-bugs or cochineal insects, may require 20 to 30 minutes. The following particulars may be useful. In dealing with armoured scale insects do not scrape a stem thickly covered with insects into the KOH solution. Raise each scale separately and pick out the insect on a needle-point which has been previously moistened, and place in the KOH, taking care to keep insects from *similar* scales together, as there may be several species on the same twig. When possible boil 12 to 20 insects of the same kind, and count them as they are transferred to the different solutions. This is especially necessary when staining, as the insects are difficult to see when stained the same colour as the fluid they are in. For small specimens a shallow watch-glass is a useful staining dish, using a little stain. When about to transfer the specimens the glass is held above a mirror, placed as a reflector, when the insects are easily seen.

Larger insects, such as mealy-bugs, should be punctured with a needle before boiling. This permits of more rapid clearing. Very large, convex insects, such as *Aspidoproctus* spp., and some of the *Lecaniinae*, are too large and thick to make a single mount. These are best treated by separating the lower surface from the upper by cutting around the margin with a fine scalpel or pair of scissors before boiling. The two surfaces are then treated and mounted separately. The colour which the body assumes in boiling KOH, and whether the liquid is stained or not, should be noted.

If distilled water cannot be easily obtained, rain water which has been boiled, and preferably filtered, should be used for making up all solutions and stains, and for washing the insects between the different solutions.

After treating with boiling KOH the insects should be transferred to water containing a trace of acetic acid and through two or three changes of water. They are then ready for passing through the alcohols to stain, or, if not requiring staining, to clearing media such as oil of cloves or xylol, and thence into Canada balsam.

It has been found that the majority of scale insects are improved for study purposes by suitable staining. In fact it is practically impossible to work with unstained material of mealy-bugs and some of the *Lecaniinae.* The chitin is so delicate and transparent that the characters cannot be made out, and this difficulty increases with the age of the slides. On the other hand, some of the larger *Monophlebinae,* the more highly chitinized *Lecaniinae* (e.g. *Hemilecanium* spp.), and *Diaspinae* are so dense that staining is quite unnecessary.

After boiling specimens they become very soft and fold easily, and trouble is often experienced in transferring them from one solution to another, or in getting them to lie quite flat on the slide when mounted. This difficulty is best overcome by using a small section lifter, which may be made from thin silver or platinum wire flattened and slightly up-bent at one end. A wooden toothpick answers quite well on occasion.

When mounting the cleared specimens from xylol or oil of cloves into Canada balsam it is advisable to transfer the insect in a small drop of the clearing medium to balsam which is spread on the slide to almost the size of the coverglass used. If a drop is placed on the slide and the insects transferred to this it is likely that when the coverglass is applied the specimens will be carried to the edge of the glass, or if too much balsam is used the specimens may be found beyond the edge of the coverglass. It is a good rule to use as little balsam as practicable and to have it spread evenly before orientating the specimens and applying the coverglass.

The following methods of staining are recommended for the purposes indicated :—

(*a*) For small *Diaspinae* and other insects in which the characters merely require intensification.

*Stain :* Picric acid in xylol or beechwood creosote.

*Method :* After treating the specimens with KOH and washing, pass through the alcohols, 30 per cent., 70 per cent., 90 per cent., and absolute into xylol or beechwood creosote which contains a little picric acid in solution. Leave for about 1 minute and transfer to clean xylol for a few minutes, then mount in the usual manner. If not washed in xylol after staining the picric acid is liable to crystallize out after mounting.

(*b*) For differentiation of the more chitinized parts of the exoskeleton of *Coccidae,* e.g. for easy differentiation between the antennal segments and their conjunctiva in the *Pseudococcinae,* etc., the following stains are recommended :—

(1) *Stain :* Ziehl-Nielson solution of carbolic-fuchsin.

| | |
|---|---|
| Distilled water .......................... | 100 cc. |
| Carbolic acid .............................. | 5 gm. |
| Alcohol (abs.)............................. | 10 cc. |
| Fuchsin .................................... | 1 gm. |

Or it may be prepared by adding a 5 per cent. aqueous solution of carbolic acid to the saturated alcoholic solution of fuchsin until a metallic lustre appears on the surface of the fluid.

*Method :* After treating with KOH and washing, transfer direct to the stain. Leave for one hour if used cold. If heated until it steams, and then allowed to stand, the specimens will be well stained in ten minutes. Transfer direct to 70 per cent. alcohol. If over-stained wash quickly in 70 per cent. alcohol containing a trace of hydrochloric acid. Pass through 90 per cent. and absolute alcohol to oil of cloves and mount when cleared.

(2) *Stain :* (Method of Professor R. Newstead and Dr. P. Marchal).

Saturated solution of magenta in absolute (or 95 per cent.) alcohol.

*Method :* After treating with KOH and washing, pass through the alcohols to 90 per cent., and thence into the stain. Leave to stain for 20 to 30 minutes—or longer, wash in absolute (or 95 per cent.) alcohol, transfer to oil of cloves and mount in Canada balsam.

The following equivalents and approximations may be useful for reference :—

To make a dilution from a solution of known strength : Take the amount in cc. (or a multiple of that number) represented by the desired strength, and add water to the amount represented by the original percentage in cc. (or the same multiple of that number). Thus, to make 35 per cent. alcohol from 75 per cent., take 35 cc. of the 75 per cent. and make up to 75 cc. with water.

In using formalin it must be borne in mind that this liquid contains only approximately 40 per cent. of formaldehyde when sold, so that to make a 4 per cent. solution take 4 cc. of ordinary formalin and make up to 40 cc. with water.

1 $\mu$ = 1/1000 mm.
1 mm. = 0·0393 inch. Approximately 25 mm. = 1 inch.
1 gram = approximately 15½ grains (15·432).
1 oz. = approximately 28 grams (28·349).
1 fluid oz. = approximately 30 cc.
1 litre = 1,000 cc. = 1·759 imperial pints ; thus 4 litres = approximately 7 pints.

## OUTLINE OF CLASSIFICATION OF SOUTH AFRICAN *COCCIDAE.*

The family *Coccidae* is distinguished from the most nearly related families of the Hemiptera (*Phytophthires*), viz. the *Psyllidae, Aleurodidae,* and the *Aphididae,* by the fact that in the *Coccidae* the tarsi are normally one-jointed and bear but a single claw. In the three remaining families mentioned the tarsi are normally two-jointed and terminate in two claws. It is the rule too, in Coccids, that the females are always wingless and the males nearly always winged, possessing, however, but one pair of wings.

In the *Psyllidae, Aleurodidae,* and *Aphididae,* on the contrary, the normal condition is for the adults of both sexes to possess wings, and when present always two pairs. In the immature or stationary condition, however, many of the insects in these families bear a striking resemblance to scale insects. This is particularly the case with immature *Aleurodidae* and, among the *Aphididae,* with the aberrant *Cerataphis lataniae,* "the black seed scale" of English horticulturists. This peculiar aphis is common in South African greenhouses, and is known to occur on ornamental palms grown in the open at Durban.

As a matter of convenience the family *Coccidae,* which now comprises about two thousand described species, is divided into a number of Subfamilies.

Those known to be represented in South Africa may be distinguished as follows:—

## Family COCCIDAE.

N.B.—Adult ♀ characters used unless otherwise stated.
Adult ♂, as far as is known, with simple eyes unless otherwise stated.

I. *Anal ring bearing hairs.*

A. *Posterior extremity not cleft.*

*a.* Posterior extremity with ± produced caudal lobes which normally bear two or more stout spines, one or more long setae and shorter hairs. Adults naked or ± covered with waxy secretion in the form of meal, cotton, waxy cones or plates. Insects generally free-moving until eggs are laid. Ovisac may or may not be formed, which may partly or entirely enclose the ♀. Figure-8 glands absent in all stages. E.g. mealy-bugs, etc. .. .. .. .. .. .. .. .. .. .. .. .. .. *Pseudococcinae.*

*b.* Adults free-moving. Posterior extremity rounded. Dorsum covered with well-defined waxy lamellae or plates which are produced behind the body to form an ovisac. ♂ with compound eyes. E.g. *Orthezia insignis* .. .. .. .. .. .. .. *Ortheziinae.*

*c.* Adult fixed, often forming shallow pits in stems of plants. Usually enclosed in a ± horny, or glassy, ± transparent test which is often supplied with a short fringe of waxy filaments. Figure-8 glands usually present in one or more stages. Legs and antennae rudimentary or absent. E.g. Pustular oak scale, etc. *Asterolecaniinae.*

*d.* Insects enclosed in a resinous cell. Adult without legs, with the caudal segments produced into a ± tail-like organ bearing at the extremity the anal orifice, which is surrounded by a broken setiferous ring. E.g. Lac insects.. .. .. .. .. .. *Tachardiinae.*

B. *Posterior extremity cleft.*

*e.* Body not showing segmentation. Anal orifice valve-like, covered with a pair of triangular plates. E.g. Soft scale, etc. *Lecaniinae.*

II. *Anal ring hairless.*

A. *Abdomen not terminating in a definite pygidium.*

*a.* Adult free-moving until eggs are laid. Posterior extremity rounded; insects ± covered with mealy or cottony matter, or enclosed in a ± felted sac. Caudal lobes absent. Legs and antennae present or ± rudimentary. Antennae usually 7-jointed. E.g. Cochineal insects, etc. .. .. .. .. .. .. *Coccinae.*

*b.* Young stages free-moving, adults ± fixed to host-plant by secretion from tenent hairs on venter between legs. Legs, antennae, and mouth-parts present. Dorsum ± soft and covered with waxy meal or cottony matter (*Icerya*, etc.), or hardened and ± naked (Mammoth Scale). Antennae usually 10- or 11-jointed. Adult ♀ with or without ovisac. In *Aspidoproctus* spp. the eggs are deposited in a "marsupium" formed by invagination of portion of the ventral surface. ♂ with compound eyes .. .. .. .. .. .. .. .. .. .. *Monophlebinae.*

*c.* ♀, before emergence as adult, enclosed in a ± glassy cyst. During this time the insect probably passes through (*a*) a second larval or prae-pupal stage in which mouth-parts are present but legs and antennae absent, and (*b*) a pupal stage in which antennae, legs, and mouth-parts are absent. Adult ♀ with well-developed legs and antennae but without mouth-parts. Adult ♂ with compound eyes. Adult ♂ and ♀ with anterior legs fossorial. E.g. Vine Margarodes .. .. .. *Margarodinae.*

B. *Abdomen terminating in a definite pygidium.*

*d.* Legs and antennae present. Adults below a separate covering scale which is composed entirely of secretionary matter without the admixture of exuviae. E.g. Euphorbia *Conchaspis* .. .. .. .. .. .. .. .. .. .. .. .. *Conchaspinae.*

*e.* Legs absent. Adult below a separate covering, scale composed of secretionary matter plus the exuviae. E.g. White peach scale, etc. .. .. .. .. .. .. .. .. .. .. .. *Diaspinae.*

## Subfamily PSEUDOCOCCINAE.

From an economic standpoint this subfamily is one of the most important because it includes, among others, those common insects known as mealy-bugs.

These are of exceptional interest to entomologists, nurserymen, and fruit-growers because of (*a*) their general distribution, (*b*) their prevalence in orchards and vineyards, and (*c*) their resistance to ordinary control measures.

This resistance is no doubt accounted for, in some measure at least, by the powdery waxy secretion which covers the body, and earns for them the popular name "mealy"-bugs. The common species, the long-tailed mealy-bug of ferns, etc., is the type of the genus *Pseudococcus*, to which most of our South African forms belong.

It should be mentioned, however, that the subfamily *Pseudococcinae* has a much wider significance than is exhibited by this one genus, and, as it is at present constituted, appears in some ways an unnatural group.

### *Synopsis of South African Genera.*

N.B.—Adult ♀ characters used.

A. *Anal ring with 6 hairs.*

I. *Legs absent.*

(*a*) Insects enclosed in felted sac. Antennae rudimentary, of two or three joints .. .. .. .. .. .. .. .. .. .. .. *Antonina* Sign.

II. *Legs present.*

(*b*) Body long and narrow. Antennae short, geniculate, of 5 joints. Integument with some 3-grouped glands .. *Rhizoecus* Kunck.

(*c*) Body broadly elliptical. Antennae 6-jointed. Insect inhabiting cysts at root of grass .. .. .. .. .. .. *Natalensia* g. n.

(*d*) Body elongate oval. Antennae 7- to 9-jointed. Marginal spine areas produced on large, more or less rounded tubercles .. .. .. .. .. . .. .. .. .. .. .. .. *Tylococcus* Newst.

(*e*) Body usually elongate oval. Antennae 7- to 9-jointed, most commonly 8-jointed. Marginal spine areas not produced on tubercles .. .. .. .. .. .. .. .. .. .. .. *Pseudococcus* Westw.

B. *Anal ring with 8 hairs.*

(*f*) Antennae 7-jointed. Insect enclosed in a dense sac .. *Eriococcus* Targ.

(*g*) Antennae 8- or 9-jointed .. .. .. .. .. .. .. .. .. *Puto* (?) Sign.

### The Relative Value of Specific Characters used in the Pseudococcinae.

(*a*) *Size.*—It is difficult to state with any degree of accuracy the precise measurements of living mealy-bugs, for they are constantly moving, and the mealy covering and lateral and caudal filaments, which many of them possess, obscure the extremities. Further, when dealing with old females which have completed oviposition the body is often shrunken and is much smaller than the mounted specimens indicate. On the whole I think it is most satisfactory to give the *approximate* size of the largest living specimens observed and an average of the size of adults when mounted. There is undoubtedly a slight variation in size of individuals of the same species caused by difference of food-plant and also by climatic conditions; for this reason the host-plant and date of collection should be given with descriptions.

(*b*) *Shape.*—The normal shape of the body is elongate oval, but in a few cases there is an important variation, which may be sufficiently pronounced to at least suggest generic relationship. In *Rhizoecus* the body is exceptionally long and narrow, but this character is also found in a few species of *Pseudococcus*. In some instances the shape is given as subglobular, while in *Antonina natalensis* sp. n. the body is in the shape of half a pear, and in *Natalensis* g. n. the segments of the body are quite characteristic, as shown in the sketch (Fig. 11).

It may be seen that such variations, when constant, are of importance in the determination of species, especially as they are found in only a few cases.

(*c*) *Colour.*—The descriptions of colour apply really to three distinct phases: (1) the colour of the mealy secretion, (2) that of the body as seen through the secretion, and (3) that of the body when freed from secretion, as when first dropped into boiling KOH.

The mealy secretion is most often white, but it may be tinged with yellow, as in *Ps. filamentosus* Ckll.; bright yellow, as in *Ps. aurilanatus* Mask.; or decidedly buff, as in *Ps. iceryoides* (Mask.) and *Ps. nipae* (Mask.). In most cases the dorsum of the insect is densely coated with a white, powdery, mealy secretion; but, in a few instances where the insects are enclosed in a cottony mass (*Ps. transvaalensis* sp. n.) the insect itself is practically free from such meal. The same may be said of the young females of *Pseudococcus flagrans* sp. n., which are embedded in a dense layer of white, powdery wax between the leaf-bases of grass; but later, when the insects ascend the grass-stems apparently to await the males, a slight mealy covering is secreted. In such cases the true body-colour may be seen, but in many others, where the dorsum is thickly covered with secretion, the true colour is only seen on the ventral surface where the meal is scant, or when the insect is rubbed, or dropped into hot KOH. The most common colour is pinkish, or purplish, but many variations have been recorded; and, just as constant variations in shape may be useful in the determination of the species, so the differences in colour may give a clue to relationship at least. Thus, while many species show but slight difference from the most common pinkish or purplish tints *Pseudococcus stelli* sp. n., *Pseudococcus crawi* and *solani* are pale yellow; *Pseudococcus capensis* always appears slightly brownish, *claviger* reddish-brown; *formicarii* yellowish-brown; *aphyllonis* and *olivaceous* olive-brown; *quercus* greenish-brown; *salinus* grey. The *filamentosus* group appears purplish-black, and *solitarius* sp. n. shiny black, etc.

When recording the colour of specimens in boiling KOH it is important to note the shade at once, as an excess of alkali changes the colour rapidly.

(*d*) *Segmentation.*—It is usual, for some reason or other, to state whether the segmentation of the body is conspicuous or not. As a character for determination this is quite useless. In the majority of cases it merely amounts to whether the mealy secretion is abundant or scant. The segmentation of the body is always more distinct in the second nymphal stage than in the adult. The distinctness gradually diminishes as the adult becomes replete. It varies, too, in the same species, as it depends somewhat upon whether the insects are in sheltered or exposed positions.

(*e*) *Lateral and Caudal Filaments.*—The presence or absence of lateral or caudal filaments, and their nature when present, is a character which may assist, in a preliminary way, in the determination of species. In a few cases (e.g. *P. transvaalensis* sp. n.) caudal filaments are present and lateral ones absent. In *P. adonidum* all the filaments are more slender than are those of *P. citri.*

There is naturally the relation between these filaments and the dermal spine-gland areas which gives the point significance.

(*f*) *Antennae.*—The number of segments in the antennae is a character which is generally given generic rank, and in the majority of cases seems quite satisfactory as such. In the genera which I now include in the tribe *Pseudococcini*, however, this particular character is undoubtedly unstable, and is therefore unsuitable to retain this significance. I shall deal with this point briefly under the discussion of the genus *Pseudococcus.*

I wish to draw attention here to the practice of giving the antennal formula as a specific character.

This is done in a large number of the descriptions of the species, and it is only after one has really endeavoured to determine specimens with its aid that the impossibility of the task is realized. A formula is composed of numbers indicating the joints, the largest, i.e. longest, being given first, the shortest last, with the others in order of their length. When several segments vary so much that the sequence may be altered, the numbers are placed in brackets.

I am inclined to think that many, if not most, of the antennal formulae have been made on simple comparisons of the segments under the microscope, and not by actual measurements.

If we remember, too, that most of the descriptions are made from mounts which are merely boiled in potash, and cleared without staining, the difficulty of observing the comparative lengths of the segments will be obvious.

Under these conditions the dermis is colourless, and becomes very transparent in Canada balsam, and the exact point at which the segments begin, and terminate, is difficult to determine.

Antennal formulae, constructed from stained specimens, however, are quite unsatisfactory for the determination of species. That this is the case may be best illustrated by a few measurements with the formulae constructed from them.

The following are made from specimens of *P. adonidum* Westw., collected at the Edgbaston Botanical Gardens in November, 1913.

Antennal segments :—

| I | II | III | IV | V | VI | VII | VIII |
|---|---|---|---|---|---|---|---|
| 65 | 72 | 76 | 38 | 42 | 38 | 46 | 104 |

Formula :—8 3 2 1 7 5 (6 4)

| I | II | III | IV | V | VI | VII | VIII |
|---|---|---|---|---|---|---|---|
| 58 | 65 | 63 | 36 | 41 | 38 | 43 | 96 |

Formula :—8 2 3 1 7 5 6 4

| I | II | III | IV | V | VI | VII | VIII |
|---|---|---|---|---|---|---|---|
| 74 | 72 | 74 | 48 | 62 | 43 | 43 | 101 |

Formula :—8 (1 3) 2 5 4 (6 7)

It is not an uncommon occurrence for the two antennae of the same insect to give different formulae, and from one collection of material, about 40 specimens, I constructed the given formulae of five described species. The measurements were made from specimens stained by the carbol fuchsin method, with the Zeiss microscope, obj. D, and 7·5 measuring ocular. The results are more accurate by this method than by plotting from camera lucida drawings. The lengths of the antennal segments are, nevertheless, of great importance in the determination of species if they are accurately made from stained specimens, and properly tabulated.

The most useful arrangement of antennal data seems to be arrived at by giving the range of variation in measurements of the different segments, with the addition perhaps of the mode of each. After working over a large series of slides one is impressed with the characteristic appearance of the different antennae. But this difference is difficult to express. The nearest approach is obtained by a scheme such as is used in the charts given with the different species, and this supplies a most useful aid for the preliminary location of an insect from slide specimens.

Wherever possible the range of measurement represents at least 10 measurements, 20 to 30 being made where material is sufficiently plentiful to allow such to be done. The measurements are then plotted in the centre of each antennal column and the curve completed. Thus it appears that where any segment is constant the curve approaches a simple line, and a wide band represents a wide range of variation.

Similarity of antennal curve, whilst indicating similarity of antennal formula, does not of necessity indicate identity of species, but it does give a clue to work upon; and, possibly at times, indicates relationship. Other characters—the legs, setae of anal lobes and anal ring, and dermal characteristics—can then be compared; if the similarity still persists, the description can be referred to for other details.

It should be mentioned, while dealing with the antennae, that the measurement of the first segment is often unsatisfactory. This is due to the fact that the outer edge is much narrower than the inner, the side being hollowed out to allow lateral bending and the insertion of segment II. An intermediate length is indicated in the chart given, but slight variation in segment I may be disregarded.

The hairs and spines on the antennal segments are similar in the majority of cases, but a few striking variations occur.

In *Rhizoecus* spp. there are always 3 or 4 stout falciform spines on the terminal segment as illustrated in Fig. 10*d*, and in a few examples of *Pseudococcus* there are stouter spines which seem to indicate an intermediate stage between ordinary spines and the falciform type of *Rhizoecus*.

(*g*) *Legs.*—The remarks concerning the uselessness of an antennal formula as a specific character apply equally well to general remarks on the legs, which are commonly made in descriptions of species of *Pseudococcini*. In order to be of use, the measurements should be carefully made and tabulated, and use should be made of the three pairs of the same specimen. If only one set of measurements is to be given I would suggest that the mesothoracic leg be made use of, as this is usually a more or less reliable clue to the other two pairs.

The plan adopted by the writer (1912), gives the measurements in $\mu$, in the following order:—

1. Length of coxa.
2. Breadth of coxa across base.
3. Length of trochanter plus femur.
4. Breadth of femur.
5. Length of tibia.
6. Breadth of tibia.
7. Length of tarsus plus claw.

This was the outcome of an endeavour to obtain measurements in direct lines from points which remain fixed although the legs are folded in different ways in mounting, and is generally used in the present paper.

Considered alone, the measurement of the legs would not form a satisfactory character for specific determination ; but, taken in conjunction with the antennal segments and the comparative lengths of the setae of the anal lobes and of the anal ring, it is an important factor.

The remarks on the unsatisfactory nature of the first antennal segment, for measurement, also apply to the coxa, but, even allowing variation in this character, the leg-series of measurements is most useful. The greatest importance is attached to the comparative lengths of the femur plus trochanter and of the tibia, as (always allowing some margin for variation) these are remarkably constant for the species.

An unusual type of trochanter is recorded in the case of *Ps. natalensis* sp. n. Abnormal legs are not uncommon, and occur in the *Monophlebinae* as well as the *Pseudococcinae* (Fig. 12*d*).

(*h*) *Mentum.*—The mentum in the ♀ series of the *Pseudococcinae* is, I believe, always trimerous, consisting of a bi-lobed basal portion, which is but delicately chitinized, and forms the pivot on which the mentum proper turns. The two apical segments are heavily chitinized, and form a ± pointed cone, the apex bearing a definite series of hairs. The two segments may be distinctly separate, or, as is often the case, more or less fused into one piece. The approximate size and shape of the mentum vary but little among specimens of the same species, but there is often only slight variation between different species of the same series. The only useful record to be made of this character seems to me to consist of the approximate length of the two apical segments, and whether it is broadly or acutely pointed as in Fig. 13*a*.

(*i*) *Length of Rostral Loop.*—Some writers give this as a specific character, but it appears quite useless. Two mounted specimens of *P. citri*, collected at the same time, show the following variation in this character : Length of body (*a*) 3·4 mm ; (*b*) 2·6 mm. Rostral loop (*a*) 190 $\mu$ ; (*b*) 370 $\mu$.

(*j*) *Dermal Characters.*—Very little attention seems to have been paid to the dermal glands and other dermal characters of the mealy-bugs, except to note the absence of figure-8 gland-pores in all stages. Occasional mention is made of a "sternal plate," as in the description of *Phenacoccus iceryoides* Green, and of "circular spinnerets," as in *Ps. ceriferus* Newst. (= *Ps. virgatus* Ckll.).

The absence of detailed description results, largely, no doubt, from the fact that unstained material was used, for in such slides the dermal characters are almost invisible.

The subcutaneous "tubes" which are so common in many species of mealy-bugs, are only seen in stained specimens. It may not be necessary to describe all the dermal characters in detail, but when sufficient species have been examined I think certain types can be evolved which will be of the greatest value. For instance, the majority of species have well-defined marginal spine areas, while in a few cases such are absent (Figs. 22–33). In some again the gland-pores over the whole surface of the body are uniform in size, in others the ventral pores are small and simple, while those of the dorsum are large and disc-like. Further, some species have subcutaneous tube-glands restricted to the posterior segments, in others they may be uniformly distributed or entirely absent. In *Rhizoecus* there are peculiar grouped glands, in groups of three, crowded together and presenting a propeller-like appearance. The character of the spines and bristles on the derm varies, the conical spines of the marginal areas being stout, or slender, or entirely bristle-like, or absent.

Unfortunately I have not seen *stained* material of a sufficient number of species to be able to classify them according to the different types, but I refer to the subject in the hope that some one more favourably situated than I am may undertake to do so.

(*k*) *Setae of Anal Ring and Anal Lobes.*—The only mention of this character in the majority of descriptions is the number of hairs which the anal ring bears. All the series which I now include in the *Pseudococcini* have the anal ring with six hairs. It was observed that the length of the anal ring hairs remained fairly constant throughout all the females of the same species, but this did not furnish a satisfactory specific character in itself, because there was not sufficient difference between the lengths in different species. The anal lobes are furnished with conical spines and glandular pores, and each bears one long seta. These setae remain fairly constant in length for the species, so that the comparative length of the setae of the anal lobes with those of the anal ring forms, I think, quite a good character when taken in conjunction with the antennal segments and the legs.

*Intracellular Symbionts.*—Very little is known concerning the intracellular symbionts of the *Coccidae*; but, apart from the intense interest attached to them—owing to their relation with metabolism—they may throw a very important light on the subject of relationship. This may not indicate specific differences in many instances, but regarding the larger groups and their derivation I feel that a great deal may be anticipated.

The following seven species have been described from Coccids :—

1. *Lecaniascus polymorphus* Moniez, 1887, from *Lecanium hesperidum.*
2. *Saccharomyces apiculatus* var. *parasiticus* Lindner, 1895, from *Saissetia hemispherica.*
3. *Oospora saccardiana* Berlese, 1906, from *Ceroplastes rusci.*
4. *Saccharomyces pseudococci farinosi* Šulc., 1910, from *Pseudococcus farinosi* D.G.
5. *Coccidomyces rosae* Buchner, 1911, from *Lecanium corni.*

6. *Coccidomyces pierantonii* Buchner, 1911, from *Icerya purchasi.*
7. *Coccidomyces dactyloppii* Buchner, 1911, from *Pseudococcus citri.*

Some of these are not so widely separated as their generic names would suggest, while on the other hand Nos. 5, 6, and 7, which have been placed provisionally in the same genus, are three widely divergent forms.

As a matter of fact my studies at Birmingham University under Professor F. W. Gamble, F.R.S., who brought this fascinating subject to my attention, seems to show that Nos. 1 and 2 are very closely related; Nos. 3 and 5 are probably of the same group; but 6 and 7 are entirely distinct from one another and from the rest, except possibly from No. 4.

Nos. 1 and 2 were isolated and grown on a variety of media, but never produced endospores. The forms represented by *Coccidomyces dactylopii* Buchner are probably restricted to the *Pseudococcini.* They are remarkable in that the individual organisms do not infect the ova independently. Instead of this a number together, enclosed in a "sferette," to use Dr. Pierantoni's term, acts as the infecting unit. (Plate XX., Figs. 34–39.)

It is not my intention to deal with the subject further at this point, but merely to indicate a most fascinating field for study, and at the same time one which may be instrumental in elucidating several important points of relationship in the *Coccidae.*

I am hoping to be able to deal with the subject of intracellular symbionts of the South African *Coccidae* at a later date.

## Tribe ? .

### Gen. ANTONINA Sign.

"Adult ♀ apodous; anal lobes rudimentary; antennae atrophied or rudimentary; anal orifice with six hairs.

Ovisac felted or solid and wax-like.

Larva with the anal lobes well developed; antennae of six joints; anal orifice with six hairs" (*Newstead*).

### 1. Antonina natalensis, sp. n.

(Plate XVII., Fig. 8.)

Adult ♀ enclosed in a dense, tough, felted sac at the base of grasses.

Ovisac: At first sight the ovisacs appear spherical, but on closer inspection they are found to be somewhat produced at the anterior end, so as to be really pear-shaped, 4·5 mm. long and 3·8 to 4 mm. broad. In colour the sac is yellowish-white to buff.

Adult ♀: Purplish-black in colour, about 4 mm. long, distinctly semi-pyriform, being flattened ventrally and broadly rounded behind while the anterior end is narrowed. There is no secretionary covering, but the walls of the sac are closely adherent to the body of the insect. On placing into boiling KOH a dense cochineal tint is liberated and the insect appears sooty-black. The liquid is stained very deeply with a dark dusky purple (Ridgway). When cleared, stained, and mounted the insect is about 4·5 mm. long and 4 mm. broad.

The antennae are 3-segmented, joint 2 being longest (44 $\mu$ long on the inner margin). Joint 3 is irregularly conical, 34 $\mu$ long, and has 8 to 10 hairs at its apex (Fig. 8).

The mouth-parts are normal; legs absent; and anal ring with 6 bristles. The circum-anal region is closely pitted with gland-pores of two sizes. The larger ones are about 7 $\mu$ in diameter; the small ones only about 2 $\mu$. The latter are supplied with short, parallel-sided, subcuticular tubes. There are a number of scattered hairs around the anal groove, some of which may attain 130 $\mu$ in length. The setae of the anal ring are about 120 $\mu$ long. The dermis of the remainder of the body is clear except for scattered, small pores, some of which have bristle-like hairs. The spiracle-tubes broaden suddenly inwardly, and present a reticulated appearance.

Habitat: On grass, Pietermaritzburg, Natal.

Collected by A. Kelly, November, 1914. Description made from two ♀♀, being the only specimens found, associated with *Pseudococcus bantu.*

Collection No.: 33.

### 2. Antonina transvaalensis, sp. n.

(Plate XVI., Figs. 1–1*a*. Plate XVII., Figs. 9–9*c*.)

Adult ♀♀ in closely felted sacs attached to the bases of stems of grasses.

Ovisacs oval, spherical, or flattened according to the position on the food-plant. When attached to the outer surfaces of grasses the ovisacs are often clustered and rounded (Fig. 1), when between leaf-sheaths circular, and disc-like (Fig. 1*a*). The ovisac is usually complete, white, densely felted, and brittle.

In size the ovisacs measure about 2·8 mm. in diameter. There is a distinct circular opening in the end of each, through which the white waxy caudal filaments of the ♀ project. Usually there are two such filaments almost as long as the enclosed ♀, but in a few cases (as in Fig. 1*a*) there are a number which appear to have been broken off or shed, and others produced. The ♀ shown in Fig. 1*a* was kept in a tube, and on October 26th was found outside the ovisac. Peculiar movements were noticed, and although observed for half an hour no appreciable progress was made, but the movements looked as though a "scraping" motion was being performed with the anterior end, the bristle-like antennae being utilized for the purpose. This can hardly be looked upon as a means of locomotion, I imagine, and as the ♀ was found about $\frac{1}{8}$ inch *below* the ovisac, I think the movements were rather due to the insect having fallen out. On the dorsum were a number of very delicate waxy filaments, but these did not seem to be attached to body. They were, I think, from the inner lining of the ovisac.

Adult ♀ viviparous; when alive may attain 2·6 mm. long by 1·8 mm. broad; chestnut-brown in colour; distinctly segmented. Margins appear thin and lighter in colour.

In boiling KOH the insects become purplish and stain the liquid deeply.

When cleared and mounted the dermis is clear and colourless except around the anal end, where it is much more chitinous, much wrinkled, and brown in colour. The anal ring has 6 long bristles and lies deeply recessed in a trough-like cavity. The anal lobes are represented by several stout hairs; the circum-anal region bears many sharp, strong spines and gland-pores, and is finely rugose.

The two pairs of spiracles are conspicuous, yellow, of usual size, shape, and position (Fig. 9*a*).

Antennae of 3 segments, often appearing to have but 2, owing to the indistinct nature of 1. The segments are all very short, 1 being broad, 2 narrowed, and 3 irregularly conical, bearing several hairs (Fig. 9).

Larva, purplish in colour, elongate, active. Antennae of 6 segments, of which 6 is longest, being as long as 4 + 5 (Fig. 9*b*). Anal ring with 6 bristles. Anal tubercles produced, each bearing a very long seta and 2 shorter hairs. The setae of the anal lobes are about three times as long as those of the anal ring; the shorter hairs on the lobes are of about the same length as the latter (Fig. 9*c*).

Habitat: On roots of grass; Daspoort, Pretoria. Collected by the writer, October 11, 1914.

Material studied includes a number of ovisacs with ♀ ♀ and young enclosed; 16 larvae, and 15 ♀ ♀ cleared and mounted.

Collection No.: 70.

## Gen. RHIZOECUS Künck.

Adult ♀ exceptionally long and narrow. Antennae short, geniculate, of 5 joints, the terminal segment bearing several falciform spines as well as the usual hairs. Anal ring with 6 hairs. Integument with some 3-grouped glands.

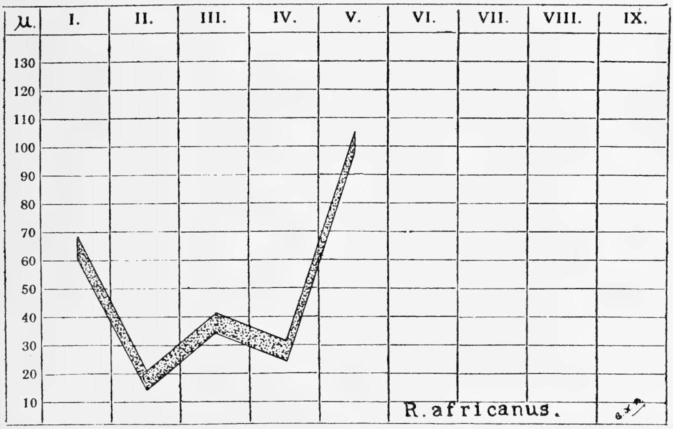
### 3. Rhizoecus africanus sp. n.

(Plate XVII., Figs. 10–10*e*).

The material on which this species is founded consists of 15 ♀ insects which were collected on the roots of flowering plants in Mr. Ayres' nursery at Capetown in February, 1906. The specimens were kept in alcohol in the Cape Collection.

As I have never seen the insect alive, and no notes were made at the time of collection, it is impossible to give details of secretion, etc.

The spirit specimens were of a purplish-brown colour, but turned purple in boiling KOH. In size they range from 2 mm. to 3·8 mm.; are elongate and narrow, with parallel sides; the two extremities are rounded, of about equal width.




In mounted specimens the most striking characters are the extreme length of the body posterior to the legs; the prominent anal lobes (Fig. 10) with the two or more long setae and several shorter hairs; the elongate mentum; the geniculated antennae, which are short and stout (Fig. 10*d*); the absence of eyes; and the 3-grouped glands (Fig. 10*b*).

The antennae are 5-segmented, joint 5 being long, and bearing 4 stout, falciform spines in addition to the normal hairs (Fig. 10*d*). Joint 3 is much longer than 2, usually twice the length.

The measurements of the antennal segments give the following range:—(1) 62–68; (2) 15–22; (3) 35–42; (4) 25–32; (5) 98–106.

The legs approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 52 | 85 | 180 | 58 | 85 | 27 | 105 |
| II. | 52 | 68 ? | 180 | 51 | 102 | 27 | 115 |
| III. | 52 | 85 | 220 | 68 | 122 | 34 | 120 |

There are two long stout spines on tarsus II, and one on tarsus III, the other being replaced by a spine-like hair. Tarsal digitules are apparently absent.

The anal lobes are furnished with several (2 to 5) long setae and a few shorter hairs. The longest setae measure approximately 170 $\mu$ ; the shorter ones 95 $\mu$. Those of the anal ring are usually about 105 $\mu$ in length.

The dermis is characterized by (*a*) two pairs of "eye-shaped cicatrices" (Fig. 10*a*) ; (*b*) small pores, some of which have longer or shorter hairs (Fig. 10*b*) ; (*c*) large disc-like gland pores, which are chiefly confined to the dorsum (Fig. 10*c*), and (*d*) grouped glands, with 3 elongate pores pressed together, and presenting a propeller-like appearance (Fig. 10*b*). These 3-grouped glands appear to be widely scattered over the body-surface, but are probably in two transverse series across each segment, about 10 such gland-groups in each row.

This insect reminds one very much of *R. terrestris* (Newst.), but obviously differs in size. The chief microscopic differences are that the grouped glands are far more numerous in *africanus* than in *terrestris* ; the antennae of the latter, as figured by Newstead (Monograph II, Plate lxix., Figs. 5, 5*a*) show the 3rd joint shorter, or equal in length with 2, while in *africanus* joint 3 is always much longer than 2. The stout spines which are so striking on the tibia and tarsus of *africanus* (Fig. 10*e*) are apparently absent in *terrestris*.

## Tribe PSEUDOCOCCINI.

### Gen. NATALENSIA g. n. Type: *fulleri* sp. n.

Larva elongate, of the usual *Pseudococcus* type. Antennae six-segmented, terminal joint longest. Anal ring with six hairs. Caudal lobes moderately produced ; each with one long seta and several shorter hairs and spines. Adult ♀ enclosed in a double-walled cyst of felt-like substance, the two layers of similar texture, readily separated. Cysts of type species subterranean, attached to roots of grass (Fig. 2).

♀ of type species broadly elliptical, flat beneath, convex above; antennae and legs present. Anterior and posterior segments in form of rectangular plates, anterior one with median rounded projection. Mouthparts well developed but small. Anal ring large, with six hairs. Caudal lobes not produced, but represented by caudal setae.

This genus most nearly approaches *Cryptoripersia* Ckll., but from the formation of the cysts, and the characters of the adult ♀, it is certainly quite distinct.

### 4. Natalensia fulleri sp. n.

(Plate XVI., Fig. 2. Plate XVII., Figs. 11–11*d*.)

Adult ♀ entirely enclosed in a double-walled cyst.

Cysts (Fig. 2): Outer cyst may attain 9 mm. long by 5 mm. broad, dark-coloured owing to adherent soil; brittle when dry. As only dry material has been observed by the writer the following description of colour, etc., may have to be modified later when fresh specimens are obtained.

Texture—after boiling in KOH for 30 minutes—tough, felt-like, nearly 1 mm. in thickness, dirty brown in colour. Fragments pressed on slide below coverglass in alcohol give one the impression of the texture being waxy, not definitely fibrous.

Inner cyst pale buff-coloured. This has the appearance of being more loosely constructed. The outer shape and size are those of the interior of the outer cyst, from which it separates readily. Larvae were found intermingled with the inner layers of this cyst-like ovisac.

Larva in boiling KOH, from dry material, dark brown, elongate, 0·6 mm. long and 0·25 mm. broad; legs long; antennae normal, of 6 segments, of which 6 is much longer than any of the others. Two is next, being about one-half the length of 6. Others subequal and shorter. Caudal extremity as illustrated (Fig. 11*b*).

♂: Not observed.

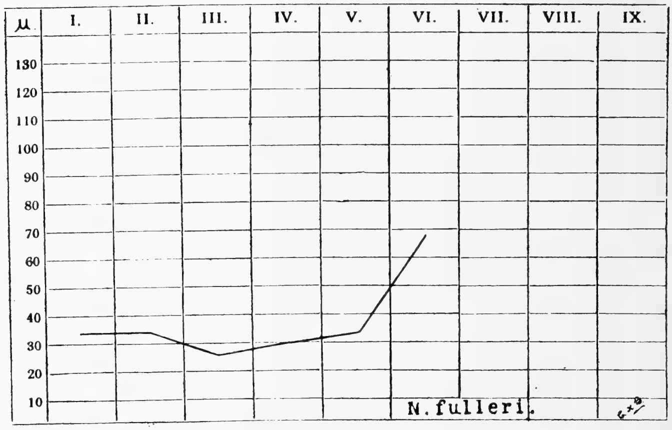
Adult ♀ (from dry material), after boiling in KOH dark brown in colour, broadly elliptical, 4 mm. long and 4·5 mm. broad, convex above and flat beneath. Segmentation very distinct. The anterior and posterior segments are rectangular and plate-like. In front the anterior segment is produced into a rounded cone, giving the insect the appearance of possessing a short rounded snout. The antennae project from below the sides of the snout as shown in the sketch (Fig. 11), which was kindly made with camera lucida by Mr. Claude Fuller.

Antennae of 6 segments, measurements in $\mu$:—(1) 34; (2) 34; (3) 27; (4) 30; (5) 34; (6) 68.

The legs are comparatively small and delicately chitinized. They measure in the type:—

| | Trochanter + Femur. | | Tibia. | | Tarsus + Claw. |
|---|---|---|---|---|---|
| | long. | broad. | long. | broad. | long. |
| I. | 136 | 37 | 68 | 20 | 88 |
| II. | 122 | 34 | 85 | 20 | 72 |
| III. | 126 | 34 | 95 | 20 | 88 |

There are a few scattered spines at the margins, but no conspicuous gland-pores were seen. Anal ring with six bristles. Caudal lobes not produced, bearing several hairs of about same length as those of anal




ring. No long caudal setae present in the specimens studied, but such are easily displaced in working with dry material.

Collected on the roots of grass in the nests of a small red ant in the Botanic Gardens, Pietermaritzburg, Natal, by Mr. Claude Fuller, 1910.

Material examined included a number of cysts on roots, five adult ♀ ♀ and numerous larvae.

Collection No.: 43.

### Gen. TYLOCOCCUS Newst.

Adult ♀ *Pseudococcus*-like except that the marginal spine areas are produced on ± rounded tubercles.

### 5. Tylococcus chrysocomae sp. n.

(Plate XVI., Fig. 5. Plate XVIII., Figs. 12–12*f*.)

Ovisac (Fig. 5): White, dense, elongate oval, may reach 5 mm. long and 2 mm. in diameter. The ovisacs may be single or clustered. The adult ♀ is found at one extremity of the ovisac and often appears as though partly enclosed owing to the median dorsal keel of white secretion.

Ova: Small, broadly oval, pale olivaceous yellow in colour.

Larva (mounted from dry material): Elongate, 0·4 mm. long. Antennae of 6 segments, 6 being longest, as long as 3 + 4 + 5 (Fig. 12*e*). Anal ring with six bristles. Caudal lobes very prominent, each bearing one long seta and two comparatively long stout spines (Fig. 12*f*).

♂: Not observed.

Adult ♀: Dark olivaceous at time of oviposition, becoming dark brown when ovisac is complete. Margins with a fringe of delicate filaments, and dorsum with a median keel of white secretion.

When cleared, stained, and mounted, the adult ♀ is 2 mm. to 2·5 mm. long. Around the margins of the body there is a series of 34 large rounded tubercles usually bearing 3 to 8 stout conical spines. In addition to these there are other series in which the tubercles are small or obsolete, their position being indicated by one or more stout spines. The median dorsal series of *insolitus* is represented, as a rule, by two single spines, separated slightly, on the median line, entirely without tubercles. The subdorsal series of *insolitus* is also represented by 1 to 3 spines, with tubercles either very small or entirely absent.

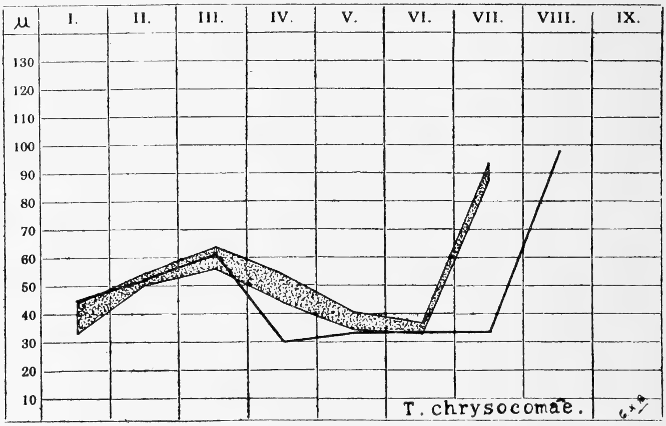
The posterior pair of marginal tubercles take the place of the caudal lobes of *Pseudococcus*. In addition to stout conical spines, of which there are usually 3 to 5, these tubercles bear the caudal setae which are about equal in length to those of the anal ring, i.e. about 90 $\mu$ long (Fig. 12*b*).

The eyes are prominent, roundly conical, with the apical portion transparent. Mentum about 132 $\mu$ long.

The dermis is characterized by numerous large and small gland-pores. The large form are disc-like, with very thick rings and small circular pores. These are most commonly distributed across the middle of the segments.

The antennae are remarkable in that there are forms with 7 joints, others with 8 joints, and a third class with 7 and 8 segmented forms in the same insect. The three classes are represented by adult ♀ ♀ with completed ovisacs. The measurements, however, are comparatively constant, the 7-jointed form ranging:—(1) 34–44 $\mu$; (2) 51–54 $\mu$; (3) 57–68 $\mu$; (4) 44–58 $\mu$; (5) 35–40 $\mu$; (6) 34 $\mu$; (7) 88–102 $\mu$ (Fig. 12).

The 8-jointed form measures approximately as follows:—(1) 44; (2) 52; (3) 61; (4) 30; (5) 34; (6) 34; (7) 34; (8) 98 μ.




Twenty-seven females were studied. Of these twenty-two had 7-segmented antennae, three had a 7-jointed antenna on one side and an 8-jointed form on the other, and two had 8-jointed antennae. In these cases the segmentation was quite distinct, not represented by a pseudo-articulation such as is often found in the antennae of *Pseudococcus* spp.

The legs are well developed, and measure in μ as follows:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 68 | 108 | 245 | 61 | 190 | 30 | 112 |
| II. | 71 | 119 | 260 | 64 | 212 | 34 | 119 |
| III. | 71 | 119 | 275 | 61 | 238 | 34 | 122 |

A normal tarsus III is shown in Fig. 12*c*; the abnormal leg III from the same insect forms Fig. 12*d*.

Habitat: On stems of *Chrysocoma tenuifolia* Berg. Collected by Mr. C. P. Lounsbury, Tulbagh, C.P., December 20, 1906. Also on same plant at Grahamstown, C.P. Collected by Mr. A. Kelly, March 4, 1915.

Remarks: The material studied consists of numbers of dry ovisacs with ♀♀, ova, and larvae, and 27 adult ♀♀, cleared and stained (Tulbagh material). Also numerous ♀♀ with ovisacs and ova, and 4 adult ♀♀ cleared and mounted (Grahamstown material).

This is a very distinct species. The only other described insects belonging to the genus are:—*Tylococcus madagascariensis* Newst., *T. cycliger* (Leonardi), and *T. insolitus* (Green). A variety of *Pseudococcus stelli* sp. n. has been described under the name var. *tylococciformis* var. n. in this paper, but I am not yet decided as to exactly what relation it bears to that species.

Collection Nos.: 44 and 61.

### 6. Tylococcus insolitus (Green).

*Phenacoccus insolitus* Green, Mem. Dep. Agr. of India, II., 2, p. 26, 1908, Plate iii., Fig. 10.

Ovisac: White, elongate when complete, extending below and behind the adult ♀. In texture it is coarsely fibrous, composed of white cottony matter with coarse glassy filaments intermixed. Length when complete about 2 mm.; width about 1 mm.; upper suface slightly rounded.

Ova: Pale creamy or greenish-white; slightly farinose, about 0·33 mm. long.

Larva: Pale yellowish or greenish-white in colour, with 4 distinct, large, black dorsal dots. Margin with fringe of delicate glassy filaments, which remind one of *Ps. virgatus* Ckll.

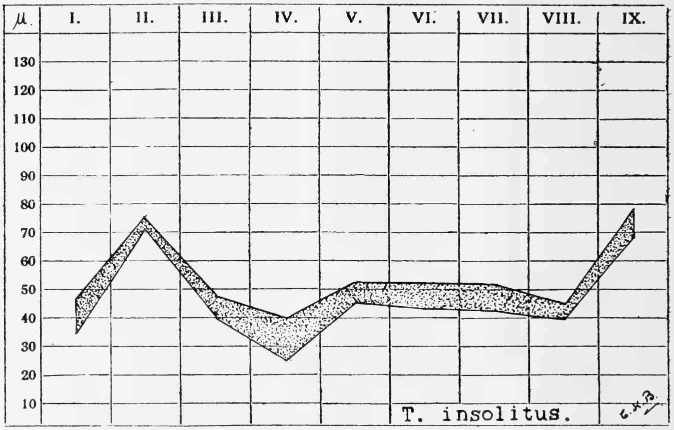
Freshly mounted in balsam 0·4 mm. long; antennae 6-segmented. Marginal and dorsal tubercles conspicuous; eyes distinct, with a small black mark below each. Anal ring large, with six hairs. Marginal glassy filaments arise from the stout spines of the rounded tubercles.

Adult ♀: About 1·5 mm. long and 1 mm. broad, pale greenish-yellow with black dorsal markings. When seen under a pocket lens there is a central black dot, and usually five others surrounding this about half-way between the central spot and the margins. Two of these are towards the anterior end and three posterior. On the dorsum and margins are numbers of relatively stout glassy filaments. Examined under a low power it is seen that these filaments arise from rounded tubercles, and are secreted from stout conical spines, the number of filaments varies with the number of spines; there are usually from four to twelve radiating from the same protuberance.

Instead of caudal filaments there are two comparatively short, dense, wide plates, more or less curved and compressed at the base, curving outwards, in some cases, like a vase. Insects when dead and rubbed dark purple-brown.

In boiling KOH the colour becomes brownish-red, but does not stain the liquid.

When cleared, stained, and mounted the insects average 2 mm. in length. The most striking feature is the presence of the numerous large rounded protuberances, which are distributed as follows :—(*a*) Marginal tubercles thirty-four in number, seventeen on each side, the seventeenth or posterior pair bearing setae as well as stout spines. These take the place of the caudal lobes. (*b*) A median dorsal series of twelve tubercles extending over the whole dorsum, and not interrupted on the abdominal segments.* (*c*) A subdorsal series on each side about midway between the median and marginal series, each consisting of 10 tubercles, the




posterior two of the median series not represented. (*d*) On each of the three thoracic segments there are two further tubercles present, one on each side between the median and subdorsal series. The marginal series are the most prominent, being large, and rounded, and bearing on an average 10 very stout conical spines 30 μ long. The number of spines varies from 5 to 12 on this series of tubercles, 6 or 7 being the most common number at the anterior end and 10 to 12 on the first abdominal segments. The other series are generally smaller, and possess fewer spines, the median and subdorsal series being most pronounced on the thoracic segments where 6 or 7 spines is the usual number. In all other cases 3 to 5 spines appear normal.

The dermis is characterized by (*a*) small gland-pores, few in number, some with subcutaneous tubes and others with bristle-like hairs ; and (*b*)

* Although the description of *T. insolitus* states that "the medium series absent on the abdominal segments" the figure l.c. Plate iii., Fig. 10, shows the distribution of tubercles exactly as in the South African insect.

large "disc" glands, most common in the abdominal region, where they are arranged in close order across the segments.

The antennae are 9-jointed, the range of measurements being:—(1) 36–48; (2) 72–75; (3) 40–48; (4) 27–40; (5) 47–52; (6) 44–52; (7) 44–52; (8) 40–45; (9) 68–78.

The mentum is normal, about 110 μ long. The eyes are comparatively large and conspicuous.

The legs approximate:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 80 | 100 | 290 | 45 | 230 | 30 | 112 |
| II. | 85 | 105 | 300 | 60 | 245 | 35 | 120 |
| III. | 85 | 105 | 310 | 65 | 290 | 35 | 135 |

The tarsal digitules are slender hairs. Digitules of the claw slightly knobbed.

The setae of the anal lobes are about 140 μ long. In addition to the long setae each lobe bears a few shorter hairs and 4 or 5 stout conical spines. The setae of the anal ring are about as long as the long setae of the lobes (140 μ).

Habitat: On hibiscus, Kingwilliamstown, C.P. Coll. J. W. Hodgson, February 27, 1915.

Collection No.: 31.

## Gen. PSEUDOCOCCUS Westw.

This genus comprises the well-known insects commonly known as "mealy-bugs." Their soft bodies are usually covered with a more or less dense coat of powdery secretion.

The shape of the body is generally elongate oval, and there are usually two short, rounded, caudal lobes which bear the caudal setae.

The antennae are 6- to 9-jointed, but 8 is the most common number.

As a rule the oviparous species construct a dense ovisac of white cottony material, whereas those which are viviparous make no such ovisac.

N.B.—The synonymy of this genus, as used in this paper, requires explanation, or rather justification, as it comprises forms generally included in the genus *Phenacoccus* Ckll., and encroaches upon the genus *Ripersia* Sign.

Pending further study, the results of which it is hoped to publish at a later date, a brief explanation will suffice.

I am quite convinced that the forms included by Mrs. Fernald (Catalogue, 1903) under the genera:—*Phenacoccus* (p. 89); *Ceroputo* (p. 94); *Tylococcus* (p. 95); *Trionymus* (p. 96); *Pseudococcus* (p. 96); *Erium* (p. 112); *Pseudoripersia* (p. 115); *Ripersiella* (p. 115); and *Ripersia* (p. 116) are closely related. In fact they probably represent a phylogenetic series originating in a form similar to *Ripersia* s. str. All forms have the anal ring with 6 hairs and the caudal lobes ± similar. The larvae of the whole series are of the same type and all have 6-jointed antennae.

Several lines of development are apparent in the series, but the most striking characteristic is illustrated by the acquisition of additional antennal segments in the adult ♀. For instance, in *Ripersia* s. str. the adult ♀ retains the original larval number, i.e. 6, but in *Phenacoccus* the adult ♀ has 9, the additional segments appearing with the ecdyses.

I have attempted to indicate the relationship between the genera by isolating them to form the tribe *Pseudococcini.*

*Ripersia*, *Pseudococcus*, and *Phenacoccus* are established on antennal characters; the remainder, which are the more modern genera, upon others. Strictly speaking the three first mentioned should retain their Signoret significance in which *Ripersia* Sign. has 6-jointed antennae; *Pseudococcus* Westw. (which replaces the "*Dactylopius* Costa" of Signoret) 8-jointed antennae; and *Phenacoccus* Ckll. (= "*Pseudococcus* Westw." of Signoret) 9-segmented antennae. This arrangement accommodated the insects known to Dr. Signoret very well, and the fact that there was no genus made for strictly 7-jointed forms was obviously due to the lack of the insects showing that character. Had this antennal form proved a satisfactory generic character the establishment of a genus to include those insects with 7-jointed antennae in the adult ♀ would have completed the series; and the separation of species into the four genera would have been extremely simple. In reality this could never be done with the *Pseudococcini*, for a number of different conditions influence the antennal character of the adult ♀, which must therefore be considered as an unstable character, and, as such, quite unsuitable to retain generic significance.

The majority of the species described in the genus *Ripersia* are reported from the nests of ants, and the genus has been extended to include insects with 7-jointed antennae as well as those with 6. Strangely enough other forms, with 7-jointed antennae, which are found on plants, are included in *Pseudococcus*. But the fact that insects are found below stones or in the nests of ants cannot have this influence, or else, on occasion, *P. citri* and *P. adonidum* must also be *Ripersia* spp., as they have been found in ants' nests in Massachusetts (King and Tinsley, Psyche, p. 297, 1898). If the genus *Ripersia* can be extended to include insects possessing 7-jointed antennae (because there is no special genus for the 7-jointed forms) can we still extend its bounds to include a form such as *Ps. transvaalensis* described later in this paper, which has adult females with 6-, 7-, or 8-jointed antennae?

Climatic or seasonal variations may have an effect on the antennal character of insects in this series. Thus, in *Ps. agrifoliae* Essig and *Ps. trifolii* Forbes we have two distinct generations, a summer form in which all the adult females have 8-jointed antennae, and a winter generation in which all the adult females have 7-jointed antennae. Again, in *Phenacoccus acericola* King, we apparently have a similar condition, the summer form being 9-jointed and the winter form with 8 segments. Obviously we cannot place the two generations in the last-mentioned case in two different genera (*Phenacoccus* and *Pseudococcus*).

I am inclined to associate the smaller number of antennal segments in these cases with retarded metabolism, as this is always found in the winter forms. Perhaps we can account for the new form of *Ps. citri*, which I describe later as var. *phenacocciformis* in a similar manner.

I repeat that the antennal condition in the *Pseudococcini* cannot retain generic significance and that other characters must be utilized. Throughout the whole tribe we must include in the same genus forms with 6- to 9-jointed antennae, or perhaps 6- to 10-, for *Ceroputo pilosellae* Šulc. has the antennae 9- or 10-jointed.

This must be applied to those genera which are founded upon other characters. For instance, in *Tylococcus* Newst., which is characterized by the presence of projecting marginal protuberances, the type (*T. madagascariensis* Newst.) has 8-jointed antennae, but this genus must be extended to include *T. chrysocomae* sp. n. with 7 or 8, and *T. insolitus* (Green) which has 9. It is quite within the range of possibility that a 6-jointed form may be discovered. As a further instance we may note *Ceroputo* Šulc., which is characterized by waxy lamellae which cover the dorsum of the ♀ "like an *Orthezia*."

As already mentioned, the type species, *C. pilosellae* Šulc., has 9- or 10-jointed antennae in the adult ♀; *C. volynicus* Nassanow has 9, and *C. mexicanus* Ckll. 8.

## SERIES A, WITH SEVEN-SEGMENTED ANTENNAE.

### 7. Pseudococcus filamentosus (Ckll.).

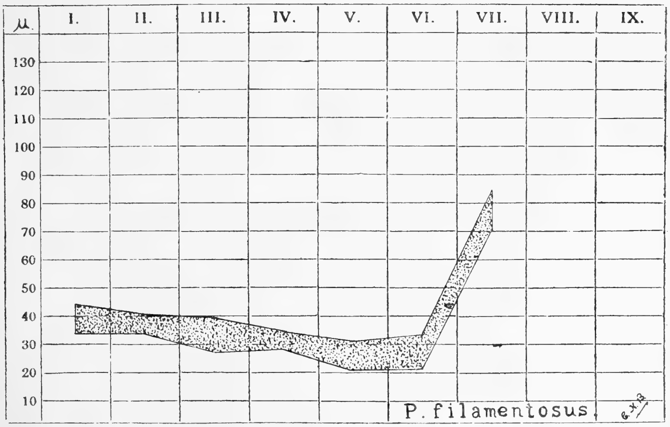
(Plate XVIII., Fig. 13.)

*Dactylopius filamentosus* Ckll., The Entom., xxvi., p. 268, 1893.
,, *vastator* Mask., N.Z. Trans., xxvii., p. 74, 1894.
,, *filamentosus* Tins., Can. Ent., xxxii., p. 64, 1900.
,, *perniciosus* Newst. & Willcocks, Bull. Ent. Res. 1, 2, pp. 138–140, 1910.

My chart for this species is as follows:—

Adult ♀: Size mounted may reach 4 mm.

Antennae: 7-segmented, range of measurements:—




Legs: Measurements in $\mu$ approximate:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 57 | 88 | 170 | 54 | 78 | 27 | 81 |
| II. | 68 | 92 | 182 | 58 | 88 | 27 | 81 |
| III. | 68 | 102 | 195 | 61 | 108 | 34 | 81 |

The trochanter is normal (Fig. 13). Cf. *Ps. natalensis* (Fig. 14).

Mentum long (138 $\mu$), acute (Fig. 13*a*.).

Setae of anal lobes may reach 205 $\mu$ in length.

Setae of anal ring about 135 $\mu$.

Host-plants: Citrus, *Grevillea robusta*, hibiscus, etc.

Habitat: Bathurst, C.P., Natal Coast, and Pretoria, T.P.

The records of this species in South Africa are:—On hibiscus from Richmond, Natal (U.S.D.A. Ent. Div. No. 7232). On orange from Natal (Cockerell); orange, Capetown (U.S.D.A. Ent. Div. No. 7706); Native tree, Sp. indet., Natal, Lounsbury, October, 1914; *Grevillea robusta*, Pretoria, Mr. K. Munro, November 9, 1914.

The Washington reference No. 7706 was in all probability recorded from Capetown because the material was sent from that town, but it is clearly recalled that it was collected in Bathurst (Lounsbury). The species has never become established in the Western Province of the Cape as far as I have been able to ascertain.

The most closely related South African species are *Ps. natalensis* and *Ps. solitarius* spp. n. q.v.

Collection No.: 57.

### 8. Pseudococcus natalensis sp. n.

(Plate XVIII., Figs. 14, 14*a*.)

*Dactylopius filamentosus* Ckll., "small variety," Entom., xxxiv., p. 224, 1901.

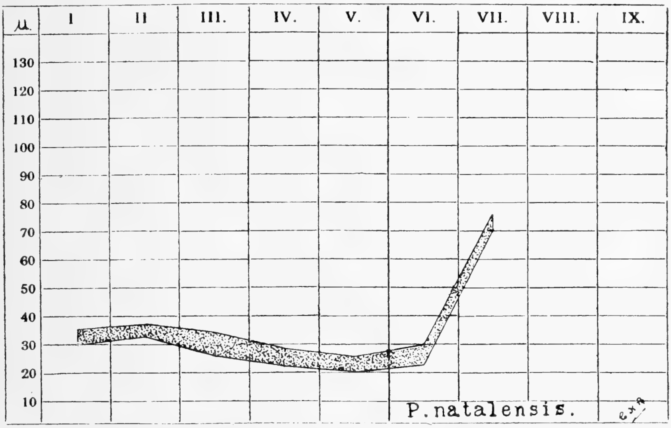
Ovisac: The ovisacs are long and narrow, and are clustered one above the other in the leaf-sheaths, often forming a row two inches in length. They are entirely closed, and have dense white walls of felted material, often roughened on the outside, and brittle when dry. They enclose the viviparous female and the larvae. It is remarkable for a truly viviparous mealy-bug to be enclosed in so dense a sac. The majority of the ♀ specimens mounted fresh by C. Fuller contain well-developed larvae.

♀. Not adult: 1·12 mm. long when mounted, has antennae 6-jointed measuring as follows:—(1) 34; (2) 34; (3) 34; (4) 18; (5) 20; (6) 68.

♀. Adult: In colour, both dry and in KOH this insect is like *filamentosus*. It also has 7-jointed antennae of very similar length, but apart from these points it is an entirely different insect. *Ps. filamentosus* Ckll. is much larger, constructs a large *cottony* ovisac which contains large numbers of eggs, but does not enclose the insect itself. But the most striking character of *natalensis* in mounted specimens is the remarkable trochanter, which is quite different from that of any other mealy-bug known to me. It is shoe-shaped and has a distinct conical protuberance, which bears a very strong, short, conical spine (Fig. 14).

Mounted specimens measure approximately 2 mm. long by 1·4 mm. broad.

The range of variation of the antennal segments is:—(1) 30–34; (2) 33–37; (3) 27–34; (4) 23–28; (5) 20–24; (6) 23–30; (7) 71–75.




The legs vary within the range indicated below:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 35–44 | 68–72 | 150–164 | 38–42 | 90–102 | 24 | 75 |
| II. | 40–48 | 68–72 | 160–172 | 38–42 | 100–108 | 24 | 75 |
| III. | 46–52 | 70–80 | 174–184 | 38–42 | 105–136 | 24 | 84 |

Setae of anal lobe: May attain 154 $\mu$ in length.

Setae of anal ring: Average 105 $\mu$ in length.

The dermis shows single gland-pores, scattered short hairs, and marginal spines usually in groups of 2. The circum-anal region has comparatively large gland-pores which bear short subcutaneous tubes.

The mentum (Fig. 14*a*) is short (80 $\mu$) and broadly conical.

♂: Of the usual *Pseudococcus* type, with 10-jointed antennae and four caudal bristles 22 mm. long. The specimens were mounted by C. Fuller in 1900, and no note was kept of living characteristics.

Length of body without antennae 0·75 mm.

Breadth across thorax 0·24 mm.

Length of wing 0·92 mm.

Length of antenna 0·6 mm.

Antennal segments approximate:—(1) 34; (2) 54; (3) 68; (4) 58; (5) 61; (6) 64; (7) 57; (8) 57; (9) 51; (10) 68.

All segments with the normal number of hairs.

Habitat: On grass at Tongaat (alt. 63 ft.) and also at Pietermaritzburg (alt. 2,200 ft.) Natal. Collected by Claude Fuller 1899 and 1900.

Collection No.: 64.

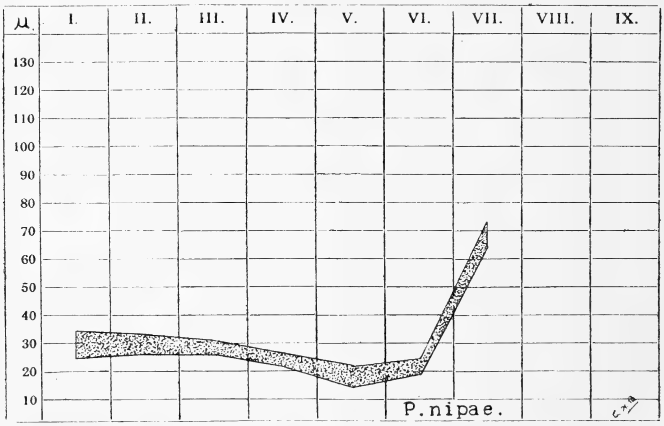
## 9. Pseudococcus nipae (Maskell).

*Dactylopius nipae* Mask., N.Z. Trans., xxv., p. 230 (1892).
" " Newst., Ent. Mon. Mag., xxix., p. 187 (1893).
" " Mask., N.Z. Trans., xxvi., p. 88 (1893).
" " " The Entom., xxvii., p. 45 (1894).
" " King, Can. Ent., xxxiv., p. 59 (1902).

Adult ♀ covered with conical masses of buff-coloured wax; hence commonly called "Spiny mealy-bug" in South African nurseries.

Size mounted about 1·5 mm. long and 1·2 mm. broad.

Antennae 7-segmented with range of measurements as indicated in diagram:—




The legs approximate:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 35 | 67 | 136 | 40 | 70 | 24 | 61 |
| II. | 37 | 67 | 140 | 44 | 70 | 24 | 68 |
| III. | 36 | 67 | 152 | 51 | 75 | 24 | 68 |

The setae of the anal lobes may reach 75 $\mu$ in length.

Those of the anal ring are about 100 $\mu$ long.

Host-plants : Common on a variety of cultivated palms.

South African localities: Introduced into a nursery in the Cape Peninsula about 1906, probably from Belgium (A. E. Kelly). Now common also at Graaff Reinet (C.P.), Durban (Natal), and in Pretoria (Tr.)

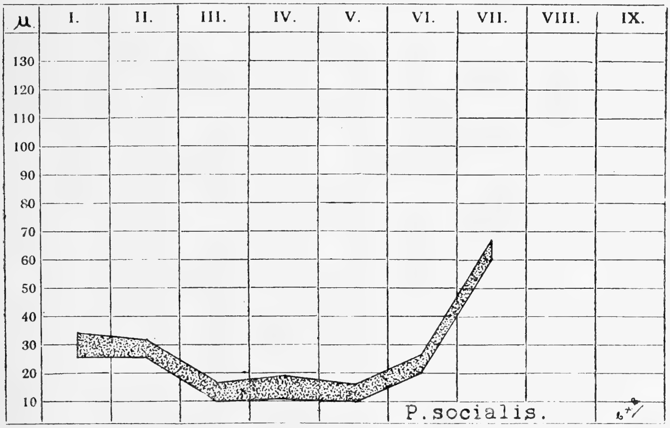
Collection No. : 58.

### 10. Pseudococcus socialis sp. n.

(Plate XVIII., Fig. 15.)

Ovisac : An irregular mass of white cottony secretion, about 3 mm. in diameter, in the axil of a grass-leaf was found to cover numbers of ova and larvae, and also eight adult insects, all of which contained eggs.

The larva is of the usual type, but the caudal lobes are not produced. The antennae are comparatively long, of 6 segments, with 6 as long as 3 + 4 + 5.




The adult ♀ is elongate, of a purplish-brown colour, the whole body being slightly powdered with white. There were no signs of lateral or caudal filaments. Below the cluster of insects there was a dense white layer of meal.

When placed into boiling KOH the insect turns black, then deep rich purple.

The average size of ♀ insects (containing ova) when mounted is 1·7 mm. long and 0·8 mm. broad.

The antennae are 7-segmented, the joints exhibiting the following range of variation:—(1) 27–34; (2) 27–31; (3) 10–17; (4) 11–19; (5) 10–17; (6) 20–27; (7) 61–65.

The eyes are comparatively small and inconspicuous.

The legs approximate:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 34 | 51 | 120–136 | 30 | 71 | 17 | 58 |
| II. | 40 | 56 | 130–140 | 30 | 75 | 17 | 61 |
| III. | 40 | 56 | 140–154 | 34 | 90 | 17 | 68 |

The setae of the anal lobes may attain 112 $\mu$ in length; those of the anal ring average 82 $\mu$.

The dermis is characterized by the usual gland-pores and a few scattered bristle-like hairs. The gland-pores of the venter are small and simple; those of the dorsum larger and disc-like (Fig. 15). There are no definite marginal gland areas.

Habitat: On grass in front of Union Buildings, Pretoria. Collected by the writer November 20, 1914.

Material studied consists of 8 adult ♀ ♀ and numerous larvae.

Collection No.: B 52.

### 11. Pseudococcus solitarius sp. n.

(Plate XVIII., Fig. 16.)

Adult ♀ with ovisac: The adult ♀ before secreting the ovisac is active, but comes to rest on the stem of Acacia, either in the axil of a leaf or at the base of a short stem or thorn. Although as many as six insects have been found on the same twig, in no case have two been found forming their ovisacs at the same point.

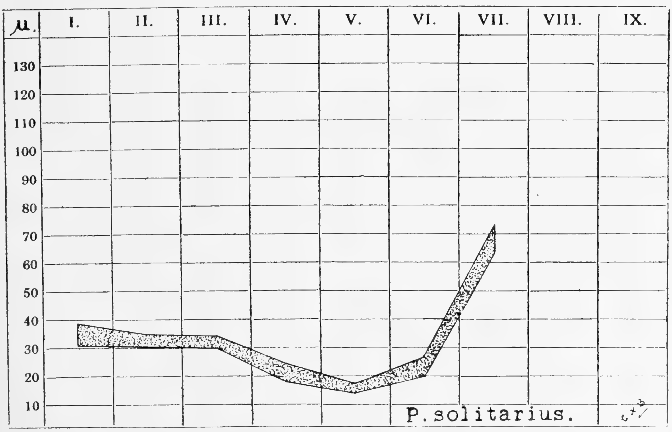
At first a thin layer of cottony matter is secreted, and this increases in amount until it appears as a round or broadly oval disc below the insect. In a few instances the ♀ was situated towards the anterior end of the sac, so that the head was in contact with the twig and the ovisac protruded beneath and behind her. When completed the ovisac is usually spherical, nearly twice the width of the insect in diameter, with the ♀ on top. Occasionally the uppermost fibres of the sac partly or wholly enclose the ♀, but as a rule this is not the case.

Ova: An exceptionally large number of ova are produced by the adult ♀. They are dark purplish-brown in colour, but turn black in boiling KOH.

Larva: Elongate, active, purplish in colour when alive, greenish when mounted in Canada balsam, 0·51 mm. long, 0·21 mm. broad. Antenna with 6 segments, of which 6 is longest, being as long as 3 + 4 + 5. Segment 1 comparatively long; 2, 3, 4, 5 subequal. Anal ring with 6 hairs. Caudal lobes each with one long setae, which is about twice as long as those of the anal ring, and two slender spines.

Adult ♀: The dorsum of the ♀ is covered by a rather dense powdery secretion, usually white, occasionally yellowish. No lateral filaments observed, but in some cases two short caudal ones were present. The colour of the insect, as seen at the segments, or in old adults, is shining black. In boiling KOH the black colour is retained until the body is nearly cleared, when it has a decided green tint, and is exceedingly difficult to clear. In this it reminds one of *Ps. filamentosus* Ckll. The liquid is stained but very slightly, having a slight violet tint.

♀ Mounted, varies in size, but is most often about 3 to 3·5 mm. long and 1·8 to 2 mm. broad. The derm is clear and bears scattered solitary pores and a few scattered hairs in the anterior portions, and some spine-like bristles on the posterior segments. The antennae are 7-jointed, the segments measuring as follows:—(1) 32–38; (2) 30–34; (3) 30–34; (4) 18–23; (5) 17; (6) 20–27; (7) 64–72.




The legs measure in $\mu$:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 52 | 102 | 176 | 64 | 85 | 34 | 68 + 26 |
| II. | 58 | 108 | 187 | 64 | 88 | 34 | 68 + 26 |
| III. | 52 | 120 | 204 | 61 | 108 | 34 | 68 + 26 |

The setae of the anal lobes average 170 $\mu$ long; those of the anal ring are approximately 120 $\mu$ in length.

Mentum large (150 $\mu$), tapering acutely to the tip (Fig. 16).

♂: Not yet observed.

Habitat: On thorn-trees (*Acacia* spp.), common in and around Pretoria. Collected by the writer, September and October, 1914. The succeeding generation was observed, still solitary, with ovisacs completed December 20, 1914.

Material studied consists of numbers of adult ♀♀ with ovisacs and 14 ♀♀ cleared, stained and mounted.

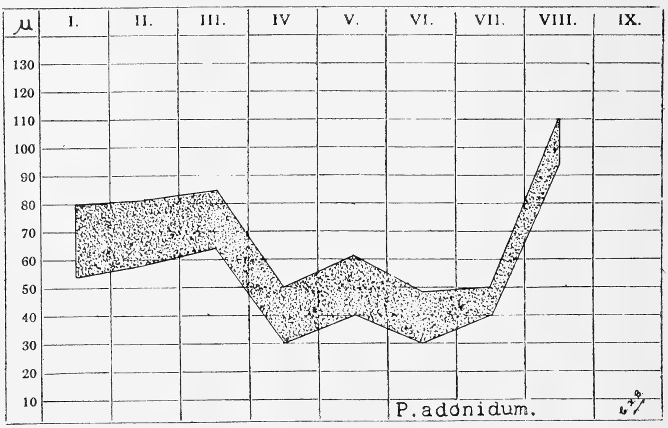
This insect, in some respects, seems to be intermediate between *Ps. hymenoclea* (Ckll.) and *Ps. filamentosus* (Ckll.), but it is certainly distinct. *Ps. acaciae* (Mask.) and *Ps. albizziae* (Mask.) are also in this series. The latter has 8-jointed antennae, but *acaciae* must be very similar to the species under discussion but smaller; the size given by Maskell being "length about 1/25 inch."

Collection No.: 65.

## SERIES B, WITH EIGHT-SEGMENTED ANTENNAE.

### 12. Pseudococcus adonidum (Linn.) Westw.

The antennal chart for this common species is given to complete the series.



*Coccus adonidum* Linné, Syst. Nat. edit., xii., p. 140, 1767.
*Pseudococcus adonidum* Westwood, Mod. Class. Ins. I., p. 118, 1839.
*Dactylopius longispinus* Targ., Catalogue, p. 32, 1869.
*D. adonium* Sign. Essai, p. 306, 1875.
*D. hoyae* Sign., p. 317. *D. lilacearum* Sign., p. 319.
*D. robiniae* Sign., p. 322. *D. tuliparum* Sign., p. 323.
*D. zamiae* Sign., p. 328.
*Coccus laurinus* Bdv., Ent. Hort., p. 353, 1869.
*Boisduvalia lauri* Sign., p. 338, 1875.
*D. longifilis* Comst., Report, p. 341, 1881.
*Ps. longispinus* (Targ.) Brain, Ann. Ent. Soc. Amer., v., p. 177, 1912.

Setae of anal lobes may reach 135 μ in length; those of the anal ring are usually about 145 μ long.

Host-plants: Ferns, palms, etc.

S.A. localities: Cape, Natal, and Transvaal. Common in greenhouses and nurseries.

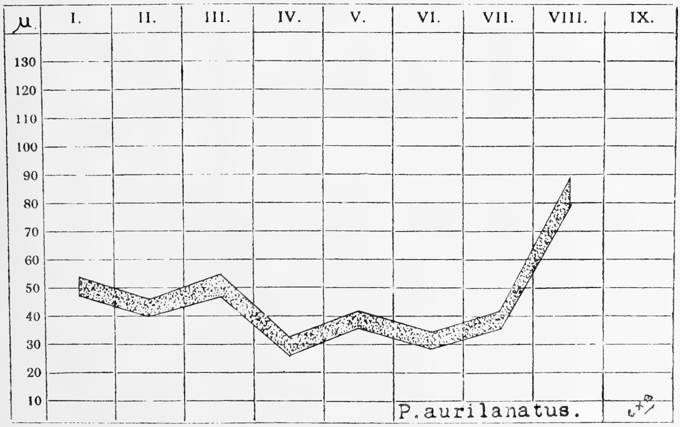
Remarks: This is the common "long-tailed" mealy-bug, which now has a world-wide distribution.

Collection No.: 55.

### 13. Pseudococcus aurilanatus (Mask.).

*Dactylopius aurilanatus* Mask., N.Z. Trans., xxii., p. 151, 1889.
,, ,, Craw., 5th Bien. Rep. Cal. Bd. Hort., p. 45, 1896.

Antennal curve:—



*Dactylopius aurilanatus* Mask., N.Z. Trans., xxix., p. 320, 1896.
,, ,, Frog., Dept. Ag. N.S.W., No. 175, p. 4, 1897.
,, ,, Full., 1st Rep. Ent. Natal, p. 105, 1901.

Adult ♀: Size mounted about 2·5 mm.

Legs: Measurements in $\mu$ approximate:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 70 | 68 | 185 | 40 | 112 | 27 | 85 |
| II. | 75 | 70 | 194 | 44 | 120 | 27 | 85 |
| III. | 75 | 75 | 208 | 44 | 136 | 27 | 85 |

The setae of the anal lobes are about 180 $\mu$ long; those of the anal ring 150 $\mu$.

Host-plants: *Araucaria* spp., including *A. bidwelli*, *A. excelsa*, *A. brasiliana*, *A. cooki*, and *A. cunninghami* (A. Kelly).

S.A. localities: Johannesburg and Pretoria (Tr.), Durban (Natal), and Graaff Reinet (C.P.).

Collection No.: 45.

## 14. Pseudococcus bechuanae sp. n.

On December 4, 1914, mealy-bug material was received from Vryburg, Bechuanaland, accompanied by a letter stating that the insect was a great pest on geraniums.

The specimens had been badly shaken in the post, but it was clear that large patches of the stem had been completely covered with ovisacs. The white secretion appeared powdery rather than cottony.

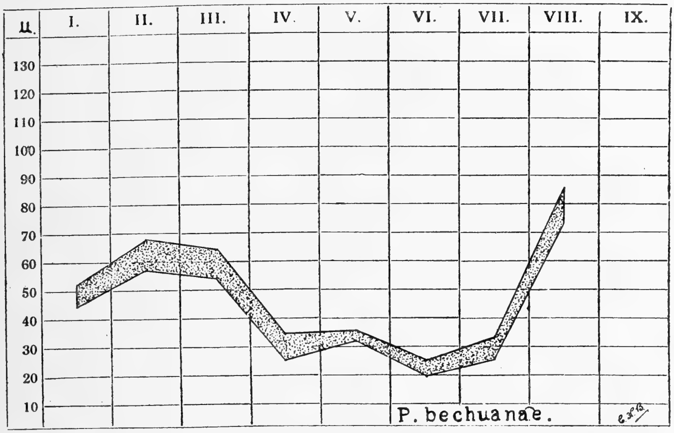
The females embedded in this were pinkish in colour when young, but purplish in older specimens. There were no lateral filaments, and only two short, blunt, caudal ones. The female when adult reaches approximately 3 mm. in length. In boiling NaOH the insect becomes very dark purple, almost black, while the liquid is stained but very slightly.

When cleared and mounted the most striking character is the absence of marginal spine areas, and the presence of scattered gland-pores of two sizes. The small ones are by far the more numerous; the larger ones have subcuticular tubes which are swollen inwardly. One of these always takes the place of the marginal spine areas, and there are often transverse lines of such across the middles of the segments.

The antennae are always 8-jointed, with 8 showing a pseudo-articulation in a few cases. The range of measurements of the segments is:—(1) 46–52; (2) 58–68; (3) 54–64; (4) 27–34; (5) 34; (6) 20–24; (7) 27–32; (8) 74–85.

The legs approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 68 | 100 | 248 | 61 | 185 | 34 | 85 |
| II. | 74 | 102 | 255 | 61 | 204 | 34 | 85 |
| III. | 78 | 102 | 275 | 61 | 238 | 34 | 85 |




The setae of the anal lobes are about 130 μ long; those of the anal ring average 95 μ in length.

Habitat: On geraniums, Vryburg, Bechuanaland. Collected by H. E. Sargent, December 3, 1914. Material studied consists of 12 adult ♀ ♀.

Collection No.: B 53.

## 15. Pseudococcus bromeliae (Bouché).

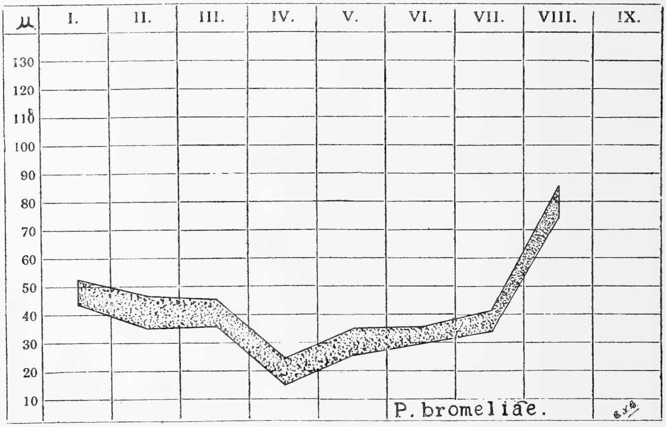
*Lecanium bromeliae* Bouché, Schadl. Gart. Ins., p. 49, 1833.
,, ,, ,, Naturg. Ins., p. 20, 1834.
,, ,, Burm., Handb. Ent., i., p. 70, 1835.
,, ,, Curt. Gard., Chron., p. 131, 1841.
*Aspidiotus* ,, Bouché, Stett. Ent. Zeit., v., p. 295, 1844.
*Dactylopius* ,, Sign., Ann. Soc. Ent. Fr. (5), v., p. 310, 1875.
*Lecanium* ,, Sign., Ann. Soc. Ent. Fr. (5), vi., p. 610, 1876.
*Dactylopius theobromae* Dougl., Ent. Mon. Mag., xxv., p. 317, 1889.
,, *bromeliae* Mask., N.Z. Trans., xxvi., p. 88, 1893.
,, ,, Cotes, Ind. Mus. Notes, iii., No. 5, p. 51, 1894.
,, ,, Tryon, Queensland Agr. Journ., viii., p. 297, 1901.

I have no doubt that the common pineapple mealy-bug of the Eastern Cape Province and Natal belongs to this species, and the following measurements are included to assist in future determinations of the species :—

Specimens of adult ♀, mounted, average 2·75 mm. in length.

Adult ♀, viviparous, usually containing well-developed larvae when mounted. The larvae are 0·45 mm. in length, have 6-jointed antennae, and moderately produced caudal lobes. On the dorsal surface, between the position of legs III and the caudal lobes there are two large stomata-like pores (?) ("eye-shaped cicatrices"), which are also retained in the later stages.

The adult ♀ has 8-jointed antennae which range in size as follows (from 12 specimens) :—(1) 45–52; (2) 36–47; (3) 37–44; (4) 17–23; (5) 27–35; (6) 30–34; (7) 34–41; (8) 75–85 μ.




The leg measurements approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 60 | 95 | 200 | 50 | 110 | 25 | 64 + claw |
| II. | 64 | 100 | 210 | 54 | 110 | 25 | 66 + claw |
| III. | 68 | 106 | 250 | 68 | 130 | 27 | 70 + claw |

The mentum is distinctly segmented, and is about 150 μ long.

The setae of the anal lobes may attain 145 μ in length, but average 134 μ, while those of the anal ring are approximately 88 μ in length.

Regarding the antennae, Signoret, 1875, p. 310, gives the following particulars :—

> "Les antennes de la femelle mère sont de huit articles, quoique nous en ayons trouvé aussi de sept, mais l'état normal est huit. Dans ce cas, le deuxième et le troisième sont égaux et plus longs que les quatrième, cinquième, sixième et septième, qui sont les plus courts, et, dans ceux-ci, le septième est un peu plus long, le huitième le double plus long que le précédent et d'une longueur égale aux quatrième, cinquième et sixième réunis; la pubescens est rare et peu longue, celle des pattes au contraire assez longue."

Maskell, 1893, pp. 88–89, writes :—

> "Antennae of eight joints, of which the second and third are equal, and longer than the fourth, fifth, sixth, or seventh; the eighth is about equal to the fourth, fifth, and sixth together; the hairs on the joints are short."

In describing an insect found on *Theobroma cacao* in the gardens of the Royal Botanic Society (England) in April, 1889, Douglas, 1889, p. 317, describes the antennae in the following terms :—

> "Antennae short, of 8 joints (Fig.), 1st very stout, not short; 2nd and 3rd longer, in length subequal, strong, but each consecutively thinner; 4th shortest of all; 5th and 6th each a trifle longer than 4th, subequal; 7th a trifle longer than 6th; 8th pointed, longest of all, equal to 5th, 6th, and 7th together, all with fine projecting hairs, the terminal ones on 8th longest."

Douglas named this species *Ps. theobromae*, but I think it was in all probability *Ps. bromeliae* (Bouché).

## 16. Pseudococcus burnerae sp. n.

(Plate XVI., Fig. 3. Plate XVIII., Fig. 17. Plate XIX., Fig. 22.)

Adult ♀ ♀ with ovisacs usually aggregated in compact masses on the undersides of the leaves of the various host-plants (Fig. 3).

The ovisacs are white, cottony, generally more or less spherical when complete, but the exact contour often obscured by the crowding of many together. The adult female is generally visible on top of the ovisac, the sides of which are raised around the insect. It therefore looks as though it had been pushed into the soft cottony mass. In other cases the insect is found at one side of the ovisac, which protrudes behind and below it, giving a decided *Pulvinaria* effect.

Ova and larvae pale translucent brown at first; showing slightly purplish later.

Larva of the usual type, with 6-jointed antennae; joint 6 long.

Adult ♂ of the usual type.

Length of head and body 775 $\mu$ to 1 mm.

Length of wing 1 mm.

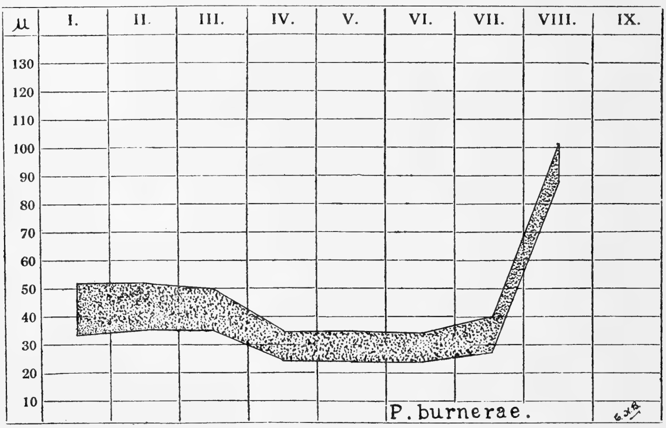
Length of caudal bristles 308 $\mu$.

Antennae 10-segmented measuring as follows :—(1) 34 ; (2) 58 ; (3) 68 ; (4) 51 ; (5) 51 ; (6) 45 ; (7) 48 ; (8) 44 ; (9) 44 ; (10) 72.

The adult ♀ is so densely covered with white, powdery secretion that the general body-colour is entirely obscured. The colour impression conveyed, however, is grey—perhaps slightly purplish or brown. There is no median, dorsal, clear patch as in *citri*. All filaments are slender except the two caudal ones, which are more delicate than those of *citri*. The caudal filaments may attain one-third the length of the body. The lateral ones are similar to those of *capensis* in that they are shortest at the anterior end, and gradually increase in length towards the posterior extremity.

When mounted the adult ♀ is about 2·5 mm. long and 1·5 mm. broad.

The antennae are uniformly 8-segmented, the range presented from 25 measurements being :—(1) 34–52 ; (2) 36–52 ; (3) 36–50 ; (4) 24–35 ; (5) 24–36 ; (6) 24–34 ; (7) 28–40 ; (8) 88–102.




It may be of interest to record the variation in antennal range of measurements on three host-plants.

(*a*) On granadilla, collected December, 1914, in Pretoria :—(1) 40–52 ; (2) 44–52 ; (3) 44–50 ; (4) 27–34 ; (5) 32–36 ; (6) 27–34 ; (7) 35–40 ; (8) 92–102.

(*b*) On *Gleditschia*, Bloemfontein, October 22, 1914 (J. C. Faure) :—(1) 37–45; (2) 36–44; (3) 40–47; (4) 24–30; (5) 27–34; (6) 27; (7) 30–34; (8) 90–96.

(*c*) On *Viburnum*, Lydenburg (Transvaal), March 9, 1914 (C. B. Hardenberg) :—(1) 34–45; (2) 38–44; (3) 36–42; (4) 26–35; (5) 26–35; (6) 24–32; (7) 28–34; (8) 88–95.

The legs vary within the usual limits, but the following approximate measurements may be given as typical :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 68 | 85 | 210 | 56 | 150 | 30 | 108 |
| II. | 74 | 94 | 230 | 64 | 170 | 30 | 115 |
| III. | 80 | 110 | 260 | 70 | 220 | 30 | 125 |

The marginal spine areas possess the usual two stout spines and a number of small gland-pores. These latter vary in number according to the position on the body, 6 to 8 being the usual number anterior to leg III.; 11 to 14 towards the posterior end (Fig. 22).

The dermis is characterized by small gland-pores scattered over the venter, many of which have slender subcuticular tubes; and large disc-like glands on the dorsum. There are also a few scattered hairs and spines.

The setae of the anal lobes are uniformly about twice the length of those of the anal ring, the most common lengths being roughly 200 $\mu$ and and 100 $\mu$ respectively.

Habitat: On granadilla (*Passiflora edulis*), Pretoria, collected by D. Gunn, December, 1914.

*Nerium oleander*, Pretoria, collected by the writer September 23, 1914.

*Sida rhombifolia* and *S. longipes*, Pretoria, collected by C. Fuller, October, 1914.

*Viburnum* sp., Lydenburg (Transvaal), collected by Mr. C. B. Hardenberg, March 9, 1914.

*Gleditschia* sp., Bloemfontein, collected by J. C. Faure, October 22, 1914.

The Oleander material was remarkable for the large amount of honey-dew which covered the entire twigs, and for the "curled" effect which many of the leaves exhibited. I cannot say whether this distortion was due to the insects, but it certainly appeared that this was the case, for no curled leaves were found which did not harbour hundreds of the insects on their lower surface.

I have great pleasure in associating the name of Miss O. Burner, of New York, with this interesting species.

Collection Nos.: B 45, 47; B 50, 66, and 66*a*.

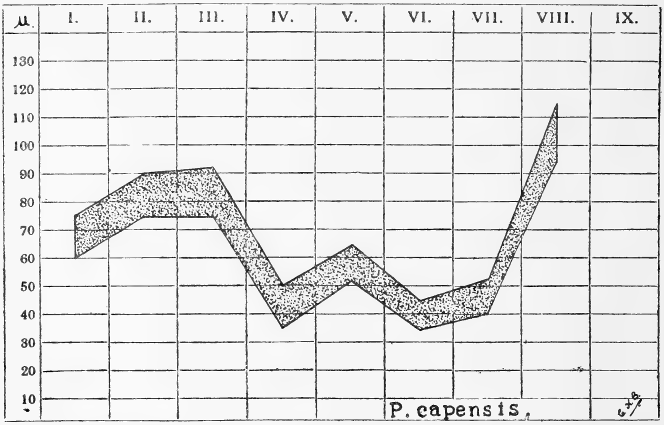
17. Pseudococcus capensis Brain.

*Ps. capensis* Brain, Ann. Ent. Soc. Amer., v., 2, p. 182, 1912.

Adult ♀, usually appears distinctly brownish through the white secretion. The dorsal stripe of *citri* is absent and the insect generally appears more flattened. The lateral filaments are slender and increase in length towards the caudal end. Caudal ones may attain half the length of the insect.

Size, mounted, about 4 mm. long.

Antennal curve :—




Legs :—Measurements in $\mu$ approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 83 | 129 | 304 | 91 | 228 | 38 | 114 |
| II. | 98 | 129 | 327 | 91 | 258 | 38 | 121 |
| III. | 98 | 129 | 357 | 95 | 311 | 53 | 129 |

Setae of anal lobes :—About 152 $\mu$ in length; and setae of anal ring about 180 $\mu$ long.

Since describing this species two years ago a number of new host-plants have been added to the list, chiefly through the energies of C. W. Mally, the Cape Entomologist. Up to the present time it has been determined by the writer on the following plants, all of which were collected in the Cape Peninsula or at Stellenbosch :—

*Albizzia lophantha*, *Anona* (custard apple), apple, *Cenia turbinata*

Pers., *Clematis vitalba,* croton, *Cryptostemma calendulaceum* R. Br., grape, lucerne (crowns of), *Malva parviflora, Mesembryanthemum edule, Oxalis cernua,* peach, pear, *Pelargonium* sp., *Phytolacca dioica,* pumpkins, red clover, *Richardia africana* (arum lily), *Rhus* sp. (between galls on), *Robinia pseudacacia, Rumex* sp., *Senebiera coronopus, Senecio vulgaris, Silene gallica, Solanum sodomaeum, Sonchus oleraceus,* Spanish sulla, and *Spergula arvensis.*

This insect is undoubtedly the worst pest the vine-growers in the Constantia Valley have to contend with at present, and will probably be one of the most difficult to combat. Mr. Mally is now working on fumigation methods for the species, but it is apparent that this will have to be accompanied by clean-culture methods. In July and August, 1914, *capensis* was found to be common on weeds, including *Sonchus, Spergula, Silene, Cenia,* and *Cryptostemma* mentioned above, in the same vineyard, and also on *Rhus* sp. in the adjoining bush, while only few insects were seen on the vines themselves. Mealy-bug was abundant in the grapes of this vineyard last season.

Collection Nos.: 49, 54, 67, 67*a*.

### 18. Pseudococcus citri (Risso).

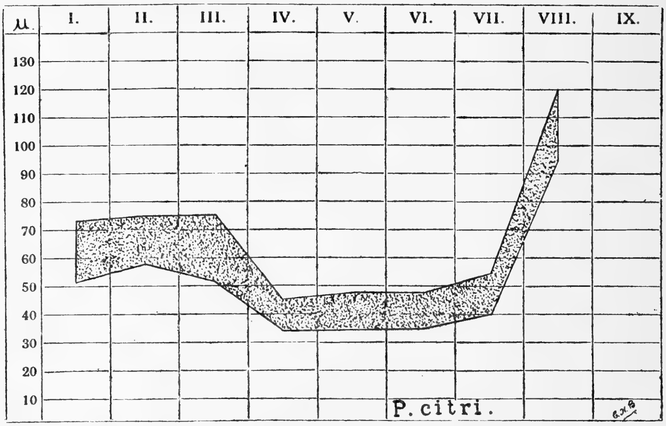
(Plate XX., Fig. 34.)

*Dorthesia citri* Risso, Essai Hist. Nat. des Orangers, 1813.
*Dactylopius vitis* Niediel, Bull. Soc. d'Acclim., p. 328, 1870.
*D. alaterni* Sign., Essai, p. 309, 1875.
*D. citri* Sign., p. 312. *D. ficus* Sign., p. 315.
*D. indicus* Sign., p. 317. *D. lavandulae* Sign., p. 318.
*D. viburni* Sign., p. 323.
*Boisduvalia quadricaudata* Sign., p. 339.
*Lecanium phyllococcus* Ashm., Can. Ent., xi., p. 160, 1879.
*Dactylopius brevispinus* Targ., Ann. di Agr., p. 137, 1881.
*D. destructor* Comst., Report, p. 342, 1881.
*Ps. citri* (Risso), Brain, Ann. Ent. Soc. Amer., v., p. 178, 1912.

Adult ♀: The antennal range, constructed from 30 measurements, is illustrated on p. 116 for comparison.

The setae of the anal lobes are about 225 $\mu$ long; those of the anal ring average 115 $\mu$.

This cosmopolitan species is found in all parts of South Africa, and it seems probable that it will, in time, spread to a number of our native plants. I have not yet been able to draw up a comprehensive host index




for the species, but have recently (October, 1914) received it on *Chaetachme aristata*, the "Umkovoti"-tree of Natal.

Collection No.: 48.

### 18*a*. Pseudococcus citri var. phenacocciformis var. n.

(Plate XIX., Fig. 28.)

Adult ♀ has the appearance of *Ps. citri*; the median dorsal stripe, secretion, and filaments as in that species.

The completed ovisac was in every case slightly covering the caudal extremity of the insect. Ovisac loosely constructed, cottony, irregularly oval in outline.

Antennae normally 9-segmented; one insect has its antennae 8-segmented, in one of which a distinct pseudo-articulation is visible.

Mounted specimens are about 3 mm. in length.

Range of measurement of antennal segments :—(1) 46–52; (2) 61–68; (3) 61–65; (4) 34–38; (5) 37–47; (6) 37–44; (7) 47–52; (8) 44–47; (9) 60–68.

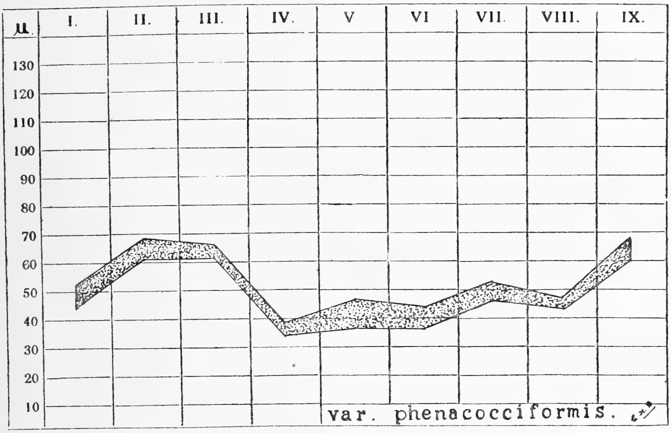
It will be observed that these measurements all fall within the range for *citri* including 8 + 9 for the terminal joint of that species.

The legs approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 74 | 120 | 272 | 58 | 190 | 30 | 120 |
| II. | 85 | 128 | 312 | 64 | 238 | 34 | 136 |
| III. | 85 | 128 | 340 | 64 | 276 | 34 | 136 |

The setae of the anal lobes average 250 $\mu$ in length; those of the anal ring are about 138 $\mu$ long.

On the ventral side the dermis has many small circular pores, some with bristles, and there are a number of scattered hairs; some of the latter, in the region of the antennae, are long. The dorsum has many




larger pores with a few smaller ones scattered irregularly. The marginal areas have two short stout spines and a number of small pores closely surrounding them.

Habitat: On *Bouvardia* sp. (Rubiaceae), Rosebank, C.P. Collected by C. P. van der Merwe, November, 1914.

Material studied consists of a number of ovisacs with ova and 5 ♀ ♀ mounted.

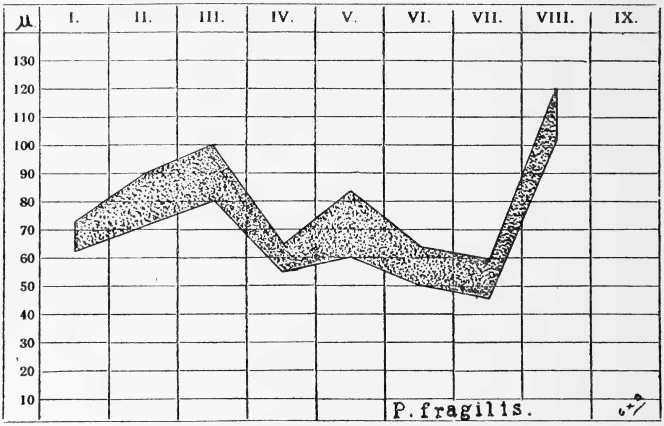
Collection No.: 35.

## 19. Pseudococcus fragilis Brain.

*Ps. fragilis* Brain, Ann. Ent. Soc. Amer., v., 2, p. 186, 1912.

Adult ♀: Largest mounted specimen about 4 mm. long and 2·4 mm. broad.

Antennal range :—




Legs: Measurements in $\mu$ approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 121 | 167 | 364 | 106 | 250 | 38 | 136 |
| II. | 129 | 167 | 417 | 102 | 304 | 38 | 144 |
| III. | 129 | 170 | 432 | 106 | 342 | 45 | 144 |

Setae of anal lobes about 230 $\mu$; those of anal ring average 190 $\mu$.
Host-plant: Citrus.
Locality: Only known from Constantia, C.P.
Collection No.: 51.

### 20. Pseudococcus graminis (Mask.).

*Dactylopius graminis* Mask., N.Z. Trans., p. 36, 1891.

"Adult female enclosed in a sac of white felted secretion, aggregated in masses thickly covering stems of grass: the sacs are of irregularly elliptical form. Insect dark-purple, or almost black, globular, segmented: diameter about one-twentieth inch. Antennae of eight joints, the first seven subequal (the sixth perhaps shorter than the rest), the last as long as any two of the others, fusiform, and bearing a few hairs. Mentum trimerous. Feet slender; digitules all fine hairs. Anal tubercles very small and inconspicuous, each with a seta and two or three spines.

Anogenital ring with six hairs. Epidermis bearing a number of simple circular and small tubular spinnerets.

Larva and male not observed.

Habitat: On grass, Natal, South Africa."

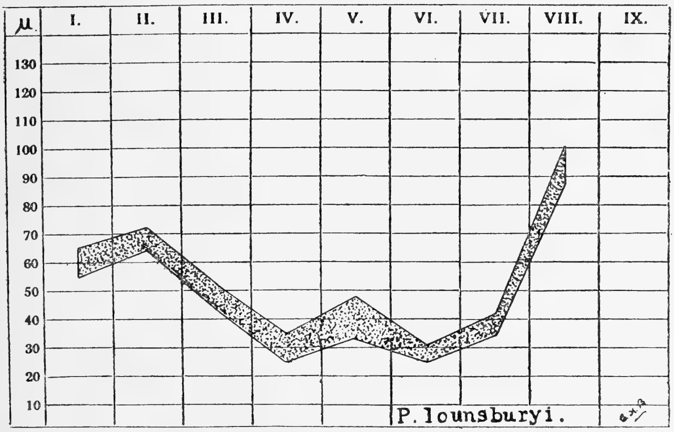
The above is Maskell's description. As far as I can ascertain the species has never again been discovered. At first I thought *Ps. natalensis* would prove to be this insect, but *natalensis* has 7-jointed antennae, and Maskell's illustrations show *graminis* to be quite distinctive in habit.

## 21. Pseudococcus lounsburyi Brain.

*Ps. lounsburyi* Brain, Ann. Ent. Soc. Amer., v., 2, pp. 179–182, 1912.

Adult ♀ (living), about 3·7 mm. long and 1·65 mm. broad.

Antennal range :—




Legs: Measurements in μ approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 83 | 129 | 281 | 76 | 190 | 38 | 106 |
| II. | 83 | 121 | 304 | 76 | 205 | 40 | 106 |
| III. | 90 | 129 | 334 | 79 | 243 | 48 | 121 |

Setae of anal lobes: To 160 μ in length; those of anal ring about 128 μ long.

Host-plant: *Agapanthus umbellatus* L'Hérit.

Locality: Cape Peninsula.

Remarks: This species was again collected by the writer in July, 1914, in the type locality. At that time it was not nearly so plentiful as when first collected in 1910.

Collection No.: 50.

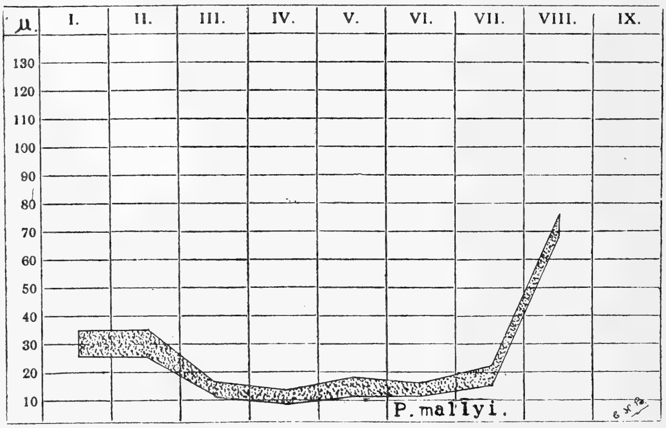
### 22. Pseudococcus mallyi sp. n.

Ovisac: No definite ovisac was seen, but adult ♀ ♀ and young were clustered in a white powdery secretion in the leaf-sheaths.

Adult ♀: The adult is bright rose-pink in colour, some specimens being uniformly covered with white powder. There were no traces of filaments of any kind. Legs and antennae colourless.

The insect is exceptionally long and narrow, mounted specimens averaging 2·16 mm. long by 0·75 mm. broad. The elongate appearance reminds one very much of a *Rhizoecus*.

The antennae are normally 8-segmented, with joints 3, 4, 5, and 6 very short. In one case joints 4 and 5 were fused. The range of variation in the antennal measurements from 14 specimens is as follows:—(1) 27–34; (2) 27–35; (3) 12–17; (4) 9–13; (5) 12–18; (6) 12–15; (7) 16–22; (8) 68–75.




The measurements of the antennae in which segments 4 and 5 had fused is:—(1) 27; (2) 30; (3) 13; (4) 20; (5) 13; (6) 17; (7) 74.

The legs approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 36 | 51 | 156 | 30 | 88 | 24 | 86 |
| II. | 38 | 54 | 156 | 34 | 108 | 24 | 95 |
| III. | 40 | 56 | 174 | 34 | 154 | 30 | 102 |

The setae of the anal lobes are approximately 142 $\mu$ long; those of the anal ring are 68 $\mu$ in length.

Habitat: On grass (sp. indet.), Rosebank, C.P., November 25, 1914.

Material studied consists of 14 adult ♀ ♀ and young. I have great pleasure in associating the name of C. W. Mally, Entomologist of the Cape Province, with this species.

Collection No.: 32.

### 23. Pseudococcus mirabilis sp. n.

(Plate XVIII., Fig. 18. Plate XIX., Fig. 23.)

A large quantity of mealy-bug material was collected on a spiny-leaved plant at Ceres, C.P., by Chas. P. Lounsbury, in October, 1898. This was stored in tins and envelopes, dry, and as no further collection of this species has been made, the following description is made entirely from dry material.

The ovisacs are creamy-white or slightly buff-coloured, and are aggregated on the leaf-cluster bases in conspicuous masses. Externally the sacs appear dense and smooth, but when disturbed they are seen to be made up of very fine cottony material.

The adult is apparently viviparous, from the fact that well-developed larvae are present in the mounted specimens (dry material).

When boiled in KOH the dried female turns a bright brown colour, and when fully distended is not more than 1·5 mm. long. Stained and mounted the adult ♀ is seen to have 8-jointed antennae; but it is a very remarkable insect in the following particulars. The legs are short; the dermis is very thickly covered with gland-pores, those of the dorsum being about twice as large as those of the venter; many of the ventral pores are furnished with bristle-like hairs; and the circum-anal region is quite unusual. The anal lobes are short and somewhat pointed, and bear the usual setae, several shorter hairs and two stout spines; the anal ring is unlike that of any other mealy-bug known to me, as it is decidedly pointed posteriorly, with the posterior edges somewhat straightened and more heavily chitinized. The six bristles are situated on these thickened edges; the anterior rounded arch is free (Fig. 18*a*).

The measurements are as follows :—

Antennal segments (Fig. 18) :—(1) 17–20; (2) 18–22; (3) 8–15; (4) 9–15; (5) 9–15; (6) 18–22; (7) 18–20; (8) 27–35.

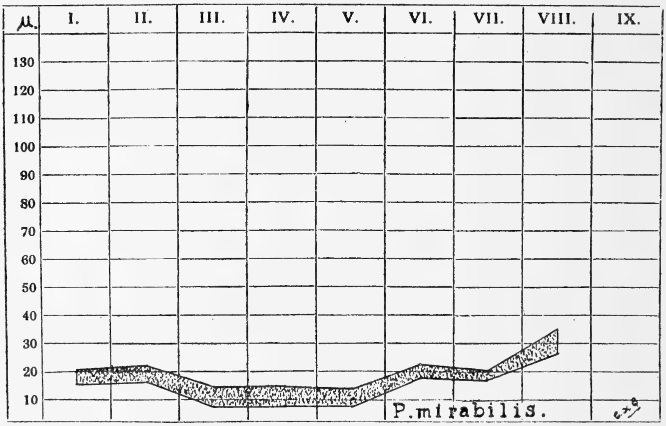
The legs in $\mu$ approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 30 | 51 | 88 | 30 | 51 | 18 | 51 |
| II. | 30 | 51 | 102 | 34 | 58 | 18 | 58 |
| III. | 35 | 51 | 122 | 38 | 85 | 24 | 68 |

The setae of the anal lobes are about 92 $\mu$ long; those of the anal ring average 47 $\mu$ in length.

Habitat: On spiny veld plant (*Borbonia cordata* Linn.), Ceres, C.P. Collected by Chas. P. Lounsbury, October, 1898.

Species founded on dry material. 12 ♀ ♀ mounted.




Remarks: The waxy material adherent to the insects studied is quite different from the secretion generally found in the *Pseudococcini*. After boiling the specimens in a strong solution of KOH for fifteen minutes they were passed through the alcohols and stained by the magenta method, cleared in oil of cloves and mounted in Canada balsam. Every mounted specimen has some portion obscured by a more or less dense mass of waxy-looking material.

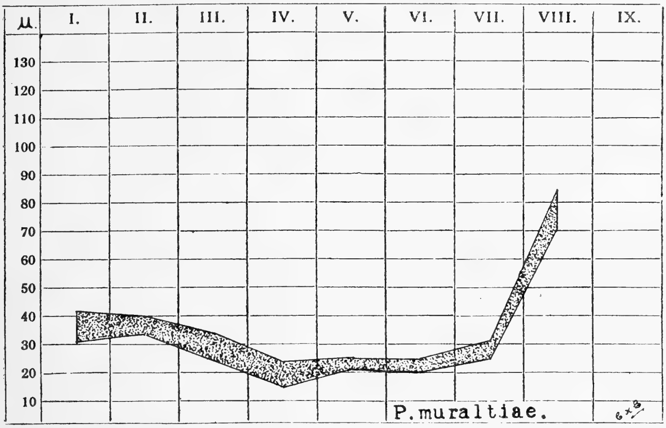
Collection No.: B 54.

## 24. Pseudococcus muraltiae Brain.

*Ps. muraltiae* Brain, Ann. Ent. Soc. Amer., v., 2, pp. 184–186, 1912.

Adult ♀: The largest specimen seen was 1·9 mm. long and 1·13 mm. broad.

Antennal range :—




Legs : Measurements in $\mu$ :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 45 | 75 | 159 | 60 | 98 | 30 | 84 |
| II. | 45 | 76 | 170 | 60 | 98 | 30 | 98 |
| III. | 53 | 84 | 190 | 60 | 128 | 28 | 106 |

Setae of anal lobes : To 150 $\mu$ in length.
Setae of anal ring : To 120 $\mu$ in length.
Host-plant : *Muraltia heisteria*, D.C.
Locality : Cape Peninsula.
Collection No. : 52.

## 25. Pseudococcus quaesitus sp. n.

(Plate XVIII., Fig. 19. Plate XIX., Fig. 24.)

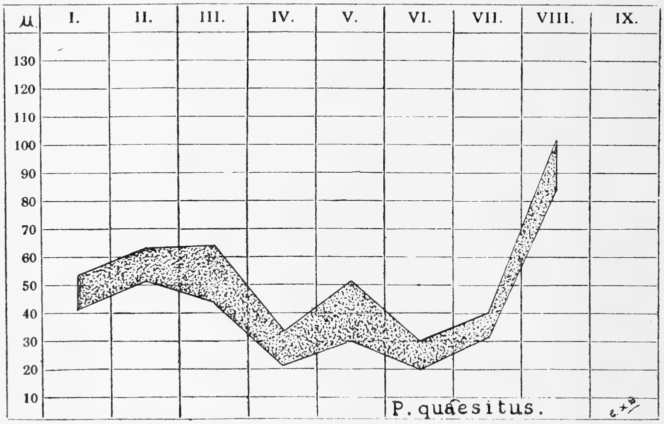
Ovisac : The ovisacs are often collected into masses which remind one of *Ps. filamentosus* Ckll., but present a pinkish tinge rather than yellow or greyish. Seen singly, as in cavities in tree-trunks, the ovisacs are usually more or less button-shaped, with straight vertical sides and a rounded top. The largest observed measured approximately 3 mm. in diameter.

Ova : Bright orange-yellow coloured, the mass showing pinkish.

Larva : 0·35 mm. long. At first orange-yellow in colour, later pinkish ;

of the usual type, with 6-jointed antennae. Eyes prominent, showing as black specks.

Adult ♀ may reach 4 mm. in length, pinkish coloured at first and later purplish, with dense, white, powdery secretion. Lateral filaments short and fragile. Caudal filaments two in number, stout, may attain one-third the length of the body. Colour in boiling KOH purplish. Clear and stained the derm has small pores with sharp spinose hairs scattered over the whole body. In addition there are in the circum-anal region numerous smaller gland-pores without spines, and scattered, single, large pores, about three times the diameter of the latter. On the venter of the ante-penultimate segment in front of the caudal lobes are two long hairs (120 $\mu$), one on each side.




Antennae: In a series of 24 mounted adult ♀ specimens all showed the eighth segment with a pseudo-articulation, but in no single case could the articulation be considered complete. The measurements of the segments are remarkably constant for the Pretoria material; the Grahamstown specimens have usually slightly longer segments. It should be mentioned that the first segment is hollowed out in an unusual manner, being much narrower on one edge than on the other (Fig. 19). Measurements of this segment might be given to range from 32 $\mu$ to 58 $\mu$, but that used is the middle measurement, i.e. that of the posterior margin.

Range of measurements of antennal segments:—(1) 42–54; (2) 52–63; (3) 44–64; (4) 22–34; (5) 30–51; (6) 20–30; (7) 32–40; (8) 85–102.

Legs : The measurements in $\mu$ for the legs approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 66 | 100 | 235 | 60 | 138 | 30 | 102 |
| II. | 68 | 108 | 256 | 75 | 173 | 34 | 105 |
| III. | 78 | 120 | 282 | 78 | 230 | 38 | 116 |

Setae of anal lobes may reach 240 $\mu$ in length.

Setae of anal ring may reach 132 $\mu$ in length.

♂ : The ♂ puparia are apparently hidden amongst the clusters of ♀ ovisacs. A number of the latter were picked off and placed in a tube when collected on November 9th so as to obtain a quantity of larvae. By November 16th two males had emerged, and were mounted. They were of the usual type, with head and body brown in colour, but the whole insect was exceptionally densely powdered. They have two long caudal filaments, about as long as the head and body combined without the antennae. The measurements are as follows :—

Length of head and body 0·82 mm.

,, antennae 0·75 mm.

,, wing 0·6 mm.

Antenna 10-segmented :—(1) 30 ; (2) 64 ; (3) 84 ; (4) 40 ; (5) 44 ; (6) 44 ; (7) 40 ; (8) 40 ; (9) 40 ; (10) 47.

Habitat : On *Acacia caffra* and *A. robusta*, Pretoria District, collected by the writer, and on *A. horrida* Grahamstown, Cape Province, collected by C. P. Lounsbury, January, 1899.

Remarks : This species was first observed at Pretoria in September, 1914, when solitary females were observed scattered over the trees, often partly hidden beneath the ovisacs of *Ps. solitarius*. Specimens were collected and mounted, and the pseudo-articulation of the 8th segment was noticed, but as this was at the end of winter it was thought that this character was associated with the season. Some species, such as *Ps. trifolii* Forbes, and *Ps. agrifoliae* Essig, are known to have two distinct seasonal generations, the winter form with 7-jointed antennae, and the summer one with 8.

By the end of October, however, *Ps. solitarius* had almost disappeared, and large numbers of *Ps. quaesitus* were found aggregated at the bases of leaves and thorns, the clusters of ovisacs forming conspicuous masses. On November 9th many young had emerged and had collected at the bases of the leaf-stalks, their pink colour and collective habits reminding one of *Ps. sacchari* Ckll.

A week later an old acacia-tree was observed on one of the hills which surround Pretoria, in which were a number of holes, obviously from early wounds. The openings to these were nearly closed by rough bark and accumulations of resinous gum, but the vast numbers of ants entering and leaving the holes plainly showed the presence of some attraction. On breaking away the bark and gum it was found that the whole edge of the cavity was lined with mealy-bugs and their ovisacs. These proved to be of this species. It was remarkable that although there were hundreds of female insects in the holes none were observed on the twigs of the tree itself.

Material studied: 24 ♀ ♀, 2 ♂ ♂, and numerous ova and larvae (Pretoria material), and 14 ♀ ♀ (Grahamstown material).

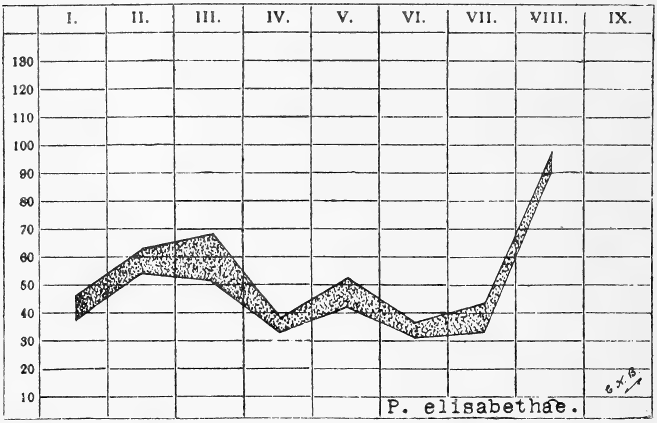
Collection Nos.: 60 and 63.

### 26. Pseudococcus elisabethae sp. n.

Ovisac: Loose, cottony, white, usually more or less spherical, sometimes slightly elongate; may attain 3 mm. in length.

Ova and larvae pale yellow.

Adult ♂ olivaceous-brown with opaque white wings. The two caudal filaments are white, slender, as long as the head and body together




without antennae. The measurements from a freshly mounted specimen are:—

Length of head plus body 0·8 mm.
,, antennae 0·6 mm.
,, wing 0·9 mm.
,, caudal setae 0·3 mm.

The antennae are 10-jointed, the approximate measurements of the segments being:—(1) 44; (2) 68; (3) 85; (4) 68; (5) 58; (6) 68; (7) 58; (8) 58; (9) 68; (10) 58.

♀ (half-grown): About 1·3 mm. long, flesh-pink in colour, with very short lateral filaments and two short caudal ones, which in a few cases reached one-fourth the length of the body.

♀ adult; When living the ♀ is about 2 mm. long, and is pale brown to dark olivaceous-brown in colour. In boiling NaOH the colour changes to reddish-brown. The antennae are 8-jointed in the thirteen specimens studied, and present the following range of variation:—(1) 36–45; (2) 54–62; (3) 52–68; (4) 34–38; (5) 44–52; (6) 32–36; (7) 34–44; (8) 92–98.

The mentum is long and narrow; the eyes are small and inconspicuous.

The dermis has many gland-pores, which are all small. Many of these are supplied with hair-like spines, which are generally short in the posterior region, but long between the antennae. The lateral spine areas are normal, with two short conical spines and 6 to 10 small gland-pores. The legs approximate:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 85 | 108 | 240 | 68 | 176 | 30 | 112 |
| II. | 85 | 120 | 265 | 68 | 220 | 30 | 125 |
| III. | 85 | 120 | 290 | 72 | 255 | 34 | 125 |

The tarsal digitules are clubbed hairs.

The setae of the anal lobes range from 170 to 210 $\mu$; those of the anal ring average 165 $\mu$ in length.

Habitat: On rhenosterbosch (*Elytropappus rhinocerotis* Less.). Collected at Newlands, C.P., January, 1915, by C. P. van der Merwe.

It gives me great pleasure to associate my mother's name with this species.

Collection No.: B 58.

## 27. Pseudococcus sacchari (Ckll.).

*Dactylopius sacchari* Ckll., Jn. Trin. Nat. Club, ii., p. 195, 1895.
,, ,, Green, Mem. Dept. Agr. India, II., i., p. 23, 1908.

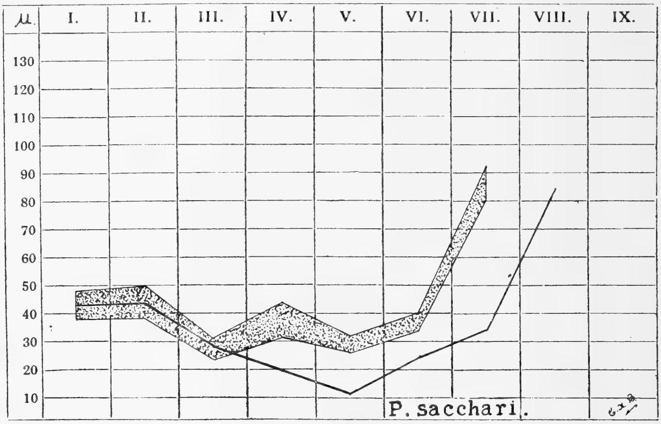
The mealy-bug which is so abundant in the sugar-cane of Natal is undoubtedly of this species. Specimens have also been received recently from Beira and Tzaneen (Tr.).

The original description by Prof. Cockerell was made from alcohol specimens, and the measurements given later, in 1899, were probably made from a limited number of females. The following details are therefore added to assist in future determination.

The living insects are clustered in the leaf-sheaths, twenty to thirty females and many young often being found at the same node. They are pink or flesh-pink in colour, sparingly powdered with coarse white meal. Some are entirely without lateral filaments; others possess them, but they are short. Caudal filaments are more commonly seen. The segmentation is distinct, and the posterior segments appear to be somewhat retracted, giving the insect a truncate appearance.

The average size of the female is about 4 mm. long, but two specimens collected by C. P. Lounsbury measured 6 mm. and 6·5 mm. respectively.

In mounted specimens the most striking characteristics are the com-




paratively short legs and antennae, the scattered (single) gland-pores, and the long hairs and setae of the posterior segments. The caudal tubercles are not produced, but each bears a long seta, which may reach 300 $\mu$ in length, and several shorter hairs. The 6 setae of the anal ring average 150 $\mu$ in length. On each side of the penultimate segment there is an area which simulates the caudal lobe, also bearing a long seta (280 $\mu$) and several shorter hairs. The presence of this second pair of setae at once distinguishes this insect from any other yet known in South Africa, and is such a prominent characteristic that I think it could not have been present in the material examined by Prof. Cockerell. This could be accounted for by the fact that in mounting specimens from spirit material the coarse setae are often broken away. On the other hand, I may be dealing with a different insect, but the other characters agree so well that I do not think this is the case.

The antennae are normally 7-jointed, but a very small percentage of the specimens have 8-jointed forms, while some individuals show 7- and 8-jointed forms together.

The range of variation for the normal form is as follows, from 25 insects :—(1) 38–48; (2) 38–50; (3) 24–31; (4) 32–44; (5) 27–32; (6) 34–40; (7) 80–92 μ.

The usual 8-jointed form approximates :—(1) 44; (2) 44; (3) 28; (4) 20; (5) 12; (6) 27; (7) 37; (8) 85 μ.

One specimen, apparently abnormal, had antennae which measured :—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R. | 37 | 34 | 20 | 11 | 11 | 17 | 30 | 71 μ |
| L. | 37 | 34 | 20 | 12 | 17 | 23 | 34 | 72 μ |

The legs are comparatively constant, and measure approximately :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 44 | 81 | 200 | 47 | 115 | 30 | 102 |
| II. | 48 | 98 | 220 | 51 | 128 | 32 | 102 |
| III. | 51 | 102 | 228 | 51 | 145 | 32 | 102 |

Setae of anal lobes : To 300 μ in length.
Setae of anal ring: To 154 μ in length.
Setae of penultimate segment to 288 μ long.
Collection Nos. : 59 and 59*a*.

## 28. Pseudococcus transvaalensis sp. n.

(Plate XIX., Fig. 25.)

Adult ♀ ♀ enclosed in elongate sacs attached to the roots of plants. In a few cases two females were found in the same sac.

Ovisacs elongate, white, more or less cottony, 3·5 mm. long and about 1·6 mm. broad, adherent to the roots to a depth of 15 to 18 inches in the soil.

Larvae: Yellowish in colour, of the usual type.

Adult ♀ : Purplish in colour, about 2 mm. long, with a slightly waxy secretionary covering. When seen alive it is somewhat narrowed posteriorly, and has no lateral but two stout caudal filaments. The colour in boiling KOH is black and then violet. Cleared, stained, and mounted the insects average 2 mm. long by 1·5 mm. broad.

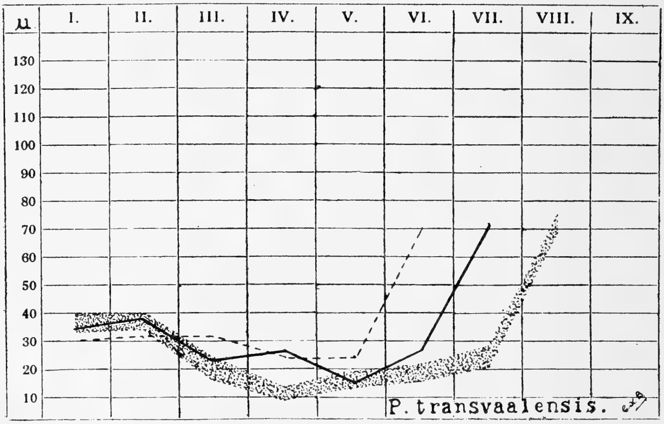
The antennae are normally 7- or 8-jointed, but occasional examples are found with 6-jointed forms, in which joints 3 and 4 are more or less fused.

The range of variation in the segments is as follows :—

(*a*) 8-jointed form :—(1) 34–40; (2) 35–40; (3) 17–24; (4) 9–13; (5) 13–18; (6) 17–22; (7) 22–28; (8) 68–75.

(*b*) 7-jointed form :—(1) 30–34 ; (2) 30–38 ; (3) 20–24 ; (4) 12–27 ; (5) 14–17 ; (6) 22–27 ; (7) (68–72).

(*c*) The 6-jointed form is generally :—(1) 30 ; (2) 32 ; (3) 32 ; (4) 25 ; (5) 25 ; (6) 70.




The legs measure approximately :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 51 | 78 | 170 | 51 | 102 | 27 | 85 |
| II. | 54 | 85 | 177 | 54 | 106 | 27 | 85 |
| III. | 58 | 91 | 200 | 58 | 135 | 27 | 85 |

The eyes are exceptionally small and inconspicuous.

There are numerous small gland-pores scattered over the body, many of which are supplied with spine-like hairs. There are also larger circular pores which have no bristles. On the margin of each segment is a gland-pore area with usually two stout hairs like those of the caudal lobes, and also one broad subcutaneous " tube " (Fig. 25).

The setae of the anal lobes are from 120 $\mu$ to 150 $\mu$ in length ; those of the anal ring 85 to 95 $\mu$.

Habitat : On the roots of *Salvia runcinata* growing in front of Union Buildings, Pretoria ; collected by the writer, October 8, 1914 ; on roots of aster in the office garden, October 13, 1914 (Claude Fuller), and on roots of cornflower, collected by Miss Impey, Sunnyside, Pretoria, December 28, 1914.

Material studied consists of 25 ♀ ♀ , ova and larvae.

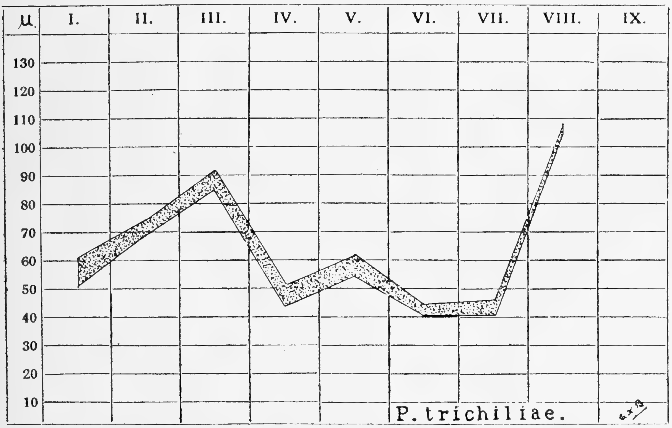
Collection Nos. : B 46, B 47, and B 47*a*.

## 29. Pseudococcus trichiliae sp. n.

(Plate XIX., Fig. 26.)

Adult ♀ spinning ovisac, approximately 4 mm. long, pale olivaceous in colour, uniformly covered with white meal. Lateral filaments absent. Caudal filaments 2; strong, white, about one-third the length of the body. In removing insects from ovisacs these are usually broken off, so that the majority appear to have no caudal filaments. Half-grown females usually have 4 to 6 caudal filaments, the two median ones longest and thickest.

Ovisac: The ovisac, when completed, is an elongate sac, which may attain 6 mm. long. It appears longer owing to the projection of the




anterior half of the insect in front. The posterior half of the ♀ is hidden by the ovisac which has parallel sides, is but slightly broader than the insect, and is broadly rounded behind. It is white and cottony, reminding one of the ovisac of a *Pulvinaria*.

Ova: The eggs are very pale yellow in colour, 0·31 mm. long by 0·15 mm. broad.

Larva: Elongate, active, pallid opaque, with comparatively long antennae. Length, 0·36 mm.; breadth, 0·18 mm. Antennae 6-jointed, with 6 longest and terminating in a distinct conical projection. Other segments subequal. Anal tubercles moderately produced, each with a long seta. Anal ring with the usual 6 hairs.

Adult ♀ : In boiling KOH the ♀ becomes light brown in colour, and the liquid after about five minutes' boiling is champagne-coloured. After fifteen minutes the liquid is clear with a distinct carmine tint, which is retained throughout the boiling.

The antennae are long, and comparatively slender, reminding one of *Ps. fragilis*, but those of the latter are even longer, and more slender.

The antennal segments of *Ps. trichiliae* vary within the following range :—(1) 51–61 ; (2) 68–74 ; (3) 85–91 ; (4) 44–51 ; (5) 54–61 ; (6) 41–44 ; (7) 41–47 ; (8) 108.

In 18 specimens all antennae fall into this series except one, which was obviously abnormal. Its measurements were :—(1) 61 ; (2) 68 ; (3) 85 ; (4) 47 ; (5) 61 ; (6) 34 ; (7) 58 ; (8) 78.

The conical apex of the terminal segment is in all cases very distinct. Hairs on antennae numerous, usual.

Legs : The measurements of the legs are also remarkably constant, showing only a slight range of variation. The approximate or average series may be stated :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 120 | 130 | 320 | 85 | 248 | 40 | 120 |
| II. | 120 | 136 | 375 | 85 | 320 | 40 | 134 |
| III. | 125 | 150 | 405 | 85 | 355 | 50 | 150 |

The digitules of the tarsi are slender hairs ; those of the claw terminate in large clubbed ends.

The dermis is transparent, but has a few single scattered gland-pores which are small, and scattered hairs. Between the antennae, on the dorsum, some of these hairs attain a length of 136 μ.

The eyes are small, conical, and appear to be exceptionally distant from, and posterior to, the insertion of the antennae.

The setae of the anal lobes and of the anal ring are, unfortunately, always bent in mounted specimens, again resembling *Ps. fragilis* in this characteristic, thus rendering their measurements difficult. The approximate lengths are :—

Setae of anal lobes : 270 μ long.

Setae of anal ring : 170 μ long.

♂ : Of the usual type, grey, with head and body darker, finely powdered. Caudal filaments two, nearly as long as insect without antennae, comparatively thick, white.

Length of head and body, 1·35 mm. ; breadth across thorax, 0·38 mm. ; length of antennae, 0·75 mm. ; length of wing, 1·3 mm.

Antennae usual, of 10 segments, measuring :—(1) 51 ; (2) 71 ; (3) 120 ; (4) 88 ; (5) 74 ; (6) 71 ; (7) 71 ; (8) 68 ; (9) 68 ; (10) 81 μ.

All segments with numerous hairs.

Habitat: On *Trichilia* sp. (Meliaceae), Durban. Collected by Chas. P. Lounsbury, October 27, 1914.

On Silver-leaf tree (*Leucadendron argenteum* R. Br.) in Mr. Pillan's garden, Rosebank, Capetown, October 30, 1914. Collected by C. W. Mally.

Remarks: Senator F. G. Churchill, of Berea Park Road, Durban, wrote to Claude Fuller in November, 1913, regarding this species. He says: "My attention has been drawn to an insect blight on many of the large shady Umkuhlu-trees in the grounds and avenues in Durban—some trees looked as if seriously injured by it. It begins on the main trunk and works its way up and outwards to the young top shoots, which eventually become white with it." In the specimen I have before me the insects are clustered on the stems and flower-buds, the ovisacs forming large, conspicuous masses. Adults with ovisacs, ova and larvae are present (October 31, 1914). The larva of a coccinellid is present, but not in large numbers.

Fuller says the trees, when badly infested, are quite conspicuous, and that predaceous or parasitic insects must become numerous, for the serious infestation of the trees disappears, almost suddenly, about January.

Collection No.: B 51.

### 30. Pseudococcus virgatus (Ckll.).

(Plate XVI., Fig. 4.)

*Dactylopius virgatus* Ckll., The Entom., xxvi., p. 178, 1893.
,, ,, vars. *a, b, c, d* Ckll., The Entom., xxvi., p. 178, 1893.
,, *ceriferus* Newst., Ind. Mus. Notes, iii., p. 24, 1895.
,, *talini* Green, Ind. Mus. Notes, iv., No. 1, p. 7, 1896.
,, *virgatus* Tins., Can. Ent., xxx., p. 22, 1898.
,, ,, de Charmoy, Pr. Soc. Amic. Scien., p. 44, 1899.
*Pseudococcus virgatus* Kirkaldy, Fauna Haw., iii., 2, p. 103, 1902.
,, ,, var. Ckll., Dav. Acad. Sci., x., p. 130, 1905.
,, ,, *madagascariensis* Newst., Milleil. Zool. Mus. Berl., C. 2, p. 166, 1911.

The South African insect which is referred to this species was found in Natal by Claude Fuller on croton, citrus, iron weed (*Sida rhombifolia* Linn.), *Convolvulus* sp., and guava; and has recently been found by the writer on grass in Pretoria. When adult it is a striking insect owing to the dark subdorsal patches and the very long delicate filaments which adorn the body (Fig. 4). These filaments are shed and matted into a kind of nest, in which the insect sits while spinning the ovisac.

I was inclined at first to consider it as a distinct species, because no single description is adequate, but, considering the range of variation shown in other localities, and the possibility of an insect being spread with greenhouse plants, etc., I have decided rather to retain the South African form under *Ps. virgatus* Ckll., and give the measurements of legs, antennae, etc., in full, in the hope that some one who has access to a greater range of material—such as is at present in the Washington Collection—will compare the insects from different localities in detail.

In the original description of *Ps. virgatus* (Ckll.) the size of the adult ♀ is given as 4·5 mm.; var. *b* is 3·5 mm. long; var. *d* "2 mm.—not adult"; *Ps. virgatus madagascariensis* Newstead is said to be "considerably longer and broader than typical examples of *Ps. virgatus* (Ckll.)." The South African forms are 3 to 3·5 mm. in length, i.e. identical in size with *D. ceriferus* Newst. The size is not given for *D. talini* Green (*loc. cit.*).

The references to the mealy secretion vary, but this is readily understood as the young females are lighter in colour and do not exhibit the submedian dark patches and the character of the delicate filaments and also of the caudal, waxy projections vary according to whether the insect is in a sheltered position or not. They are also easily dislodged in packing. It would be quite impossible to determine the character of these appendages from spirit material.

The dermal characteristics are not always described, so comparison is impossible, but the "circular spinnerets" mentioned by Prof. Newstead in his *Ps. ceriferus* and *Ps. virgatus madagascariensis* are present in the South African specimens.

The antennal measurements are given in $\mu$ as follows:—

Tinsley in the Canadian Entomologist, vol. xxx., 1898, p. 222, gives measurements of type material from Jamaica:—(1) 45–60; (2) 55–80; (3) 85–95; (4) 45–55; (5) 50–65; (6) 55–60; (7) 53; (8) 115–120. Ceylon material:—(1) 59–65; (2) 67–76; (3) 90–104; (4) 53–57; (5) 53–65; (6) 51–62; (7) 56–62; (8) 120–127. Mexican material:—Mr. Tinsley writes: "I have also recently examined specimens from Mexico, and find them to fall between the Jamaica and Ceylon specimens in size. It will be noticed that the Ceylon specimens are longer than those from Jamaica."

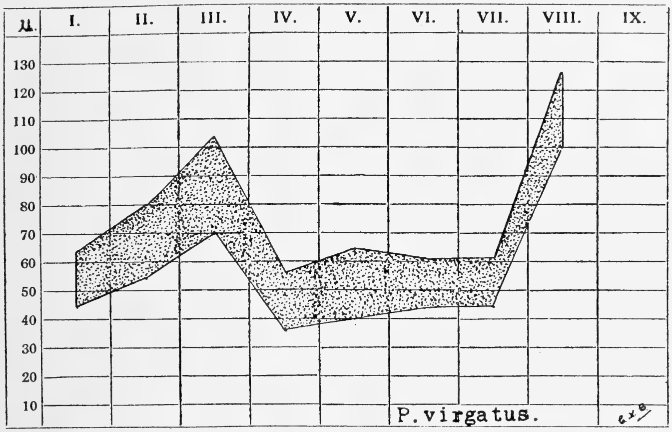
In the description of *Ps. virgatus* var. (Davenport, Academy of Science, x., p. 130, 1905) Cockerell gives the following antennal measurements:—(1) 50; (2) 63–65; (3) 70–72; (4) 37–42; (5) 40–45; (6) 43–47; (7) 45–47; (8) 100.

The South African specimens vary between the limits:—(1) 51–61; (2) 64–74; (3) 71–85; (4) 37–51; (5) 44–58; (6) 44–54; (7) 48–54; (8) 108–120.

It will be observed that this material most nearly approaches the

Phillipine specimens when considered from the standpoint of antennae.

Range from four series, viz. Jamaica, Ceylon, Philippines, and South Africa:—(1) 45–65; (2) 55–80; (3) 70–104; (4) 37–57; (5) 40–65; (6) 43–62; (7) 45–62; (8) 100–127.




Cockerell (1905, *loc. cit.*) gives some measurements of the anterior leg of his variety, but, unfortunately, the mesothoracic and metathoracic legs are not dealt with.

Tinsley (*loc. cit.*) merely mentions that the "legs agree perfectly with the published description." The measurements mentioned above, given by Prof. Cockerell, are as follows:—"Anterior leg with femur and trochanter 292 $\mu$ long, tibia 212, tarsus 89; claw rather long, simple."

The South African material is approximately:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 115 | 136 | 350 | 85 | 245 | 43 | 136 |
| II. | 118 | 150 | 380 | 88 | 275 | 34 | 136 |
| III. | 150 | 158 | 440 | 80 | 340 | 34 | 136 |

The setae of the anal lobes average 270 $\mu$ long; those of the anal ring are about 170 $\mu$ in length (S.A. material).

I should mention that the spinnerets and their "tubes" in this material agree with the description given by Prof. Newstead in his var. *madagascariensis.* The tubes are visible only in stained preparations.

The ♂ is of the usual type; the antennae of my specimens agree with those described by Prof. Cockerell in the original description.

If I am correct in uniting all the forms mentioned above, the distribution of the species will be as follows:—

Jamaica: On tree? On *Prosopis juliflora*, *Acalypha*, *Anona*, *Triculus cistodes*, cotton, violets, *Colocasia esculenta*, cocoanut palm, etc.

India (*ceriferus*): On croton and leaves of trees.

Ceylon (*talini*): On talinum, lilium, and croton.

Lucban, Tayabas, Philippines: On cultivated croton.

Madagascar: "On an unknown plant."

Mauritius: On "*Leucoena glauca*."

Hawaii: On (?)

Natal: On croton, citrus, *Sida rhombifolia* Linn., *Convolvulus* sp., and guava (Fuller).

Pretoria: On grass (C.K.B.).

I was surprised to find this species on grass in front of the Union Buildings. There is a nursery within 200 yards of the spot, and I think it may have escaped from crotons or other plants, although, as far as I can ascertain, the insect has not been recorded from Pretoria before.

In connection with this species I should mention an interesting observation made by C. Fuller while Entomologist of Natal. He has on many occasions observed the adults of the large Cetoniid *Macroma cognata* devouring this mealy-bug and the common soft scale *Coccus hesperidum*. He mentioned this in his First Report from Natal (p. 43, 1901), and assures me he has seen it repeatedly since that time.

Collection No.: 68.

### 31. PSEUDOCOCCUS WACHENDORFIAE Brain.

*Ps. wachendorfiae* Brain, Ann. Ent. Soc. Amer., v., 2, pp. 183–184, 1912.

Adult ♀, living, may attain 4·1 mm. long and 1·9 mm. in breadth.

Legs: Measurements in $\mu$ approximate:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 91 | 121 | 334 | 83 | 212 | 42 | 91 |
| II. | 106 | 136 | 342 | 91 | 235 | 45 | 98 |
| III. | 129 | 152 | 364 | 91 | 281 | 54 | 114 |

Setae of anal lobes: To 180 $\mu$ in length.

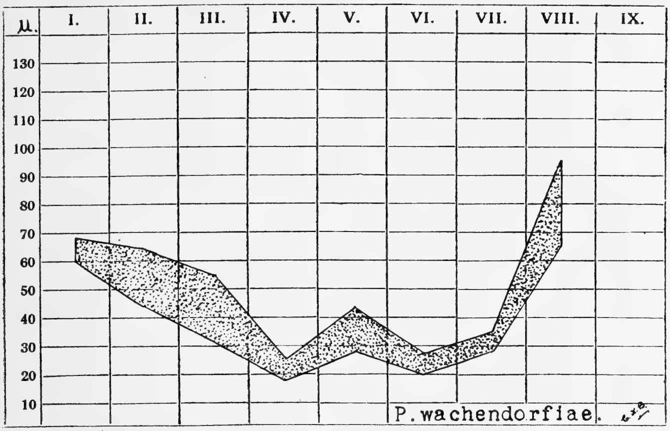
Setae of anal ring: To 144 $\mu$ in length.

Host-plant: *Wachendorfia paniculata* Linn.

Locality: Cape Peninsula.

Collection No.: 53.

Antennal range :—




SERIES C, WITH NINE-SEGMENTED ANTENNAE.

32. PSEUDOCOCCUS BANTU sp. n.

(Plate XIX., Fig. 27.)

Ovisac: Large clusters of irregular white ovisacs were found at the bases of the leaves and on the crowns of grass.

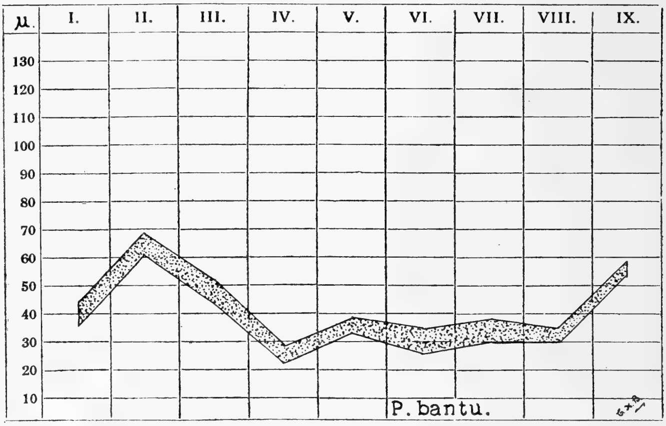
Ova and larvae: Pallid to cream-coloured.

Adult ♀: Small, orange in colour, with a very slight covering of powdery secretion, but without lateral or caudal filaments. In boiling KOH the colour turns pale brown, then yellow, while the liquid remains colourless.

The dermis is characterized by the regularity of the scattered gland-pores. Those of the dorsum are large and disc-like : the ventral pores are small; a few with spinose hairs. The marginal areas have but few additional pores surrounding the two *slender* spines (Fig. 27).

Mounted specimens average 2·3 mm. long by 1·8 mm. broad.

The antennal segments measure :—(1) 37–44 ; (2) 61–68 ; (3) 44–52 ; (4) 24–28 ; (5) 34–38 ; (6) 27–35 ; (7) 30–38 ; (8) 30–35 ; (9) 54–58.




Between the antennae, on the ventral side, are two long hairs, about 100 $\mu$ long.

The eyes are prominent and retain the stain.

The legs approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 85 | 102 | 230 | 58 | 170 | 34 | 108 |
| II. | 85 | 102 | 240 | 62 | 204 | 34 | 108 |
| III. | 85 | 102 | 290 | 85 | 235 | 51 | 122 |

The setae of the anal lobes are about 170 $\mu$ long; those of the anal ring average 120 $\mu$ in length.

Habitat: On crowns of grass (sp. indet.), Pietermaritzburg, Natal. Collected by A. Kelly, November, 1914.

Material studied consists of large numbers of ovisacs, ova and larvae, and 11 adult ♀ ♀ stained and mounted.

Collection No.: 34.

### 33. Pseudococcus caffra sp. n.

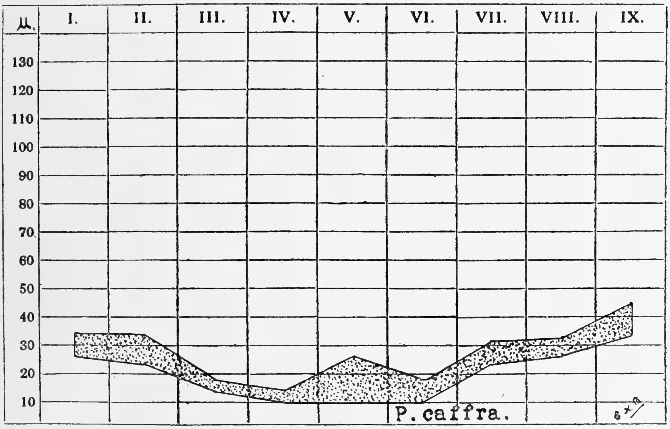
(Plate XIX., Fig. 29.)

On November 6, 1914, C. P. van der Merwe sent a few specimen mealy-bugs on grass from Rosebank, C.P. These insects were in the leaf-sheaths and appeared to have made elongate ovisacs which had been crushed or broken in transit. There was no cottony material present, but rather a dense, powdery secretion.

The adult ♀ is orange-brown in colour except at the extremities, which are decidedly pinkish. The largest specimen seen measured 2·4 mm. in length.

Mounted specimens average 1·8 mm. in length and 0·8 mm. broad.

The antennae are uniformly 9-segmented with joints 4 and 6 always very short. Joint 5 is usually twice the length of 4 or 6, but occasionally is of equal length. The range of variation is indicated below, but it should be noted that the average for 5 is about 22 $\mu$, the short form (10 $\mu$) being the exception. (1) 27–34; (2) 23–34; (3) 14–18; (4) 10–14; (5) 10–27; (6) 10–18; (7) 23–31; (8) 27–32; (9) 34–45.




The venter is characterized by the usual small scattered pores, many of which have bristle-like hairs. On the dorsum the gland-pores are about twice the size of those of the venter, and are without the bristles.

The marginal spine area is shown in Fig. 29.

The legs approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 35 | 68 | 170 | 37 | 112 | 27 | 85 |
| II. | 37 | 68 | 175 | 40 | 112 | 27 | 90 |
| III. | 38 | 70 | 195 | 44 | 136 | 27 | 104 |

The setae of the anal lobes average 136 $\mu$ in length; those of the anal ring are about 85 $\mu$ long.

Habitat: On grass, Rosebank, C.P. Collected by C. P. van der Merwe, November 6, 1914.

Material studied consists of numerous young and 5 adult ♀ ♀.

Collection No.: 41.

### 34. Pseudococcus flagrans sp. n.

(Plate XVI., Fig. 6. Plate XVIII., Fig. 20. Plate XIX., Fig. 30.)

While digging in an ancient termite nest at Daspoort, a suburb of Pretoria, on October 11, 1914, my attention was drawn to some roots of grasses which had the appearance of having been recently white-washed. Small black ants were present in numbers, and an examination showed that a large pink mealy-bug, embedded in a compact, powdery, waxy secretion was the object of attraction. On pulling apart the leaf-sheaths below ground-level they were found tightly packed with this solid waxy secretion, which always appeared powdery rather than fibrous. Deeply embedded in this were female insects of different sizes (Fig. 6). When removed, the insect left a distinct cell in the wax, and was herself free from secretion. The colour of the insects—bright pink to flesh-colour—was in marked contrast with that of the secretion. Although females were present up to 4 mm. in length no trace of ova or larvae was found, so after removing a number for study the roots were planted in the insectary.

On October 20th seven insects, all large specimens, were found above the ground on the grass itself. They varied in position from half an inch to three inches above the ground. All exhibited the same phenomenon. They were hanging from the grass, head downward, with the posterior portion of the body, from the 2nd pair of legs, recurved, so that the ventral surface was exposed from above. They remained in this position throughout the day, and on October 21st all had disappeared except one, which was nearest the ground. This had secreted a very thin covering of delicate waxy filaments, and showed signs of two caudal filaments and a very delicate marginal fringe, but the colour of the body was still quite distinctly visible.

On October 24th five females were similarly observed on the grasses, all without waxy secretion of any kind. Whether these were the specimens observed on October 20th, or others, I cannot say.

Taking into consideration the entire absence of ova and larvae, and the position of the insects on the grass stems, I would suggest that this indicates a mating instinct, but males have not yet been seen.

Adult ♀: Elongate, parallel-sided, about 4 mm. long, bright pink to flesh-coloured. No lateral filaments were observed, but in two cases short caudal ones were present, while one insect indicated that there may, in certain cases, be four caudal filaments instead of two.

In boiling KOH the colour rapidly changes from pink to deep purple, but the liquid remains colourless.

In mounted specimens the most striking distinguishing character is the four median ventral "*plates*" (Fig. 20). These are large and disc-like; they are situated near the posterior margins of the first four abdominal segments, one on the middle line of each. They have thick chitinous margins, circular, 65–68 $\mu$ in diameter. Smaller individuals exhibit plates approximately 50 $\mu$ in diameter. In a few examples there seem to be indications of a sternal plate similar to that mentioned by Green in his *Phenacoccus iceryoides*, and possibly also some smaller plates, similar to the abdominal ones on segments 5 and 6. The dermis is characterized by simple gland-pores with thin edges and numbers of hairs or bristles. In addition to the small gland-pores there are numerous disc-like glands, but they are scarcely noticeable, appearing as impressions in the derm rather than thickenings. They are indicated in Fig. 30. The dermal hairs are most numerous in the circum-anal region, where a large number are as long as the setae of the anal ring. The antennae are extremely variable, but since the majority of the large specimens have 9-jointed forms I include the insect in this series, but it should be remarked that the terminal segment is always comparatively short. In a few instances segments 8 and 9 are only separated by a pseudo-articulation. In this case they are indicated by two measurements united by a + sign and included under 8.

*Example* 1.

| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
|---|---|---|---|---|---|---|---|---|---|
| R. | 47 | 68 | 34 | 37 | 40 | 24 | 34 | 88 / 31 + 54 | |
| L. | 51 | 72 | 37 | 37 | 40 | 27 | 34 | 34 | 48 |

*Example* 2.

| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
|---|---|---|---|---|---|---|---|---|---|
| R. | 51 | 51 | 27 | 34 | 31 | 27 | 24 | 27 | 51 |
| L. | 41 ? | 51 | 27 | 31 | 23 | 20 | 18 | 64 / 27 + 37 | |

*Example* 3.

| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
|---|---|---|---|---|---|---|---|---|---|
| R. | 51 | 51 | 34 | 34 | 34 | 27 | 24 | 30 | 48 |
| L. | 48 | 51 | 31 | 34 | 27 | 24 | 21 | 64 / 17 + 47 | |

*Example* 4.

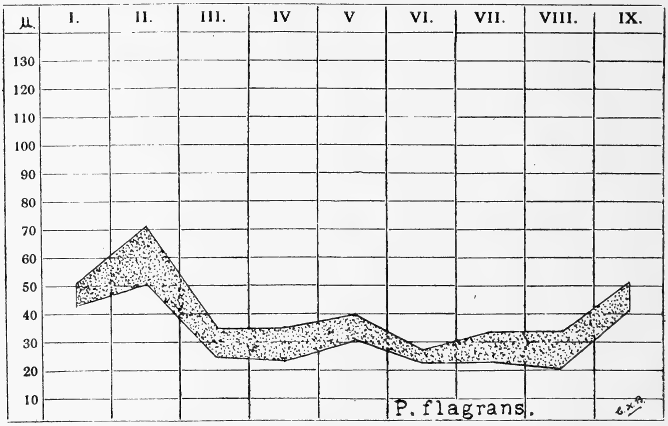
| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
|---|---|---|---|---|---|---|---|---|---|
| R. | 41 | 51 | 30 | 75* | 51 | | | | |
| L. | 44 | 51 | 37 | 23 | 34 | 23 | 23 | 21 | 48 |

*Example* 5.

| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
|---|---|---|---|---|---|---|---|---|---|
| R. | 47 | 51 | 34 | 23 | 34 | 27 | 27 | 23 | 48 |
| L. | 47 | 51 | 34 | 30 | 37 | 27 | 23 | 23 | 41 |

In example 4 (*) there is an indication of a pseudo-articulation about the middle.

It will be obvious that no general scheme can be given for the antennae of this species, but the 9-jointed forms do show some constancy in the relative size of the segments.




In the measurements of the legs the specimens seem to fall into two classes, of which the following are types:—

Type *a*.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 68 | 85 | 228 | 58 | 146 | 34 | 95 |
| II. | 81 | 102 | 248 | 61 | 176 | 44 | 102 |
| III. | 91 | 102 | 289 | 71 | 204 | 51 | 108 |

Type *b*.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 85 | 102 | 255 | 54 | 170 | 34 | 148 |
| II. | 91 | 102 | 290 | 68 | 200 | 40 | 119 |
| III. | 100 | 102 | 305 | 80 | 240 | 51 | 136 |

The setae of the anal lobes vary from 170 to 210 $\mu$ with 185 $\mu$ the mode; those of the anal ring vary between 135 $\mu$ and 152 $\mu$.

The eyes are pronounced, but flattened; and the mentum is short, averaging about 85 $\mu$ in length.

Although the measurements of the antennal segments and those of the legs vary so greatly, this mealy-bug is readily distinguished from any other found in South Africa by other characters. The ventral median plates alone would separate it. I am at a loss to explain their function.

At first they look like thick-ringed pores, owing to the transparency of the derm at that point, where it is quite free from gland pores and hairs.

Collection No.: 69.

### 35. Pseudococcus nitidus sp. n.

(Plate XVI., Fig. 7. Plate XIX., Fig. 31.)

Ovisac: The ovisacs are found singly in crevices in the rough bark of the old limbs of thorn-trees (*Acacia caffra*). They are closely felted, smooth, and in the majority of cases have the shape and approximate size of an adult insect (Fig. 7), being about 3 mm. long and so smoothly felted on the exterior as to look like a piece of white kid. In a few instances there is a slight indication of a fine silky ovisac protruding below this kid-like sac, but such cases are exceptional. At first the adult entirely fills the sac, but, as eggs are laid, the body shrinks until the sac appears to be filled with ova, amongst which the shrunken body of the ♀ is found.

Ova: Elongate, oval, pale brown in colour, 0·3 mm. long; shell with numerous longitudinal wrinkles.

Larva: Pale translucent brown, 0·3 mm. long and 0·15 mm. broad, appearing truncate anteriorly. Antenna as long as the width of the body, of 6 segments, measuring: (1) 20; (2) 23; (3) 22; (4) 20; (5) 20; (6) 47 $\mu$.

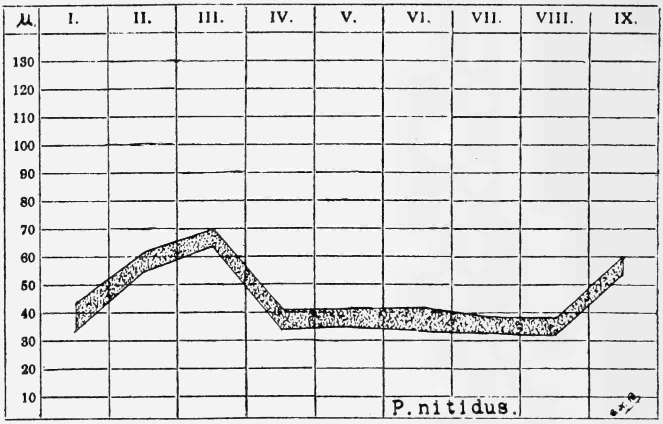
The caudal lobes are extremely conspicuous, with almost parallel sides, and are rounded apically. Eyes large, prominent, with transparent "lens."

Adult ♀: 2·5 mm. long, translucent brown in colour; legs and antennae of the same colour. No waxy secretion and no filaments except two extremely short caudal ones which appear as two white specks. The insect moves very slowly. In boiling NaOH the brown colour deepens slightly, but no purplish colour is produced.

Cleared and mounted the insect is characterized by its long legs and antennae and the prominent caudal lobes. The eyes are conspicuous, owing to the unusual manner in which they retain the stain. The dermis is quite free from the usual hairs except between the antennae, but has scattered, single gland-pores, from the centres of which small, acute spines project. The usual stout spines of the anal lobes are replaced by much more slender ones. In addition to the gland-pores with the short spines are a number of slightly larger openings which have distinct subcutaneous tubes. In the circum-anal region a number of the spines are longer than those of the remainder of the body, but they are always acute and spine-like, never linear and hair-like (Fig. 31).

The measurements in $\mu$ are as follows:—

Range of antennal segments:—(1) 34–44; (2) 56–62; (3) 64–70; (4) 34–42; (5) 36–42; (6) 34–42; (7) 33–38; (8) 33–38; (9) 54–60.




The legs are long and slender; although variations occur the following represent an average of measurements:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 60 | 85 | 225 | 52 | 180 | 23 | 100 |
| II. | 64 | 85 | 240 | 52 | 190 | 23 | 105 |
| III. | 68 | 90 | 260 | 52 | 225 | 23 | 112 |

Claw with a distinct tooth one-third distance from apex.

Setae of the anal lobes: To 175 $\mu$ in length.

Setae of the anal ring: To 120 $\mu$ in length.

♂ : Puparium elongate, white, felted, but with a silky gloss, 2 mm. long, 0·9 mm. broad.

♂ : Pupa removed from completed silky puparium greenish-grey in colour, elongate, 1 mm. long.

♂ : Head, legs, and antennae bright translucent brown; body slightly greenish; wings iridescent. Caudal filaments 4, median two as long as the head and body without antennae, two outer ones about one-third length of median.

Head and body: 1·12 mm. long.

Antenna: 0·9 mm. long, of 10 segments.

Wing: 1·35 mm. long.

Segments of antenna in $\mu$:—(1) 110; (2) 61; (3) 159; (4) 122; (5) 115; (6) 105; (7) 88; (8) 80; (9) 71; (10) 78.

Terminal joint broadly rounded at the apex. All joints with long bristles, those of the apical whorl reaching 75 $\mu$ in length.

Habitat: ♀ ♀ with ovisacs and ♂ puparia on rough bark of *Acacia caffra*, Pretoria, November, 1914. Collected by Miss Impey. As the earlier stages have not been observed outside the ovisac, it is impossible to say whether Acacia is the food plant of this species or not, as it is possible that the ♀ and ♂ migrate from grass, etc., before spinning the ovisac and puparium.

Material studied consisted of 2 ♂ ♂, 11 adult ♀ ♀, and numerous ova and larvae.

Collection No.: 39.

### 36. Pseudococcus segnis sp. n.

(Plate XIX., Fig. 32.)

A few twigs of native spiny-leaved veld bush were sent to this office by W. C. Winshaw, of Stellenbosch, as they were infested with adult ♀ ♀ and young of a species of *Ceroplastes*. The twigs were packed in a small glass sweet-bottle, the wide mouth of which was covered with muslin.

On examination it was found that there were also four specimens, apparently adult, of a dark green mealy-bug, quite different from any other known in the country. The description is as follows:—

Adult ♀: The four specimens range from 2·8 to 3·4 mm. in length, and are dark olivaceous-green in colour. There are no lateral or caudal filaments, and only a slight trace of white secretion, the insects appearing rather greasy or slug-like. This absence of secretion may be due to shaking in transit.

The insects progressed with a smooth, slow motion, which intensified the slug-like impression.

The legs and antennae are rich dark brown.

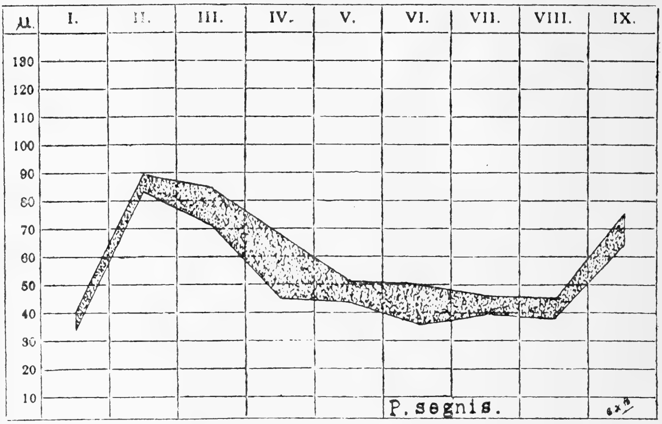
In boiling NaOH the colour becomes blackish-brown, then light brown, and the liquid is slightly stained of a similar brownish tint.

Cleared, stained, and mounted, it is noticed that the derm is clear and has scattered gland-pores—all of which are small. There are few scattered hairs, the longest being between the antennae (78 $\mu$).

The marginal spine areas comprise 2 *slender* spines and 5 to 8 small gland-pores (Fig. 32). There are two pairs of "eye-shaped cicatrices" in the usual position.

The eyes are comparatively small and inconspicuous. The mentum is 100 $\mu$ long.

The antennae are uniformly 9-segmented, and exhibit the following range of variation :—(1) 34–40 ; (2) 84–88 ; (3) 71–85 ; (4) 47–68 ; (5) 44–51 ; (6) 37–50 ; (7) 40–47 ; (8) 38–46 ; (9) 64–74.




The legs approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 100 | 125 | 335 | 91 | 238 | 37 | 136 |
| II. | 100 | 125 | 335 | 95 | 261 | 44 | 138 |
| III. | 100 | 125 | 354 | 102 | 308 | 44 | 138 |

Tarsal digitules fine hairs. Tooth on inside of claw quarter distance from tip.

The setae of the anal lobes are 136 $\mu$ long ; those of the anal ring 130 $\mu$.

Habitat: On *Cliffortia ruscifolia* Linn. (*Rosaceae*). Stellenbosch, C.P. Collected by W. C. Winshaw, December 13, 1914.

Collection No. : B 55.

### 37. Pseudococcus stelli sp. n.

(Plate XIX., Fig. 33.)

Ovisac : The ovisacs are rounded masses of cottony material usually found singly in the leaf-bases near the tips of the twigs where the leaves are closely imbricated. A number may be close together on such twigs, but in no case was more than one ovisac found to a leaf. In form they appear almost spherical, but adapted to the shape of the cavity between the leaves.

The greatest diameter averages approximately 2·5 mm. Completed ovisacs, when full of ova or emerging larvae, usually exhibit a slight yellowish tinge from the colour of the eggs or larvae within.

Ova: Pale creamy-yellow, 290 $\mu$ long and 145 $\mu$ broad.

Larva: Recently hatched is the same colour as the egg, but measures 415 $\mu$ in length. The antennae are 6-segmented with 6 about as long as 3 + 4 + 5 which are subequal. Eyes prominent, rounded. Anal lobes well produced, each bearing the usual seta.

♂ puparium: The ♂ puparium is usually found in the bases of the leaves which contain the ovisacs, and is often partially or wholly hidden by the latter. It is a delicate, elongate, flattened, white sac, about 2 mm. long, closed and rounded in front but open behind. The four white caudal filaments and the tips of the wings are visible before the ♂ emerges. Males were emerging when the material was received on December 19, 1914.

♂ : The living male is reddish in colour, but the colour is obscured by a fine white powdery covering. The wings are white and appear "mealy," but exhibit the usual beautiful iridescence. There are four dense white caudal filaments, the median pair being slightly the longer, about the length of head and body without antennae. The other pair arises from the margins of the next abdominal segment and projects somewhat outwards as well as backwards, so that the two pairs of filaments are quite distinctly separated. When freshly mounted in Canada balsam the body, legs, and antennae are amber-yellow in colour; the eyes are prominent, black.

Length of head + body: 1 mm.

Length of wing: 1·1 mm.

Length of antenna: 0·9 mm.

The antennae are 10-segmented, the segments measuring (as freshly mounted in Canada balsam):—(1) 40; (2) 54; (3) 153; (4) 125; (5) 108; (6) 102; (7) 95; (8) 81; (9) 75; (10) 78.

The segments bear ± irregular whorls of hairs, the majority of which are about 60 $\mu$ long.

The posterior abdominal segments are distinctly separated at the margins, the lateral margin being produced in broad rounded projections, from which the four caudal setae arise. These latter are approximately 200 $\mu$ long.

♀ : The adult ♀ is pale canary-yellow in colour, about 2 mm. to 2·5 mm. long. The lateral filaments are very short, but distinct, and gradually increase in length posteriorly. The caudal ones, two in number, are also short, about twice as long as the next pair, stout at the base and tapering towards the tip.

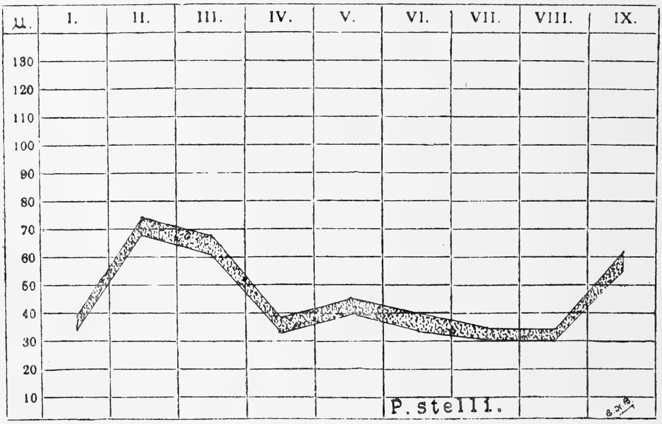
The waxy secretion on the dorsum is white and powdery, except that at points in the middle of the segments there appear minute cones of secretion, which form transverse lines across the dorsum.

In boiling NaOH the colour becomes reddish but the liquid remains practically colourless. When stained and mounted the dermis is almost clear, but exhibits two " eye-shaped cicatrices " between the antennae and the position of legs I., and two others about an equal distance from the posterior extremity. The gland-pores of the venter are small and few in number. Those of the dorsum are about three times the size of the ventral ones, and are most numerous in transverse rows across the segments. There are a few scattered hairs; some situated between the antennae being long (70 $\mu$). The eyes are prominent, conical, and retain the stain.

The marginal spine areas comprise 2 spines and 5- to 8-grouped gland-pores (Fig. 33).

The mentum is about 105 $\mu$ long.

The antennae are uniformly 9-jointed, the measurements of the segments varying but slightly as indicated by the following range in $\mu$:—(1) 34–40; (2) 68–74; (3) 61–68; (4) 34–38; (5) 40–46; (6) 34–40; (7) 30–34; (8) 30–34; (9) 56–62.




The most common measurements are :—(1) 40; (2) 68; (3) 64; (4) 34; (5) 44; (6) 37; (7) 34; (8) 34; (9) 58.

The leg measurements approximate :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 85 | 85 | 230 | 54 | 190 | 25 | 98 |
| II. | 90 | 92 | 246 | 57 | 231 | 27 | 100 |
| III. | 102 | 102 | 270 | 61 | 261 | 34 | 104 |

The tarsal digitules are simple hairs, and there is a distinct tooth one-third the length from the tip of the claw. The caudal lobes are prominently produced, and bear the usual setae, which average 210 $\mu$ in length, and, in addition, two shorter hairs and three stout spines. The setae of the anal ring are about 135 $\mu$ long.

Habitat: On spiny-leaved veld bush (*Borbonia cordata* Linn.), Stellenbosch, C.P. Collected by W. C. Winshaw, December 17, 1914.

Material studied included 8 adult ♀ ♀ and 3 adult ♂ ♂.

Collection No.: B 56.

### 37*a*. Pseudococcus stelli var. tylococciformis sp. n. var. n.

(Plate XVIII., Fig. 21.)

On the twigs with *Ps. stelli* were a few specimens identical in appearance except that the body was beautiful rose-pink in colour instead of yellow. The waxy secretion was exactly similar, and when mounted the legs, antennae, etc., were also identical, but the lateral spine areas were produced on small truncate tubercles (Fig. 21). The insects showing this character were on an average slightly smaller than the adults of *stelli*, but the antennae were uniformly 9-segmented.

Collection No.: B 56*a*.

## Tribe ERIOCOCCINI.

### Gen. ERIOCOCCUS Targ.

"The normal characters for this genus are: Adult ♀ elongate or short ovate; segmentation more or less distinct; dorsum or margin usually spiny. Antennae of six or seven joints. Legs persistent. Anal orifice with six or eight hairs. Anal lobes conspicuous.

Ovisac of ♀ usually elliptical or elongate, more or less convex, felted, and either with or without a minute opening at the anal extremity.

Puparium of ♂ resembling that of the ♀, but much smaller.

♂ ♂ winged, or rarely apterous." (*Newstead.*)

### 38. Eriococcus araucariae Mask.

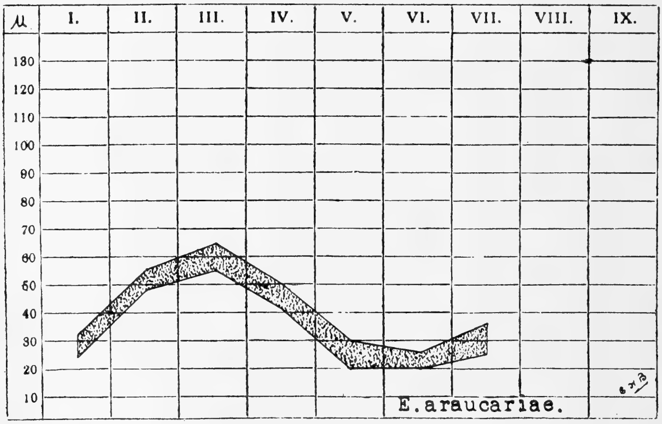
(Plate XXI., Figs. 40–40*b*.)

*Eriococcus araucariae* Mask., N.Z. Trans., xi., p. 218, 1879.
*Rhizococcus* ,, Comst., Rep. U.S. Dep. Ag., 1880, p. 339, 1881.

*Eriococcus araucariae* Lounsb., Rep. Ent. Cape Good Hope, p. 19, 1897.
,, ,, Fuller, First Rep. Ent. Natal, p. 107, 1900.

The insect here referred to is not in entire agreement with Maskell's original description of *E. araucariae,* but is evidently the same as that reported from America as *Rhizococcus araucariae* (Mask.) by Comstock. It has been established in South Africa for many years, and is now widespread throughout the Union. The following measurements from South African material may be useful for comparison :—

Antennal segments vary within the range :—(1) 24–32 ; (2) 48–54 ; (3) 56–64 ; (4) 42–50 ; (5) 20–30 ; (6) 20–26 ; (7) 27–36.




The caudal lobes are long (100 $\mu$) and narrow, and bear several strong, stout, blunt spines and a single seta which is often 200 $\mu$ long.

The hairs of the anal ring (8) are generally 135 $\mu$ long.

Collection No. : 30.

## Gen. PUTO Signoret.

In his "Essai," p. 341, 1875, Dr. Signoret defines the genus as follows (figure references omitted) :—

" Ce genre nouveau se basera sur les yeux proéminents dans la femelle, la présence de douze yeux, dont quatre grands, et huit ocelles dans le mâle ; l'absence dans les deux sexes de digitules à extrémité renflée ; huit poils sur l'anneau génito-anal ; deux poils sur le balancier ; antennes de neuf articles dans la femelle, de dix excessivement longs dans le mâle."

The ♀ characters may be summarized thus :—Eyes prominent, digitules not clubbed, anal ring with eight hairs, antennae with 9 segments.

The ♂ characters are remarkable; the size especially (3 mm. long without wings) compared with that of the ♀ (3·5 mm.) makes one doubtful whether the insect described is the male of that species or not.

## 39. Puto (?) africanus sp. n.

(Plate XXI., Figs. 41–41*f*.)

Adult ♀ enclosed in a dense felted or papery sac, which is generally white or yellowish in colour. Many of the sacs, in the dry material at hand, are broken at one end, and appear as white cups attached to the stem of the host-plant.

The ovisacs, when not deformed by massing together, are regularly elongate oval about 2 mm. long and 1·2 mm. in diameter. The large number of small slender sacs beneath the larger ones suggests that either the younger ♀ form inhabits a sac, or that large numbers of males are produced.

Ova or larvae not observed.

♂ : Not known.

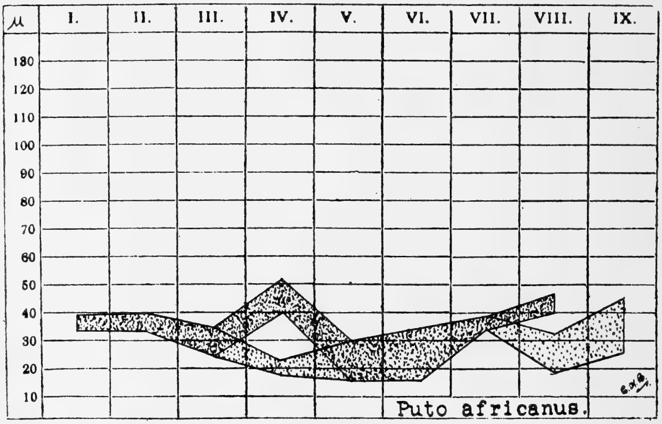
Adult ♀ : The adult ♀ as recovered from dry material is merely a black shrivelled mass without indications of secretionary covering of any kind, and without lateral or caudal filaments.

In boiling NaOH the insect is restored to the usual elongate oval form of *Pseudococcus* and is at first deep black in colour. Later it simulates the insects of the *filamentosus* group of mealy-bugs, being very difficult to clear and taking on a deep green colour before clearing. When stained and mounted the insect differs from *Pseudococcus* in having antennae of a different type although they are 8- or 9-jointed (Plate XXI., Figs. 41–41*a*) ; in having the anal ring with 8 hairs instead of 6; and in having conical spines scattered over the posterior part of the body. From *Eriococcus* it differs also in the antennae; in having the spines comparatively short and of an indefinite arrangement; and particularly in the absence of the elongate caudal lobes.

In mounted specimens the body averages 1·7 mm. in length and 0·9 mm. in breadth. The antennae are 8- or 9-jointed, the apical segments being wider and more irregular in outline than is usual in *Pseudococcus* spp. (Plate XXI., Fig 41).

Six series of measurements are included in the table below to illustrate the inconstancy of the antennal segments :—

| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
|---|---|---|---|---|---|---|---|---|---|
| 1. | ? | 37 | 24 | 51* | 24 | 34 | 34 | 44 | — |
| 2. | 34 | 40 | 24 | 44* | 17 | 34 | 34 | 44 | — |
| 3. | 34 | 37 | 24 | 40† | 24 | 34 | 34 | 40 | — |
| 4. | ? | 34 | 34 | 18 | 34 | 23 | 38 | 18 | 27 |
| 5. | 34 | 37 | 24 | 18 | 30 | 24 | 38 | 30 | 47 |
| 6. | 38 | 34 | 24 | 20 | 23 | 17 | 34 | 34 | 37 |




The legs, on the contrary, are remarkably constant. The following measurements are approximate for the series :—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 51 | 84 | 150 | 52 | 88 | 27 | 85 |
| II. | 51 | 84 | 164 | 52 | 102 | 30 | 95 |
| III. | 51 | 84 | 180 | 52 | 135 | 30 | 95 |

The digitules, both of the claw and tarsus are knobbed hairs.

The dermis is characterized by numerous small gland-pores either with subcutaneous "tubes," or bristle-like hairs. When seen in optical section, as in mounted specimens, a region between the insertion of legs III. and the anal ring has numerous large pores with short, stout conical spines as shown in Plate XXI., Figs. 41*b* and 41*c*. The anal ring is broad and bears

* Without pseudo-articulation. † With pseudo-articulation.

8 hairs, 6 in the chitinous ring and 2 posterior to this where the ring is incomplete (Fig. 41*d*). The anal lobes are rounded outwardly instead of posteriorly, and bear one long, stout seta, several shorter, more slender setae, and two stout conical spines. The large setae of the caudal lobes were in every case broken, but are at least 220 $\mu$ long, probably much longer. The smaller setae reach 136 $\mu$ in length.

The setae of the anal ring are about 110 $\mu$ long.

Habitat: On a native shrub (*Tamarix articulata* Vahl.). Collected by C. P. Lounsbury and C. Fuller, near Cape Town, January, 1898.

Remarks: This insect is tentatively included in the genus *Puto* of Signoret because of the 9-jointed antennae and the eight hairs on the anal ring.

Collection No.: B 70.

## Subfamily ORTHEZIINAE.

This subfamily contains comparatively few individuals which all possess a very characteristic appearance owing to the waxy plates or lamellae which adorn the bodies of the female. The males, where known, are also distinguished readily by the possession of compound eyes, and a tuft of long filaments which terminates the abdomen.

### Gen. ORTHEZIA Bosc.

*Orthezia* Bosc., Journ. de Phys., xxiv., p. 173, 1784, etc.
*Dorthesia* l'Abbé d. Orthez, Journ. de Phys., xxvi., p. 207, 1785, etc.

Adult ♀ partly or wholly covered with waxy lamellae; antennae of 7, 8, or 9 joints, usually 8. Legs well developed and normal. Larva with 6-jointed antennae.

#### 40. Orthezia insignis Dougl.

(Plate XXVI., Fig. 57.)

*Orthezia insignis* Douglas, Jn. Q. Micr. Club, p. 169, 1887 (♀ only).
,, ,, Lounsbury, 32nd Rep. Mass. Agr. Coll., p. 111, 1895 (♀ only).
,, ,, Lounsbury, Rep. Ent. Cape G. Hope, p. 36, 1898.
,, ,, Green, Circ. Roy. Bot. Gard. Ceylon, p. 83, 1899.
,, ,, Fuller, 1st Rep. Ent. Natal, p. 109, 1901.

*Orthezia insignis* Newstead, Monograph, ii., pp. 236–241, 1902.
,, ,, Fuller, Natal Agr. Jn., p. 1035, 1907.

Common names :—Ceylon, " Lantana bug."
England, " Kew bug."
Natal, " Sugar-iced bug " (Fuller).
America, " White-tail Mealy-bug."

Ovisac: Varying in length; may attain three times the length of the body; white, except in old individuals, when it is often dirty or covered with " sooty " fungus, parallel-sided and upturned, rounded behind and attached to the body of the ♀. The adult is active and carries the ovisac around with her until the young are hatched. Upper surface of ovisac with longitudinal furrows and median ridge flatly rounded and broad.

Larva: Active, about 0·31 mm. long and 0·26 mm. broad; very broadly and regularly oval. Legs very long; legs II. longer than body (0·32 mm.). Antennae long (0·24 mm.), of 6 joints, which measure approximately :—(1) 34; (2) 35; (3) 34; (4) 30; (5) 37; (6) 100 $\mu$. Joint 6 with a strong blunt spine.

Adult ♂: " A graceful little insect . . . of a slaty-grey colour, with very long slender antennae, a single pair of greyish wings, and a tuft of long white silky filaments at the end of the body. The eyes are black and divided into numerous facets." (*Green.*)

Adult ♀: Varies in colour according to age, and ranges from light green to dark brownish-green, and later to nearly black. Antennae and legs fulvous.

" Short-broad-oval, surrounded (except over the head) by a marginal series of snow-white, laterally connected lamellae, which, after the first three on each side, are directed backwards and downwards, gradually increasing in length, the posterior ones overhanging the marsupium; but of these the middle three are shorter and more distinct, the median one, over the middle channel, shortest and broadest of all, either turned up vertically or horizontal, and having a median sulcation; the dark surface of the body level, nude, the segmentation plainly discernible, but on the middle are two longitudinal, narrow, contiguous yet distinct lines of small, granulose, white, lamellate projections. These lines, beginning at the base of each antenna, extend backward for a short distance convergently, but almost immediately after each curves outward and again inward, so as to leave a small, dark, oval space between them; then both are parallel, and close together up to the anal extremity." (*Douglas.*)

When cleared and mounted the insect is about 1·7 mm. long and is slightly narrowed in front and broadly rounded behind. The antennae are 7- or 8-jointed, the segments varying in the 10 specimens examined as follows:—(1) 106–120; (2) 100–115; (3) 105–125; (4) 95–105; (5) 100–124; (6) 85–95; (7) 85–95; (8) 180–200.

The 7-jointed form is unusual. One specimen, measuring 1·7 mm. when mounted, has one antenna distinctly 7-segmented and the other apparently 6-jointed owing to the failure of 6 and 7 to separate. The measurements of the 7-jointed form are: (1) 115; (2) 108; (3) 125; (4) 102; (5) 112; (6) 88; (7) 188.

The terminal spine is stout and blunt.

The legs are long and bear numerous spines. The approximate measurements in $\mu$ are:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 123 | 200 | 530 | 123 | 430 | 50 | 330 |
| II. | 150 | 240 | 530 | 130 | 500 | 50 | 360 |
| III. | 150 | 240 | 550 | 130 | 525 | 50 | 385 |

The trochanter is quite different from the usual Coccid form in that it is quite small, narrow, and almost annular. The derm is characterized by slightly curved, bluntly pointed gland-spines with dilated bases. The distribution of these corresponds to the position of the waxy plates and the attachment of the ovisac.

The eyes are small, hemispherical, and deeply pigmented.

There are no caudal lobes and no setae; the anal ring bears 6 hairs measuring approximately 150 $\mu$.

Habitat: On lantana, coleus, gardenia, camellia, ixora, jacaranda, cestrum, chrysanthemum, etc. Known to occur along the coast-belt from Cape Town to Natal.

I have recently (February, 1915) received this species on *Citharoxylon* sp. from Mr. James Wylie, Curator of the Municipal Botanic Gardens of Durban, who writes me that he has also seen it on *Hamelia patens*, *Thunbergia erecta*, Ruellia and Lantana.

This species was probably introduced many years ago. It was first reported as a pest in 1898 by C. P. Lounsbury, when it was exceptionally abundant on a few lantana hedges in the Cape Peninsula.

Collection No.: 12.

## Subfamily COCCINAE.

The subfamily *Coccinae* comprises a small number of insects which resemble the mealy-bugs (*Pseudococcinae*) very much, but differ mainly in the hairless anal ring.

As constituted at present, only two genera are included in this subfamily, the cochineal insects (*Coccus* spp.) and an aberrant group included in the genus *Sphaerococcus*. These latter may be compared with the Pseudococcine genus *Antonina*.

### Gen. COCCUS Goeze (?).

"♀ : Without ciliated anal ring or anal lobes. Antenna normally with 7 joints, the number occasionally reduced by the confluence of two or more segments. Derm with irregular clusters of glandular pores and truncate spines. Eyes prominent, simple. Legs well developed. The truncate spines are cylindrical and apparently tubular. They are very numerous on the wild forms, but are generally reduced—both in number and size—on the cultivated species." (*Green*, 1912.)

### 41. Coccus cacti Goeze 1778 (and others).

(Plate XXII., Fig. 43.)

*Coccus cacti* Goeze, Ent. Beitr., ii., p. 341, 1778.
*Dactylopius coccus* Costa, Faun. Regn. Nap., Cocc., p. 16, 1835.
*Pseudococcus cacti* Westw., Mod. Class. Ins., ii., p. 445, 1840.
*Coccus cacti* Sign., Ann. Soc. Ent. Fr., (5), v., p. 347, 1875.
,, ,, Comst., Rep. U.S. Dep. Ag., 1880, p. 346, 1881.
*Dactylopius coccus* Fernald, Catalogue, p. 80, 1903.
*Coccus cacti* Green, Journ. Econ. Biol., p. 82, 1912.

"Adult female subglobular, slightly narrower behind. Purplish-red, pruinose, but without conspicuous white tomentum.

Eyes prominent, cylindrical, rugosely chitinous.

Antennae short, basal joints very broad, others narrowing successively, 7-jointed, 1st joint very irregular in form, 2nd joint represented by a broad chitinous ring, 3rd and 4th usually more or less confluent, the junction incompletely demarked by bands of translucent intersegmental tissue, 5th broad and short, 6th approximately equal in breadth and length, 7th elongate, twice as long as broad, with some stout curved hairs on the apical half, a few stout spiniform hairs on the apical margins of the other joints with the exception of the 3rd, rarely 6-jointed by suppression of the 5th or 6th joint. Length of antenna 0·2 to 0·3 mm. Breadth of basal joint 0·16 mm.

Legs stout, terminating in a slender, longish curved claw, femur and trochanter together 0·38 mm., tibia 0·16 mm., tarsus (without claw) 0·15 to 0·16 mm.

The most conspicuous feature of the derm is the presence of numerous clusters of large, thick-rimmed pores, each with a pentagonal lumen, which occur over the whole surface, but are less pronounced on the median area. The number of pores in a cluster varies from 2 to 25, and averages 12 or 13.

The truncate spines are very inconspicuous, small and slender, tapering slightly towards the extremity, some of them almost hair-like. They are scattered very sparsely over the body, but are grouped more closely on the area surrounding the anal orifice, where they are mingled with some simple pointed hair-like spines.

Length of adult female (under compression) from 4 to 6 mm. Breadth 3 to 4·5 mm. Average dimensions 4·75 × 3·87 mm." (*Green.*)

Habitat: On *Opuntia tomentosa, O. decumana*, and *Nopalea cochinelifera* in Botanic Gardens, Cape Town.

This species has been established in Cape Town for many years. It does not have the toxic effect on the host-plant which is so striking in *C. indicus.*

Collection No.: 36.

## 42. Coccus confusus capensis Green.

*Coccus confusus capensis* Green, Journ. Econ. Biol., p. 91, 1912.

"Adult female profusely covered with white mealy secretion which more or less completely conceals the form of the individual insects. Broadly oval, usually narrowed behind.

Eyes moderately prominent; not densely chitinous.

Antennae small, basal joint very broad; 2nd joint ring-shaped; 3rd and 4th approximately equal, and twice as broad as long; 5th and 6th smaller, broader than long; 7th irregularly ovate, longer than broad, tuberculate. Total length of antennae 0·15 to 0·17 mm. Breadth of basal joint 0·07 to 0·09 mm.

Legs small, moderately stout; femur and trochanter together 0·2 to 0·23 mm.; tibia 0·08 to 0·12 mm.; tarsus (without claw) 0·1 to 0·12 mm.

Dermal pores conspicuous, in dense clusters (especially towards posterior extremity); a few single pores and small scattered groups; largest groups with 30 pores; average 15.

Truncate spines numerous and conspicuous; stout, cylindrical; proportionately shorter than in typical *confusus* or *newsteadi*; diameter of base usually much more than half the total length of spine.

Length of body (under compression) from 2·5 to 3·5 mm. Breadth 2 to 2·75 mm. An average of sixteen examples gives a dimension of 3 × 2·27 mm." (*Green.*)

Habitat: On *Opuntia monacantha*, Cape Province, Natal, and Orange Free State; common in districts where the food-plant abounds. This species has been recorded on one occasion on *Nopalea cochinelifera*, when found growing in close proximity to infested *O. monacantha* at Pretoria (1913).

Collection No.: 38.

### 43. Coccus indicus Green.

(Plate XXII., Fig. 44.)

*Coccus indicus* Green, Mem. Dept. Agric. Ind., 1908, ii., 2, p. 28.
*Coccus cacti* var. *ceylonicus* Green, Ind. Mus. Notes, iv., 1, p. 7, 1896. Nom. nud.
*Coccus indicus* Green, Journ. Econ. Biol., p. 84, 1912.

"Adult female subglobular; purplish-red, the colour concealed beneath a mass of white mealy tomentum.

Eyes moderately prominent, rounded, not densely chitinous.

Antennae short, tapering gradually to extremity; 7-jointed (rarely 6-jointed, through the complete confluence of 3rd and 4th joints); all the segments broad and short, much broader than long, with the exception of 7th, which is irregularly subglobular—the breadth approximately equal to the length; some stout curved hairs on terminal segment. Length of antenna 0·12 to 0·16 mm. Breadth of basal joint 0·06 to 0·08 mm.

Legs small, moderately stout; femur and trochanter together 0·16 to 0·2 mm.; tibia 0·06 to 0·09 mm.; tarsus (minus claw) slightly longer than tibia, 0·08 to 0·1 mm.

The dermal pores, which are such a conspicuous feature in *C. cacti*, are small and inconspicuous in this species, and are without thickened chitinous rims. They occur singly and in small clusters of 3 or 4 pores; rarely clusters of 5 or 6 occur.

The truncate spines are very numerous and conspicuous—even under a comparatively low magnification. They are short and stout, cylindrical and parallel-sided, with very broadly expanded bases which give a characteristic appearance to the spines of this species. The base is usually as broad as, and sometimes slightly broader than, the total length of the spine. They are scattered thickly and evenly over the whole dorsum and on the ventral marginal area of the abdomen. The largest spines are grouped on the abdominal margin.

Length of body (under compression) of Indian examples varies from 2·5 to 5 mm. An average of 19 examples gives a dimension of 3·93 × 3·16 mm. Ceylon examples are slightly smaller, ranging from

1·75 to 4 mm., with an average (from 17 examples) of 2·95 × 2·37 mm." (*Green.*)

Habitat: On *Opuntia monacantha* under experimental conditions at Rosebank Experiment Station, C.P., Natal Museum, and Division of Entomology, Pretoria.

This species was introduced by the Queensland Prickly Pear Commission in 1913. An attempt is being made to establish it in this country because of its toxic effect on its host-plant.

Collection No.: 37.

## Gen. SPHAEROCOCCUS Mask.

The characters of this genus are somewhat vague, and require revision. The definition given by Maskell, in the N.Z. Trans., 1892, p. 237, is as follows: "Adult females naked, or producing cotton or wax. Anal tubercles absent; anogenital ring hairless. Antennae of usually less than seven joints, sometimes atrophied. Feet sometimes absent, sometimes atrophied, sometimes deformed. Adult ♂ unknown."

### 44. Sphaerococcus africanus sp. n.

Ovisac: Creamy-white to yellowish in colour, densely felted, varying in size to 3 mm. long and 2·75 in diameter; usually almost spherical, sometimes more or less elongate oval. Ovisacs generally separate and distinct, occasionally more or less clustered.

Larva: Freshly mounted, orange-yellow, broad, 0·3 mm. long. Antennae of 6 segments; eyes prominent, deeply pigmented. Mouthparts extraordinarily broad and large. Caudal lobes not produced, but represented by one long seta on each side.

Adult ♀: Entirely enclosed in the felted sac; pale translucent brown; no secretion; colour in boiling KOH deep brown, liquid slightly coloured brownish.

Size mounted may reach 3 mm. long by 2·8 broad. Antennae short, 6- or 7-jointed, usually 7. The 6-jointed form arises from the failure of the two apical segments to divide.

The segments vary considerably in size, the range from 12 measurements being:—(1) 20–30; (2) 20–25; (3) 13–20; (4) 14–23; (5) 12–18; (6) 17–22; (7) 40–48.

The legs are small, approximating:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I. | 20 | 60 | 85 | 40 | 47 | 21 | 51 |
| II. | 22 | 60 | 95 | 47 | 51 | 24 | 64 |
| III. | 28 | 60 | 120 | 74 | 57 | 30 | 64 |

The dermal pores over most of the body are small and simple; some are supplied with bristles; others with long subcutaneous tubes. In the circum-anal region there are numerous, scattered, large, disc-like pores and numerous long hairs, some of the latter reaching 100 $\mu$ in length.

The anal ring is comparatively small, and hairless.

Habitat: On *Borbonia cordata* Linn. Somerset West, C.P., Nov. 26, 1906, Coll. T. F. Dreyer.

On Rhenosterbosch (*Elytropappus rhinocerotis* Less.), Stellenbosch, Nov. 1914, Coll. C. P. van der Merwe.

On *Cliffortia ruscifolia* Linn. Stellenbosch, Coll. W. C. Winshaw, December 17, 1914.

Collection Nos.: A 32, B 32, and C 32*a*.

## Subfamily MONOPHLEBINAE.

The Monophlebinae are all comparatively large insects of exceptional interest. Representatives of three genera are known to occur in South Africa, viz. *Monophlebus*, *Icerya*, *Aspidoproctus*. In the early stages of all, and in all stages of the two first-mentioned, the ♀ insects have somewhat the appearance of mealy-bugs of large size, as the bodies are covered with a more or less dense covering of waxy secretion. In *Aspidoproctus* the derm becomes very hard and dense in the older stages, and has little or no secretionary covering.

### Gen. MONOPHLEBUS Leach.

♀ : Body usually dark brick-red in colour, more or less obscured by a coarse granular waxy secretion; body-wall remaining thin and soft to maturity; legs and antennae well developed, dark in colour to black. Insects active and free-moving except at the ecdyses and time of oviposition, when they cling to leaves or twigs and become fixed by tenent hairs on the venter.

Antennae of 11 segments.

♂ : With two long caudal appendages to the abdomen. (In *M. fulleri* the caudal appendages are about as long as the body.)

♂ with compound eyes.

45. Monophlebus africanus Newst.

Schultze, Zool. u. anthro. Ergeb. einer Forsch. im. w.u.z. Sudafrika Jena, pp. 15–16, 1912.

"Female, early adult. Faintly farinose. Ovate, with a faint constriction at the thoracic area; low convex above; sides thick; segmentation marked. Colour (in alcohol) pale dull orange to dull orange-crimson; legs and antennae black. A few pale hairs are visible at the margins, under a low power, otherwise the integument appears smooth and glabrous. Under a higher magnification the derm is seen to bear slender hairs, rather widely separated, but these are more numerous and longer on the venter than on the dorsum; between the hairs there are minute circular spinnerets, some of which have a central orifice shaped somewhat like a figure-of-8. Antennae normally of eleven segments, but these organs are given to considerable variation even in examples of the same stage, and are also sometimes asymmetrical. Eyes obconical, black. Legs short and stout; anterior tarsi with a bilateral row of 3–4 stout simple spines ventrally; anterior tibiae with 3 (possibly 6) very long spinose hairs on the upper surface. The other legs are similar.

Length 8–10 mm.

Penultimate stage of female. Of the same form and colour as the adult female. Antennal segments varying in number from 7–9; the apical segment may be either pointed (rare) or broader (frequent) and longer than the preceding one.

Male: Pale orange-crimson, in alcohol. Legs, sclerites (dorsal and ventral), and eyes black. Abdominal lobes or tubercles on terminal segment two in number, these are nearly as long again as the width of the preceding segment; each with 3–4 very long stout hairs. Margin of two preceding segments faintly produced but not distinctly tuberculate; these are also furnished with one or two rather long hairs. Tip of genital armature widely rounded and faintly emarginate; base scarcely wider than the apex, sides parallel. Wings faintly infuscated. Antennae brownish-black and furnished with very long hairs; apical segments wanting.

Length from point of head to tip of the closed wings 2·50 mm.

The anal tubercles of the male, in life, would no doubt be furnished, each with a single long filamentous appendage, but these had entirely disappeared in the alcohol. I assume that there would be three pairs of these filaments present, in life: one long median pair and two short lateral ones.

These insects (the females) give off a pale dull orange stain in alcohol; which permanently stained the white paper labels a dull pale red. It is very rarely that Coccids produce such an effect in alcohol, and may, therefore, be taken as a very marked character.

In form and colour the female looks like a very small form of *Monophlebus sjostedti*, Newst. *M. africanus* differs in being much smaller, has a much shorter terminal segment to the antenna, and has simple tarsal spines. The male may also be distinguished by its pale infuscated wings—a character which is apparently unusual in the males of this genus.

Habitat: Rooibank bei Walfischbai, Mai, 1905, in der Wurzelgeflechten der *!kuibes*-Pflanze; Steinkopf, August, 1904, L. Schultze.

Deutsch-Sudwestafrika, Luderitzbucht, December, 1903, L. Schultze.

Kap Cross, L. Schultze."

This insect has not been seen by the writer, but the above description is given for comparison with the other known South African species.

### 46. Monophlebus fortis Ckll.

*Monophlebus fortis* Ckll., The Entom., xxxiv., p. 224, 1901.
,, ,, The Entom., xxxv., p. 319, 1902.

Professor Cockerell's description is as follows:—

"♀: Dark grey, distinctly segmented, mealy, posterior end covered with cottony secretion; sides with scattered long pale bristles; legs black. Length 5½, breadth 2½ mm.

Boiled in liquor potassae, does not stain it. Hairy skin just as in *M. fulleri*, also legs, with the same spear-shaped processes, which are even better developed on the tibia. 'Cicatrices' as in *fulleri*. Length of tibia about 1,100 $\mu$, tarsus (without claw) about 580. Antennae 11-jointed; measurements in $\mu$: (1) 150; (2) 150; (3) 150; (4) 110; (5) 110; (6) 110; (7) 110; (8) 130; (9) 120; (10) 120; (11) 160.

Very close to the last (i.e. *M. fulleri* Ckll.) but smaller, though certainly adult, and without the longitudinal white keels.

Richmond, Natal, under bark of Eucalyptus; only one found."

This species has not yet been found again.

### 47. Monophlebus fulleri Ckll.

(Plate XXII., Fig. 45. Plate XXIII., Figs. 49–49*i*).

*Monophlebus fulleri* Ckll., The Entom., xxxiv., pp. 223–224, 1901.

The specimen described by Prof. Cockerell, *l.c.*, was probably adult with two antennal segments missing instead of one as suggested in the description.

The following particulars are given from fresh specimens collected at Pretoria by the writer October, 1914, to January, 1915, and from spirit material collected at Queenstown, C.P., by T. F. Dreyer in 1907 (Cape No.: 1898).

The adult ♀ is viviparous, giving birth to young during an extended period. During this time the body becomes shrivelled and presents numerous folds and creases.

Larva: The newly hatched larvae are deep red coloured (like the other stages denuded of secretion) and are at first naked. They apparently soon settle down in the leaf-sheaths of grass and secrete a white waxy matter which is regularly arranged in masses very much like the covering of an *Orthezia*. The deep red colour of the body is plainly visible between the waxy matter.

The larvae are at first small, 0·316 mm. long, elongate, rather narrow behind (Fig. 49). The legs and antennae are black. Round the margins of the body are numerous short, blunt, hair-like appendages which form a regular fringe. At intervals are long bristle-like hairs arising from thickened sockets. On the dorsum of the abdominal segments are three series of similar appendages with a few longer hairs interspersed. On the anterior parts are several series of similar hairs. The eyes are conspicuous and deeply pigmented. Mentum short. The antennae are comparatively long, being half as long as the body. They are 5-jointed with III. and V. long, the others subequal. The measurements approximate: (1) 40; (2) 40; (3) 85; (4) 48; (5) 105.

♂ series: On November 18, 1914, while observing this species on the grasses in front of Union Buildings, elongate masses of cottony material were found in the axils of grass-leaves. The photograph (Fig. 45) shows the size and shape of these, as the adult ♀ on the grass above measured 7·2 mm. long. This cottony sac looked exactly like the elongate ovisac of some mealy-bug. The insect enclosed by this puparium was at first, to all external appearance, exactly like a half-grown female except that there were no mouth-parts.

*Prae-Pupa:* Cleared and mounted the ♂ prae-pupa is 2·8 mm. long, and 1·4 mm. broad, with legs and antennae well developed, but mouth-parts absent. The dermis is similar to that of the ♀ but the three cicatrices are shorter and more broadly oval.

The antennae (Fig. 49*b*) are 9-jointed, and measure:—

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| R. | 74 $\mu$ long and 150 broad | 74 | 68 | 44 | 47 | 47 | 50 | 52 | 125 |
| L. | 74 $\mu$ long and 136 broad | 64 | 68 | 48 | 51 | 51 | 51 | 52 | 120 |

The legs I., II., and II. approximate:—

108 187 431 110 385 61 230.

Pupa proper: The pupa proper has the leg-, antenna- and wing-cases free. The antenna-case is distinctly 10-segmented (Fig. 49*c*). The abdomen terminates in two conical lobes; these are more highly chitinized than the remainder of the body-case and bear several stout spines (Fig. 49*d*). There is also a strongly chitinized median plate.

The adult ♂: A number of ♂ puparia were collected and kept in a glass tube loosely closed with cotton-wool. On December 1st the first adult appeared, two others emerging on December 3rd. The adult ♂ is a striking insect, with deep red and black body, black legs, eyes and antennae, and smoky-black wings which have the costal margin fuscous. There are two abdominal prolongations, very much wrinkled and hairy (Fig. 49*f*), having the same appearance as the terminal portion of the abdomen in mounted specimens. In specimens kept alive for a day after emergence the body-colour was somewhat obscured by a slight covering of mealy white wax.

The ♂ varies slightly in length, but the middle specimen of the three, from the point of view of size, is 7·6 mm. long over antennae, head, body, and appendages, while the head and body alone measure 3·5 mm. The width across the expanded wings is 7 mm.

The antennae are 10-segmented and are 2·61 mm. long. When cleared and mounted they appear very dark brown rather than black, and are whorled with long fine bristles (about 308 $\mu$ long on basal joints) (Fig. 49*g*).

The segments measure:—(1) 136; (2) 136; (3) 357; (4) 290; (5) 272; (6) 246; (7) 240; (8) 220; (9) 205; (10) 250 $\mu$.

This male is apparently very much like that of *Monophlebus africanus* Newstead in colouring and general appearance but is larger, as the wings alone are 3·15 mm. long in *fulleri*, while in *africanus* the length from point of head to tip of closed wings is given as 2·5 mm.

Adult ♀: The insects most commonly seen are of a sordid white or buff colour, due to a coarse mealy covering. After moulting, however, the newly emerged insect is a deep rich red, with the antennae and legs black.

At the time of ecdysis the insects cling to the grass by the legs, but are also slightly glued to the stem by secretion from tenent hairs on the venter, between the three pairs of legs, exactly in the same manner that *Aspidoproctus* is attached.

Prior to the adult moult the insect is almost as large as the adult ♀, but it has 8-jointed antennae, and the legs are much smaller, the femur plus trochanter and the tibia each being about 462 $\mu$ long.

The adult ♀ is most commonly between 5 and 6 mm. in length, but occasionally insects are found which reach 7 to 8 mm. long. The legs and antennae are long, but the joints are variable in length.

One of the largest insects collected in Pretoria measured when alive 7·2 mm. long, 3·5 mm. broad, and 3·5 mm. high. When cleared and mounted the antennae measured :—

| Segments | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R. | 142 | 146 | 122 | 68 | 68 | 74 | 85 | 85 | 74 | 64 | 136 |
| L. | 136 | 142 | 129 | 74 | 74 | 78 | 81 | 91 | 78 | 74 | 146 |

In this specimen the femur + trochanter varied from 958 to 1,000 $\mu$; the tibia was 816 $\mu$, and the tarsus without claw was I. 492 $\mu$, II. 540 $\mu$, III. 585 $\mu$.

A small form from Pretoria measured: Antennae :—

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R. | 85 | 85 | 92 | 58 | 68 | 68 | 68 | 68 | 68 | 68 | 153 |
| L. | 102 | 91 | 102 | 58 | 68 | 71 | 68 | 68 | 68 | 68 | 153 |

Legs :—Femur + trochanter 770 $\mu$; tibia I. 616 $\mu$, II. 650 $\mu$, III. 695 $\mu$; tarsus without claw I. 338 $\mu$, II. 368 $\mu$, III. 385 $\mu$.

One of the Queenstown specimens which is about 6 mm. long measures: Antennae :—

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R. | 98 | 100 | 100 | 58 | 68 | 68 | 68 | 68 | 85 | 80 | 136 |
| L. | 120 | 85 | 100 | 58 | 68 | 68 | 68 | 68 | 76 | 74 | 140 |

Femur + trochanter I. 800 $\mu$, II. 800 $\mu$, III. 846 $\mu$; tibia 620 to 675$\mu$ and tarsus without claw 340 to 380 $\mu$. The trochanter in all cases appears to be two-segmented (Fig. 49*i*).

Habitat: On grass (sp. indet.) Natal (Coll. Fuller), Queenstown Municipal Gardens, C.P. (Coll. T. F. Dreyer), and on *Cynodon* sp. Pretoria, Transvaal, collected by the writer.

Collection No.: 4.

### 48. Monophlebus hirtus, sp. n.

(Plate XXVI., Fig. 59.)

A slide in the collection at Pretoria has on it two specimens of ♀ *Monophlebus* sent to the office in April, 1913.

The records show that these were sent in by C. C. Robertson, of the Division of Forestry, who wrote as follows :—

Kologha, Stutterheim, C.P.
*April* 23, 1913.

I am sending you by post to-day a box containing some insects found yesterday at Kubusie Plantation adhering to the bark of shoots of trees of *Pinus canariensis*, about 6 ft. high. They were seen only on shoots the tips of which were dead, and not on the surrounding healthy shoots.

The other specimens were placed upon young pine-trees in the office garden, but as no further records were made they apparently disappeared.

Claude Fuller, who saw the insects when they arrived, says that they were dark red in colour, larger and darker coloured than *M. fulleri.*

The slide shows the insect to be quite distinct from anything I have yet seen, the name *hirtus* being suggested by the appearance under the microscope.

The two mounted specimens measure :—

(*a*) 8 mm. long and 4·5 mm. broad.
(*b*) 6·2 mm. long and 3·5 mm. broad.

The dermis is closely crowded with slightly clubbed glandular hairs, and occasional long hairs, the latter fitting into thickened sockets.

The antennae in both insects are 11-segmented, the joints measuring :—

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (*a*) | R. | 145 | 170 | 156 | 70 | 68 | 68 | 102 | 102 | 102 | 102 | 175 |
| | L. | ? | 168 | 154 | 68 | 68 | 70 | 98 | 102 | 102 | 102 | 175 |
| (*b*) | R. | 153 | 136 | 120 | 68 | 68 | 74 | 85 | 91 | 85 | 85 | 170 |
| | L. | 136 | 115 | 120 | 68 | 68 | 68 | 85 | 92 | 85 | 85 | 170 |

Legs :—

| | Femur + trochanter. | Tibia. | Tarsus without claw. |
|---|---|---|---|
| (*a*) | 1,078 μ | 840–942 μ | 430 μ |
| (*b*) | 847μ | 800 μ | 460 μ |

Some of the marginal hairs, especially those of the posterior margin, are exceptionally long, reaching 750 μ in length.

Habitat : On shoots of *Pinus canariensis.* Kubusie Plantation, Stutterheim, C.P. Collected by C. C. Robertson, April 23, 1913.

Collection No. : 3.

## Gen. ICERYA Signoret.

♀ : Body usually yellow to reddish-brown in colour, densely covered with white or yellowish powdery or cottony material which may entirely obscure the body-colour, and may be separated into definite masses suggesting the appearance of an *Orthezia.*

Body remaining soft to maturity. Oviparous specimens stationary at maturity, secreting a large fluted ovisac ; viviparous species usually active throughout life, not producing an ovisac.

Legs and antennae dark in colour, often black.

Antennae of 11 segments.

♂ with two short caudal appendages to the abdomen. (In *I. purchasi* the caudal appendages are one-eighth as long as the body.)

♂ with compound eyes.

### 49. Icerya euphorbiae, sp. n.

(Plate XXV., Fig. 56. Plate XXVI., Fig. 60.)

Adult ♀ : With waxy secretion the adult ♀ is similar in size to *I. seychellarum*, but differs in appearance chiefly in the following particulars :—

(*a*) The insect is viviparous and forms no ovisac.

(*b*) The waxy secretion is not divided into distinct masses, but appears rather to be covered with a more or less homogeneous membrane of waxy secretion which at maturity breaks away at the margins and posterior end. At these points there are indications of definite waxy masses.

The colour of the secretion is generally uniformly white, but in a few instances the covering layer shows faint indications of yellow.

The body-colour, denuded of wax, is orange-red.

Cleared and mounted the adult ♀ averages 8 mm. long. The dermis is characterized by pale hairs, long and short, and numerous small gland pores. These pores have the margin beaded and the pore itself triangular. There are no large circular beaded pores like those found in *seychellarum*.

The antennae, which are 11-jointed, are long and densely chitinized. They are thick at the base and gradually diminish in thickness towards the apex. The basal joint is comparatively short; joint II. is thick and long (110 $\mu$), with a large basal rounded protuberance on its outer edge; joint III. is about as long as II., cylindrical; joint IV. to X. subequal (50 to 60 $\mu$); XI. long (150 $\mu$).

♂ puparium: "Length 3 mm., width 2 mm., and 1·5 mm. high; elongate oval, very convex, flat beneath, formed of red matter and exuviae covered with white meal: open behind." (Fuller, notes 1898.)

♂ : (From specimens mounted by Claude Fuller, 1898) The mounted insect is a large, striking creature with dark red body, smoky brown wings, and long delicate antennae. The head and body, without antennae, measure about 3·3 mm. The greatest width is across the mesothorax (0·9 mm.). The abdominal segments taper gracefully from 0·7 mm. for segment I. to 0·3 mm. at the terminal segment. The caudal processes, without the setae, measure 0·35 mm. Apically they bear a number of long setae, many of which are about 1 mm. in length. The wings are about the length of the head and body combined, the average total width across expanded wings being about 7·5 mm.

The antennae, which are about 3 mm. long, are 10-jointed. Each segment except the basal one bears two whorls of long (0·7 mm.) hairs. The extremities of the segments appear swollen and the intermediate portion is narrower, producing a decided hour-glass effect.

Larva (mounted): About 0·86 mm. long. Antennae 6-jointed, about 0·33 mm. long without terminal setae; longest terminal seta about 1·1 mm. long.

Caudal extremity with 4 very long setae, the longest of which is about 1·2 mm. long.

The approximate length of the antennal segments is as follows: (1) 50; (2) 68; (3) 50; (4) 45; (5) 52; (6) 160 $\mu$.

The setae around the margin of the body are about 0·415 mm. long. The dermis has a number of large disc-rosette gland-pores, with a wide beaded rim.

Habitat: On large tree *Euphorbia,* East London, C.P. Collected by Chas. P. Lounsbury, 1898; also by J. L. King, East London, January, 1915.

Remarks: The following note, which was made at the time of the first collection of material, appears in the Cape records: "Large *Icerya*-like Coccid on Euphorbia, East London. Occurs in small but well-defined patches on its host-plant. Has no ovisac like that of *I. purchasi.* It is preyed upon by *Rodolia chermisina.* Adult ♀ flat and naked beneath, very convex above, and coated with a thick covering of white meal. Larvae hatching 17.X.'98."

Collection No.: 7.

### 50. Icerya natalensis (Douglas).

*Ortonia natalensis* Douglas, Ent. Mon. Mag., xxv., p. 86, 1888.
" " " " " pp. 232, 233, 1889.
" " Lewis, Journ. Q. Mic. Club, iii., 2, p. 356, 1889.
*Icerya* " Fernald, Catalogue, p. 25, 1903.

Until a few days ago (March 16, 1915) this species had apparently been lost sight of for about eighteen years. It was originally collected by the late Rev. J. R. Ward, of Richmond, Natal, in 1888, and sent to Mr. G. Henderson, who was then editor of the *British Bee Journal.* In turn, it was given to Mr. R. T. Lewis, who passed it on to Mr. J. W. Douglas, the describer of the species.

Mr. Arnold W. Cooper, of Richmond, Natal, is the only other person known to me who has collected this species, and according to a letter just received from him, the insects were only found in the immediate neighbourhood of Richmond, i.e. on the banks of the Illovo and at Byrne. Mr. Cooper also informs me that the host-plants given for this species, acacia, orange, and lemon (Fernald), are certainly wrong, as it was found only on a small native bush "about two or three feet high with small pinnate leaves." From a specimen sent, Miss S. Stent, of the Division of Botany, has kindly determined the plant as *Cliffortia serrulata* (Engl.) Diels.

Unfortunately I have not been able to refer to the original description of *Icerya natalensis.* Moreover, there were no specimens in the collection which could possibly represent this species, a difficulty overcome, however, by receiving notes and slides from Mr. Cooper. The following are extracts :—

"*I. natalensis* was always uncommon, and I only knew of it in two places, from both of which it disappeared before 1897, and I have not seen it since. I find I made the following notes in 1896 :—

Larva, newly hatched: Colour reddish-brown; length 0·70 mm., breadth 0·37 mm. Antennae: Length 0·42 mm., 6-jointed; 6(4.3.2)5.1.

♀, 3rd stage: Antennae 9-jointed, joints of about equal length. Body covered with white cottony secretion and several long hairs.

Adult: Antennae 11-jointed; 11(1.2)3(10.9.8.7.6)5.4, clavate, cylindrical; 25 to 30 hairs, sensory on last joint, about 12 similar hairs on other joints; length about 1·78 mm.

Feet: Two upper and two lower digitules.

Ungue: End somewhat blunt and rounded on upper edge.

Body: With long hairs and numerous spinnerets; covered with white secretion; makes a long cottony ovisac from which it becomes detached.

Since writing this morning I have been able to go down to the Illovo, and found two specimens of *I. natalensis.* I cut off a small branch with one which I am sending by post, and I left the other. Neither is full grown. I find from my notes that they are mature in April; but the present stage is interesting, being just prior to making the egg-sac. There are two or three of the shrubs near each other, but both the insects were on a branch overhanging the bank. I will keep a look-out later for others. As far as I remember I have never seen more than seven at a time on these bushes, and have not found them elsewhere, and I used to search the banks for them. There was one shrub of the same plant near Byrne where there were a few, the only two places where either Mr. Ward or I ever found them."

The living specimen which accompanied this letter was a young ♀, 7 mm. long and about 4 mm. broad. It had no white waxy covering, and the body was bright orange-chrome in colour. The venter is flat, the dorsum somewhat convex with the median thoracic area raised in three rounded elevations. The grooves and depressions appear grey, with the sides lightly sprinkled with yellowish powder. The legs and antennae are fuscous.

The slides, which are dated 1895, are in excellent condition. The following particulars concerning them may be of use in the determination of slide material :—

Larva (mounted) : About 0·8 mm. long. Antennae 6-jointed about 0·46 mm. long without terminal setae.

Longest terminal setae about 0·2 mm. long.

Caudal extremity with 4 long setae, the longest of which are about 0·8 mm.

The measurements of the antennal segments of three specimens on this slide are :—

| | i. | ii. | iii. | iv. | v. | vi. |
|---|---|---|---|---|---|---|
| A. | 44 | 68 | 62 | 58 | 48 | 136 |
| | 48 | 68 | 68 | 50 | 48 | 136 |
| B. | 52 | 68 | 68 | 54 | 48 | 142 |
| | 40 | 68 | 62 | 50 | 48 | 142 |
| C. | 44 | 68 | 62 | 54 | 52 | 140 |
| | 48 | 68 | 65 | 54 | 52 | 142 |

The setae around the margin, on the first abdominal segments, are about 0·4 mm. long.

The derm has a number of large disc-like glands with a broad-beaded edge similar to those of *I. euphorbiae.*

Adult ♀ (mounted) : Slide A measures approximately 8 mm. long and 5 mm. broad. Slide B 10 mm. long and 5 mm. broad.

Antennae :—

| | i. | ii. | iii. | iv. | v. | vi. | vii. | viii. | ix. | x. | xi. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A. | 153 | 146 | 140 | 80 | 102 | 92 | 100 | 90 | 90 | 102 | 170 |
| | 153 | 153 | 162 | 88 | 95 | 80 | 85 | 88 | 102 | 102 | 156 |
| B. | 170 | 180 | 176 | 102 | 102 | 118 | 115 | 130 | 120 | 120 | 215 |
| | 170 | 192 | 185 | 118 | 115 | 118 | 130 | 136 | 136 | 136 | 215 |

The antennae of slide A are somewhat shrunken, so that those of B are probably nearer the average. The derm has hairs and large and small glands all somewhat similar to those of *I. seychellarum.* The larger pores, however, are much fewer in number.

Habitat : On *Cliffortia serrulata* (Engl.) Diels. (*Rosaceae*), near Richmond, Natal. Collected by Arnold W. Cooper.

Remarks : This seems to be an extremely uncommon species which is restricted to a single host-plant. The reference given for host-plants, (Fernald, p. 25), is undoubtedly an error. Early in 1900 Claude Fuller discussed this species with the late Rev. Ward and A. W. Cooper, and in company with them examined the bushes upon which the type specimens were originally discovered, but failed to find it. Mr. Fuller assures me that at that time there was no suggestion whatever that the insect occurred upon any other plant than the native shrub *Cliffortia.*

Collection No.: 5.

### 51. Icerya purchasi Maskell.

(Plate XXII., Fig. 46. Plate XXV., Fig. 55. Plate XXVI., Fig. 61.)

"Australian Bug," Report of the Commission appointed by His Excellency the Governor to inquire into and report upon the means of exterminating the insect of the family *Coccidae* commonly known as the Australian Bug, Cape Town, 1877.

,, ,, Government Notice No. 113, 1877 (Letter by Mr. Roland Trimen).

*Icerya purchasi* Mask., N.Z. Trans., xi., p. 221, 1878.

,, ,, Mask., N.Z. Scale Insects, pp. 104, 105, 1887.

,, ,, Comstock, U.S. Dept. Agr. Rept., p. 347, 1881.

,, ,, Lewis, Journ. Q. Mic. Club, iii., 2, p. 356, 1889.

,, ,, Lounsbury, Rep. Ent. C.G.H., p. 92, 1896.

,, ,, Lounsbury, Rep. Ent. C.G.H., p. 21, 1898.

,, ,, Fuller, Natal Agr. Journ., 1907, p. 1035.

Common names :—Australian Bug.
Cottony Cushion Scale.
Fluted Scale.
Dorthesia.

Ovisac: White, about as broad as the body of the insect, upper surface roundly arched, and distinctly fluted. The completed ovisac may attain a length of three times that of the body of the adult ♀.

Adult ♀ : "Adult female dark, reddish-brown, covered with a thin powdery secretion of yellowish meal, and with slender glassy filaments; stationary at gestation, and gradually raising itself on its head, lifting the posterior extremity until nearly perpendicular, filling the space beneath it with thick white cotton, which gradually extends for some distance behind it in an elongated, white ovisac, longitudinally corrugated; ovisac often much longer than the insect, and becoming filled with oval red eggs. Length of female, about one-fifth inch, reaching sometimes nearly one-third inch. Body previous to gestation lying flat on the plant, the edge slightly turned up; on the dorsum a longitudinal raised ridge, forming one or more prominences. Insect covered all over with numerous minute fine hairs, more thickly on the thoracic region; round the edge these hairs are longer, and are arranged in tufts somewhat closely set; the tufts are black, and contain from twenty to thirty hairs in each. Amongst the hairs in the tufts are several protruding tubular spinnerets, having on the outer end a kind of multiglobular ring or crown; from these proceed cylindrical, glassy, straight tubes as long as the tufts of hair. Long, fine, glassy, delicate filaments, as long as the body of the insect, radiate from the edge all round; but these, being very fragile, are often irregular, or absent. During gestation thick, short, cottony processes form at the edge of the thorax, seemingly attached to the feet. Antennae of eleven joints, very slightly tapering; each joint bearing hairs. Feet normal, somewhat thick. Rostrum not long; mentum triarticulate. Procreation commencing soon after the first formation of the ovisac, the eggs being ejected into the sac as it grows" (Maskell).

The adult ♀ (mounted) averages 5 mm. long. The dermis is characterized by numerous tufts of black hairs, and gland-pores of two sizes. Both of these have beaded edges; the larger ones are circular, the smaller broadly elliptical.

Antennae 11-jointed; joints II. and III. subequal (115 $\mu$); IV., V., VI., VII., VIII., and IX. subequal (56–68 $\mu$); X. about 90 $\mu$; XI. comparatively short (about 135 $\mu$).

The following interesting account of the male of this species is taken from Prof. C. V. Riley's 1886 Report, pp. 480–481, 1887:—

"The adult male is a trifle over 3 mm. in length, and has an average wing expanse of 7·5 mm. The general colour is orange-red. The head above is triangular in shape, with the apex blunt and projecting forward between the bases of the antennae. The eyes are placed at the other apices of the triangle, and are large, prominent, and furnished with well-marked facets. There are no mouth-parts, but on the underside of the head is a stellate black spot with five prongs, one projecting forward on the conical lengthening of the head, one on each side to a point just anterior to the eyes and just posterior to the bases of the antennae, and the remaining two extending laterally backwards behind the eyes. The antennae are light brown in colour, and are composed of ten joints. Joint 1 is stout, almost globular, and nearly as broad as long; joint 2 is half as broad as 1 and is somewhat longer; joint 3 is nearly twice as long as 1 and slightly narrower than 2; joints 4, 5, 6, 7, 8, 9, and 10 are all of about the same length as joint 3, and grow successively a ittle more slender; each joint, except joint 1, is furnished with two whorls of long light-brown hairs, one near base and the other near tip; each joint is somewhat constricted between its two whorls, joint 2 less so than the others. There are no visible ocelli. The pronotum has two wavy subdorsal longitudinal black lines, and the mesonotum is nearly all black, except an oval patch on the scutum. The metanotal spiracles are black, and there is a transverse crescent-shaped black mark, with a short median backward prolongation. The mesosternum is black. The legs are also nearly black and quite thickly furnished with short hairs. The wings are smoky black, and are covered with rounded wavy elevations, making a reticulate surface a cross-section of which would appear crenulate. The costa is thick and brown above the subcostal vein, which reaches costa at a trifle more than four-fifths the length of the wing.

The only other vein (the median) is given off at about one-sixth the length of the wing, and extends out into the disk a little more than one-half the wing length. There are, in addition, two white lines, one extending out from the fork of the sub-costal and the median nearly straight to the tip of the wing, and one from the base in a gradual curve to a point some distance below the tip. Near the base of the wing below is a small ear-shaped prolongation, folded slightly on itself, making a sort of pocket. The halteres are foliate, and furnished at tip with two hooks, which fit into the folded projection at base of wings. The abdomen is slightly hairy, with the joints well marked, and is furnished at tip with two strong projections, each of which bears at tip four long hairs and a few shorter ones. When the insect is at rest the wings lie flat upon the back."

Larva (mounted): About 0·6 mm. long. Antennae 6-jointed, about 0·415 mm. long without terminal setae; longest terminal seta about 0·8 mm. long.

Caudal extremity with 6 very long setae; longest of which measures about 1 mm. The antennal segments approximate in $\mu$:—(1) 40; (2) 60; (3) 54; (4) 60; (5) 50; (6) 136.

The marginal setae are more numerous than in any of the other South African species, but are shorter, averaging about 0·1 mm.

The dermis has numerous scattered "rosette" glands.

Habitat: On citrus, acacias, roses, etc., throughout the Union.

Australian Bug was probably introduced into South Africa at Cape Town in 1872 or early in 1873. It was certainly present in the Botanic Gardens, Cape Town, in 1873. According to the Report (*l.c.* 1877) it was observed in the village of Ookiep, Namaqualand, a few months after its discovery in Cape Town, but strangely enough it was not seen in Stellenbosch until the end of 1876. In 1877 it was known to occur in Cape Town and suburbs, Simonstown, Stellenbosch (Mulder's Vlei), Paarl, Malmesbury, Wellington, Ookiep, Bredasdorp, George (Brak River), Uitenhage, and East London.

Mr. Roland Trimen (*l.c.* 1877) states that the first specimens seen by him in Cape Colony occurred in 1873, at Claremont, on blackwood (*Acacia melanoxylon*) obtained from the Botanic Gardens at Cape Town. He states: "In the course of a few months the insect increased so prodigiously in number, and the Australian acacias became so laden with them to such an extent that in the early part of 1874 the large blackwood-trees in the gardens, which were infested to a greater extent than any other plant, had to be cut down." The plants to which the insect had spread up to 1877 were given as follows: *Acacia melanoxylon*, Australian acacia, golden willow, *Casurina*, *Pittosporum*, blue gum (rarely), Australian "bottle-brush," oak, orange, vine, fig, *Laurustinus*, rose, rosemary, strawberry, verbena, plumbago, Indian jasmine, bougainvillea, hawthorn, poinsettia, and hakea.

Mr. J. C. Brown, in his paper "On the 'Australian Bug' in South

Africa," Journal of Forestry, vi., p. 44, May, 1882, quotes Trimen as writing under date of March 17 (1882?), that the insect had then mainly attached itself to orange-trees, " many of the finest plantations have been destroyed and others are on the high road to destruction. You will remember," he says, " how good and cheap oranges used to be here; they have lately been threepence and fourpence apiece, and often inferior in quality even at such a price."

In 1886 Miss Ormerod received specimens from Port Elizabeth (letter to C. V. Riley), and in 1888 it was collected at Richmond, Natal (Lewis, *l.c.*).

After this date the spread of the insect was probably rapid, and the list of host-plants grew with the range of distribution.

The Vedalia ladybird (*Novius cardinalis*) was introduced into California in the year 1888 and was sent from there to South Africa three years later.

Collection No.: 6.

## 52. Icerya seychellarum (Westwood).

(Plate XXII., Fig. 47. Plate XXV., Fig. 54. Plate XXVI., Fig. 62.)

*Dorthesia seychellarum* Westw., Gard. Chron., p. 830, 1855.
*Orthezia seychellarum* Targ., Catalogue, p. 30, 1869.
*Coccus sacchari* Sign., Ann. Soc. Ent. Fr. (4), ix., pp. 93, 94, 1869.
*Icerya sacchari* Sign., Ann. Soc. Ent. Fr. (5), v., p. 352, 1875.
,, *seychellarum* Mask., N.Z. Trans., xxix., p. 329, 1897.
,, ,, de Charmoy, Pr. Soc. Amic. Scien., p. 47, 1899.
,, ,, Ckll., Ent. Mon. Mag., p. 86, 1902.
,, ,, Green, Mem. Dept. Agr. India, ii., 2, p. 18, 1908.

Ovisac: White, usually short and broad, with posterior margin truncate. Upper surface flatly arched, faintly fluted; most common length, when completed, about as long as the body of the ♀.

Adult ♀: Size with waxy secretion, but without counting ovisac, usually about 10 mm. Waxy secretion arranged in more or less regular masses, yellow on dorsum and white at margin. Around the body are numerous fine silky or glassy filaments. The secretion of the young stages is often entirely yellow, the colour being slightly darker than in the adult.

Denuded of its waxy covering the insect is orange-red in colour.

Cleared and mounted the adult ♀ averages 8 mm. long. The derm has numerous hairs and gland-pores of two sizes; the smaller are more or less broadly oval, with a diameter of 10 $\mu$. These have a beaded edge and an elongate elliptical pore. The larger pores are distributed around the margin of the body. They are circular with a diameter of about 17 $\mu$. The rim of these is comparatively narrow, beaded, and encloses a large transparent pore which is circular with a slight intrusion at one point.

The antennae are 11-jointed. Joint II. is regularly cylindrical without the protuberance of *euphorbiae*, III. is usually somewhat constricted below the middle; IV., V., and VI. are about subequal (50 $\mu$); VII. and VIII. subequal (68 $\mu$); IX. and X. subequal (85 $\mu$); joint XI. long, usually 170–180 $\mu$.

Larva (mounted): About 0·52 mm. long; antennae 6-jointed, about 0·385 mm. long without terminal setae; longest terminal seta about 0·44 mm. long.

Caudal extremity with 6 very long setae, longest of which is about 0·86 mm. long. The antennal segments approximate in $\mu$:—(1) 44; (2) 60; (3) 64; (4) 50; (5) 50; (6) 115.

The marginal setae measure approximately 0·23 mm. The derm is characterized by numerous large, scattered, "rosette" glands.

Habitat: On rose and ficus, Natal (T. D. A. Cockerell, *l.c.*, p. 86). On palms, Durban, Natal. Collected by Chas. P. Lounsbury, October, 1914.

Remarks: This species is also recorded from the Seychelles, Mauritius, Madeira, China, New Zealand, and Formosa on a variety of host-plants, including sugar-cane, guava, palms, rose, and citrus. Prof. Cockerell suggests that it is most likely a native of South Africa.

Collection No.: B 5.

## Gen. ASPIDOPROCTUS Newstead.

*Walkeriana* Newstead, Proc. Zool. Soc., Lond., lxii., p. 947, 1900.
s. g. *Aspidoproctus* Newst., Proc. Zool. Soc., Lond., lxii., p. 947, 1900.
*Lophococcus* Ckll., The Entom., xxxiv., p. 227, 1901.
*Walkeriana* s. g. *Aspidoproctus* Fernald, Catalogue, p. 331, 1903.
*Aspidoproctus* Newstead, Mitteil. a dem. Zool. Mus. Berl., p. 158, 1911.

♀: Body densely chitinous, becoming quite hard and horny at maturity. Colour in young stages castaneous, with a slight secretionary covering; later shiny, dark castaneous to nearly black, with marginal waxy appendages which are often forked; and in some cases a few dorsal appendages of similar texture. Dorsum may be smooth (*maximus*), or with short conical protuberances (*armatus*), or with one or three long "horns" (*mirabilis* and *tricornis*). Insects large, adults ranging from nearly half an inch in length (*mirabilis* and *tricornis*) to one and one-third inches (*maximus*). Insects at maturity stationary, fixed to stems of food-plants by secretion from tenent hairs on venter.

Eggs deposited in a marsupium formed by invagination of portion of venter. (N.B.—The marsupium in the Australian genus *Calipappus* is formed by the intussusception of the terminal abdominal segments.)

Ventral orifice closed by a secretionary flap.

Antennae of 10 segments.

♂: With two caudal appendages of medium length (in *A. maximus* the caudal appendages are one-fifth as long as the body). ♂ with compound eyes.

This genus, so far as is known, contains seven described species which are confined entirely to the African continent. Five of these, viz. *A. armatus, maximus, mirabilis, pertinax,* and *tricornis,* are known to occur in the Union of South Africa or Rhodesia.

N.B.—In his paper " On a new Scale Insect from Zomba, B.C.A.," in the Proceedings of the Zoological Society of London, pp. 947–948, 1900, Professor Newstead describes and figures an insect which he names *Walkeriana pertinax* n. sp. Certain characters, such as the secretionary flap which covers the ventral opening, are given specific rank, but only provisionally so, as it was at first intended to make *pertinax* the type of a new genus with the name *Aspidoproctus.*

In the Entomologist, vol. xxxiv., p. 227, 1901, Professor Cockerell created a new genus, *Lophococcus*, from an insect sent from Natal by Claude Fuller. This became *L. mirabilis*, the type species. The generic characters are given, " *Lophococcus* n.g. A genus of Monophlebine Coccidae, allied to *Monophlebus*, which becomes fixed in the adult female state, with a strongly chitinous skin, and has a large erect spine in the middle of the back, this spine originating as an elevated fold of the skin. No ovisac. Type *L. mirabilis.*"

Since that date five other species have been described, four by Professor Newstead, viz. *A. maximus* and *A. armatus* in 1911, *A. tricornis* in 1912, and *A. giganteus* in 1914, and one by M. P. Vayssière, viz. *A. vuilleti* (Ann. des. Epiph.), 1913.

There is no doubt that all seven species are con-generic, and that according to the Law of Priority by Art. 25 of the International Code of Zoological Nomenclature the name *Aspidoproctus* should be retained for the genus. All agree, apparently, in the following particulars :—

*a.* They are typically Monophlebine in the early stages.

*b.* At maturity the integument becomes dense, hard, horny, and brittle when dry.

*c.* Adults attach themselves to stems of host-plants by secretion from the anterior median ventral surface.

*d.* Eggs are produced in a large marsupium formed by the invagination of a portion of one of the ventral segments.

*e.* The ventral orifice of the marsupium is closed by a secretionary flap.

*f.* Large numbers of ova are produced in the marsupium; from two to six thousand, according to the size of the species (Plate XXIV., Fig. 50*b*).

*g.* The larvae escape from the marsupium by the ventral surface shrinking away from the posterior margin of the covering flap.

*h.* The larvae are all of the same type, with 5-jointed antennae, and all secrete long glassy, waxy filaments, which assist in distribution by wind (Plate XXIV., Figs. 51*a*, 51*b*).

The section of *A. maximus* shown in Plate XXIV., Fig. 50*b* was made from a specimen which had been stored in 70 per cent. alcohol for six years. The marsupium in this case did not occupy the whole body cavity, and judging by the hard condition of the walls of the cavity it did not appear that it would do so. Unfortunately, I have not been able to obtain fresh material to investigate the matter further with this species. Spirit specimens of *armatus* seem to indicate that the marsupium in this species, too, occupies part of the body cavity only.

From fresh material of *A. tricornis* collected in Pretoria in January of this year it is evident that the marsupium, when replete, occupies the whole of the body cavity except the "horns." The hard chitinous tegument was broken away, beginning from the median horn, and it was found that there was no trace of organs left between the marsupium and outer body-wall, but merely a little yellowish lymph-like fluid, streaked with blood-red. The wall of the marsupium was regularly domed, parchment-like in texture, quite soft, appearing white in colour, but stained with blood-coloured matter.

The marsupium was quite free from the general body-wall at all points, except where it was attached to the edges of the ventral orifice.

It was computed that between 2,500 and 3,000 ova were present in the marsupium, and that about 5 per cent. of the ova had hatched (January 24, 1915).

The ventral surface had begun to shrink, and there was a very narrow slit between the hind margin of the secretionary flap and body. On removing the flap the orifice was found to be tightly packed with a dense white powdery substance.

The newly-hatched larvae observed among the eggs inside the marsupium had only the slightest traces of the waxy filaments which adorn the dorsum of the larvae when they emerge.

I have watched the emergence of larvae on several occasions. In all cases the slit was very narrow and the larval insects appeared to have difficulty in escaping, relying in some cases on other insects pushing them from behind. The waxy filaments were crushed down close to the dorsum, forming a smooth layer between the insect and the edge of the orifice, and giving the dorsum a glossy, finely striated appearance. On emergence, however, the filaments stand erect from the dorsum as shown in Plate XXIV., Figs. 51*a* and 51*b*. Fig. 51*b* shows a section of the insect shown in 51*a* after all the larvae had emerged, the white egg-shells remaining within the marsupium.

## 53. Aspidoproctus armatus Newstead.

(Plate XXVI., Fig. 63. Plate XXVII., Figs. 65 and 65*a*.)

*Aspidoproctus armatus* Newstead, Mitteil, aus dem Zool. Mus. in Berlin, p. 160, 1911.

Professor Newstead's description is as follows:—

"Female adult. Elongate, narrowed posteriorly; margin in front more or less truncate; sides broadly concave and deeply and coarsely punctate. Cephalic area sloping suddenly downwards, the area defined by two widely separated and rounded ridges, most clearly defined towards the margin, each terminating with a short, stout, tooth-like waxen appendage; thoracic area with two large transverse ridges each bearing four large bluntly pointed processes, one lateral and two median; abdominal area flat, tapering more or less posteriorly; margin forming a distinct ridge along which are six small and bluntly pointed processes of which the first and last are the largest; margin with a series of blunt tooth-like waxen appendages, many of which are bifid. The whole of the dorsum bears a thin coating of greyish granular wax, but is darker and more homogeneous over the blunt processes. Venter flat or concave, mealy. Colour in alcohol dull crimson; venter terracotta red. Derm of venter thickly studded with short stout spines, scattered between them are numerous small circular spinnerets, and at greater intervals large, clear, circular glands; besides these there are also a number of large subcutaneous bell-shaped organs (? glandular) having a finely reticulated lip; the relatively small area protected by the secretionary operculum almost covered with circular spinnerets, and arising from between them many slender hairs. Thoracic spiracles large. Antennae of 10 segments, of which the terminal one is much the longest.

Length 12–17 mm.; width 8–12 mm.; height 6–8 mm."

Habitat: On M'sasa-tree (*Brachystegia randii*), Macequece, Portuguese East Africa, in association with *A. maximus*. Sent to Mr. Lounsbury, Cape Town, by E. Ross Townsend in October, 1908.

Also on M'sasa-tree in Salisbury, S. Rhodesia, in association with *A. maximus*. Coll. C. P. Lounsbury, 1908.

Collection No.: D 15.

## 54. Aspidoproctus maximus Newstead.

(Plate XXIV., Fig. 50. Plate XXV., Fig. 52. Plate XXVII., Fig. 64.)

*Aspidoproctus maximus* (Sanders MSS.) Newstead, Mitteil, a. d. Zool. Mus. Berlin, pp. 158, 159, 1911.

Larva: About 0·8 mm. long, dark reddish-brown, active, dorsum and margins with numerous long delicate erect waxy or silky-looking filaments, which no doubt aid in distribution.

♀ Young: 10 mm. long, very flat and wrinkled (Fig. 50). Antennae 10-jointed similar to those of the adult ♀.

♀ Adult: "Female adult. Castaneous when dry, pale yellowish-brown to dark brown in alcohol. Ovate, slightly narrowed in front, convex above; more or less flat ventrally; dorsum with 3 rows of deep and rather widely separated pits arranged in zones and taking the contour of the margin; within the zones on the thoracic area are several other similar pits, and the cephalic area has two more or less distinct and slightly divergent carinae. Margin with a series of large white tooth-like waxen appendages measuring on an average 3 mm. in length: 29 of these appendages were present in one individual, and this number may be taken as approximately correct; but they are rarely retained in old adults. Ventral (genital) orifice covered by an operculum or 'secretionary flap' (Newstead), as in *Aspidoproctus pertinax* Newst. Legs extremely short. Antennae broken away in the examples submitted. Dorsal epidermis thickly studded with circular spinnerets and large irregular ovate, clear, glandular spaces resembling the glands in certain species of *Lecanium*; there are also numerous minute spines attached to disc-like bases; the gland-tracts corresponding to the pits in the non-macerated examples, are much more chitinized than the surrounding integument and are furnished with a number of circular spinnerets. Ventral epidermis clothed with rather long stout spines, interspersed with small circular spinnerets and large circular pores; besides these there are a number of minute compound glands surrounded by dark chitine, these are much more numerous in the abdominal region, and are arranged more or less in lines radiating from the genital orifice towards the margin. Marginal gland-tracts much larger than those either on the venter or dorsum.

Length of old adult 33 mm.
Width of old adult 25 mm. (= 1 inch).
Height of old adult 15 mm. (= ½ inch)." (*Newstead.*)

♂ Prae-pupa : Dull rusty red, varying from 4·5 to 6 mm. long ; ventra surface flat ; legs well developed ; mouth-parts absent. Dorsum convex, median area roundly so, margins slightly depressed. Margin with numerous pale hairs. Antennae 9-jointed, tapering, with long slender hairs (Fig. 52*a*). Eyes inconspicuous until mounted.

♂ Puparium : On reaching the prae-pupal stage the insect—in many cases at least—leaves the tree and seeks shelter beneath fallen leaves or other debris, and secretes a massive, white, downy puparium. This assumes a more or less regular mass 10 to 14 mm. long and about half as wide. It is composed entirely of extremely delicate, white, waxy matter, which impresses one as being softer and more downy in texture than is the ovisac of any mealy-bug known to me.

♂ Pupa (from single spirit specimen) : Dull reddish-brown or rusty red, 6 mm. long and 2·2 mm. across the abdominal segments. The appendages are quite free from the body (*pupa libera*). There are no indications of mouth-parts. The posterior extremity is cleft (Fig. 52*b*).

♂ Adult : Head and body about 5 mm. long, cochineal red in colour, but more or less covered with a downy secretion of wax. Antennae long, brownish or purplish in colour, with many fine, long whorled hairs. Legs brown. Wings smoky brown. Subcostal vein reddish ; costal margin fulvous. Width across expanded wings 13–15 mm. Caudal processes concolorous with body, slender, with many whorled hairs similar to those of antennae. Length of caudal processes from one-fifth to one-fourth the length of the body without antennae.

Habitat : On M'sasa-tree (*Brachystegia randii*), Salisbury, March 17, 1908. Also found in small numbers on *Grevillia robusta*, casurina, hibiscus, and flamboyant. (C. P. Lounsbury.)

Remarks : This species first attracted attention in Rhodesia in the early part of 1908. On the 17th of March of that year specimens were sent to Mr. Lounsbury at Cape Town by the Secretary for Agriculture of Southern Rhodesia, who wrote that the insects were travelling rapidly along a belt of trees on one side of the town (Salisbury), and that the affected trees were dying off at the tops. Later in the year Mr. Lounsbury visited Salisbury and made a report on the insect. This appeared in the Rhodesian Agricultural Journal for October 1908.

Trees which bear numbers of the insects are conspicuous for the amount of honey-dew below them. Concerning this Mr. Lounsbury writes (*l.c.*, p. 34) :—

"The quantity exuded is not large considering the size of the insect, yet it is this 'honey-dew' which chiefly attracts attention to the insect, and gives rise to complaints against it. It is a clear, colourless, sweet liquid, discharged through a single orifice in the back most freely when the insect is disturbed. Sometimes a thin jet is ejected for several seconds, and this may follow no greater stimulus than blowing hard with the breath. Ants gather to get the liquid, and a certain small bird which frequents the kopje is evidently very fond of it, poking the insect with its beak to get it. The ground beneath badly infested trees becomes heavily coated with it, and in consequence becomes shiny, black, and disagreeably sticky."

There is only one generation in a year. Rupert W. Jack made observations on this species in 1912, and although these are not complete he has kindly supplied the following particulars :—

*October* 15, 1912.—♀♀ nearly replete. Ova in centre of marsupium mature. Those near body-wall still immature, and the wall itself still contains the yellow offensive fluid present in immature scales.

*November* 20, 1912.—A few larvae emerging.

*February* 6, 1913.—Majority have increased from 4–5 mm. long.

*March* 6, 1913.—Males have moulted to a dull orange, migratory instar which leave the tree to secrete a fine white web in fallen leaves, grass, etc., at the base of the tree. Males isolated in the laboratory had finished secreting their web by 7.3.13, and emerged as adults between the 10th and 24th of April. These lived 4 to 5 days.

*April* 7, 1913.—Female forms moult again.

*June* 19, 1913.—Females flat, 10–13 mm. in length. These began to fill out in September, and reached their full size by the middle of October.

After each moult the young migrate to thicker twigs or branches.

Collection No.: C 15.

### 55. Aspidoproctus mirabilis (Ckll.).

(Plate XXV., Fig. 53. Plate XXVIII., Fig. 67.)

*Lophococcus mirabilis*, Ckll., The Entom., xxxiv., p. 248, 1901.

Professor Cockerell's description is as follows :—

"♀ : Adult very convex, 10 millim. long, 8 broad, and 7 high, exclusive of the dorsal spine ; very strong chitinized throughout, hard, tough, but brittle, blackish brown, rugose and dull, with a thin coating of granular wax ; on the middle of the back is a stout erect spine about 3 millim. long, like a spike on a military helmet ; on each side is a pair of short stout spines in the subdorsal region, the posterior smaller and not amounting to more than a nodule ; anterior end of insect somewhat elevated, with two more or less developed blunt and thick longitudinal keels ; margin nodular ; on the under surface the thoracic region is firmly attached to the bark, so that when the insect is taken off a piece of bark comes with it. Anal orifices large and very little posterior to the middle of the insect, as in *Crypticerya*.

Younger ♀ : 8 millim. long, and not over 3 high (excluding spine) ; the protuberances of the adult all well developed, the spine about as large ; there is also a protuberance just in front of the spine; the anterior keels converge to a nodule in the middle line, forming a reversed V; and there are blunt lateral keels, including the subdorsal protuberances, crenulate posterior to them. Margin with about fourteen tooth-like dull white protuberances on each side, these being really lamellae of dense wax; from about the bases of these lamellae come some very fine silvery threads.

Still younger forms have the dorsal spine arising as a transverse fold. The cast skins of the young forms are snow-white, much as in *Icërya*, with a fringe of waxy lamellae. The legs and antennae of the young are large and ferruginous.

The legs and antennae seem to come to their full development in individuals little over 5 millim. long.

Antennae 10-jointed, the joints after the third greatly bulging on one side, the sutures therefore very deep; last joint long and falciform. Measurements in $\mu$ :—(1) ? ; (2) 90; (3) 90; (4) 60; (5) 60; (6) 70; (7) 70; (8) 75; (9) 75; (10) 216 to 294. Joints 2 and 3 are broader than long. Young examples have atennae 8-jointed; club ordinary.

Legs well developed, little hairy; tarsus half length of tibia; inner side of tibia with extremely short spines. Mouth-parts well developed. Skin strongly chitinized, very densely beset with short hairs; the blunt hairs of some Monophlebids are represented by stout hairs with lanceolate heads; small round glands interspersed, not nearly so numerous as the hairs; there are also larger round or suboval brown spots, arranged more or less in rows. Below the mouth there are two large apertures in the chitinous surface, more or less connected in the middle line, and at the next suture beyond there is a large transverse aperture. Spiracles well developed."

On *Acacia* spp. Bathurst and East London (C.P.) Ladysmith (Natal), Estcourt (Natal), and Rustenburg District of the Transvaal (F. Thomsen).
Collection No.: 15.

## 56. Aspidoproctus pertinax (Newstead).

*Walkerina pertinax*, Newst., Proc. Zool. Soc., Lond., pp. 947-948, 1900.

Professor Newstead's description (omitting figure references) is as follows:—

"♀. Adult dark castaneous, slightly shining; form above generally highly convex and evenly rounded, forming an almost complete hemisphere, but one specimen was decidedly more elongate and less convex; cephalic area suddenly constricted, much wrinkled and furrowed at the sides, and with 4–6 large, deep, and variously shaped punctures; margin in front emarginate, and within a broad, deep, upward-sloping, central groove, surmounted on either side by a strongly-rounded ridge. Subdorsal and marginal rows of very short, stout, dusky-white, waxy processes, placed close together, and gradually lessening in size from the centre towards the extremities; there is also a double dorsal row of much smaller processes, which also lessen towards the extremities, the largest pair occupying almost a central position. Much mealy substance is scattered round the base of the waxy processes, and the hollows and wrinkles are covered with the same material. Underside flat or slightly concave, with radiating grooves, more or less covered with white mealy secretion; sides sharply raised. Antennae of 10 joints, of which the terminal one is much the longest, and, with the exception of the first, all the joints are furnished with short, fine hairs: formula 10, 1, 2, 3, (4, 5, 6), (7, 8, 9). Legs very small; digitules to claw simple. Rostral apparatus present, but owing to the density of the surrounding tissues it is impossible to make out its true character. Ventral opening very large, somewhat hexagonal and without marginal hairs, the whole aperture covered by a thin anteriorly-hinged valve or flap of dark brown *secretionary matter* occupying approximately the area indicated by the dotted line in Fig. 4; the line of attachment being immediately beneath the insertion of the posterior legs, its exact course being indicated by large gland-tracts, the largest of which are hidden beneath the legs. Epidermis covered with minute hairs and circular glands.

Long 14–20·5, wide 11–15, high 7–10 mm.

Larva elongate ovate, above with median, subdorsal, and marginal bands of spiny hairs. Antennae of 5 joints, of which 5 is equal in length to 2, 3, and 4 together: formula 5, 3, 2, 1, 4. Legs very long and slender; digitules to claw very fine simple hairs; claws faintly tridentate. Anal ring without hairs.

6258 well-matured larvae were counted from the anterior of a single ♀.

Hab. On an unknown tree, Zomba, Central Africa. Collected by H.B.M. Commissioner A. Sharpe, C.B., 1900."

Collected by Rupert W. Jack in ants' nest, Ummati River, Rhodesia, October 30, 1911.

Collection No.: E 15.

## 57. Aspidoproctus tricornis (Newstead).

(Plate XXIV., Figs. 51, 51*a*, 51*b*. Plate XXVII., Figs. 66 and 66*a*. Plate XXVIII., Figs. 68 and 68*a*.)

*Lophococcus mirabilis* var. *tricornis*, Newstead, Schultze, Zool. u. anthro. Ergeb. einer. Forsch. im. w.u.z. Sudafrika, p. 16, 1912.

Professor Newstead's description is as follows:—

"♀. Adult: Dark castaneous, in alcohol; external surface faintly polished. Form roughly hemispherical with three enormous horn-like projections on the dorsum, arranged transversely in the form of a trident; the middle one, the longest, measures 7 mm. from base to tip and is equal to the width of the body at the margin; lateral horns 3·5 mm. long, project considerably beyond the sides of the body; all the horns are rather flat at the base but have rounded ends; margin strongly and irregularly crenulated, the prominences being bluntly spinose; posterior margin deeply emarginate. Ventral orifice covered with a secretionary flap. Derm of venter densely clothed with strong, narrow, lanceolate spines in the mid-region between and surrounding the legs; beyond this the spines are few in number and smaller. Spinnerets at the margin of the large ventral orifice packed closely together; these present a large quatrefoil-pore. Antennae of 10 segments, the last in length equal to the three preceding ones; all the segments with fine hairs. Legs well developed and stout, resembling those of other Monophlebids. Length at base 7 mm.; width 7·50; height from base to tip of middle spine (longest axis) 10 mm.; expanse of lateral spines 11 mm."

Habitat: On *Acacia robusta*.

Collected by Miss Impey, Pretoria, November 9, 1914; also found by the writer on thorn-trees in front of the Union Buildings, Pretoria, November, 1914. Some females were collected, and larvae emerged in December, 1914, and January, 1915.

From the examination of numerous specimens of *A. mirabilis* and *A. tricornis* in the collection I have no doubt that the latter should be given specific rank.

Collection No.: B 15.

## SUBFAMILY MARGARODINAE.

The *Margarodinae* are probably the most remarkable of the *Coccidae*. Both sexes possess very strong front legs which are obviously adapted to their fossorial habits. The males are winged; the females, as with all Coccids, are wingless.

The most striking feature in the female series is the existence of praepupal and pupal stages which are passed in a glassy cyst before the adult proper emerges. During the early part of this period the insect has well-developed mouth-parts but no legs; a later stage, when both mouth-parts and legs are absent, and which probably represents a true pupal stadium, is present in the case of *M. capensis*, and probably in other species too.

At maturity the female emerges from the cyst and probably moves about in the soil. The newly-hatched larva, however, is best suited by its form for locomotion below ground, and the natural distribution of the insects most likely takes place in this stage. In the four South African species which have been observed (*M. capensis*, *M. péringueyi*, *M. greeni*, and *M. ruber*) the adult female surrounds herself with a dense coat of waxy filaments before the eggs are deposited, and looks, in this stage, like a subterranean mealy-bug.

### GEN. MARGARODES Guilding.

Subterranean, anterior legs of both sexes adapted for digging. Antennae 7- to 10-jointed.

Adult ♀ soft, mouth absent, legs and antennae present; intermediate stage hard, more or less pearl-like; globular to ovoid.

#### *Synopsis of South African Species of* Margarodes.

A. *Cyst irregular in outline, ± triangular.* Adult ♀ whitish-yellow; antennae 7- or 8-jointed.
  - (*a*) Cyst brassy to bronze in colour.
    Adult ♀ with 7- or 8-jointed antennae. Derm wrinkled .. .. *M. trimeni.*

B. *Cyst spherical.* Adult ♀ ♀ whitish-yellow; antennae 8-jointed.
1. Cyst large (about 5 mm. diam.), dark in colour, outer layer wrinkled and bark-like.
   (*b*) Adult ♀ with derm properly shagreened; antennae 8-jointed *M. capensis.*
2. Cyst smaller, shining, about 2·5 mm. in diameter, outer surface not bark-like.
   (*c*) Cyst amber-yellow. Adult ♀ with few scattered disc-glands in anterior part of body. Antennae 8-jointed. Lateral thoracic spine areas entirely replaced by fine hairs .. .. .. .. .. .. *M. greeni.*
   (*d*) Cyst creamy yellow. Adult ♀ with numerous disc-rosette gland-pores in anterior part of body. Lateral thoracic spine area present. Antennae 8-jointed.. .. .. .. .. .. .. .. *M. newsteadi.*
   (*e*) Cyst milky white. Adult without disc-glands in anterior part of body. Lateral spine areas of thorax prominent. Antennae 8-jointed .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. *M. péringueyi.*

C. *Cyst spherical.* Adult ♀ carrot-red. Antennae 9- or 10-jointed.
   (*f*) Cyst white, translucent, red colour of body of insect showing through. Adult ♀ carrot-red with 9- or 10-jointed antennae .. *M. ruber.*

## 58. Margarodes capensis (Giard) Brain.

(Plate XXVIII., Fig. 69.)

*Margarodes* (*Sphaeraspis*) *capensis* Giard. C. R. Soc. Biol., Paris (10) No. 25, p. 683, 1897.

Cyst: Large, almost spherical, may attain 7 mm. for largest diameter, very dark castaneous to black, with outer surface roughly wrinkled. Where portions have flaked off the colour is bright reddish-brown to bronze. (Spirit material.)

In some notes made by Claude Fuller from the fresh material in 1898 I note that he remarks: " Cyst shell composed of three layers: outer, red (bark-like); middle of median thickness, yellow, with thick ridges approaching outer wall; inmost thin and transparent."

Encysted stages: The encysted stages of this species are particularly suitable for study, owing to the dense condition of the tegument. In the small species found in Pretoria, on the contrary, the skin in these stages is extremely delicate, and the characters are therefore difficult to determine. I have in this collection a number of *capensis* specimens collected by C. P. Lounsbury and Claude Fuller at Waylands, C.P., in 1898, and stored in spirits, and also a number of slides made at the time of collection from fresh specimens.

There appears to be two distinct stages during the encysted period, a second larval or prae-pupal, and a pupal stage.

The main difference between the two is the entire absence of mouth-parts in the pupal stage.

In both forms the body is almost spherical, but slightly longer than broad, and slightly broader than thick. They are semi-transparent, and yellowish in colour.

The integument is smooth and shiny (in spirits), but slightly stippled when cleared and seen under the microscope. There are no traces of legs or antennae, and no signs of segmentation, except as indicated by the arrangement of the spiracles.

In the prae-pupal stage mouth-parts are present. They are comparatively small, with a very short single-jointed mentum, and a long delicate rostral loop. In both stages there is a conspicuous series of marginal spiracles which consists of 18 single pores, nine on each side. In addition to these there are two subdorsal pores, one on each side at about one-third the length from the anterior extremity; and a single ventral pore close to the mouth-parts in the prae-pupa and in same position in the pupa.

The anal opening is small and is represented in both stages. In the prae-pupa there are four glandular discs, two on each side of the anal opening, each with two to four small circular openings. In the pupa there appears to be but two of these, the outer pair being absent.

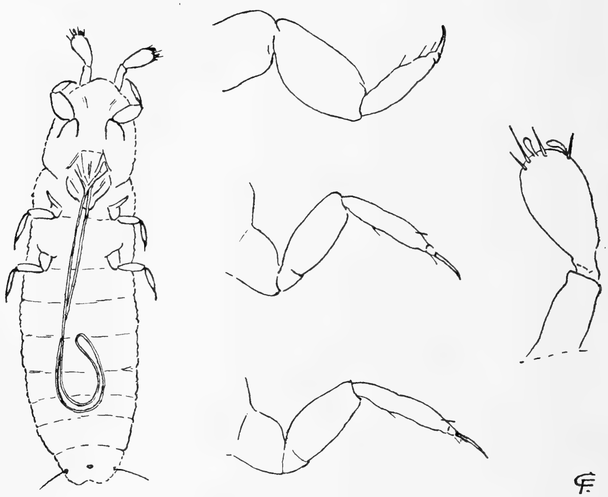
Adult ♀: The adult ♀ varies greatly in size, the largest specimens in the collection being 5 mm. long (spirit material) and 7·4 mm. (mounted). The body is sordid white to yellowish except the claws which are brownish-black. The segmentation is very distinct. On the ventral surface the segments are represented by deep transverse furrows, and appear crowded together, while those of the dorsum are broad and flatly rounded.

The antennae appear 7-jointed in unstained material, but when stained the large second joint always exhibits two whorls of hairs, and there is a distinct articulation. Joint I. is broad, and more delicately chitinized than the others; II. is very short, annular, with an apical whorl of bristles; III., broader and longer than II.; IV., V., VI., and VII. gradually diminishing in width, each with apical whorl of bristles; VIII. truncate, flatly rounded at apex (Fig. 69).

The dermis is coarsely shagreened, and is characterized by numerous bristle-like hairs and rows of short, stout, conical spines on the thoracic and abdominal segments.

Larva (from a slide made by C. Fuller, 1898): Very long and narrow (0·924 × 0·23 mm.) almost vermiform. Antennae short, close together, as far as can be determined, of two joints; basal cylindrical, slightly longer than broad; apical joint elongate, swollen, almost pyriform, apex with numerous bristles.

Legs short (about 0·16 mm. long), prothoracic legs slightly stronger than the others. Mouth-parts broad, about one-third width of body, mentum short; rostral loop very long, recurved, straightened out would extend just beyond posterior end of body. Posterior extremity slightly bilobed, the anal orifice a short distance from extremity. On margins at level of anal opening are two caudal setae, one on each side, about 180 $\mu$ long.



Larva of *Margarodes capensis* with legs and antenna further enlarged.

Habitat: At roots of vines at the following places in the south-western Cape Province: Olifantsberg, Worcester District, 1896; Waylands Farm, P. O. Darling, Malmesbury District, C. P. Lounsbury, 1897, and C. Fuller, 1898; Helderberg, Stellenbosch, C. P. Lounsbury, 1904.

Extracts from notes made by C. Fuller at time of collection :—

"Cyst stage is attached to the vine by means of a long filamentous rostrum.

| | |
|---|---|
| 28.12.97. | Adult ♀. Length 7 mm., yellow, pilose. |
| 30–31.12.97. | Fine cottony secretion on abdominal segments of ♀. |
| 3.1.98. | Large numbers of white eggs deposited in strings. |
| 4.1.98. | Still depositing eggs. Secreted matter of fine white silky nature and coming from abdominal segments dorsally, laterally, and ventrally. |

16.2.98. In the hard soil of the vineyard it was found that the ♀ deposited her eggs in the shell of the cyst. This was noted in many instances, but I am inclined to think that in a suitable soil the ♀ would deposit her eggs away from the cyst. Females placed upon sand in the office invariably burrowed downwards, making true tunnels which were not filled in behind the insect as it progressed."

Material studied consists of a number of cysts, prae-pupae, 1 pupa (spirit) and 6 adult ♀ ♀ mounted from spirit, and 1 slide of larvae prepared by C. Fuller in 1898.

Collection No.: 9.

### 59. Margarodes greeni sp. n.

Cyst: Almost spherical, about 2·5 mm. in diameter, amber-yellow; very much like those of *M. newsteadi.*

Adult ♀: 2·5 to 3 mm. long when mounted, very like *péringueyi* in appearance except that the lateral spine areas of the thorax are entirely replaced by fine, long hairs. The dermal hairs are all comparatively longer and more slender than in any other species known in South Africa. The antennae are plainly 8-jointed, joint II. rather more than half the length of III. The hairs on the antennae are also longer than those of *péringueyi.*

Habitat: At roots of vines, collected by F. W. Pettey, Elsenberg, Stellenbosch, C.P., October, 1914.

I have pleasure in associating with this species the name of Ernest E. Green, whose excellent work on the Coccidae of Ceylon is so well known.

Material studied consists of a number of cysts and four adult ♀ ♀.

Collection No.: 10*a*.

### 60. Margarodes newsteadi sp. n.

Cyst: Almost spherical, about 2·5 mm. in diameter, creamy yellow in colour. In colour the cyst of this species is intermediate between those of *péringueyi* and *greeni.*

Adult ♀: Slightly longer and broader than *péringueyi,* which it resembles very closely. In mounted specimens it is readily separated from all other South African species except *M. greeni* by the presence of large disc-rosette glands on the anterior portions of the body. From *M. greeni* it is easily distinguished by the presence of lateral thoracic spine areas, which are replaced by fine hairs in *greeni.*

The antennae are 8-jointed, joint II. very narrow, annular, only about one-fourth the length of III. The anterior claws are strong, densely black in outline, inner edge thinner, red-brown in transmitted light, with the inner margin entire, not crenulate as in *péringueyi.*

Habitat: At roots of grass, Pretoria, October, 1914. Cysts collected by the writer. Material studied consists of a number of cysts and two adult ♀ ♀.

I have pleasure in associating the name of Prof. R. Newstead, F.R.S., with this species.

Collection No.: Y.C 10.

### 61. Margarodes péringueyi sp. n.

(Plate XXVIII., Fig. 72.)

Cyst: Almost spherical, about 2 to 2·5 mm. in diameter, milky-white in colour, translucent. Cysts collected at roots of grass by writer at Pretoria, October 4, 1914, and placed in a damp cell made by lining a deep petri dish with moist filter-paper. Adults began to emerge on October 12, 1914.

Adult ♀: 2·5 to 3 mm. long, when extended, creamy white to pale yellow in colour with a median dorsal region which sinks below the lateral areas, and through which the darker body contents are visible.

When moving the body is broadly oval in outline, slightly narrowed in front; segmentation plainly visible. The insects are positively thigmotactic, and wandered around aimlessly until they had forced their way between the edge of the filter-paper and the dish, and invariably came to rest between the paper and the bottom of the dish.

The antennae are distinctly 8-segmented (stained material) the small joint II. more distinct than in *capensis*, nearly half the length of III.

The dermal hairs and spines numerous and normal.

Habitat: Very common in Pretoria and district at roots of grass. It has been collected in large numbers in lawns and also in the veld. The characteristic odour is strongly developed in this species when first moistened. Some specimens collected in a garden in Pretoria by Miss Impey included adult ♀ ♀ which had left the cysts and were enclosed in white cottony secretion in small lumps of soil. Eggs were laid by these ♀ ♀ in January, 1915, but larvae were not observed.

Material studied consists of a number of cysts and 4 adult ♀ ♀ mounted.

It gives me great pleasure to associate the name of Dr. L. Péringuey, Director of the South African Museum, Cape Town, with this species. He was one of the first naturalists in the country to recognize the true nature of these interesting insects.

Collection No.: 10.

### 62. Margarodes ruber sp. n.

(Plate XXVIII., Fig. 71.)

Cyst: Almost spherical, about 2 mm. in diameter, white, translucent to semi-transparent, the red colour of the female being plainly visible before emergence.

Cysts collected in association with *M. péringueyi* at Pretoria on October 4, 1914. ♀ ♀ began to emerge October 21, 1914.

Adult ♀ : 2 mm. to 2·5 mm. long when extended, elongate with a distinct constriction at the junction of the cephalothorax with the abdomen. Colour deep reddish-yellow to carrot colour. Two small scarlet eye-spots between the antennae. Antennae and legs pale, except the stout front claws, which are brownish-black.

Colour in boiling KOH dark red-brown, then magenta; the liquid remains colourless.

A newly emerged female was placed on a dish of loosely packed soil, and took four minutes to bury herself. The hole was quite vertical, and was made by means of the front claws. The insect did not remain in one position, but constantly turned around in a circle, the front claws being the axis.

Antennae 9- or 10-segmented, the 10-jointed form with a very small annular joint II. as in *capensis*. Those called 9-jointed are probably similar, but with the small joint II. invisible owing to unsuitability of orientation in mounting. Antennae thick at base and gradually tapering. Dermal hairs and spines comparatively long and strong, the spine areas of the sides of thorax being especially prominent. On each side of anal opening is a thickened triangular patch bearing one or two setae.

Habitat: On roots of grass, associated with *M. péringueyi*. Collected by the writer, Pretoria, October, 1914.

Material studied consists of a number of cysts and 7 adult ♀ ♀ mounted.

The colour of this insect, together with the tapering, annular, and 10-jointed antennae, gave me the impression that this might be the prae-pupal stage of the male of one of the common species on grass at Pretoria. Some specimens kept alive for ten days in a moist cell, however, showed no signs of pupating, and behaved in exactly the same manner as did the ♀ ♀.

Collection No.: 11.

### 63. Margarodes trimeni Giard.

(Plate XXVIII., Fig. 70.)

*Margarodes trimeni* Giard, C. R. Biol. Paris, iv., pp. 126, 412, 712, 1894.

Cyst: Shell-like, more or less irregular in outline, but narrowed at one end. Usually the cysts are more or less triangular when seen in profile, with the base broadly rounded and the apex bluntly pointed. The surface generally exhibits a few rounded protuberances of irregular disposition. The "flakes" appear to be imbricated from the wide end, where the adult emerges.

Size: Largest specimens 5·5 mm. long and 4 mm. at greatest width.

Colour: Brassy yellow to bronze.

The empty cysts of this species are collected by children and threaded to make necklaces.

Adult ♀: In appearance this insect greatly resembles *M. capensis*, but is of slightly smaller size. The largest specimens when mounted range from 4·5 to 5·2 mm. in length. The chief differences between *trimeni* and *capensis* are:—

(*a*) The entirely distinctive cysts.

(*b*) The antennae of *trimeni* are 7- or 8-jointed, the small joint II. being absent in two out of four specimens mounted.

(*c*) The front claws of *trimeni* are more slender at the base than those of *capensis*.

(*d*) The dermal hairs of *trimeni* are shorter and much stouter than those of *capensis*, and the derm is coarsely rugose instead of shagreened.

(*e*) *capensis* is only known from vine roots; *trimeni* from other plants.

Habitat: The cysts of this species ("ground pearls") were found in numbers in, or near, termite nests in the south-west of the Cape Province. The real host-plants are not known. Some of the dry cysts, from which the insects had not emerged (collected in 1898), were placed in a moist cell in December, 1914, and still produced the strong soapy *Margarodes* odour.

Material studied consists of a number of cysts and ♀ ♀ (spirit material), and 5 ♀ ♀ mounted.

Collection No.: 8.

# DESCRIPTION OF PLATES.

## PLATE XVI.

(Figs. 1–7.)

All figures slightly enlarged.

1. *Antonina transvaalensis* sp. n. Cluster of ovisacs on crown of grass. 1*a*, Single specimen, flattened form, with insect exposed.
2. *Natalensia fulleri* g. and sp. n. Gall of adult ♀ on root of grass.
3. *Pseudococcus burnerae* sp. n. ♀ ♀ with ovisacs on granadilla.
4. *Pseudococcus virgatus* (Ckll.) on orange-leaf.
5. *Tylococcus chrysocomae* sp. n. Completed ovisacs.
6. *Pseudococcus flagrans* sp. n. Adult ♀ in waxy secretion on grass stem.
7. *Pseudococcus nitidus* sp. n. Completed ovisac.

## PLATE XVII.

(Figs. 8–11*d*.)

All figures except 11 enlarged according to scale.

8. *Antonina natalensis* sp. n. Antenna of adult ♀.
9. *Antonina transvaalensis* sp. n. Antenna of adult ♀. 9*a*, Spiracle of ♀; 9*b*, antenna, and 9*c*, caudal extremity of larva.
10. *Rhizoecus africanus* sp. n. Anal extremity of adult ♀. 10*a*, "Eye-like cicatrice" of ♀; 10*b*, dermal characters of venter; 10*c*, dermal characters of dorsum; 10*d*, antenna of adult ♀; 10*e*, tibia and tarsus III. of ♀.
11. *Natalensia fulleri* sp. n. Camera lucida sketch after boiling in KOH. 11*a*, Antenna of adult ♀; 11*b*, part of caudal extremity of larva; 11*c*, tibia and tarsus II. of adult ♀; 11*d*, mentum of adult ♀.

## PLATE XVIII.

(Figs. 12–21.)

All figures magnified according to scale.

12. *Tylococcus chrysocomae* sp. n. Antenna of adult ♀ (7-jointed form). 12*a*, Marginal tubercle, and 12*b*, caudal tubercle of adult ♀; 12*c*, normal tarsus III. of ♀, and 12*d*, abnormal leg III. of same insect; 12*e*, antenna, and 12*f*, caudal extremity of larva.

13. *Pseudococcus filamentosus* (Ckll.). Trochanter of ♀. 13*a*, Mentum of adult ♀.
14. *Pseudococcus natalensis* sp. n. Trochanter, and 14*a*, mentum of adult ♀.
15. *Pseudococcus socialis* sp. n. Disc-like gland-pores from dorsum of adult ♀.
16. *Pseudococcus solitarius* sp. n. Mentum of adult ♀.
17. *Pseudococcus burnerae* sp. n. Mentum of adult ♀.
18. *Pseudococcus mirabilis* sp. n. Antenna, and 18*a*, caudal extremity of adult ♀.
19. *Pseudococcus quaesitus* sp. n. Antennal segment I. of adult ♀.
20. *Pseudococcus flagrans* sp. n. One of the ventral "plates" of adult ♀.
21. *Pseudococcus stelli* var. *tylococciformis* sp. and var. n. Two of the marginal tubercles from the anterior region, between the antennae of adult ♀.

## PLATE XIX.

(Figs. 22–33.)

All figures greatly enlarged.

Marginal spine areas of adult ♀ of:—

22. *Pseudococcus burnerae* sp. n.
23. *Pseudococcus mirabilis* sp. n.
24. *Pseudococcus quaesitus* sp. n.
25. *Pseudococcus transvaalensis* sp. n.
26. *Pseudococcus trichiliae* sp. n.
27. *Pseudococcus bantu* sp. n.
28. *Pseudococcus citri* var. *phenacocciformis* var. n.
29. *Pseudococcus caffra* sp. n.
30. *Pseudococcus flagrans* sp. n.
31. *Pseudococcus nitidus* sp. n.
32, *Pseudococcus segnis* sp. n.
33. *Pseudococcus stelli* sp. n.

## PLATE XX.

(Figs. 34–39.)

Figs. 34 and 35 original; 36–39 after Pierantoni.

34. *Pseudococcus citri* (Risso). Adult ♀ enlarged.
35. Transverse section showing position of "mycetom" or symbiont mass (my.).
36. Portion of mycetom highly magnified. Large cells "sferules" containing a number of "sferettes."
37. Five "sferettes" containing numbers of elongate symbiont organisms (*Coccidomyces dactylopii* Buchner).
38. Early stage in the infection of the ovum by "sferettes" (sf.).
39. Later stage in which the mass of "sferettes" is rounding off to form the "polar mass."

## PLATE XXI.

(Figs. 40–41*f*.)

All figures to larger scale except 41*b*

40. *Eriococcus araucariae* Mask. Antenna of adult ♀. 40*a*, Anal lobe; 40*b*, tibia and tarsus III.
41. *Puto africanus* sp. n. 8-jointed, and 41*a*, 9-jointed form of antennae; 41*b*, caudal extremity showing position of caudal lobes and spine area; 41*c*, portion of spine area to larger scale; 41*d*, caudal lobe and half anal ring; 41*e*, mentum; 41*f*, tibia and tarsus I.

## PLATE XXII.

(Figs. 42–48*a*,)

42. *Orthezia insignis* Douglas. Adult ♀.
43. *Coccus cacti* Goeze. Adult ♀ ♀ on *Opuntia* sp.
44. *Coccus indicus* Green. Adult ♀ ♀ on *Opuntia monacantha.*
45. *Monophlebus fulleri* Ckll. Adult ♀ (7·2 mm. long) and ♂ puparium.
46. *Icerya purchasi* Mask. Adult ♀ ♀ with ovisacs.
47. *Icerya seychellarum* Westw. Adult ♀ ♀ with ovisacs.
48. *Icerya euphorbiae* sp. n. Dorsal view of ♀. 48*a*, Lateral view of ♀.

## PLATE XXIII.

(Figs. 49–49*i*.)

All figures to larger scale except 49.

49. *Monophlebus fulleri* Ckll. Larva, drawn to scale given. 49*a*, Antenna of young ♀; 49*b*, antenna of prae-pupa; 49*c*, antenna case of pupa; 49*d*, caudal extremity of pupa; 49*e*, haltere of ♂; 49*f*, caudal processes of ♂; 49*g*, antenna of ♂; 49*h*, antenna of adult ♀; 49*i*, trochanter of ♀.

## PLATE XXIV.

(Figs. 50–51*b*.)

50. *Aspidoproctus maximus* Newst. Half-grown ♀ ♀. 50*a*, Adult ♀ ♀; 50*b*, longitudinal section of adult ♀ showing position of "marsupium"; v.o. ventral orifice.
51. *Aspidoproctus tricornis* (Newst.). Adult ♀ on *Acacia* sp. 51*a*, Side view. Note waxy filaments of larva which became fixed to secretion from dorsal opening. 51*b*, Longitudinal section of same specimen after all young had emerged and nothing but the white egg-shells remained.

## PLATE XXV.

(Figs. 52–56.)

52. *Aspidoproctus maximus* Newst. Larval antenna. 52*a*, Prae-pupal antenna; 52*b*, pupa.
53. *Aspidoproctus mirabilis* (Ckll.). Larval antenna.
54. *Icerya seychellarum* Westw. Larval antenna.
55. *Icerya purchasi* Mask. Larval antenna.
56. *Icerya euphorbiae* sp. n. Larval antenna. 52, 54, 55 and 56 × about 70 times.

## PLATE XXVI.

(Figs. 57–63.)

57. *Orthezia insignis* Dougl. ♀ antennae.
58. *Coccus cacti* Goeze. ♀ antennae.
59. *Monophlebus hirtus* sp. n. ♀ antenna.
60. *Icerya euphorbiae* sp. n. ♀ antenna.
61. *Icerya purchasi* Mask. ♀ antennae.
62. *Icerya seychellarum* Westw. ♀ antenna.
63. *Aspidoproctus armatus* Newst. ♀ denuded of waxy appendages, natural size.

## PLATE XXVII.

(Figs. 64–66*a*.)

64. *Aspidoproctus maximus* Newst. Antenna and derm glands of young ♀ (10 mm. long). 64*a*, Prae-pupa; 64*b*, derm glands around antenna of adult ♀; 64*c*, anal orifice of young ♀.
65. *Aspidoproctus armatus* Newst. ♀ antenna. 65*a*, Portion of anterior lateral margin of adult ♀.
66. *Aspidoproctus tricornis* (Newst.). ♀ antenna. 66*a*, Anal orifice of ♀.

## PLATE XXVIII.

(Figs. 67–72.)

67. *Aspidoproctus mirabilis* (Ckll.). ♀ antenna. 67*a*, Portion of venter showing tenent hairs.
68. *Aspidoproctus tricornis* (Newst.). One of the lateral "horns" cleared and mounted. 68*a*, Ventral opening.
69. *Margarodes capensis* (Giard) Brain. ♀ antennae.
70. *Margarodes trimeni* Giard. ♀ antennae.
71. *Margarodes ruber* sp. n. ♀ antennae.
72. *Margarodes péringueyi* sp. n. ♀ antennae.

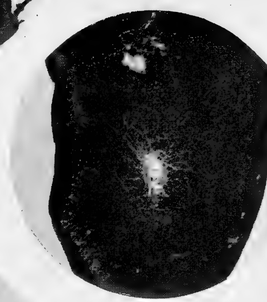
Plate XVI.
Figs. 1–7.

1.

1a.

2.

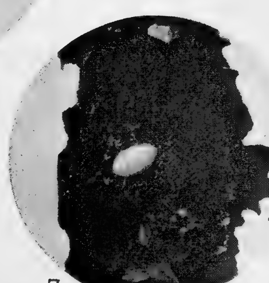
3.



4.

5.

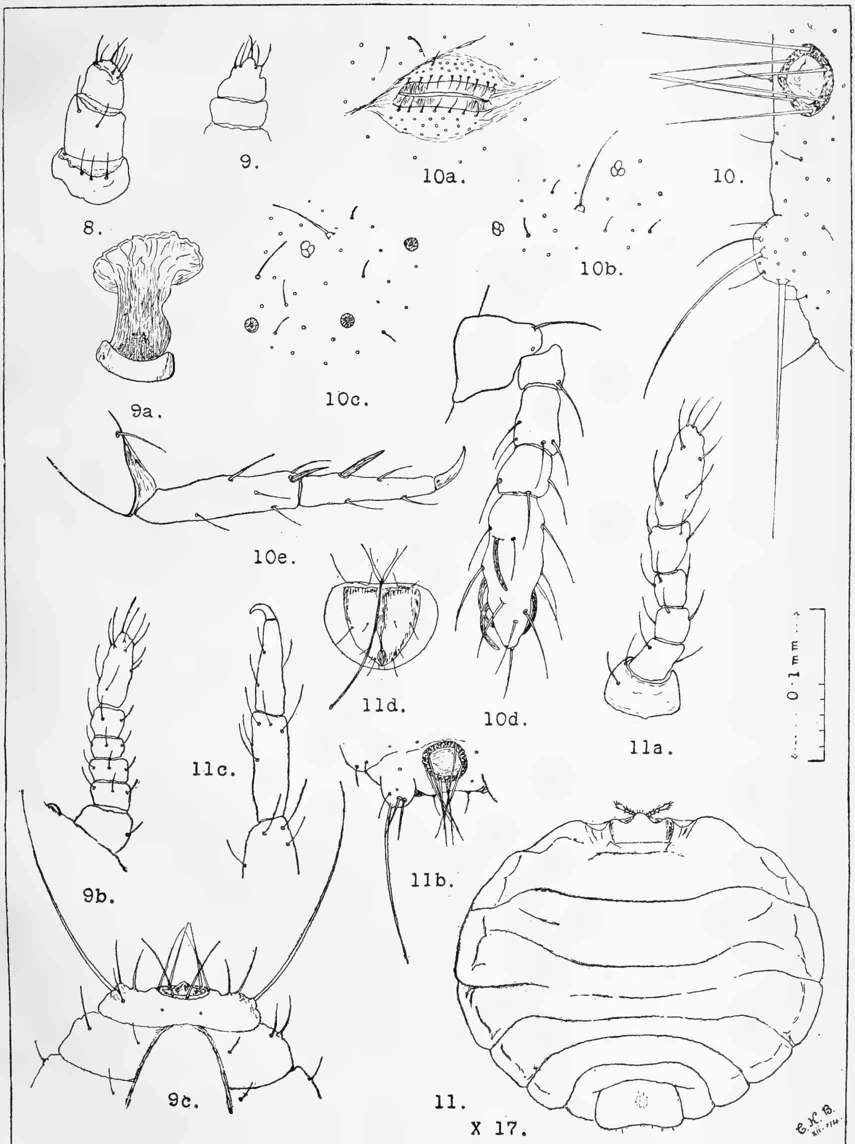
6.



7.

Photos F. Thomsen.

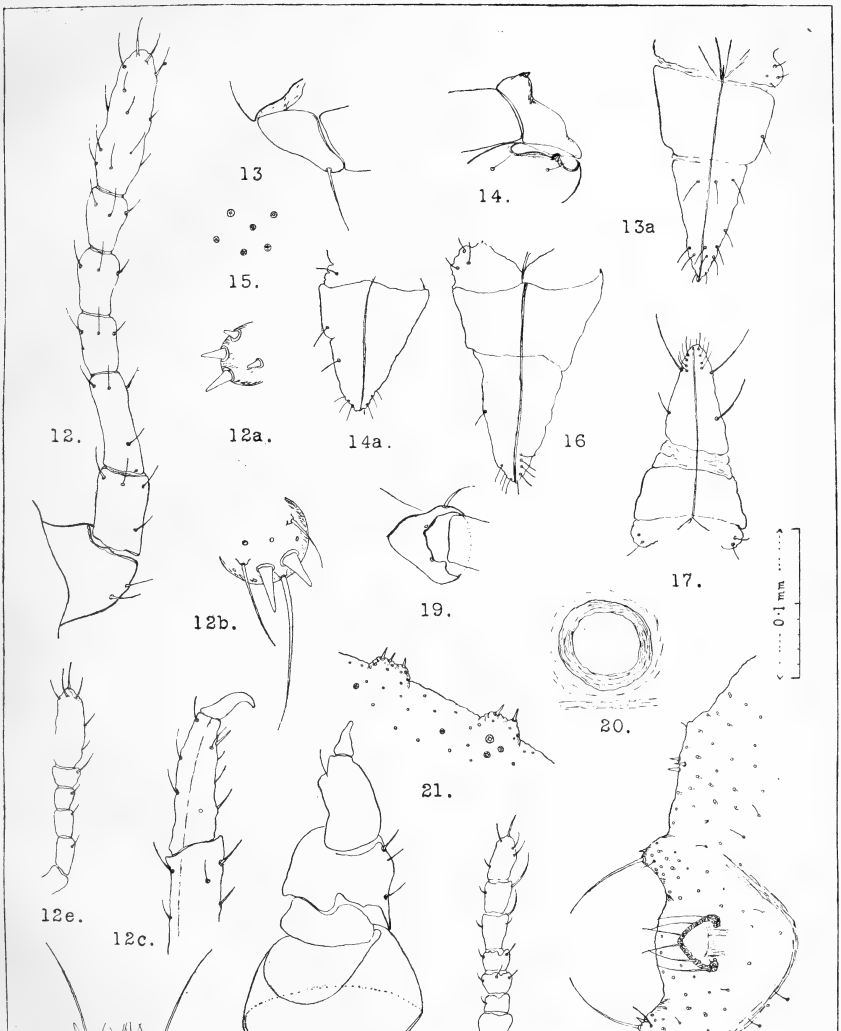
West, Newman proc.




Chas. K. Brain.

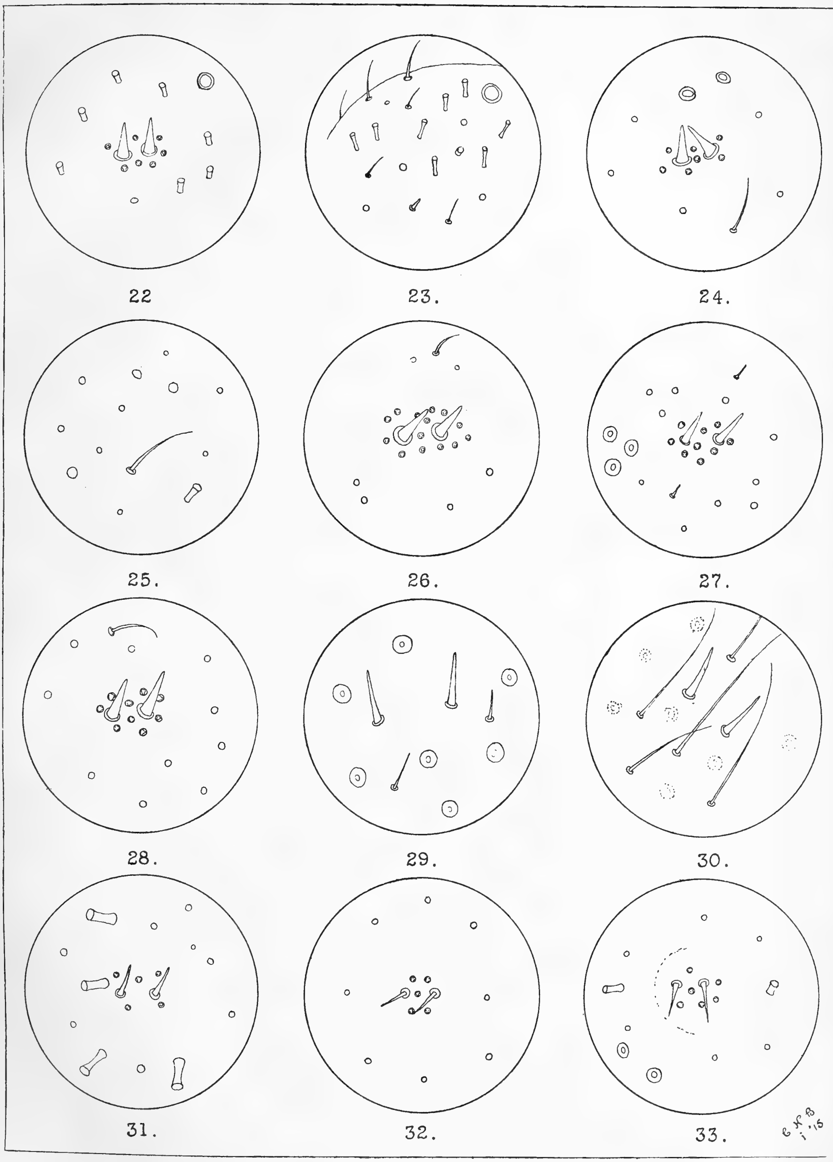
West, Newman proc.

Plate XVIII.
Figs. 12–21.



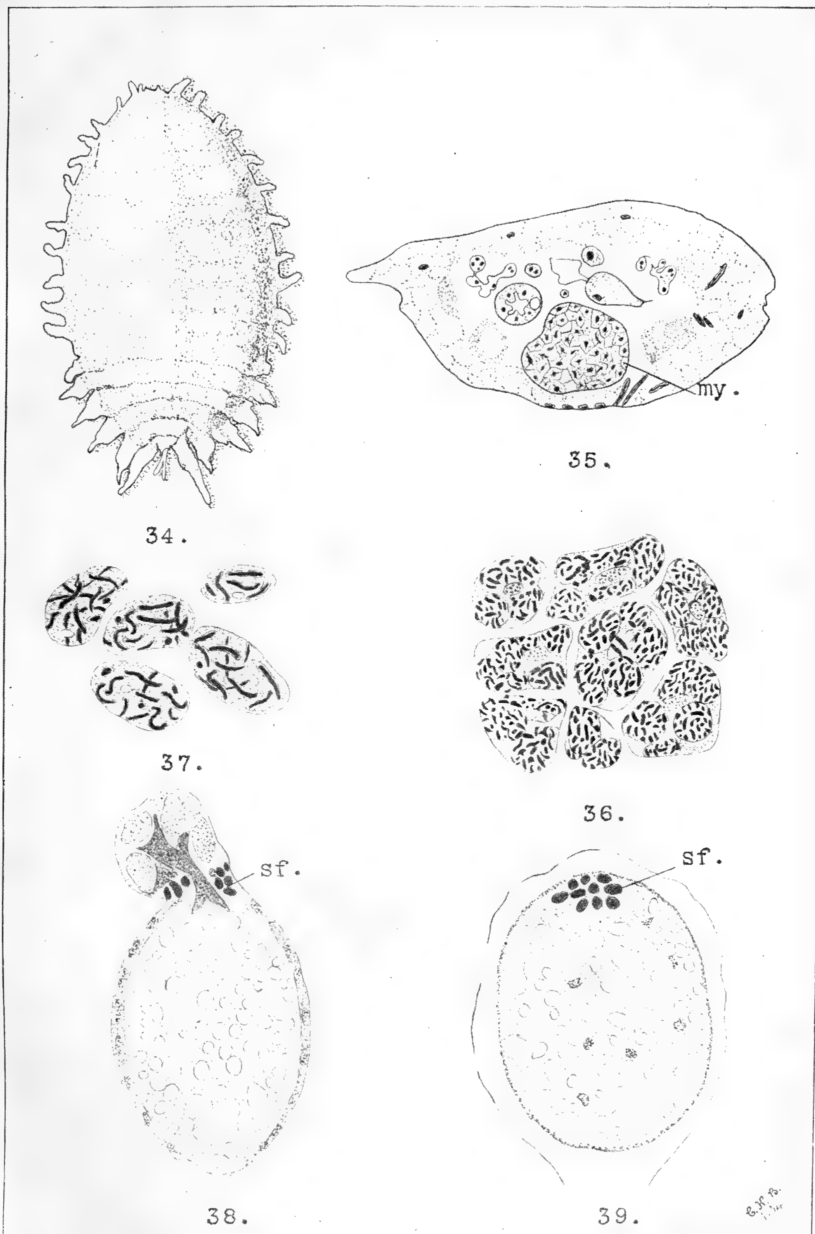

Chas. K. Brain.

West, Newman proc.



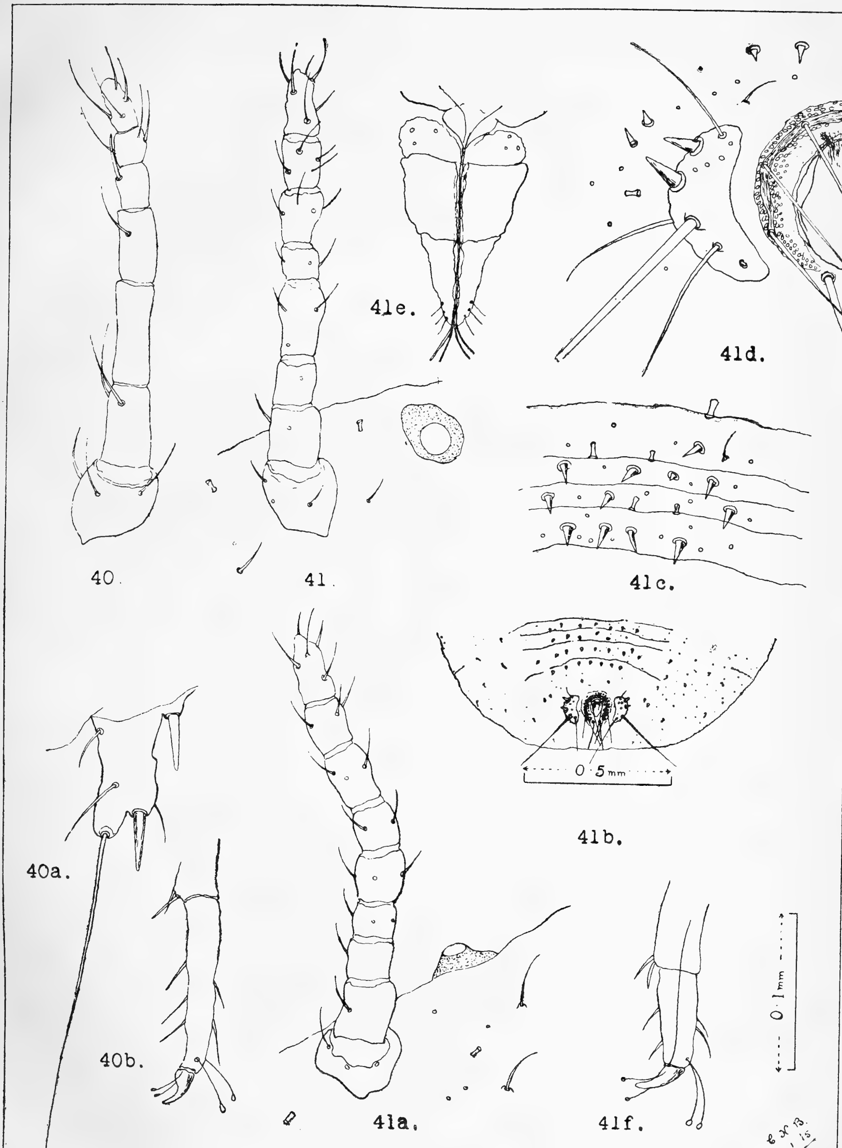

Chas. K. Brain.

West, Newman proc.




Chas. K. Brain.

West Newman proc.



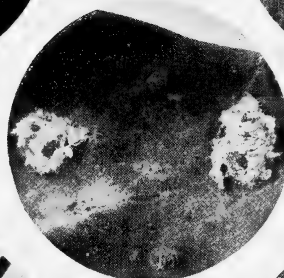

Chas. K. Brain.

West, Newman proc.

Plate XXII.
Figs. 42–48.

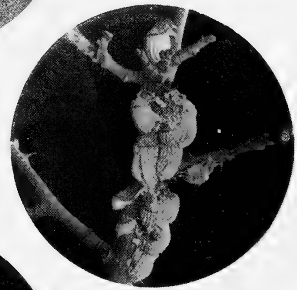
42.

43.

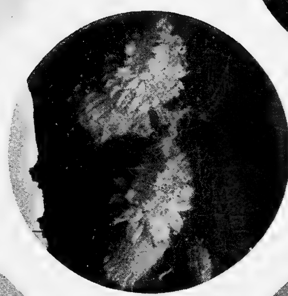


44.

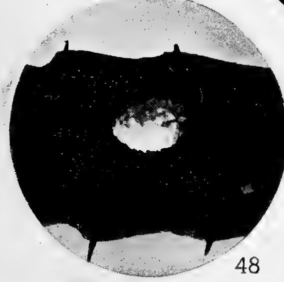

45.



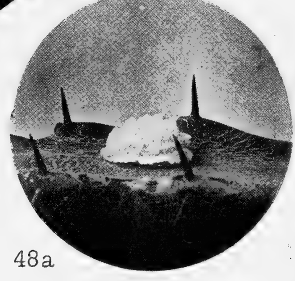
46.



47.



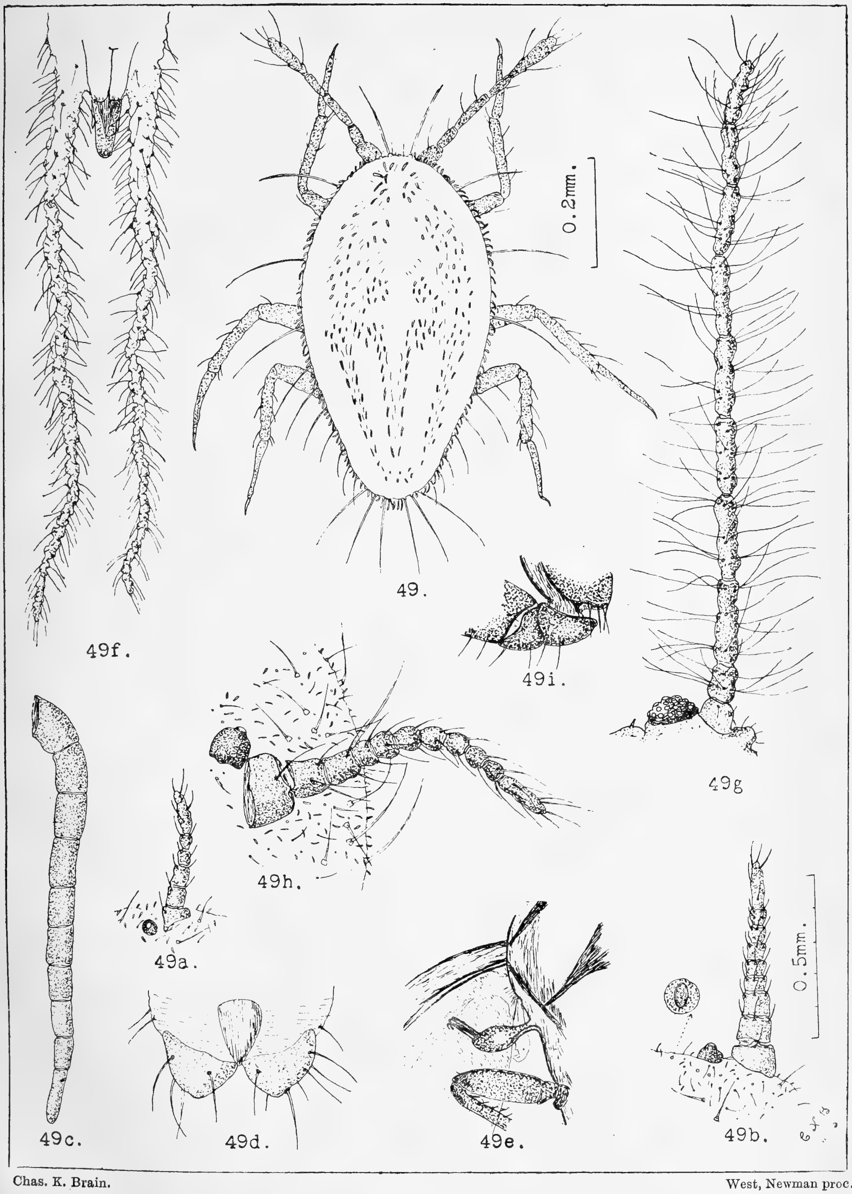
48



48a

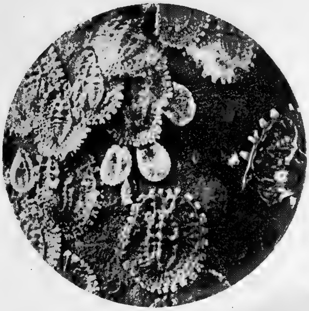
Photos Chas. K. Brain.

West, Newman proc.

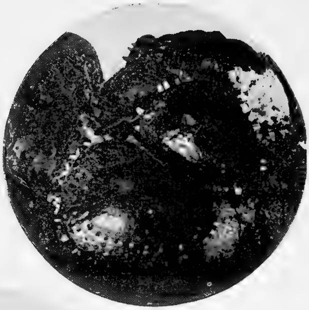



Chas. K. Brain.

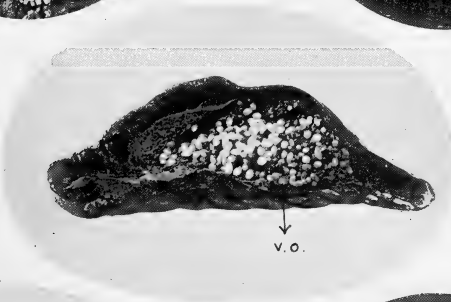
West, Newman proc.



50.

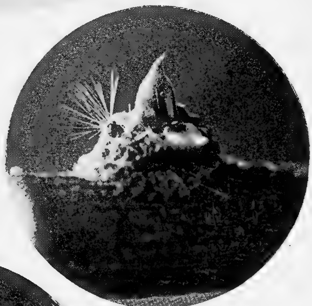


50a.




50b.

51.



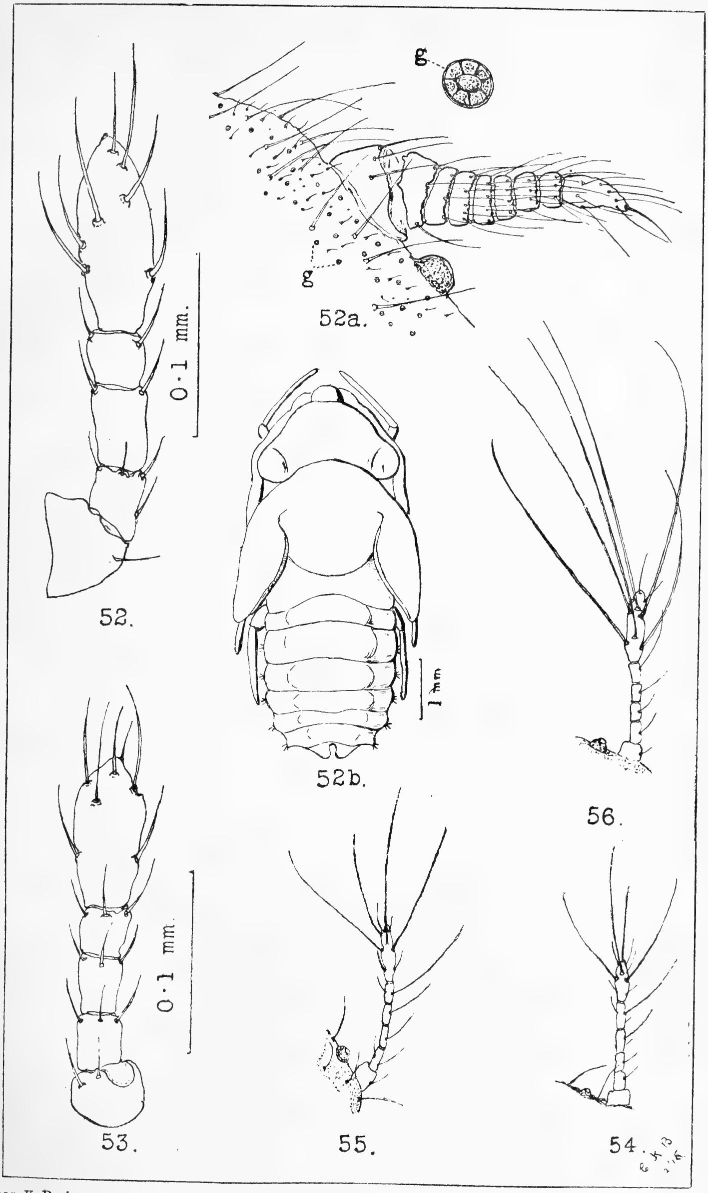
51a.

51b.

Photos Chas. K. Brain.

West, Newman proc.

Plate XXV.
Figs. 52–56.

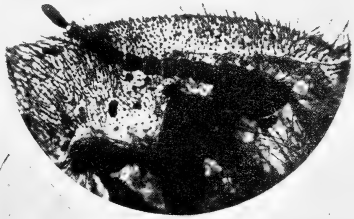



Chas. K. Brain.

West, Newman proc.

57.

58.

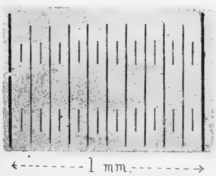


59.

60.

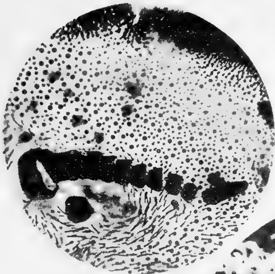
61.

62.



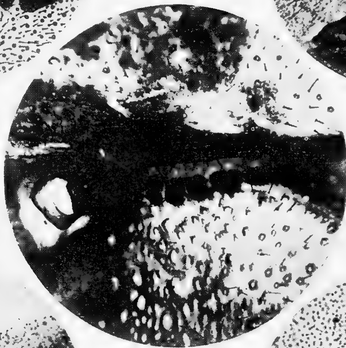

Scale for Figs.
57 to 72 except 63.

63.

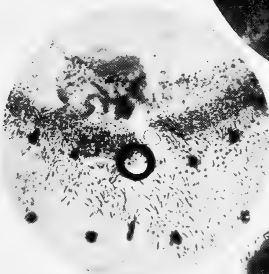


64.

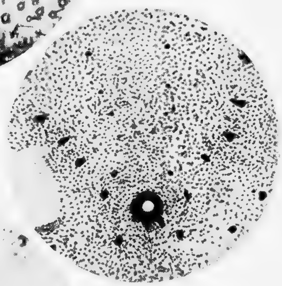
64a.



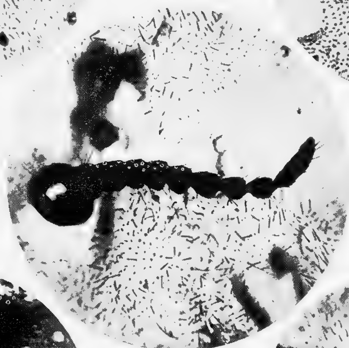
64b.



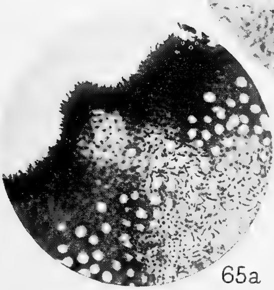
64c.



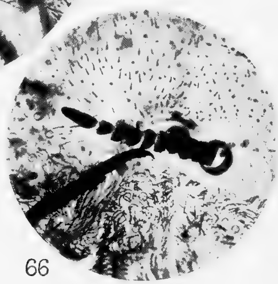
66a.



65.



65a



66

Photomicr. Chas. K. Brain.

West, Newman proc.

67. 68. 69. 67a. 68a. 70. 71. 72.

Photomicr. Chas. K. Brain. West, Newman proc.

# TRANSACTIONS

OF THE

# South African Philosophical Society.

... following volumes have been published:—

| | PUB. | s. | d. |
|---|---|---|---|
| Part 1 | 1878 | | |
| Part 2 | 1879 | 2 | 6 |
| Part 3 | 1880 | 2 | 6 |
| Part 1 | 1881 | 5 | 0 |
| Part 2 | 1881 | 2 | 6 |
| Part 3 | 1882 | 2 | 6 |
| Part 1 | 1884 | 2 | 6 |
| Part 2 | 1886 | 10 | 0 |
| Part 1 | 1887 | 2 | 6 |
| Part 2 | 1888 | | |
| Part 1 | 1888 | | |
| Part 2 | 1893 | 2 | 6 |
| Part 1 | 1890 | 2 | 6 |
| Part 2 | 1892 | 2 | 6 |
| Part 1 | 1895 | 10 | 0 |
| Part 2 | 1896 | 20 | 0 |
| Part 1 | 1893 | 2 | 6 |
| Part 2 | 1896 | 5 | 0 |
| Part 1 | 1897 | 5 | 0 |
| Part 2 | 1898 | 7 | 6 |
| —Part 1 | 1897 | 15 | 0 |
| Part 2 | 1898 | 7 | 6 |
| Part 3 | 1899 | 7 | 6 |
| —Part 1 | 1900 | 12 | 6 |
| Part 2 | 1900 | 12 | 6 |
| Part 3 | 1901 | 7 | 6 |
| Part 4 | 1902 | 12 | 6 |

| VOL. | | PUB. | s. | d. |
|---|---|---|---|---|
| XII.— | (Pp. 1–560) | 1901 | 21 | 0 |
| | (Pp. 561–896) | 1902 | 14 | 0 |
| | (Pp. 897–920) | 1903 | 2 | 0 |
| XIII.— | (Pp. 1–288) | 1904 | 12 | 6 |
| | (Pp. 289–546) | 1907 | 8 | 6 |
| | (Pp. 547–752) | 1906 | 10 | 0 |
| XIV.— | Part 1 | 1903 | 5 | 6 |
| | Part 2 | 1903 | 8 | 6 |
| | Part 3 | 1903 | 11 | 0 |
| | Part 4 | 1903 | 5 | 0 |
| | Part 5 | 1904 | 3 | 0 |
| XV.— | Part 1 | 1904 | 3 | 6 |
| | Part 2 | 1904 | 3 | 6 |
| | Part 3 | 1904 | 17 | 0 |
| | Part 4 | 1905 | 7 | 6 |
| | Part 5 | 1905 | 12 | 6 |
| XVI.— | Part 1 | 1905 | 10 | 0 |
| | Part 2 | 1905 | 10 | 0 |
| | Part 3 | 1906 | 5 | 0 |
| | Part 4 | 1906 | 15 | 0 |
| | Part 5 | 1907 | 8 | 6 |
| XVII.— | Part 1 | 1907 | | |
| | Part 2 | 1908 | | |
| XVIII.— | Part 1 | 1907 | 9 | 0 |
| | Part 2 | 1908 | 12 | 0 |
| | Part 3 | 1907 | 4 | 6 |
| | Part 4 | 1909 | 7 | 0 |

...pies may be obtained from the Honorary Secretary of the ... Society of South Africa; or from Messrs. Wm. Wesley & ... 28, Essex Street, Strand, London.

*...s of the Society may obtain the publications from the Secretary only, at half of the above prices.*

... of vol. I., Part 2 of vol. IV., Part 1 of vol. V., and vol. XVII. ... 2 are out of print.

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH

| | | |
|---|---|---|
| Vol. I. | Part 1 | 190[illegible] |
| „ I. | Part 2 | 1910 |
| „ II. | Part 1 | 1910 |
| „ II. | Part 2 | 1911 |
| „ II. | Part 3 | 1912 |
| „ II. | Part 4 | 1912 |
| „ II. | Part 5 | 1912 |
| „ III. | Part 1 | 1913 |
| „ III. | Part 2 | 1913 |
| „ III. | Part 3 | 1913 |
| „ IV. | Part 1 | 1914 |
| „ IV. | Part 2 | 1914 |
| „ IV. | Part 3 | 1915 |
| „ V. | Part 1 | 1915 |
| „ V. | Part 2 | 1915 |

Copies may be obtained from the Honorary

Messrs. Wm. Wesley & Son, 28, Essex Street

*Members of the Society may obtain the*

*Secretary only, at half of the above*

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH AFRICA.

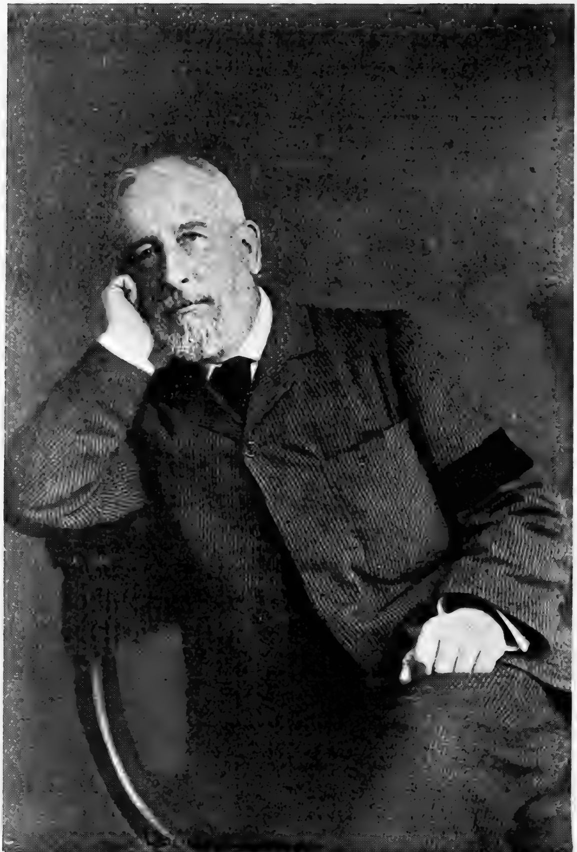
VOLUME V.—PART 3.
1915.



CAPE TOWN:
PUBLISHED BY THE SOCIETY.
1915.

[Price 10s. 6d.

# CONTENTS.



David Gill

S. B. Barnard photo. West, Newman proc.

# SIR DAVID GILL, K.C.B., LL.D., D.Sc., F.R.S., F.R.A.S.

(Plate XXIX.)

It is in a spirit of deep reverence that I seek to place before the Royal Society what David Gill was in the great domain that he filled so spaciously —what he was as a pioneer in modern astronomy, what he was as an accomplished geographer, what he was as a competent man of affairs, and above all what he was as the honoured friend of a host of men in many lands.

In him was blended in a pleasing and splendid harmony, strength and tenderness, power and gentleness, force and grace.

Outstanding among his peers in science, a worker whose energy was boundless, whose industry was untiring, a thinker whose thoughts and visions outran the advancing march of astronomical progress, he yet found time for, and delight in, the discharge of a multitude of tender charities of hearth and home and friendship.

His hospitalities were both generous and thoughtful; his friendships wide, sincere, and lasting; his letters—and he was ever a prodigal letter-writer—are the reflex of the man's sweet simplicity and strong personality; his winsome magnetic influence was the visible evidence of a soul true to itself and responsive to what was best and noblest in others.

His character was as ideal as his thoughts were high. Honest, courageous, unselfish, trustful, he gave for twenty-eight years to South Africa the example and the inspiration of a life lived on a high plane of thought and action. It may be said of him what can be said of few other South African workers, that the passage of the years only increased his reputation and his usefulness.

One is somewhat reluctant to make choice of events and circumstances out of a career so happy and so fruitful, so rich and so suggestive. There is much to tell. And in the telling the thought may often fail of finding adequate expression.

David Gill was born at 48, Skene Terrace, Aberdeen, on the 12th of June, 1843. His death took place at De Vere Gardens, London, on the 24th of January, 1914, so that the span of his life was just a little over the threescore years and ten.

His father, as also his grandfather before him, were well-known and highly-respected clock and watch-makers in the town of Aberdeen. To this day in many a home in the north of Scotland there is testimony to the excellence of the work turned out by the Gills; and no doubt the future astronomer owed much of his own aspiration after the best, as well as his impatience with inferior work on the part of others, to the rugged and upright character of his forebears. It is certain that his strongly developed mechanical skill, his deftness and sureness of touch, came from a long line of superior workmen. From Gill himself I heard this story of his first meeting with Nasmyth the engineer. After some slight conversation on many matters, Nasmyth blurted out in Scotch, "Man, I like yer thum!" Gill had the engineer's thumb and hand, broad, strong, flexible.

From his mother he inherited the tenderness and delicate sympathy which never failed him all through his life, and which made his friendship such a rare gift, and his comradeship a memorable experience.

Until his fourteenth year young Gill attended the Bellevue Academy in the town of Aberdeen. In 1857 he went to Dollar Academy, where he found an inspiring influence in Dr. Lindsay, at whose house he boarded. It was Dr. Lindsay who gave a permanent direction to Gill's mind and purpose by strengthening and fostering that aptitude for science and mathematics which even in his boyhood was clearly noticeable.

In 1858 Gill was at Marischal College, Aberdeen, taking the ordinary arts curriculum of those days.

In 1859 there entered into his life its most potent intellectual influence. In this year he took the senior mathematical class, and the class for Natural Philosophy, thus coming under the spell of that great teacher and prophet Clerk Maxwell. The impact of Maxwell's keen intellect upon the reflective and receptive mind of young Gill was deep and lasting. Of his college days under Maxwell he thus wrote towards the close of his life: "They were hours of purest delight to me;" and yet again, "Maxwell was supreme as an inspiration." Indeed, he never ceased to write and speak in terms of highest admiration of his teacher, and it is delightful to know that in the after-years the relationship begun as pupil and master became one of most intimate friendship.

It is significant to note that towards the close of his stay at Marischal College, Gill was strongly drawn towards the study of electricity, probably due to Maxwell's influence, and those intimately acquainted with him know that he never lost his practical interest in, or his thorough knowledge of, this science, a knowledge and an interest which stood him in good stead when electricity became the simplest and most effective motive force in observatory equipment.

The future cast for young Gill was that he should follow the career of his father and grandfather, and in this direction at the close of his college career he spent a year at Besancon, in order to make himself thoroughly acquainted with all the details of clock-making. This action of his is typical of his whole life.

But events were moving otherwise than turning this young man into a prosperous watchmaker. Gill having heard of the establishment of a time service at Edinburgh, thought it would be a good thing to introduce a similar service into Aberdeen. And so in 1863—he was then barely twenty years of age—he brought his proposal for a more accurate time service before David Thomson, Professor of Natural Philosophy at King's College, Aberdeen.

Thomson gave Gill a letter of introduction to Piazzi Smyth, then Astronomer Royal for Scotland. Thus armed, Gill proceeded to Edinburgh to make inquiry into the method of firing the time-gun there. Fortunately he was received at the old Calton Hill Observatory with every kindness, and no trouble was spared to show him every detail of the time-gun and time-ball service.

"This," he says in his History of the Cape Observatory and of its observers, "was my first introduction to an astronomer and an observatory." It is noteworthy that Piazzi Smyth had been Maclear's assistant at the Cape before coming to Edinburgh, and thus Gill's first introduction to astronomers and observatories was to one intimately associated with the land where in after-years he spent the best and happiest days of his long life.

On returning to Aberdeen Gill lost no time in carrying out his purpose. A portable transit instrument was unearthed from out the lumber-rooms of King's College, and once more erected on the solid masonry piers on which it had rested, unused, for many years. The instrument truly was a very imperfect one, but it is an old precept of astronomy that it is not the instrument that matters, but the man using it.

A good sidereal clock, as well as a mean time clock, was set up beside the transit instrument. An electrical control of a new design was constructed by Gill himself, and thus Aberdeen, through the energy and determination of a young man, became possessed of an accurate time service.

The experience thus gained drew Gill's mind irresistibly towards astronomy. In the garden of his father's house he erected a small observatory. His first instrument was a 12-inch silver-on-glass speculum, bought from a well-known amateur astronomer of that day, the Rev. Henry Cooper Key. The adjustments and mountings were constructed by a local firm from drawings made by Gill. It has been my hap to have met one who assisted in the setting up of this now historic instrument, and the stories told of the impetuousness and inventiveness of the young astronomer are instructive as revealing how little folk like Gill change with the changing years. As I heard my friend relate anecdotes of the setting up of the 12-inch reflector in the gardens in Skene Terrace methought he was telling me the story of the erection of the McClean telescope, thirty years later in time.

With this new venture Gill started on observations of Double Stars, Nebulae, the Moon, and later on had in purpose the determination of stellar parallax, an investigation that ever attracted him. Indeed, early in his career he seemed instinctively to appreciate the direction that astronomical progress would take during the next few decades. And so in 1866 his mind was directed to photography as an aid to astronomy. In 1867 he was able to take an exceptionally good photograph of the moon. A transparency of this picture was sent to Dr. Huggins, then rising into prominence through his spectroscopic discoveries. Huggins thought so highly of the effort that he hung it in his dining-room window at Tulse Hill, and those who were privileged to visit his home knew with what delight he used to refer to this early attempt at celestial photography.

Sometime in the year 1868 Lord Lindsay saw this photograph, noticed its definition and its consequent scientific value. A question regarding it brought the information from Dr. Huggins that it was taken by a young Aberdeen watchmaker interested in astronomy, and with an instrument practically of his own construction. Lord Lindsay asked for an introduction to Gill, and the acquaintance thus began soon ripened into a very close and abiding friendship.

The future history of this photograph is of interest. It remained in the possession of Huggins till his death, when it was handed back to Gill by Lady Huggins. At the last meeting of the Royal Astronomical Society which Gill attended, that of December, 1913, it was handed over to that Society, and it now hangs in their rooms in Burlington House, side by side with other objects of historic note. A melancholy interest attaches to this presentation, for it was Gill's last public appearance. And as for the telescope with which this photograph was taken, Lord Lindsay purchased it from Gill, and it is now mounted in the City Observatory, Edinburgh.

In July, 1870, Gill married Isobel, second daughter of John Black, Linhead, Aberdeenshire. They had been attached to one another for many years previous to 1870, for it was in 1865 that the lifelong lovers met, he then twenty-two, she sixteen years of age, but the circumstances of his father's business made an earlier marriage inadvisable.

In his History of the Cape Observatory, Sir David Gill thus makes reference to Lady Gill: "One who shares my every thought." Those who, like the writer, have enjoyed the hospitality of their beautiful home at the Cape Observatory know how fitting this tribute was; how perfect their mutual understanding; how true and tried their comradeship. She shared his successes, and thus added to them; she helped to bear his defeats and disappointments, and thus lessened them. How often did one hear him say, "I must tell my wife this," or "Lady Gill will be glad to hear that." Round her happiness always his thoughts turned, and any one who reads "Six Months in Ascension" with seeing sympathy will know what part of her life he filled.

On his marriage Gill succeeded to his father's business. David Gill, senior, was then eighty-one years of age, and although strong and vigorous yet he deemed it wise to hand over the control of the business to younger hands. He lived on for other eight years, living to enjoy his son's rising fame as an astronomer.

Young Gill was now in the full vigour of his early manhood, of considerable business aptitude, keen, far-seeing, intensely alive. A photograph of him at this time shows a face little changed in essentials from what many of us remember so well. There are the same, clear, thoughtful eyes; the same broad, brooding brow. There is the hint of the large, flexible mouth of later years. The face is clean shaven, and the countenance has that peculiar softness of expression which one notices in almost all portraits of Lord Lister.

For two years Gill remained in business, through the day occupied in the ordinary routine of a successful business concern, and at night wholly engaged in exploring the wonders of the midnight sky. In this "other" part of his life his work was far from being that of the casual amateur following paths of least resistance. His investigations were of such merit, originality, and promise that they had already brought him into contact, personally and by correspondence, with some of the leading astronomers in Britain and on the Continent. Indeed, as early as 1867, when he was only twenty-four years of age, he was elected a Fellow of the Royal Astronomical Society.

In 1872 the door was opened to what was to be to him, ever afterwards, his real life-work: "One fine day in 1872 I received a letter from the Earl of Crawford and Balcarres, offering me charge of the observatory which his son (Lord Lindsay) was about to erect at Dun Echt." Gill accepted the offer, even although it meant for him very heavy pecuniary loss. But the decision was made without any hesitation, and with the full concurrence of his wife, who had implicit faith in him and in his future.

As soon as he could wind up his business he did so, and thenceforward, as long as life lasted, there were no partition walls in his days. He was now wholly devoted to astronomical research.

Pending the completion of the Dun Echt Observatory Gill paid many visits to London and Dublin in connection with the construction of the transit circle and equatorial. He also found time to visit Hamburg, Pulkova, Hanover, and most of the leading European observatories. "In this way," he says in his History of the Cape Observatory, "I made the acquaintance of the leading continental and some of the American astronomers, obtaining at the same time a very complete insight into the working and organization of large observatories."

In 1874 the well-known expedition to Mauritius took place, the object of which was, as far as Lord Lindsay and David Gill were concerned, to determine the distance of the sun from morning and evening observations of the minor planet Juno. The instrument used was the heliometer. Although it became afterwards Gill's favourite instrument, in 1874 he had had very little experience of the use of it. We mention this to exhibit his extraordinary aptitude and skill in the use of the most difficult instruments.

There is some doubt as to whom the credit of the Mauritius expedition is due, but it has always seemed to the writer that, while the pecuniary burden naturally fell on Lord Lindsay, and that the inception of the expedition perhaps was his, the organization, spirit, and success of it belonged entirely to Gill.

Through a number of accidents, adverse winds and calms delaying the arrival of Lord Lindsay's yacht, and clouds and bad weather hindering observations, the programme had to be considerably curtailed. In 1874 Juno was in opposition on November 5th. It was intended that observations should be begun on October 10th, thus giving nearly a month before and a month after the most favourable position of the minor planet But it was not till November 12th, seven days after opposition, that observations were begun, and then only twelve evening and eleven morning positions were obtained.

The quality of the observations, however, and the originality and thoroughness of the mode of reduction, secured a result far away in advance of any previous determination. For all time the question of the sun's distance was lifted from out the uncertainties of science.

Gill's Mauritius determination of the solar parallax gave a value,

$$8{\cdot}77'' \pm 0{\cdot}04''.$$

Besides this important service to science, the expedition also determined, by chronometer comparisons, the longitude of various points along the East Coast of Africa, thus ultimately linking up Greenwich with Cape Town. The chain of stations used in this determination was Greenwich—Berlin—Malta—Alexandria—Suez—Aden—Durban—Port Elizabeth—Cape Observatory, and the resulting difference in longitude between Greenwich and the Cape Observatory,

1h. 13m. 54·70s.;

a value only 0·07s. removed from a more refined and less circuitous determination made in 1908, thirty years later.

During his journey home Gill, at the request of the Egyptian Government, spent some months in Egypt measuring a base line there. This was his first introduction to geodetic work, but one reading the account of the investigation would utterly fail to discover a trace of immaturity in the mode of approach adopted, or a shadow of uncertainty in the conclusions arrived at.

Gill all through his life was drawn towards work of this character, for, though he held Herschel before him as a model to follow, his mind always gravitated towards the more refined branches of observational astronomy. He was in intellectual outlook rather the disciple of Gauss and Bessel and Struve than of Herschel and Bond. He had in any research depending largely upon the uttermost accuracy of instrumental adjustments an inspired insight into the best methods to be adopted in order to arrive at a satisfactory result; and when once his mind was quite clear as to the way he should go, he went.

The success of the Mauritius expedition made him eager to attempt again the problem of the sun's distance.

In 1877 there occurred a very favourable opposition of the planet Mars. On September 5th of that year Mars came within 34,000,000 miles of the earth, and thus there was afforded an exceptional opportunity of securing an accurate value of the sun's distance. There was considerable difficulty in obtaining the necessary funds for the expedition, and when this was arranged its prospects were nearly ruined by an accident to the heliometer.

The instrument was set up in the rooms of the Royal Astronomical Society, in order that it might be thoroughly tested. Through the insufficiency of one of the holding screws, one day the whole instrument tilted over, coming down on its eye-end, which was driven right through the floor by the force of the fall. Tradition still points to the place where the accident happened. Fortunately the damage was far less than what the horror-struck astronomer expected. Gill relates that for a few minutes he was afraid to touch the instrument, afraid to look at its bent and broken adjustments.

In ten days competent instrument-makers repaired the mountings, and soon Gill was on his way to Ascension to carry out an investigation which will ever remain a classic in astronomical endeavour. There will no doubt be more accurate determinations of the sun's distance—Gill's own later researches gave more reliable results: there will certainly be more elaborate and more highly organized investigations in the field of stellar parallaxes; but as the single achievement of one man, as a complete and admirably reasoned investigation, in which every possible avenue of error was guarded, and every line of weakness strengthened, the Ascension determination of the sun's distance stands unique and unchallenged.

His results were at once accepted by the scientific world as the last word on the vexed question of the sun's distance. The boldness and originality of his methods of observation, as well as the clearness and fearlessness of his convictions and conclusions, marked him straightway for place and distinction. The gold medal of the Royal Astronomical Society, its highest award, was bestowed upon him soon after his return, and his name became a common note in the astronomical world. He was then only thirty-four years of age.

The value deduced by Gill for the sun's parallax was

$$8{\cdot}78'' \pm 0{\cdot}01'',$$

an amount but little different from that determined at Mauritius. But this correspondence is a good deal fortuitous, as the accuracy of the Ascension results has more than three times the weight of that deduced from the Mauritius observations.

It was almost thirty years before this value was improved upon, and then again by Gill himself. But although ten years passed before another determination was entered upon the conditions and essentials of the investigation never departed from Gill's mind; and this is fortunate, for when again he took up the problem it was with a mind tried, prepared, and suitably competent to deal with it.

On his return from Ascension Gill settled down in London, happy in his home, in the society of his many scientific friends, and in the occupation of producing work that he knew to be valuable and abiding.

In 1878 his father died, and while in Aberdeen seeing after the affairs of his father's estate news reached him of the death of Main, Radcliffe observer at Oxford. Gill, who by this time had severed his connection with Dun Echt, at once applied for the post, but was told that it had been given to Stone, then Her Majesty's Astronomer at the Cape. Stone succeeded Maclear in 1870, but the appointment for the Cape was not the happiest possible. Stone had little organizing power, and his indifferent health stood in the way of his success as an observer. What we owe to him, and what no other man could probably do so well, was the reduction of the great bulk of Maclear's observations, and the Cape 1880 Catalogue. He was more fitted for a professor's chair than the management and expanding of a great observatory, and, recognizing this, he gladly accepted Oxford when it was offered to him. But as he had not completed all the reductions necessary for the 1880 Catalogue, he asked that his new appointment be allowed to stand over for a time.

When Gill knew of Stone's appointment he put in an application for the Cape vacancy, but was told by the Secretary to the Admiralty that Stone had not yet handed in his resignation, and so his application could not be considered. He was, however, permitted to leave his testimonials, that they might be considered when the vacancy did occur. This Gill knew would be when the 1880 Catalogue was completed.

Gill's commission to the Cape Observatory is dated February 19, 1879. It is fortunate for astronomy that he obtained this appointment and not Oxford, for although he certainly would have adorned any chair of astronomy, it is as a working astronomer, as a great organizer, as a courageous pioneer, as an indefatigable observer, a hard driver of himself and others, that Gill stands head and shoulders above his fellows.

And curiously enough it was a layman—a layman as far as astronomy is concerned—who rightly measured these qualities. When the Cape Observatory fell vacant in 1879, the appointment of astronomer lay in the power of W. H. Smith, then First Lord of the Admiralty. It is well known now that another, and a very strong candidate, was being pushed for the post—pushed by a body of very influential men, and so pushed that Gill's chances seemed somewhat remote. When the final decision came to be made, W. H. Smith unhesitatingly put his hand on Gill's papers, saying, "That's the man for the post."

Gill made use of the period that lay between his appointment and his leaving for the Cape in again visiting the larger observatories of Europe—Paris, Strasburg, Leiden, Groningen, Hamburg, Copenhagen, Helsingfors, Pulkova. He was thus enabled to enter into personal relations with the leading astronomers of that day. This personal note Gill never let pass out of his life. Other astronomers were to him comrades, friends, whom it was a delight to meet, and to whom it was a pleasure to write.

And herein lay much of the secret of his personal success. Notwithstanding the magnitude of his undertakings and the constant spaciousness of his thoughts, he was profoundly human. Life to him was a joyous thing, not only because of the opportunities it gave of advancing knowledge, but because of the friendships that went to make it rich, and the affections that made it beautiful. Among his last words were: "I would so like to live a little longer"—and the thought was born of the nearness of those who loved him.

At the observatories which he visited, as well as at the universities, Gill met a number of young students who in after-days rose to distinguished positions, men who have given tokens of their genius to the annals of astronomy. These men Gill bound to him by indissoluble ties.

Gill and his wife sailed for the Cape on May 2, 1879, in the *Taymouth Castle*, commanded by Captain Robinson. They arrived at the Cape on May 26th, and were met by Mr. Stone, who left the next day for England.

Gill has often spoken to me of his first impressions of the Cape, of the imperishable memory the serene beauty of the day, of the sky, of the sea, of the mountains enriched him with. He was aye a lover of beautiful things, a beautiful home, beautiful surroundings; and the serene, stately beauty of the Cape Peninsula appealed to him from the first day his eyes lighted on it. Africa woo'd him, as it has woo'd and won many another, and he never faltered in his allegiance to her conquest, just as he never lost faith in her future. He was, during all the days he spent in this land, a loyal South African.

It is difficult to realize what the observatory was like thirty-six years ago. The writer remembers it in the late 'eighties, but by that time Gill had redeemed it from dreariness and desolation. Also by that time there were signs of a growing suburb round the then countryside railway station.

When Gill arrived the grounds were a wilderness and the instruments out of date. The comforts of life were meagre and cheerless, and Cape Town seemed a long way off. Under Stone's management of the Cape Observatory no additions were made to the instrumental equipment, no improvements to the buildings or to the amenities of the observatory and its surroundings. Only a rough track, impassable in wet weather, led from the station to the observatory. Within the broken-down entrance gate, the main avenue was a footpath through a tangle of weeds. A few trees planted by Lady Maclear made the general desolation even more marked.

Then the small equipment at the disposal of Gill's predecessors, Henderson, Maclear, and Stone, was in a state of wretched repair. The micrometer screws of the transit circle were worn and affected by serious errors; pivot wheels rusted on their bearings; the non-reversibility of the instrument made it unreliable for fundamental observations. If any one will take the trouble to chart down the residuals (O–M) of any of the stars observed by Maclear during the greater part of the year, they will have abundant testimony to the faultiness of this standard instrument. After due allowance is made for latitude variation, change in level due to seasonal causes, and other known modifications, there still remain certain discordances which only faulty readings can explain. That Henderson, Maclear, and Stone should have been able to secure such a mass of reliable and valuable observations is due to their skill as observers or reducers.

No sooner did Gill enter upon his office than he set himself to raise the character and improve the equipment of the observatory. He is reported to have said that he would not rest until he had brought it into the first rank of observatories. His first endeavour was to improve his surroundings. With this end in view he invited Sir

Frederick Richards, then Commander-in-chief at Simon's Bay, and in a way Gill's superior officer, to visit the place and see it for himself. This Sir Frederick Richards did, and the result of his visit was that a company of Kroomen were appointed to keep the grounds in order. Within a few years the policies round the observatory became a veritable garden, a place where it was a delight to wander hither and thither.

As regards the poor instrumental equipment of the observatory, Gill had greater difficulties and opposition to overcome before he got things anyway near what he wished.

Failing, in the meantime, new instruments or such additional contrivances as would make the old instruments more dependable, he set himself to examine and discover their defects. There is a tale told of Bessel that when one of his assistants complained of the imperfections of the meridian circle he was using, he answered that the true astronomer was the man who could make use of a cart-wheel after a thorough inquiry into its errors. It was a maxim of Gill's that it was possible to make any instrument almost perfect by diligently ascertaining all its sources and possibilities of error, but that the finest instrument in the hands of an indifferent observer was little better than the worst. This opinion was not simply a doctrine with him. He carried it into rigorous practice, and one of the reasons why he achieved such trustworthy and accordant results with the small 4-inch heliometer is that he spent months in measuring the runs of its screws, the divisions of its circles, ts action in varying states of atmospheric conditions, till at last he knew how and when and why it departed from the behaviour of an ideal instrument, perfect as regards screws and circles and bearings.

In seeking to improve the instrumental equipment of his observatory, Gill found that one of his most worrying difficulties was the relation of the Cape Observatory to Greenwich. Through some understanding, or misunderstanding, the Admiralty insisted that all alterations or additions to instruments at the Cape should first have to be submitted to the Astronomer Royal at Greenwich.

With all his magnificent qualities Airy, like most other great men, had the imperfections of his virtues in a marked degree. He was doggedly, unreasonably conservative, and especially so in his old age. When, therefore, Gill approached the Admiralty with such reasonable requests as that a new reversible transit circle was much needed, and that the 7-inch equatorial was in such a wobbly, defective state that as an instrument, "It is nearly useless for any kind of refined micrometric work," and therefore must be replaced by a larger instrument, his application was at first set aside. Greenwich had a non-reversible transit circle, and what was good enough for Greenwich was good enough for the Cape. It is strange that a mind so acute as Airy's did not perceive, as Gill did, that a new day was dawning in astronomical progress.

From the very first Gill entered distinctly and unmistakably into the social life of the land. No doubt his comparative wealth enabled him to do this with an easier mind, and a more lavish hand, than any of his predecessors. But his own striking personality and the grace and dignity of his wife, were the greatest factors in the position he took, and held, from the beginning of his career in South Africa.

He was the honoured friend of all the Governors of his day as well as of the leading statesmen and churchmen. Notable visitors to South Africa rarely left the country without a visit to the observatory. As already indicated, his hospitality was unbounded, and it had this striking merit—that it included within its kindly harbour the student and the *savant*, the unknown and the celebrated. Underneath his roof might be found at one and the same time a scientist of world-wide fame and some young student just entering on his career, an instrument-maker with a European reputation and a humble surveyor whose desire it was to have but ten minutes' conversation with the head of the South African Geodetic Survey.

It is of more than passing interest for us in this Society to remember that one of the first things Gill did on his arrival in this land was to associate himself most intimately with the aims and labours of the old Philosophical Society. This he did, in the first instance, at the request of Sir Bartle Frere, but afterwards because of his own personal interest in everything that made for the intellectual well-being of his fellow-citizens. He was for many years president of the Society, and his papers and addresses make good and profitable reading.

It would take too long to tell the whole story of how, slowly but surely, Gill built up a new observatory, how he raised it to the very first rank among such institutions, how he gave to it its present wide outlook, how he equipped it so that it might deal efficiently with most of the activities that the new astronomy had created. We can only briefly refer to the salient facts in the revolution which Gill, in twenty-seven years of unremitting thought and toil, accomplished.

When Gill retired in 1907 the observatory had changed out of all knowing both with regard to its equipment, the range of its activities, and the character and quality of its work. Scattered over the well-kept grounds were nearly a dozen separate buildings almost all built during his tenure of office. These housed the 6-inch refractor, the 7-inch heliometer, the astrographic telescope, the reversible transit circle, the 3-foot altazimuth, the Zenith telescope, and the various measuring machines or other apparatus connected with the great star map.

In 1879 the whole staff of the observatory consisted of eight persons, including the director. In 1907 there were, besides the director, a staff of thirty-two persons, of whom twelve were ladies. This in some degree indicates the growth of the Cape Observatory during Gill's management of it. It is, however, when we consider the range of work undertaken, and brought to completion, during this period that we obtain a reasonable judgment of the advance made. No doubt, in the realm of science a man's achievement must to a very large extent be limited by his instrumental equipment, and very probably Gill's predecessors, Fallows, Henderson, Maclear, and Stone, had to make their ambitions keep step with the practical possibilities the Cape Observatory afforded in their day. That these men were able to accomplish what they did in the direction of advancing fundamental astronomy is indeed greatly to their credit. With imperfect instruments Henderson was able to winnow from out his meridian observations of Alpha Centauri a parallax for that star: this important determination was again certified to by Maclear. The latter astronomer also was able to determine with considerable accuracy the parallax of the moon, and in geodetic work he contributed to our knowledge by verifying Lacaille's arc of meridian.

But these were isolated ventures: brief departures from the routine work necessitated by a limited staff and poor instruments. The early Cape astronomers would fain travel far, but could not, and no one can read the tale of how Fallows and Henderson, Maclear and Stone chafed under the yoke of circumstance without feeling a great respect for their capacity and determination, as also a deep regret for their many disappointments.

Yet one would have welcomed at times a more combative spirit: had they chafed less and worried others more, the history of the Cape Observatory during its earlier years would have been different. David Gill had woven into the very fibre of his soul the true Scotch pertinacity and pugnaciousness. When he lacked equipment he rested not day nor night till he got it. His love for science made him bold, or importunate, or winning in dealing with those who could aid it. He had, moreover, the power of being able to pass on his enthusiasm to others, to infect them with his own buoyant optimism.

His tireless energies also kept things moving; kept his observatory constantly before the thoughts of men. He never let his workers or his world rest. No sooner was one great labour complete, some herculean task finished, than forthwith he took up another. And in this way an impression of efficiency was created which greatly helped his claims and appeals for support.

Gill had in a marked degree the power of rapid and sustained concentration. Forthwith he brought every faculty to bear on the new inquiry. It was not a gradual moving along a twilight road, groping his way as he went; he seemed to plunge into the very centre of the region of investigation.

His outward actions were an index of this quality of mind. Those of us who knew him well will remember his quick, swift movements, his rapid speech—words tumbling over one another, his habit of switching the conversation suddenly from one topic to another, his intense absorption in any matter that interested him, his study table piled high and running over with books, charts, tables, papers, and parts of instruments.

These were only some of the countless ways in which his intensity of mind, his impatient patience, revealed itself.

Gill's work at the Cape embraces four outstanding investigations, and three or four lesser activities.

The first four are: a series of determinations of stellar parallax; an exhaustive determination of the sun's parallax; a complete geodetic survey of South Africa; a photographic durchmusterung of southern stars brighter than the tenth magnitude.

Less laborious, though perhaps not much less important investigations, are the mass and parallax of the moon; the mass of Jupiter; the position of close circumpolar stars; an inquiry into the influence of brightness upon transits.

Besides these distinctive operations there was the constant supervision of the routine service of a large observatory—time determinations; astrophysical work on the spectra of stars; latitude and longitude determinations; variation of latitude; the constant of aberration; fluctuations in level due to tidal pressure or seasonal changes; regular meteorological work.

Of the four outstanding investigations, the triangulation of South Africa and the determination of the length of the longest possible arc of meridian, might be considered as one of the most necessary inquiries to which a public observatory could devote itself. It was not only a work of national importance, but it was also one of great scientific value, as it afforded data for a determination of the earth's figure.

It was an investigation which very early in his South African career interested Gill, and to which he devoted some of the best years of his life, undertaking long journeys almost into the very heart of Africa, spending hours and much energy—no small part of it in curbing impatient speech—in interviewing ministers and officers of state in order to secure the necessary funds and surveyors to carry on the work, and finally wading through interminable figures and drawings so that there might be co-ordination and unity in the vast undertaking.

The work was set in motion in 1883, and when Gill left the Cape in 1906 he had the satisfaction of knowing that every part of South Africa was triangulated with a completeness and an accuracy unsurpassed in any similar undertaking, that the chain of triangles ran right up to Tanganyika, thus giving a measured arc of meridian longer than on any other part of the earth's surface. Even had he accomplished nothing more than this sub-continental survey he would have done that which most men would consider notable and worthy of honour, yet it was carried out in a kind of "in-between" work, as a recreation from the more exacting toil of space-gauging and star-charting.

When the part of Africa lying between Tanganyika and Upper Egypt is surveyed, we shall then know, with some approach to absolute accuracy, the length of an arc of meridian stretching from the Cape to Spitzbergen, that is through 110 degrees of latitude.

The problem of stellar parallax very early interested Gill. Even in his Aberdeen days he hoped to obtain some results in this direction with his 12-inch reflector, but of course the instrument could not respond to such a demand upon its accuracy.

The success of his Mauritius and Ascension expeditions assured him that with a heliometer of larger size and superior construction it would be possible to determine differential parallax values within a margin of 0·02 seconds of arc.

In 1884 he ordered from Repsold, of Hamburg, a new instrument of 7 inches aperture. This heliometer was designed for a redetermination of the sun's distance, and incidentally for determinations of stellar parallax. The instrument was completed and erected in 1887, and after the usual trials with it—testing its action, evaluating its errors—it was brought into regular use in 1888.

In his researches on stellar parallax Gill was assisted first by Dr. Elkin and later on by Dr. de Sitter. Between them they determined the parallax of 22 stars with an accuracy never before attained. Gill took upon his own shoulders the major part of the observations, and his classic memoir on the parallax of Alpha Centauri and Sirius must ever remain an example of resolution, skill, and lucidity to all succeeding investigators in this difficult and exacting branch of astronomical research.

His determinations, united to those of certain other astronomers in the Northern Hemisphere, afforded a theoretical value for the mean distance of first magnitude stars, a constant which enters very largely into the present-day investigations with regard to the structure and great cosmic movements of the stellar universe. If we assume that the stars are uniformly distributed through space, and that their brightness and size also follow this general law of distribution, then there exists a very simple relation between the number of the stars, their brightness, and their distance.

It is difficult to say what astronomer first cast doubts on the view of a uniform law of distribution; but this much we do know—that from the moment Gill found that such stars as Canopus and Beta Centauri had practically no parallax—that is, they were at an infinite distance—he was assured in his own mind that a general uniformity was not the order of space. This, however, did not hinder or obscure the carrying out of his scheme of parallax determinations, for he knew that when this theory and that would be urged in explanation of the structure and movements of the universe of stars, they would have to be tested finally by definite parallax and proper motion results.

The data that he secured in this direction have proved of great value in the investigations of star streaming instituted by Kapteyn and carried on by Eddington, Dyson, Swarzchild, and Boss.

It is, however, with the problem of the sun's distance, the third of the four great investigations carried on at the Cape, that Gill's name is so commonly and so intimately associated.

We have already referred to his Mauritius and Ascension expeditions, and to the success that crowned his efforts on both occasions. It was to be expected that with his appointment to the Cape, and with the increased facilities which it would afford for astronomical enterprise, there would be a strengthening of his desire to determine once again the sun's distance. It seems to be a psychological law that no astronomer is ever wholly satisfied with his results, even when they are most dependable. His desire ever is to improve upon them. To the aid of this common inclination came the definite traditions of the Cape Observatory.

One of the objects of Lacaille's visit to the Cape in 1751–1753 was to determine the sun's distance by declination differences of Mars. His determination was accepted by astronomers for the greater part of a century, indeed remained unchallenged till Maclear in 1850, and again in 1862, improved on his value.

When, forty years ago, Gill took up the problem, the uncertainty with regard to the sun's distance was no less than 10,000,000 miles. His first determination, made at Mauritius, reduced the range of uncertainty to within 1,000,000 miles. His Ascension results brought this margin down to 300,000 miles.

Anxious to reduce even this amplitude of error to the narrowest limits possible, in 1883 he organized a concerted and highly complex scheme for improving the value of the solar parallax already obtained. Astronomers, generally, had by this time accepted his differential method as that which held the highest promise of accurate results.

In 1888 an opposition of Iris, and in 1889 oppositions of Victoria and Sappho, furnished him with exceptional opportunities for such a determination. His general plan was to cast behind these minor planets a network of stars, whose positions would be accurately determined by triangulating them together. Against this network the faint stellar discs of the minor planets chosen would be seen to pass, and the amount of displacement of their path, as viewed from different stations in the Northern and Southern Hemispheres, would afford data for a determination of their parallax, and consequently of the sun's distance.

Thus, simply put, was the problem to be solved. But the investigation, even in its preparatory stages, was surrounded by difficulties. This was from the beginning more fully appreciated by Gill than by any other man, and so he allowed no less than five years, 1883 to 1888, in which to consider and make preparations for the proposed scheme.

A new instrument had to be built, for the old 4-inch heliometer had had its day. This new 7-inch heliometer has already been referred to when speaking of Gill's work on stellar parallax. It was begun in 1884 from plans and drawings made by Gill; but it was not completely ready till 1887, when Gill went home to test its accuracy.

While on this errand he attended the Astrographic Congress at Paris, where he was elected, by a large majority, its senior member.

Besides a new instrument, co-operation was needed on the part of other observatories and workers, and it speaks eloquently for the personal esteem in which Gill was held, and the common faith in his genius and skill, that no fewer than twenty-two observatories gave promise of help in the undertaking. One of Germany's leading astronomers, Dr. Auwers, of Berlin, came out to the Cape to assist Gill in taking his observations and making his reductions. So many observatories co-operating necessitated endless correspondence, for men were very anxious to help, and their eagerness made them timorous. This load, no light one, Gill took entirely upon his own shoulders.

The actual and necessary observations of Iris were made in 1888, of Victoria and Sappho in 1889.

As the reduction of the observations proceeded, it was found that the orbital places of the planets were not accurate enough for Gill's purpose. And so their places, from day to day, had to be recomputed, this time by means of 8-figure logarithms, the ordinary 7-figure tables not being refined enough.

The reductions occupied nine years. The large volumes, one of them running to close on 1,000 pages of packed matter, that reveal this final essay to settle the centuries-old problem of the sun's distance will always remain a classic achievement in astronomical science. In these tomes the genius of the man stands out clear and inspiring. We may mark the unerring wisdom, wisdom akin to instinct, in dealing with difficulties, the exquisite skill in securing and in reducing observations, the indomitable patience in combating and rendering innocuous instrumental errors, poor observations, and faulty methods.

Gill's final value of the sun's parallax was

$$8{\cdot}804'' \pm 0{\cdot}005''.$$

The limit of uncertainty was reduced to

30,000 miles.

Surely it is sufficient of honour to have reduced our uncertainty of a fundamental constant from 10,000,000 miles to a quantity three hundred times less! Yet this was only one of this man's many achievements.

Two related and important facts emerged from this consideration of the sun's distance.

The mass of the moon is inseparably bound up in the problem of the solar parallax, inasmuch as the earth circles monthly round the centre of gravity of the earth-moon system. The value of the moon's mass accepted by astronomers prior to 1897, Gill proved to be in error. His equations yielded the relation,

$$E : M :: 81{\cdot}60 : 1.$$

The other matter lay more in the region of physics than in that of astronomy. There was some uncertainty as to the effect that a systematic difference of refrangibility would have on the final result. Gill proved that his heliometer method of determining stellar or solar parallax eliminates the error which otherwise might arise from this source.

Before we pass on to the last and probably greatest of Gill's achievements, his part in the great photographic star map, we may recall the rest of the history of the problem of the sun's distance.

When Gill visited Potsdam in 1891, Vogel showed him some remarkable photographs of stellar spectra that he had taken. On examining them under a powerful microscope, Gill exclaimed, "Why, here is a fine method of determining the solar parallax."

Later on in the same year he gave a short account of his visit to Potsdam to the Royal Astronomical Society, stating how impressed he was with the accuracy of the spectrographic measurements secured there, and urging that a determination of the sun's distance should be attempted by this new and promising method.

As is well known, when spectrographic measurements of stars are taken, to reduce these measurements to absolute radial velocities a correction has to be applied for the earth's orbital movement. Until very recently the margin of error in spectrographic determinations was so great that to reverse the operation and determine the earth's velocity, and consequently its distance from the sun, from the spectrograms was utterly futile. But with the great advance made in spectrography during the past ten years, Gill's hope became possible of realization.

There is something very fitting in the fact that it was at the Cape, and with the McClean telescope, on the perfecting of which Gill spent so much time and thought, that a definite spectrographic determination of the sun's parallax should be made.

In 1908 Dr. Halm, from a series of spectrograms, derived a value of the solar parallax,

$$8{\cdot}804'' \pm 0{\cdot}004''.$$

When the minor planet Eros was discovered, Gill saw its importance as a stepping-stone to the sun's distance. He accordingly urged that a similar combined effort to that made in 1888 and 1889 should be undertaken at the planet's opposition during 1900 and 1901. This was done, and the observations were discussed by Hinks, of Cambridge, who obtained as the mean value of the sun's parallax,

$$8{\cdot}807'' \pm 0{\cdot}002''.$$

Although many astronomers would consider the determination of the sun's distance, and the improvements he effected in securing and reducing observations, as among Gill's most notable achievements, it is on his inception and furtherance of the great photographic star map that his fame depends with most men.

His mind was early drawn to the importance of photography as an auxiliary to astronomical research, and although the peculiar circumstances of his career compelled his thoughts to run in the direction of refined instrumental work, the possibility of one day using photography in depicting charting and defining the heavenly bodies never passed from his outlook. And thus there is nothing fortuitous in his discovery in 1882 that it was possible to photograph the stars. Accident has little part in the life of a man like Gill. Yet there is always something dramatic about the advent of an epoch, be it historical or scientific. Suddenly, through some unexpected circumstance, we are hustled out of the old toilsome road, out into the newer and better way along which we may travel with greater ease and rapidity. The appearance of the southern great comet of 1882 was the circumstance that ushered in stellar photography. But again, we aver, that Gill's mind was unconsciously prepared for the epoch-making change that the new discovery brought about.

The comet was first seen by Finlay on September 8th. Early in October tidings reached Gill that the comet had been successfully photographed by several people, the modern dry plate making possible what the wet plate could not.

There being no suitable photographic lens at the Cape Observatory, and no one of the staff competently acquainted with the more recent methods of developing dry plates, Gill called to his aid Mr. Allis, of Mowbray, who at once entered most heartily into the enterprise.

A camera with doublet of 2½-inch aperture and 11-inch focal length, was mounted on to the declination counterpoise of the 6-inch equatorial.

Six photographs were taken—October 19th, October 20th, October 21st, November 7th, November 13th, November 14th.

Prints of these are before me as I write, and when one compares this first impoverished venture with the magnificent pictures of the sky now turned out nightly at every standard observatory, one is stirred at the thought of the clear vision and great faith of David Gill as he looked upon the little print, $3\frac{1}{2}$ inches by 2, and saw in it the promise of a great future. In the first photograph, that of October 19th, the comet was followed, and the stars were left to trail, Gill's desire being to obtain a picture of the comet. In the second photograph, that of October 20th, the comet was left to trail : a single circumstance had changed his whole outlook. His desire now was to obtain pictures of stars.

In the succeeding star photographs, November 7th and November 14th, he increased the exposure from one hour to one and a half hours, and finally to two hours, obtaining on his last picture ten times as many stars as he did on the first.

The writer has, as one of his most cherished possessions, the first rough draft of the letter Gill sent home telling of his success, and urging the employment of photography in securing and defining star places and magnitudes. The letter reads :—

"These photographs appear to have a far-reaching interest from the fact that notwithstanding the small optical power of the instrument with which they were obtained, they show so many stars, and these so well defined over so large an area as to suggest the practicability of employing similar but more powerful means for the construction of star maps on any required scale and to any required order of magnitude."

The original six plates are now in the possession of the Royal Astronomical Society, and the small lens with which they were taken in that of the Royal Observatory at Cape Town.

In November of the same year Gill wrote to Dallemeyer requesting him to send a lens suitable for photographic work. In reply there was sent out to the Cape a rapid rectilinear lens of 6 inches aperture and 54 inches focal length.

At the same time also he sent a paper expressing his views on astrographic photography to Admiral Mouchez, director of the Paris Observatory, for presentation to the French Academy of Sciences. So strongly did Gill's letters, papers, and drawings impress Mouchez with the possibilities of stellar photography, that he urged the brothers Henry to devote their whole energies to the new mode of research. This they did, with what brilliant success we all know.

In 1884 Gill went home to England, and while there he did his best to further the idea of a Southern Photographic Durchmusterung.

The Royal Society placed an annual grant of £300 at his disposal, and with this sum the services of a competent photographic assistant was secured. Then he had the rare good fortune to open correspondence with Professor Kapteyn, of Groningen, who, with a fine unselfishness, offered to carry out all the necessary reductions for position and magnitude from the photographic plates.

Kapteyn's letter to Gill will bear repetition :—

"I have talked the matter of the Photographic Durchmusterung over with Dr. Bakhuyzen and his brother. I am bound to confess that they were not very enthusiastic about the matter ; of course, they thought the results once reached of immense value, but the drudgery to be gone through before these results are once got into the form of a Catalogue almost unbearable. However, I think my enthusiasm for the matter will be equal to six or seven years of work."

This was in December, 1885. In 1899 Kapteyn wrote :—

"The Cape Photographic Durchmusterung may at last be considered complete. The work has cost nearly double the time, the six or seven years, which I originally estimated would be required."

We may fittingly say here that the carrying out of this magnificent sidereal survey occupied from first to last fifteen years—years of unremitting labour, as the task meant the examination again, again, and yet again, of nearly half a million stars.

Then there were times when difficulties external to the actual work of reducing seemed to threaten the whole enterprise. It must have been vexatious to Gill to find that his own restricted proposals were in definite danger from his larger proposals for a comprehensive star map of the whole sky.

It may be of interest to state what the difficulties were. Work for the Cape Photometric Durchmusterung was begun on April 2, 1885, and so convinced was Gill of the value of this new method of recording the position and magnitude of stars, that he urged Admiral Mouchez to convene a congress of astronomers to consider how best to secure by photography a great catalogue of stars. It was evident that transit or meridian observations could never overtake a fraction of the work that photography could fulfil with ease. A single photograph might contain more stars than the most competent observer could measure and fix in a lifetime.

It was in 1887 that this first International Astrophotographic Congress was held. To it there came from all parts of the world no fewer than sixty leading astronomers. Gill was the guiding spirit of all the meetings, and before the Congress broke up it was agreed to begin at once a vast star map of the sky. Twenty observatories promised to co-operate in the undertaking, an undertaking which, when completed, will mean the cataloguing of over ten million stars.

Over a quarter of a century has now passed since the inception of the undertaking, and the work is not yet half done. When it is finished it will prove of inestimable value to astronomers, not only as giving them an exact picture of the sky as we see it now, but also affording material for an exhaustive consideration of those great cosmic problems that are arising, clamant, for settlement: it will also remain an abiding monument to the genius of the man who first realized its possibility and inspired its progress.

But as we have said, the larger scheme nearly wrecked the lesser.

The Royal Society, in view of the fact that a photographic survey of the whole sky was in contemplation, refused to continue their grant for a survey of a portion only. They considered that there was no need for a more restricted Durchmusterung. A few prominent astronomers also thought that the lesser survey, if successful, might prejudice the greater. In vain Gill pointed out that they would all be dead before the great star map was finished; that his southern survey was for immediate use; that there was a great need for a catalogue of stars down to the tenth magnitude.

The grant was withdrawn, and for many years Gill had to support the enterprise from his own private resources. The result was that in extent and in quality it was to some extent curtailed.

The complete Durchmusterung was published in three large volumes, and in 1902 the Royal Astronomical Society marked its high appreciation of the value of Kapteyn's splendid work by awarding to him its gold medal.

Of his self-sacrificing labours Gill says:—

"Probably the most valuable result of the Cape Photometric Durchmusterung to science is the fact that its preparation first directed Kapteyn's mind to the study of the problems of cosmical astronomy, and thus led him to the brilliant researches and discoveries with which his name is now and ever will be associated."

We would make but one slight alteration to this worthy tribute: we would couple Gill's name with Kapteyn's.

We have considered the salient matters that made up Gill's life at the Cape out of their chronological order, as his disposition was to keep two or three enterprises going at one and the same time. This change of mental position seemed to afford him a kind of relief.

The enterprises of secondary importance, if one may be allowed to make such a distinction, that occupied his attention were so numerous that one, in a brief memoir, must only select those that were typical of his mental attitude and his observational skill.

An investigation that interested him early was a determination of the mass of Jupiter, and of the orbital elements of its older satellites. As far back as 1879 Professor J. C. Adams urged him to secure observations which would lead to a more perfect knowledge of these values than they were then in possession of. It was not, however, till 1891 that Gill found himself free enough to take up the work. When he did he adopted a rather singular method of securing the necessary data. Instead of measuring the distance from, and relative angle of the moons to their primary, he determined the co-ordinates of the satellites relative to one another. This method had only once before been adopted, by H. Struve in his classical investigations on the satellites of Saturn, and then with great success. The 1891 observations were mainly by Gill: his first assistant, Finlay, contributed about one-fourth of the measures

In 1901 and 1902 similar determinations were made by Bryan Cookson under the direct supervision of Gill. To guard against systematic error in the heliometer readings—the instrument with which all the observations were made—vitiating the final results, in 1902 a series of photographic exposures of Jupiter and his satellites were taken.

The value of Jupiter's mass which emerged from a consideration of all the observations was

$$J : S :: 1 : 1047{\cdot}40,$$

a value almost identical with that found by Newcomb from a discussion of all available data.

Another investigation which was crowded in into comparatively empty hours was a determination of the distance of the moon. Earlier South African observers had approached the problem. Lacaille found a parallax of 3424·6″; Henderson, 3422·5″; Stone, 3422·7″. Gill's contribution to the investigation was to state clearly the relation which existed between the interdependent values—the ellipticity of the earth; the mass of the moon; the moon's mean motion—and to evaluate constants for the future securing of the osculating quantities. And in this we have a distinctive exhibition of his width of mental view. He never considered a problem from some limiting outlook: his view of it was always comprehensive, and as far as human judgment could go his consideration of it was usually final.

Among other investigations which interested him was the determination of the aberration constant, that is the ratio of the velocity of the earth in its orbit to the velocity of light. The lack of agreement between two distinct classes of determinations worried him considerably.

From 1892 to 1894 he instituted a series of observations with the Zenith telescope which gave as a value of the aberration constant,

$$20{\cdot}47''.$$

Gill's mind was peculiarly receptive to new impressions and new ideas. Thus when twenty to thirty years ago the labours of Huggins, Vogel, Belopolsky, and Pickering opened up an entirely new world of discovery, it was a profound regret to him that his equipment at the Cape Observatory hindered his taking an active, if not leading, part in the new enterprise.

In 1894, however, the offer of a magnificent 24-inch photographic refracting telescope, with all the necessary spectroscopic mountings, on the part of Frank McClean, Tunbridge Wells, opened up the way to astrophysical research at the Cape.

Towards the close of 1898 the telescope, with the whole of the essentials of the observatory, was in full working order, but it was not till 1901 that work was begun, owing to certain corrections which had to be made in the object-glass. From this year to the close of 1906 it was constantly used, under the direction of Gill, to determine the spectra of stars, of rare metals, as well as motion in the line of sight.

In the fitting up of this astrophysical telescope Gill took the keenest interest. It absorbed his whole energies for some years. At its erection he was mason, joiner, engineer, and handy man.

We have to leave many of his other interesting activities unrelated except in name—his detection and definition of the relation of brightness to transits, his determination of circum-polar places, his interest in the magnetic survey of South Africa, his inquiry into the diurnal range of temperature as affected by thermometer screens, an examination of the spectrum of Eta Argus, besides a constant inquiry into instrumental adjustments, on the wear of screws, on the simplification of clock machinery, on the housing of telescopes.

This enumeration alone will indicate, in some measure, the range of his mind and the scope of his energies.

Gill's tenure of office at the Cape Observatory was rounded off by two most interesting visits from astronomers and scientists outside the Colony. In 1882 there occurred the Transit of Venus, and this brought a number of well-known observers to South Africa. Among them was Simon Newcomb, the most notable of American astronomers and mathematicians. Between him and Gill a deep friendship sprang up, which continued unbroken and unshadowed till Newcomb's death. This friendship had a definite influence on both men. It made Newcomb more practical in his thoughts and undertakings; it made Gill, if possible, more severe and exhaustive in his consideration of the theoretical aspects of an investigation.

At Newcomb's request, first conveyed by letter in 1879, Gill undertook a series of observations of lunar occultations in order to obtain more accurate constants for the lunar theory. Between the years 1881–1906 no fewer than 1946 occultations were secured.

The other interesting visit was that of the British Association in 1905, one year before Gill's retirement. Perhaps to Gill the brightest circumstance in this visit was that it brought Kapteyn to the Cape. It was at this meeting of the British Association that the celebrated Dutch astronomer first announced his great discovery of star streaming in space. Some of us can remember well the small room in the municipal buildings, Cape Town, the scanty audience, the quiet speaker, the momentous announcement.

The visit was shadowed for Gill by the death of his lifelong friend, Sir William Wharton. He became suddenly ill on his way down from the Victoria Falls. He was taken to the observatory, but typhoid fever supervened on pneumonia, and he passed away after a brief illness, "to my inexpressible grief."

Wharton's death and the anxiety and worry consequent on being responsible for the success of the Association meetings affected Gill's health at this time. A great organizer he suffered like many another outstanding man from the serious weakness of keeping all details of work in his own hands. He would grow impatient of offers of help, and however much one was distressed to find him toiling away at petty tasks a clerk would do nearly as well, it was useless trying to come to his rescue. If you wish a thing rightly done, do it yourself! was a hard taskmaster for him in his, physically, less active days.

Towards the close of 1905 Gill's health began to fail, and in the early part of 1906 it had become a matter of great concern to his friends. Twice he had fainted without any apparent cause. The strenous work of many years, "laborious days, and toilsome nights," had undermined a constitution of exceptional vigour and vitality.

His medical advisers strongly urged that he should retire from active service at once and spend the rest of his days in a more bracing climate. And so, to the profound regret of all sections of the community, and most of all to his colleagues, whom his character and his kindness had bound to him by ties of unchanging affection and reverence, in October, 1906, he left the land he had served so royally for the space of twenty-seven years.

On his arrival in England he at once entered into the active scientific life of the home-land. He served as President of the British Association for the year 1907, the meeting taking place at Leicester. His address on that occasion was considered as a remarkable exposition of our scientific and astronomical position. He was president also of the Royal Astronomical Society during the year 1909–1910, and on the death of Sir William Huggins he was elected Foreign Secretary of the Royal Society.

He took a deep interest in all these and similar societies and associations for the furtherance of science, giving his services ungrudgingly in their interest.

He frequently visited the various continental capitals, or university towns, either as an honoured member of their learned societies or as a delegate of some international congress. He was the senior and most influential member of the Astrographic Convention; he was the British representative on the International Geodetic Association; he served on the International Bureau of Weights and Measures, and on the resignation of Lord Cromer he was elected President of the Research Defence Society.

The seven years of his relief from work were very happy years. He had taken up house in De Vere Gardens, and there the soul-deep, old-fashioned gracious hospitality so manifested itself that his home became the resting-place for folk kin to him in thought and purpose.

He found time also to write, and many articles of his, during these evening years, are scattered over the principal English, French, and German magazines. He wrote and spoke French with ease, and not a few of his more important contributions are in this language.

Though removed from intimate participation in the many developments of observational work, as far as he possibly could he kept himself in touch with all the activities of the day, either by letter or by conversation, mainly the former, and his letters always had a winsomeness, a charm, an inspiring heartiness that few letters possess. Some of us cannot reveal how his letters have helped us through the years.

And the passage of the days, as they moved on to the dusk of evening-time, did not dull his capacity to understand or his willingness to aid. He was as mentally alert at the close of his life, as responsive to the newer movements and methods of science as when he was a young man at the opening time of his brilliant and fruitful career.

For the most part, throughout this monograph, we have spoken of him as a great creative astronomer. But he was more than a mere observer. He had in no mean measure literary power and grace.

He always wrote lucidly, simply, and with dignity. There was no mistaking what he meant. He had, like all great thinkers, the faculty of using words sparingly, but ever fittingly and correctly. In all his works this is evident, but most of all in his last production, a "History of the Cape Observatory." There is something very characteristic in this big volume. It is indeed an epitome of the history and expression of his life. The breadth of view is there, the accurate consideration of data is there, the consummate knowledge of instruments is there, also most marvellous skill in drawing and draughtsmanship.

It was issued from the press in the middle of 1913, and very soon after Gill sought refuge in Scotland with old friends. Here he enjoyed a pleasant holiday, but the strain of producing a work so comprehensive and so laborious—a literary survey, a mathematical work, a treatise on instruments—must have weakened him considerably, and made the entrance of disease a very easy matter.

Towards the close of the year he suffered frequently from colds, but his friends were not unduly alarmed.

On Monday, December 11th, at the close of the day, he complained of deafness, and he seemed worried about it. However, next day he was able to go to the usual monthly meeting of the Royal Astronomical Society. It was at this meeting that he handed over to the Society the photograph of the moon which he had given to Sir W. Huggins in 1868, nearly half a century agone. Of the notable galaxy of astronomers who had made that day great, Airy, Hind, Huggins, Main, Stone, Adams, he alone was left, the last of the Romans. And he too, unconsciously, in his handing over for posterity the first-fruits of his long and full life, was bidding goodbye to the field that by his service he had adorned.

When he went home from the meeting of the Royal Astronomical Society he again complained of great deafness, stating that he had considerable difficulty in hearing what was said at the meeting. Next day he went to see his doctor, who attended to his ears, after which he seemed to hear better, but in the evening he was very heavy and dull, an unusual thing for him. On Sunday, December 14th, he took a short walk with Lady Gill in the Park, but returned sooner than usual as he complained of being tired. He remained indoors all the rest of the day, thus setting aside an invariable custom of his life in London of putting in an appearance at the Albert Hall Sunday afternoon concerts. He remained in the house the morning of the 15th, writing for the most part at his desk. After dinner he had a slight shivering fit which was thought to be simply influenza, but next morning Sir Lauder Brunton pronounced it to be double pneumonia.

For six weeks Sir David Gill struggled with the disease. At times it was thought that he would recover, but towards the end the heart became affected and the case was considered hopeless.

He died on the morning of January 24th almost conscious to the last.

He lies buried in the God's acre of his folk in Aberdeenshire : his memory is the heritage of the ages.

When the news of his death reached South Africa there was widespread evidence of profound regret, for although he had been gone for years from the country, yet the influence of his personality and the memory of his achievements were still unlessened and unshadowed. He had filled so large a place in the scientific life of the land that the flight of the years only seemed to accentuate the unique position he had held.

It is probable that the transition period in which Gill lived and worked may have afforded place for the discharge of his manifold and outstanding gifts. But in any age he would have been great. He possessed in no uncertain measure that creative faculty which makes an epoch and a science the servant of the man. Naturally such men come in groups, and so round Gill and of his day, and manner of thought, were Gould and Newcomb, Huggins and Darwin.

Distinctive as was the special piece of research of each of these pioneers, their outlook was ever comprehensive enough to lift their thoughts out of the narrower region in which they worked, out to where the whole area of astronomical progress was manifest and clearly defined.

It was this spaciousness of vision which so distinguished Gill as an astronomer, and made him unique in his day as an observer.

For while in certain branches of astronomical study his knowledge was peculiarly full and immediate, while his keen eye, his steady hand, his tireless resolution and energy, marked him out as a capable observer, it was the vastness of his range of thought, the illumination and suggestiveness of his judgment, that impressed men most.

A complete master of the details of any investigation, however complex and involved, a worker who never shirked the labour, however colossal, necessary to the marshalling and reducing of great aggregations of facts and figures, yet behind the details and behind the facts and the figures lay the cosmic truths which his mind ever brooded over, and which his inner vision from the hill-tops of his beloved science saw and comprehended.

David Gill was more than an observer—he was a seer.

And so his thought was never circumscribed by the task that occupied him. Was it a photograph he was taking? It was part of a great scheme some day to be realized of photographing the whole sky. Was it a stellar parallax that he laboured at?—He saw it as a step only in the gauging of the whole stellar universe. Was it the constant of aberration that claimed his attention?—Forthwith it was related to the constitution of the ether, and to the relation of the ether to bodies passing through it. Was it a base line he was measuring out on the Cape Flats?—At once there rose up a whole chain of sequences, the earth's ellipticity, the moon's parallax, the constant of gravity. His was the faculty of ever relating the part to the whole.

We have barely referred to his knowledge of instrumental equipment. There was scarcely an instrument used in an observatory with which he was not abundantly familiar. The articles on "The Telescope," "The Micrometer" in the Encyclopaedia Britannica are from his pen. He was regarded both in Europe and America as the leading authority on these matters.

Many of the most valuable improvements in practical astronomy during the past twenty years are due to his skill or experience. He never found a good but he wanted to make it better, a better but he desired to have it the best. Clocks, micrometers, measuring machines, prisms, photographic mountings, have all had the touch of his improving fingers upon them.

Men continually sought to do him honour. He was a Knight of the Prussian Order, *pour le mèrite.* He was also a Commander of the French Legion of Honour. He held honorary degrees from every university of standing in the British Isles, as well as from many colonial and foreign universities. He was a fellow or a member of almost every learned scientific society in Europe and in America.

He was twice gold medallist of the Royal Astronomical Society, once gold medallist of the Royal Society. Both the American Academy of Science and the French Academy conferred upon him a similar honour.

We have spoken of his great capacity for work. In his prime he could for weeks steadily go on observing during the greater part of the night, and then carry on during the whole day the ordinary duties connected with the direction and organization of a large observatory. His energy indeed was boundless, his industry tireless.

Because of these robust and virile qualities he often seemed a hard taskmaster, for he spared neither himself nor others. He was impatient of slow men, and upon any carelessness in the discharge of duty fell the rude shock of his anger. Whether it was the cutting of the grass on the lawn in the front of his house, the marshalling of serried battalions of pregnant figures, the building of a foundation for a telescope, the reading of a circle, the work had to be the very best possible. There must be no scamping, no slacking, no indifference, no thoughtlessness.

His standard of service he always held high, both for himself and those who worked alongside him.

To those who sat by his hearth or at his board, who walked with him o' evenings up and down the quiet avenues that he had taken pains to make beautiful, or sauntered across the wind-swept Cape Flats, there was given the great privilege of seeing behind the strenuous, exacting worker, into the heart of the man himself. His graciousness, almost winsomeness, his kindness, his humanity, made him a rare companion. His conversation, discursive yet ever full, easy yet animated, moved from books to men, from men to cities, from cities to social and political themes.

He was all through his life a wide and a wise reader, giving up a definite portion of each day to a quiet hour with a favourite book.

He knew all the leading scientific and literary men of his day, and when he grew reminiscent of Clerk Maxwell, and Tyndall, of Froude and Carlyle, of Kipling and George Macdonald, the hours became moments.

Into the political movements of the home-land, and of this land of ever-changing fortunes, he entered with the intensity of a man who is fortunate enough to see only one side of a question. All through his life he was on friendly terms with most of the South African political leaders—Bartle Frere, Rhodes, Jameson, Earl Grey, Milner.

He was a passionate lover of music, and few things gave him greater pleasure than an afternoon or evening spent in listening to good singing or playing. He did much, also, to foster a taste for good music by taking a helpful interest in the various public concerts that were given from time to time in Cape Town.

He had a fine appreciation of pictures, and his house possessed not a few of considerable value. Indeed his home was the dwelling-place of a man of refined tastes. In all its conditions and circumstances it suggested the abode of one who loved beautiful things.

Gill was the last of the old school of astronomers who lived and toiled in the strenuous epoch between the days of Lagrange, Leverrier, Bessel, and Gauss, and the present hour that heralds in the day of the New Astronomy, and he was the greatest of them all.

But to some of us it is not thoughts of his intellectual attainments, or of his great achievements in the world of science, that arise as we seek to picture the man anew to our inner vision, but rather memories of one who was abiding in his friendships, upright and honourable in all his actions, gracious and kindly in his outlook on men and things, fearless in the discharge of what he deemed to be his duty.

If much of a personal note has crept into this tribute, it is because it has never been absent from the writer's mind.

And I am sure it will not be lacking from out the thoughts of those who with knowledge and sympathy read, and so reading will supply wherein we have failed.

Of him, and of the future verdict of history upon him, we may fittingly quote the well-known words of Horace :—

"Crescit, occulto velut arbor aevo
Fama Marcelli, micat inter omnes
Julium Sidus, velut inter ignes,
Luna Minores."

ALEX. W. ROBERTS.

# PRESIDENTIAL ADDRESS, 1915.

## THE BUSHMAN AS A PALAEOLITHIC MAN.

By Dr. L. Péringuey.

Two years ago I endeavoured to give as a subject for my Presidential Address a short retrospect of what was known then of the lithic industry, or stone-implement making, in South Africa. I was thereby led to bring into the subject the antiquity of the race or races of men who evolved these artefacts. It is the study of these relics which has enabled us to postulate before he was discovered primitive man, whether ape man, man ape, or man as we now understand him. These relics have thus justified the whole edifice elaborated on the study of evoluated races of mankind, and they have allowed us to follow his increasing mental development, but they have not thrown additional light on the geological or approximate age of their early makers—an age which seems, however, to recede more and more until we are fronted by the possibility of an ancestor of the genus Homo in Tertiary times.

Since I addressed you—and this is only two years ago—the discovery of a palaeolithic human skull and mandible at Piltdown (Sussex) may prove to be epoch-making, because it has given us another genus of the Hominidae. In Australia, a skull, of considerable interest it is alleged, has been brought to light, and there has been found lately in South Africa another, unfortunately very incomplete, which is likely to throw an additional gleam of light on this very obscure and much-debated subject, the ancestry of the present man.

In order to bring greater clearness in the handling of my subject, which is greatly depending on the hypothesis of evoluated races, I must preface my considerations with a short account of these races.

If we put aside Pithecanthropus, the Ape Man, we have now, as well established prehistoric races, the Neandertal Man (Neandertal Spy, La Chapelle, les Eyzies, Le Moustier, and perhaps also Gibraltar); earlier probably than the Neandertal is the Heidelberg Man, known from a lower jaw only, but truly an extraordinary relic. This is possibly contemporaneous with, but more probably earlier than the Eoanthropus, the "Man of Dawn," a man found associated with flint implements of Palaeolithic type. It is in the mandible that the new genus differs from man; the forehead is steep, and the brow-ridges are small, whereas in the Neandertal men the forehead is low and very sloping, and the brow-ridges are enormously developed.

The discovery of the several examples of the Homo neandertalensis led to the belief that he was the ancestor of Homo sapiens, or man of this present period, at least in Europe. But another school prefers to see in the Neandertal man a kind of degenerated side branch that led nowhere. According to this school, the high forehead of Eoanthropus is a primitive character of the Hominidae, and the sloping forehead and huge brow-ridges of Homo neandertalensis are only secondary acquirements. If we were, however, to discover a human skull with a not very high, yet as nearly a vertical forehead as the Bushman, and also without very prominent orbits, but Neandertal in other respects, it would go far towards the assumption that the Neandertal race is not one that led nowhere. Such a find, however, is that of the "Boskop Man," a detailed account of which will be given you soon, I hope.

The La Chapelle man, which, being the most complete relic of its kind, is more reliable for comparison, is considered to be a Middle Pleistocene man, and its lithic industry to belong to the Mousterian. The very little found with the "Boskop"—two flakes and a scraper—may be looked upon as resembling the Mousterian lithic industry. The scraper might be of any period either Palaeolithic or Neolithic, only that the object of this address is to show with perhaps additional proofs my contention that the Neolithic in South Africa is really unknown. There is here no hiatus, no distinct period of horn and bone, or both, associated with stone, in the manner obtaining in the Northern Hemisphere, and certainly no polished stone period, nor bronze period. One would naturally expect that what obtained in other parts of the world, such as the Northern Hemisphere, would be repeated here; but it is not repeated. The great mass of documents now in our possession go far to substantiate this conclusion. That there has been an evolution is patent, but to this evolution cannot be assigned a date (uncertain, of course, and not expressible in years), as has been possible in Europe, where the Neolithic evolves directly from the Palaeolithic. My object is to try and prove that one of the surviving races in South Africa, the Bushman, if not the direct descendant of the primitive men, our ancestors, has, either through a share in filiation or by contact with them, retained a part, if not the whole, of their culture until to-day. In order to give weight to my contention, I propose to compare our documents with those obtained in Europe and elsewhere, taking as an assumption that although physical peculiarities can be separately evolved, manifestations of culture as expressed by manufacture and art cannot evolve on lines absolutely similar. If these lines are found to be alike in two or more separate regions, then it is safe to conclude that they are the expressions of the mental development of one race only.

## Lithological Divisions.

Let us recapitulate the ten divisions, or lithological epochs, defined, as previously stated, by the character of the stone or bone implements discovered at different geological levels, and with which occur, as often as not, remains of animals that are either extinct, or of others that still survive although in sparse numbers, and lastly, of those which again form the animal fauna of to-day. Of these ten divisions it will be safer, for the present at any rate, to drop the three most ancient and little-accepted periods, namely, the Icenian, the Messinian, and the Strepvan, leaving thus, in the ascending scale, seven, namely: the Chellean and the Acheulean, forming the Lower Palaeolithic; the Mousterian, forming the Middle Palaeolithic, and the Aurignacian, Solutrean, Magdalenian, included in the Upper Palaeolithic. Lastly, there is the Azilian, certainly a phase of transition that may or may not be included in the Neolithic.

If we assume that the deductions from the history of the Great Ice Age are correct, this Azilian division would extend into "Post Glacial" times, and may bridge the Palaeolithic and Neolithic periods. At the other (earlier) end the Chellean and Acheulean culture evolved during the Middle Interglacial epoch, and are followed by the Mousterian during the Second Glacial episode, which in turn is, in all probability, replaced by the Aurignacian epoch, the age or duration of which lasts wholly within the Last Interglacial period, giving way to the Magdalenian, the phase of which extends to the very end of the Pleistocene, the Azilian, as said previously, replacing the Magdalenian. These divisions of the Ice Age, based as they are on geological facts, are worthy of acceptance. Unfortunately, they do not apply to South and Central Africa, where, it is now safe to say, no traces of such glaciation exist. The climate here, during these Ice periods, was not affected thereby, and it may be taken for granted that during the Pleistocene, it remained the same as it is to-day.

But the artefacts themselves, so abundant in our river gravels and elsewhere, their style, their possible contemporaneity with remains of Mastodon, and with certainty with two extinct Antelopes, much more ancient animals than those with which they have been associated in Europe, must make us accept the possibility—for in prehistoric studies possibility is the only theory—either of contact with other races of Hominidae or identity of these races. The geological formations of this Pleistocene epoch renders the thing feasible.

In Pleistocene times the Mediterranean was not the barrier it proves now, the continents of Europe and Africa were connected with Asia, and if they were not so during the very early periods of mankind, Eastern Europe and Asia were affording a land route to migrations. Early man was perforce a hunter. This point cannot be too strongly pressed; hunting means covering ground, game moves in search of food, so does the hunter. And thus the picture I drew for another publication does not seem, after all, an impossible one.

"Let us assume that primitive man originated in Africa. When he invades Europe in the Chellean times, the climate is attractive; he brings with him his primitive weapons, the weapons of the chase, defence or offence. Are the *ferae naturae* which he has to encounter such formidable and unknown beasts as to daunt his courage? Certainly not. *Hyaena spelaea* he knows well, it is the present *H. crocuta*, found now only in South and Central Africa; *Hyaena brunnea*, occurring now from Senegal to South Africa, he also knows well. The tooth-sabred tiger or the cavern lion could have for him no more terror than his old acquaintance *Felis leo* or *Felis pardus*, the present lion and leopard whom, besides, he meets again in that country new to him. Is he frightened by *Elephas antiquus?* No; it is his old acquaintance now called *E. africanus*. *Hippopotamus major* is his old friend, *H. amphibius*; *Rhinoceros mercki* he cannot distinguish from *R. simus*, *R. bicornis*, or *R. keitloa*. No such niceties in identification for him. He either defends himself against them, or uses his growing cunning in mastering them, especially the formidable cavern bear *Ursus spelaeus*, which he has not met before. He finds no longer the numerous antelopes of his acquaintance, it is true, but *Bos bison* has the same attraction for him who has slain *Bubalus baini* or *B. antiquus*. It is quite possible that he has not known these denizens of an intensely cold climate, the woolly rhinoceros, the mammoth, the reindeer. He would follow the animals which he knew, beasts driven back by cold to receding warmer climes—to climes where, as in South Africa, the total absence of traces of pleistocene Ice Age clearly proves that there did not exist at the time the increasing rigour of the elements that has come to prevail in the country whence he retreats, either following the migration of the game on which he subsists or migrating to where it is found still.

"And if he is not of African origin, if he is of the Neandertal-Chapelle race, but, unlike the latter, has not been able to accommodate himself to the new climatic conditions, then in his retreat southward and especially to the African continent, he probably accompanies, or comes across there most of his old acquaintances, if not all, many of them, *i.e.*, the hippopotamus, the elephant, the hyaena. He finds himself among antelopes which he did not know, but horses which he knew. The hyaenas follow him, for is he not providing crumbs for them. He continues the application of methods which he has perfected elsewhere. In his emigration southwards, where he no longer finds the flint nodule so easily worked into implements, he resorts to any stone hard enough to ensure its object; hence the use of quartzite, hence also the discrepancy in technique, more apparent than real, since ultimately the 'knapping' becomes as perfect as that of the best flint. But the primary use for which the implements of new material are made is the same. They are intended to be used as picks or spades for digging trenches, cleavers to cut stakes or palisades, and the manufacture of other tools for domestic use here accompanies or follows that of the bouchers if it has not preceded it."

## Progress of Culture.

Towards the end of the Mousterian are revealed indices of a culture other than that of the usual handiwork. They increase in the shape of better finished and more varied forms in the Aurignacian, to such an extent as to cause surprise. They improve again in the Solutrean, and make special forward strides in the Magdalenian, the latter called also the Reindeer period.

It is this so-called "hiatus," this solution of continuity in the progress of culture which perturbs antiquarians, and makes its explanation difficult, even by making the Solutrean period precede the Aurignacian, instead of following it. It must, however be remembered that in the Aurignacian time or epoch climate had become milder, thereby making possible again another immigration of a race of men whose mental abilities had reached a higher plane than that of the Mousterian man of Europe, and certainly in a milder climate.

Had the primordial attempt at reconstituting man's prehistoric evolution on the basis of the artefacts he left behind him originated on material obtained in South Africa, it is plain, to me at least, that we should have had to adopt another nomenclature as well as to ascribe the dawn of art—the true test, after all, of mind's progress to the Acheulean lithic period—which here is not differentiated from the Chellean and the Mousterian—because we have found unmistakable proof of their contemporaneity with the finest and best executed rock-carvings representing wild animals discovered anywhere hitherto. These representations, in which relief is combined with intaglio and pointing, are executed on a basaltic rock, by nature of extremely hard texture. A few inches below the surface, in a "pan," were found at one station very finely worked bouchers of different sizes, but all large and of unmistakable Acheulean type. They are deeply and numerously pitted in the manner of those so abundantly met with in the Vaal River gravels and elsewhere in this country. The material of which they are made is that of the rocks on which the carvings have been executed, namely, basalt.

I want you to remember in connection with the claim for great antiquity which I make for these bouchers, the proof of which I gave before you, some time ago, of the no less great antiquity of the Vaal River implements. A clean transverse fracture revealed the fact that closely and very deeply pitted as they were on the surface, the texture inside was not by nature pitted, and that therefore this outer pitting was due to weathering influences lasting for an incalculable period. In addition, it was also shown that round the periphery was a broad discolouration zone pointing to a beginning in the disintegrating action that would, within a given time, reduce to sand this very artefact of man. I showed also that not only the large pieces were so affected, but that the by-product in the shape of flakes were exhibiting the same zone of disintegration, in spite of offering less resistance, owing to their small size, to the long continuous action of the elements of which aeolian agency was, in all likelihood, the most potent. The same phenomenon obtains in these bouchers of Acheulean type found together with the Kinderdam petroglyphs.

The white patina of the flint palaeoliths of Cisbury or Krapina falls almost into insignificance when compared with the action of ages on these South African palaeoliths. Yet they are connected with a mental development which points to a desire to fix certain events perhaps of the chase, perhaps connected with magic, as we shall see later on when I treat of pictures, painted or graved, and of others where both arts are combined. But the execution is of superior merit. It is not that of a beginner, but of an artist in full possession of his art; there is no primitiveness here in this effort of the hand prompted by the mind. Yet this mind is that of a being who, if we judge by his stone weapons, should be either anterior, the same, or allied to a man who, as the Neandertal, was very likely not able to express his thoughts or his deeds in articulated speech. But if the mental and physical development of both was the same, we must become reconciled to the supposition that this skill in portraiture was possibly developed because of the impossibility he found himself in to express the thoughts germinating in his working brain in understandable articulated sounds. This difficulty was due to the shape of his lower jaw. I think that the fragment of the jaw of our "Boskop Man" will also be found to have the same peculiarity. As to the brain, that of the Neandertal is far in excess, in point of size, to that of any race of mankind, and the skull is the longest known.

### Revision Required.

When in addition I add that on perhaps the best of these carvings figures a man only moderately conventional, pursuing an elephant and armed with a bow and arrow, you will doubtless agree with me that the accepted divisions of the Palaeolithic Ages will have to be considerably revised, if not materially altered, through the documentary evidence afforded by South Africa, and later on also probably from other South African zones.

For in truth we have in the case cited one of the oldest forms of lithic industry coupled with the expression of an extremely well-developed artistic talent, together with an only slightly conventionally-drawn figure of man far better executed than most Magdalenian figures, and armed with a bow, a weapon unknown in the Magdalenian, as also in the Aurignacian times, but greatly in vogue in the Solutrean, which lithologically is characterized by its wonderfully well-worked points for darts and arrows. There is now a tendency to place the Solutrean before the Aurignacian. If this conclusion were accepted, it would explain the presence of Solutrean points carefully worked on both sides and of splendid finish, among the large and numerous palaeoliths found in the Swaziland gravels worked for tin. So numerous are these relics in parts of Swaziland, as also in the valley of the Vaal River, where diamond "dry diggings" obtain, that one might be superficially led to the conclusion that they are the tools of early miners, whereas both artefacts and minerals have gradually found their way to these deposits through extensive denudation of the higher levels of the country round the deposits.

It is then during the three following periods, the Solutrean, Aurignacian, Magdalenian, that a culture expressed otherwise than by man's handiwork bursts almost suddenly upon us. So sudden it is that it seems almost doubtful that it should have originated with the race of Mousterian man, and the question may again be asked: Is not this new culture an importation by a newer race, or obtained by contact from another race whose mental development had by that time been more rapid or less sluggish? It is to this theory that I adhere, and my endeavour is to show that the Bushman, if himself not the ancestor of these Solutrean and Aurignacian people, may have been of them, and that he has retained many parts of their handicraft is equally certain, as will be seen from the evidence adduced.

I have stated already that an amelioration of climate had supervened in the Northern Hemisphere. It seems to have as a result, judging from the great and still increasing number of stations located in Europe, induced an immigration or return of the men who physically differed from the Neandertal. Of the Solutrean man we know nothing. But Mons. Obermaier, the well-known Anthropologist, working under the aegis of that generous patron of Oceanography and Prehistoric Antiquity, the Prince of Monaco, has quite lately discovered a skeleton in a well-defined Solutrean level in Bavaria. From this find much important information will be forthcoming. Of the Aurignacian man, we know two examples, the old woman and the young boy of the Grotte des Enfants, near Mentone. Both are pronounced to belong to a negroid race of low stature, plainly allied to, if not quite identical with the Bushman, who is a negroid race, and of very low stature. In some adjacent caves have been discovered steatopygous figurines.

Thus we find proofs of the presence of a race akin to the Bush in the south-western part of Europe, and, moreover, of a race that is going to leave there proofs of its stay similar to those found in South Africa. It is these which we shall succinctly examine, for in an Address—which *per se* must needs be the generalization of a subject, a summary in fact—it is impossible to explain the deductions by means of examples, although I could not refrain from doing so in the case of the large picture here shown.

*The Race.*

The outward appearance of the Bush race has often been discussed and enlarged upon. The average height is 144 cm., or 55½ in. He is mesaticephalic and platyrhynchian. He is a negroid, it is true, but the length of arms is less than that of the negro. The forehead is not sloping like that of the latter, and is also broader. His two characteristics are the absence of a lower lobe of the ear and a heavy projection of the upper eyelid. The Mongolian aspect, due to the great prominence of the cheek-bones, is quite fortuitous, and implies no connection with the latter race. The women, however, are remarkable, owing to natural characteristics found in no other existing races, namely, the elongation of the nymphae and the peculiar development of the nates, or buttocks, known under the name of steatopygia. This gluteal development doubtless stands as a reservoir of food, and is also present in the male, but in a very slight form. In the women the mammae become pendulous at a very early age.

From Aurignacian deposits have been recovered a certain number of anthropomorphic figures in stone or ivory executed in round boss. They all present the same characteristic execution. "The features of the head are not indicated; the breasts have an abnormal development; the globular protuberance of the abdomen is very strong, and steatopygical characters are very much in evidence." I may add that these physical peculiarities are also to be found in numerous figures of prehistoric Egypt and in some of the Ægean Islands.

*The Stone Implements.*

There is hardly a type of the Solutrean and Aurignacian stone implement that cannot be matched in South Africa. Instead of being made of flint, a material that does not exist, it consists of sandstone, silicified sandstone, quartz, or any material hard enough to fulfil its purpose. Few, if any, large implements are used, except in certain parts where bouchers of rude manufacture are connected with double-end scrapers, and occasionally tanged arrows of the Solutrean type. In the caves or shelters of the littoral where a resemblance to the Magdalenian industry is noticeable owing to the use of bone, but is more imaginary than real, large tools have been found, but they have not been pared in the manner of the Palaeolithic bouchers, and it may be stated that the Bushman race, as we know it, had abandoned the fabrication of these heavy pieces if it ever knew it. One tool, however, would seem to be peculiar to them, and it is the "Kwé," or perforated stone, of which, however, a few examples from the Mediterranean are known. But, as already stated, the lithic industry of the Bush runs parallel with that of the Aurignacian-Solutrean Man.

*Industry.*

The very great abundance of tiny parers, slender burins, which, with the equally small thin flakes used to barb their arrows, are found in almost every Station, is due to the manufacture of flat discs of ostrich egg-shell perforated in the centre, and of which strings used for ornaments are made. This style of bead is spread over Africa; discs have been discovered in tombs in the Nubian desert—as well as in very early Neolithic sepultures in Spain.

*Ornaments.*

In the sepultures of the littoral, upon which I look as necropoles, stringed rows of these tiny ostrich egg-shells were found on children, and female adults (they are likewise found in almost all graves of Bush and Hottentot women in different parts of the country), also necklaces of shells perforated in a very rude fashion for stringing; one of them in particular greatly resembles that worn by the women of Mentone. Teeth perforated for suspension, as in the old Solutrean, are not known, but flat discs, with a hole for suspension, are known, and in certain Stations bone discs and shells have been decorated on the edges, and carefully bored for suspension. The question if men bore more body ornaments than the women remains still open; but I am inclined to think that they did. I considered at first as an ornament a cylindrical bone found in a cave shelter of Humansdorp. I am led, however, to look upon it now in the light of the Magdalenian culture, as a tube for the paint which was not only intended for the parietal paintings of which I am going to speak, but also for body decoration.

*Paintings and Gravings.*

The reputation of Bush paintings is generally made. As long, however, as no comparison with other paintings of similar style and pigments was possible, this display of an artistic disposition of a member of mankind that was not looked upon as a remarkable instance of intelligence, was coupled with the result of brain power. But after the discovery in the shelters of the Aurignacian, Solutrean, Magdalenian epochs of objects graved by the men of these periods either on stone, bone, or horn, that of representations, often numerous, of animals and divers figures, painted and graved, the question arose if the latter especially were perpetrated by the men of the Reindeer Age. One of the most important of these was that of the Cave of Altamira in Northern Spain. Further discoveries have now settled the point that it is ascribable to Palaeolithic man, and the age to the Aurignacian. These caverns number now some thirty, the best known being eight in the Dordogne, six in other parts of France, and eight in North-Western Spain. The discovery of many more in this Cantabrian Region of Spain is proceeding apace. The animals often represented with as much fidelity as those graved on bone or horn are the mammoth, the two races of horses of quaternary age, the bison, reindeer, roe-deer, etc. From this enumeration it is seen that all these animals are either extinct, or have long ago migrated from the country; and as it is impossible that man could depict an animal he had not seen, the contemporaneity of the two is therefore made absolute.

Here the subjects chosen for our pictoriographs are also those of animals—classical scenes they may be termed—but the animals represented are still with us, and thus do not give any indication whatever of the age of these relics. On the other hand, the large picture here exhibited was painted, as in Altamira, on the roof of a cave that stood some 25 feet from the floor. More open at the entrance than Altamira it would be more exposed than the latter to the destructive effects of the elements. But this nine feet fragment of a much larger scene fell face downwards, and was thereby saved from the destruction that befell the remainder, of which no trace could be found. It is therefore permissible to attribute to this piece of evidence as great an age as that of Altamira. If you follow my indications, you must recognize that in colouring, stumping of shades, and graved and painted technique united, the Zaamenkomst Bush painting does not fall below the artistic merit of the Altamirian artist. Nor is it all. In the latter cave we find some palimpsests, that is to say, animals painted and graved over another animal whose fainter outline implies a greater age. Similar palimpsests are found in Bush paintings, not only in the classical, as I term it, but also in the "peinture de genre," in dancing or crowded hunting scenes. Now I take it in our case to be magic; it is prompted by the idea of either wiping out completely a haunting reminiscence, or to show superiority. Often the superposed model is better executed.

The Bushman paintings have, however, this superiority over the Aurignacian ones—that man and woman are represented, the sexes being unmistakable. In the Aurignacian certain monstrous forms are known, but man is not well delineated. Hieratic and conventional as many of our Bush paintings are, their style is found repeated in some new grottoes lately discovered in Spain, an ideographic style seems to prevail in others where the sexes are differentiated even when the male organs have been omitted or have disappeared. In the Bush, the peculiar long waist of the men (the appearance of which is enhanced by the steatopygia of the women) and other features mark the style as altogether his own. But the pigments used for these representations are the same whether used by the Aurignacian man or by the Bushman, namely, red and yellow ochre, charcoal and white clay. The toning of these ingredients is similar, the delineation of the animals equal in naturalism; the eyes are present; the subject is often, but not always, finely graved, thereby uniting or rather requiring the united skill of sculptor and painter.

We are, of course, endowing the Bush with the artistic disposition exemplified by the rock paintings attributed to him, although no one has seen such an aboriginal actually performing at his art. I have evidence now that for a brush he used a straw split at one end, and we know by numerous finds *in sitû* of the pigments he used for his parietal representations, but we did not know until lately that his better work included also the art of graving, which really stands revealed now by few examples it is true, but unimpeachable. And they thus form a link between the engraved, unpainted subjects to be found within a certain perimeter of the Union.

Of the merit of some examples I have already told you; of the age of their authors I have given you my opinion. But we have also another means of comparison in objects of similar merit and description, in Northern Africa this time, where an extinct Buffalo is delineated on rock in almost natural size, and with such a fidelity that the reconstruction of the skeleton, when it was ulteriorly found, was based on the attitude of the animal as depicted by the primitive artist. We had a similar buffalo here, and I found its remnants in connection with the Aurignacian industry of the modern Bushman.

These rock-gravings are not of equal merit, and it might be doubtful if after all they were made by the present Bush people, but in some cases that doubt must be put aside for the following reason. Certain *painted* mythological scenes are known. In these the figures are those of man with an animal's head, a long tail, and very conspicuous genitalia. We have now in the Museum three similar but *graved* scenes. They thus bridge the arts of sculpture and painting, and denote that the Bush people are or were capable of both.

One fact, however, prominently stands out, and it is the naturalism expressed by the sculptor especially, but also by the painter. The animal's attitude is life-like. The etching of a female Koodoo, evidently getting alarmed, could not be surpassed; that of the elephant flying before the hunter armed with a bow could not also be surpassed, and as for the technique, the corrugation of the skin is reproduced, the short tail is in the relief, etc., but man himself is only an accessory; few cuts with a stone delineate it well as a whole, but for him there is no especial enthusiasm. He is not the quarry; on this quarry the man's mind is concentrated, and on that alone, and so thoroughly is it so that the rest, man, is a mere accessory. This comes from being a hunter, the descendant of a race of hunters, one who had survived because he was of a race of hunters, whose craft primarily developed in one direction, the chase, to which everything else was subsidiary. In his earliest day his growing intelligence discovered the boucher, which it improved on until more craft developed, when the poisoned arrow replaced the much more ponderous outillage, but never replaced it completely.

It is for the reasons aforesaid that I claim the Bushman to be the descendant of Upper Palaeolithic Man, and to have remained such until its ultimate disappearance, which took place yesterday, because as a unit he is no more.

# SOME NOTES ON THE SOUTH AFRICAN *ERYSIPHACEAE.*

By Ethel M. Doidge, DSc., F.L.S.

(Read April 21, 1915.)

(Plates XXX.–XXXV.)

The fungi belonging to the group *Erysiphaceae,* generally known as the "powdery mildews," are responsible for a number of very widespread diseases in this country, and in some cases cause serious damage. It is a well-known fact that in Europe the mildews on cultivated plants form perithecia comparatively seldom, and this condition prevails to an even greater extent in South Africa, therefore the work of accurately classifying these fungi is rendered difficult, as although *Oidium* spp. have been reported on a wide range of indigenous host plants, on these, too, perithecia are seldom found.

In his Monograph of the *Erysiphaceae,* Salmon has traced the identity of a number of these mildews which seldom form perithecia on cultivated plants, and in the accompanying list these oidial stages are provisionally assigned to the species to which they most probably belong.

The apple mildew (*Podosphaera leucotricha* (Ell. & Ev.) Salm.) is rather a serious pest in the orchards of the Orange Free State; trees four and five years old are seriously attacked. From an orchard in that province were obtained twigs bearing numerous perithecia of the fungus, and the identity of the pest was thus established; they were most plentiful on the variety known as Rome Beauty. Several outbreaks of the apple mildew have also been reported from various localities in the Cape and Transvaal Provinces.

*Sphaerotheca pannosa* Lèv., the rose mildew, is prevalent wherever the rose is cultivated, and is very common and widespread in South Africa; indeed in some localities it is almost useless to cultivate susceptible varieties such as the Crimson Rambler. Although diseased plants have been under observation at all seasons during the past two or three years, the perithecia of this fungus have not been observed. There is only one case of the occurrence of this fungus on the peach (*Prunus persica*).

According to Salmon the perithecia of vine mildew (*Oidium Tuckeri*) were not known for the first forty-seven years of its occurrence in Europe ; then during an exceptional season in France abundant perithecia were formed, corresponding in every way to those of the American species, *Uncinula necator*. Possibly a similar occurrence may place beyond doubt the identity of the South African *Oidium Tuckeri*, but meanwhile this fungus is provisionally referred to *U. necator*.

Two new species of *Uncinula* are described, both from the Transvaal, one from the Pretoria District and the other from the Zoutpansberg. The former on *Ficus* sp. is near *U. Salicis*, but differs in dimensions and in the number and character of the appendages, the wall of the latter being distinctly scabrous in the lower half.

The *Uncinula* on *Pterocarpus* differs materially from the species described by Salmon on the same host (*U. incrassata*). It comes nearer to *U. tectona*, but differs considerably in the dimensions of perithecia, asci, and spores, and in the number of appendages.

A fungus which cannot be separated from the common and widespread *Erysiphe Polygoni* D.C., has been found on several plants belonging to the Euphorbiaceae and one Tiliaceae. The mildew of the garden pea and the sweet pea, which are fairly common, are probably to be referred to this species, but no perithecia have yet been found on either of their hosts.

The disease on different members of the Order Cucurbitaceae is one of the most troublesome pests caused by this group of fungi. It occurs throughout the country, and unless preventive measures are employed it almost invariably attacks cucumber, marrow, and pumpkin plants at the flowering period. It is responsible for a considerable amount of pecuniary loss. This fungus and the tobacco mildew (*Oidium Tabaci*) are both provisionally referred to as *Erysiphe cichoracearum*, Salmon having found the perithecia of this fungus in connection with both pests.

*Oidium Tabaci* occurs wherever tobacco is cultivated, and may attack the crop severely if the plants are at all crowded.

*Erysiphe graminis* is not very prevalent, and in only one case is reported as causing any serious damage.

The genus *Microsphaera* is not represented among the fungi collected up to the present.

The *Phyllactinia*, which occurs on several hosts, cannot be distinguished from the ubiquitous *P. corylea* (Pers.) Karst. The form on *Combretum* is more vigorous, and bears larger perithecia with more appendages than that on *Rhus*. On *Vigna angustifolia*, although numerous perithecia are formed, I have been unable to find mature asci, even in specimens collected in winter after the plants have been killed by frost. The characters of the perithecium, however, are undoubtedly those of *P. corylea*.

*Oidiopsis taurica*, which occurs on a number of herbaceous plants, has been placed in this species.

LIST OF *ERYSIPHACEAE* IN THE UNION MYCOLOGICAL HERBARIUM, PRETORIA.

(The herbarium numbers are given in brackets.)

*Podosphaera leucotricha* (Ell. & Ev.) Salm. (Plate XXX.)
On *Pyrus malus* :
Clocolan, O.F.S., February, 1911; leg. I. B. Pole Evans (1079).
Oidial stage only :—
On *Pyrus malus* :
Pretoria, 14/1/07 (256).
Johannesburg, 24/10/07 and 13/1/11 (430, 448, 1077).
Bethal, O.F.S., March, 1914 (1291).

*Sphaerotheca humuli* (D.C.) Burr., var. *fuliginea* Schlecht.
On *Bidens pilosa* :
Pretoria, March, 1910; leg. E. M. Doidge (895).
Potchefstroom, 25/4/12; leg. P. van der Bijl (2257).
Pretoria, 26/4/13; leg. E. M. Doidge (6603).
On *Cosmos bipinnata* :
Pretoria, 31/3/11; leg. I. B. Pole Evans (1301).
Oidial stage only :—
? On *Senecio* sp. :
Johannesburg, 9/11/09; leg. J. Burtt-Davy (774).
Garstfontein, Pretoria Dist., 8/4/11; leg. P. J. Pienaar (473).

*Sphaerotheca pannosa* Lev.
Oidial stage only :—
On *Rosa* spp. :
Pretoria, 31/12/05; leg. I. B. Pole Evans (110).
Piet Retief, 15/5/06 (120).
Rustenburg, 6/2/07 (238).
Silverton, Pretoria Dist., 13/12/07 (436).
Rustenburg, 21/11/07 (449).
Portuguese East Africa, 24/5/08; leg. C. W. Howard (514).
On *Rosa canina* :
Wellington, C.P., 22/2/12; leg. E. M. Doidge (2063).
On *Prunus persica* :
Groot Drakenstein, C.P., 7/2/12 (2250).

*Uncinula necator* (Schwein) Burr.

Oidial stage only (*Oidium Tuckeri*) :—

On *Vitis vinifera*:

Rondebosch, C.P., 3/3/07 (273).

Pretoria, 9/4/07 (282).

Johannesburg, 24/4/07 (306).

Stellenbosch, C.P., May, 1913 (6608).

*Uncinula polychaeta* (B. & C.) Trac. & Gall. (Plate XXXI.)

On leaves of *Trema bractcolata*.

Madjadje's Mts., Zoutpansberg Dist., June, 1906; leg. J. Burtt-Davy (181).

On leaves of *Celtis rhamnifolia*.

Fountains, Pretoria Dist.; leg. P. van der Bijl, 6/4/12 (2203); 28/3/12 (2336), 28/5/12 (2361).

Oidial stage only :—

On *Celtis rhamnifolia*.

Pretoria, 2/2/12; leg. P. van der Bijl (2096).

*Uncinula aspera* Doidge, n. sp. (Plate XXXIII.)

Epiphylla; mycelio arachnoideo, late effuso, albido, subpersistente; peritheciis sparsis, atro-brunneis, globosis depressis, 90–105 $\mu$ diam., cellulis distinctis, ca 15 $\mu$ latis; appendicibus 15–30, rectis v. leniter curvulis, simplicibus, eseptatis, tenue tunicatis, totis hyalinis, basi 5–6 $\mu$ latis, asperulis, sursum incrassatis usque 9 $\mu$, apice uncinatis v. interdum helicoideis, perithecii diametrum leniter superantibus 125–165 $\mu$ longis; ascis 4–6, ovatis v. subglobosis, sessilibus, 51–57 $\times$ 45–48 $\mu$, 4–6 sporis; sporidiis 18–21 $\times$ 13–14 $\mu$.

*Hab.* in foliis *Fici* sp., Wonderboom, Pretoria Dist., 14/7/11; leg. J. Burtt-Davy (1838).

*U. salicis* affinis.

*Uncinula Pterocarpi* Doidge, n. sp. (Plate XXXII.)

Amphigena; mycelio epiphylla dense arachnoideo, latissimo per totam matricem effuso, cretaceo v. flavidulo, persistenti; mycelio hypophyllo tenui, effuso, albido; peritheciis numerosissimis, dense gregariis v. plus minusve sparsis, primo luteis, subglobosis, dein castaneis v. atro-brunneis, globosis depressis, 100–120 $\mu$ diam., plerumque ca. 114 $\mu$, cellulis obscuris; appendicibus numerosis, 50–75, saepissime ca. 60, perithecii diametrum leniter superantibus, longitudine varia in quoque perithecio, simplicibus, eseptatis, rectis v. leniter curvulis, 3–5 $\mu$ latis, sursum non incrassatis, apice uncinatis v. saepe subhelicoideis, hyalinis, basi demum crasse tunicatis; ascis 8–12, ovatis 45–50 × 20–28 μ, basi breviter pedicellatis, curvulis, 4-sporis; sporidiis ellipsoideis hyalinis, 13–18 × 12–13 μ.

*Hab.* in foliis vivis *Pterocarpi cerisei*, Duivelskloof, Zoutpansberg Dist., Transvaal, 9/8/11; leg. E. M. Doidge (1805).

*U. Tectonae* affinis.

*Uncinula* sp.

On leaves of *Combretum* sp.

Ledzee, Zoutpansberg Dist., 7/8/11; leg. E. M. Doidge (1793).

Perithecia immature.

*Erysiphe Polygoni* D.C. (Plate XXX.)

On *Acalypha* sp.:

Garstfontein, Pretoria Dist., 25/3/11; leg. Miss J. Erasmus (1266).

On *Jatropha Zeyheri*:

Near Pietersburg, Zoutpansberg Dist., 20/3/11; leg. F. Thomsen (1286).

Ehlanzeni, Umvoti Dist., Natal, 29/4/14; leg. E. M. Doidge (8248).

On *Jatropha natalensis*:

Ladysmith, Natal, 26/1/12; leg. I. B. Pole Evans (2030).

On *Triumfetta trichocarpa*:

Muckleneuk, Pretoria, 13/4/12; leg. E. M. Doidge (2291).

On host undetermined:

Barberton, 21/3/11; leg. C. P. Lounsbury (1279).

Oidial stage only:—

? On *Pisum sativum*:

Pretoria, February, 1907; leg. I. B. Pole Evans (269).

? On *Medicago denticulata*:

Constantia, C.P., 12/0/9 (*Oidium medicagineum* Thuem.), (736).

? On *Pisum sativum*:

Potchefstroom, 20/4/12; leg. (2259).

? On *Cassia occidentalis*:

Lourenco Marques, 25/4/09; leg. C. W. Howard (674).

*Erysiphe cichoracearum* D.C.

No perithecia seen.

On *Cucurbita Pepo*:

Pretoria, 8/1/06; leg. J. Burtt-Davy (100).

Pretoria, 28/1/04; leg. J. Burtt-Davy (180).

Pretoria, 2/2/07; leg. I. B. Pole Evans (268).

Pretoria, 15/2/07; leg. I. B. Pole Evans (270).
Kentani, C.P., 5/3/13; leg. A. Pegler (6581).

On *Cucumis sativus*:
Pretoria, 9/1/14; leg. A. Bottomley (7373).

On *Cephalandra palmata*:
P. P. Rust, 12/3/06; leg. J. Burtt-Davy (132).

On *Momordica clementidea*:
Warmbaths, 18/3/09.

On *Nicotiana Tabacum* (*Oidium Tabaci* Thuem):
Tzaneen, Zoutpansberg Dist., 1906; leg. J. Burtt-Davy (135).
Piet Retief, August, 1906 (184).
Pretoria (190).
Daspoort, Pretoria Dist., 11/3/07; leg. D. Gunn (258).
Grahamstown, 5/3/07; leg. W. R. Dewar (276).
Barberton, May, 1907 (398).
Mozambique, 29/10/08; leg. C. W. Howard (643).
Rustenburg, 18/3/12; leg. P. van der Bijl (2197).

*Erysiphe graminis* D.C.

On *Triticum vulgare*:
Buffelsvlei, Lydenburg Dist., 23/9/14 (8374).

Oidial stage only :—

On *Hordeum vulgare* (Cape Barley):
Wonderboom, April, 1906; leg. I. B. Pole Evans (37).

On *Hordeum vulgare* (Thibet Barley):
Mycologist's Greenhouse, Pretoria, 8/1/07 (215).

On *Hordeum vulgare* (Chevalier Barley):
Mycologist's Greenhouse, Pretoria, 8/1/07 (243).

On *Avena sativa*:
Mycologist's Greenhouse, Pretoria, 8/1/07 (214).

*Phyllactinia corylea* (Pers.) Karst. (Plates XXXIV., XXXV.)

On *Combretum Zeyheri*:
Muckleneuk, Pretoria, 29/4/11; leg. E. M. Doidge (1506).
Letaba Drift, Zoutpansberg Dist., 6/8/11; leg. E. M. Doidge (1806).

On *Rhus incana*:
Garstfontein, Pretoria Dist.; leg. P. J. Pienaar, 24/5/11 (1533), 14/5/13 (6662).

On *Rhus discolor*:
Grootfontein, Harrismith Dist., 17/5/12; leg. P. van der Bijl (2317).

On *Vigna angustifolia*:

Muckleneuk, Pretoria; leg. I. B. Pole Evans, 18/4/11 (1413), 22/4/11 (1510), 27/4/13 (6693).

Garstfontein, Pretoria Dist., 21/4/12; leg. P. J. Pienaar (2252).

Oidial stage only (*Oidiopsis taurica* Lev.) :—

On *Tropeolum major*:

Pretoria, leg. I. B. Pole Evans, 17/3/08 (473), 6/2/09 (638, 945).

Kentani, C.P., 14/2/13; leg. A. Pegler (5668).

On *Zantedeschia* sp.:

Pretoria, 4/3/09; leg. I. B. Pole Evans (602).

On *Erythrina caffra*:

Natal, 11/4/11; leg. I. B. Pole Evans (1394).

On *Passiflora* sp.:

Pretoria, 30/3/11; leg. I. B. Pole Evans (1414).

On *Teucrium riparium*:

Pietermaritzburg, 8/4/11; leg. I. B. Pole Evans (1435).

*Oidium* spp. have also been collected on the following hosts :—

*Buddleia salvifolia*:

Pretoria Dist., 11/4/11; leg. E. M. Doidge (1373).

*Cannabus sativa*:

Potchefstroom, 20/4/12; leg. P. van der Bijl (2258).

*Chenopodium ambrosioides*:

12/11/08 (541).

*Dombeya cymosa*:

Table Mt., Natal, 18/4/11; leg. C. Fuller (1678).

*Hermannia* sp.:

Pretoria, March, 1910; leg. E. M. Doidge (896).

*Hibiscus esculentus*:

Daspoort, Pretoria Dist., 27/4/07 (393).

*Lepidium capense*:

Irene, Pretoria Dist., 23/1/08; leg. I. B. Pole Evans (445).

*Leucas Martinicensis*:

Wonderboom, Pretoria Dist., 18/3/11; leg. I. B. Pole Evans (1297).

*Pelargonium aconitiphyllum*:

Pretoria Dist., 4/12/11; leg. J. Erasmus (1943).

*Sisyrimbium* sp.

Pretoria Dist., 16/11/11; leg. P. J. Pienaar (1963).

*Solanum tuberosum*:

Skinner's Court, Pretoria, 6/1/10; leg. I. B. Pole Evans (702).

## SUMMARY.

Brief notes are given on the South African representatives of the Order *Erysiphaceae.* These cause a number of widely distributed and more or less destructive diseases of plants in this country, but they are not easily identified owing to the almost invariable absence of perithecia.

The species occurring in South Africa are enumerated, and a list given of the specimens contained in the Union Mycological Herbarium, Pretoria.

Two new species of the genus *Uncinula* are described.

THE BOTANICAL LABORATORIES OF THE
UNION OF SOUTH AFRICA,
PRETORIA.

## EXPLANATION OF PLATES.

(All drawings were made with the aid of the camera lucida.)

### Plate XXX.

A. Perithecium (*a*) and ascus (*b*) of *Podosphaera leucotricha* (Ell. & Ev.) Salm.
B. Asci of *Erysiphe Polygoni* D.C. on *Triumfetta trichocarpa*.

### Plate XXXI.

*Uncinula polychaeta* (B. & C.) Trac. & Gall.
A. Perithecium ; B. asci ; C. ends of appendages.

### Plate XXXII.

*Uncinula Pterocarpi* n. sp.
A. Perithecium ; B. asci ; C. ends of appendages.

### Plate XXXIII.

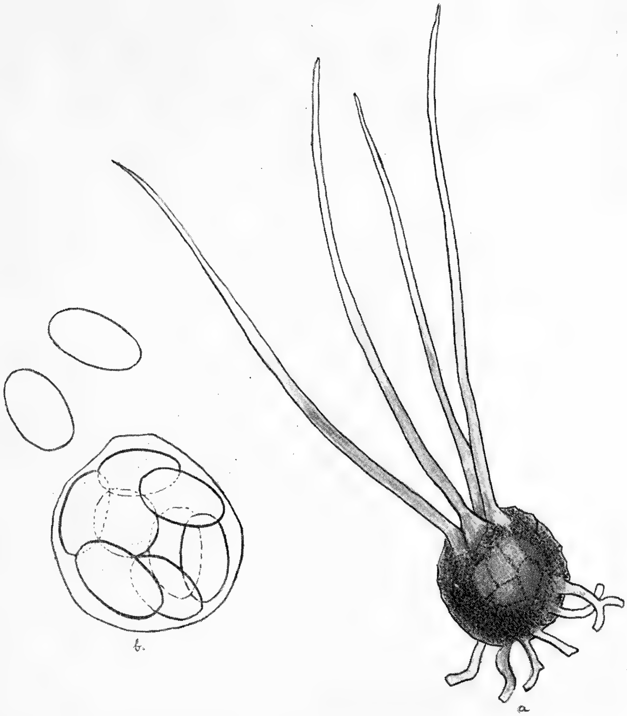
*Uncinula aspera* n. sp.
A. Perithecium ; B. ends of appendages ; C. asci.

### Plate XXXIV.

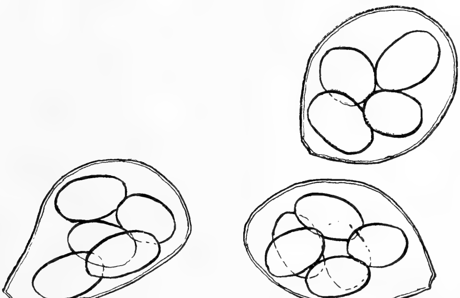
*Phyllactinia corylea* (Pers.) Karst., form on *Combretum Zeyheri*.
A. Perithecia ; B. asci.

### Plate XXXV.

*Phyllactinia corylea* (Pers.) Karst., form on *Rhus incana*.
A. Perithecia ; B. asci.



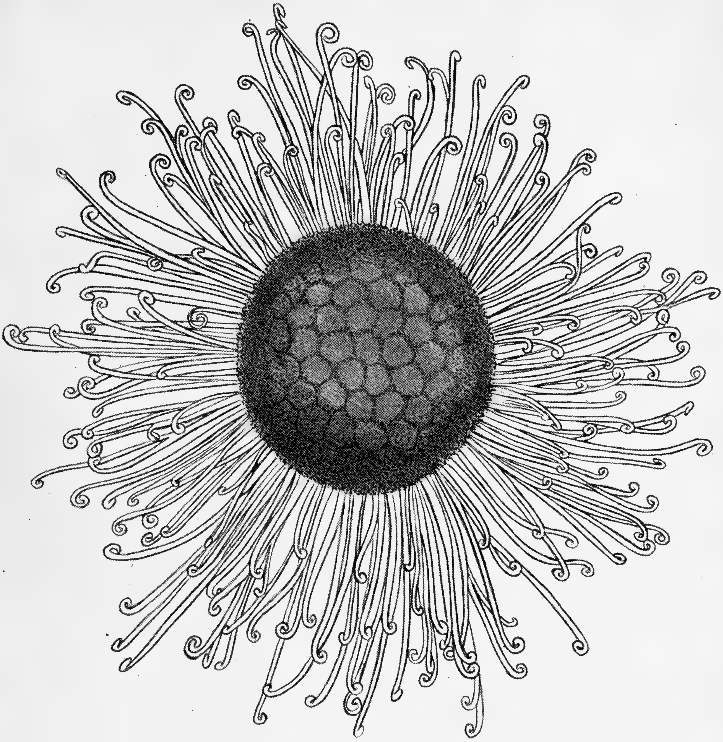

A



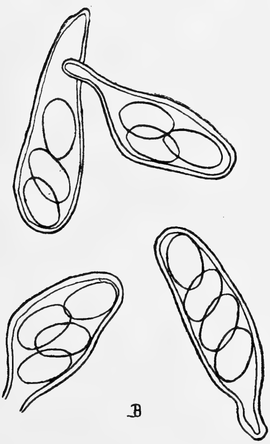
B

E. M. D. del.

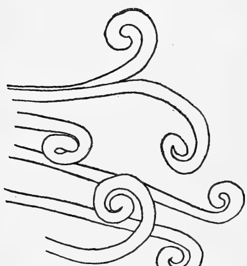
West, Newman imp.



A

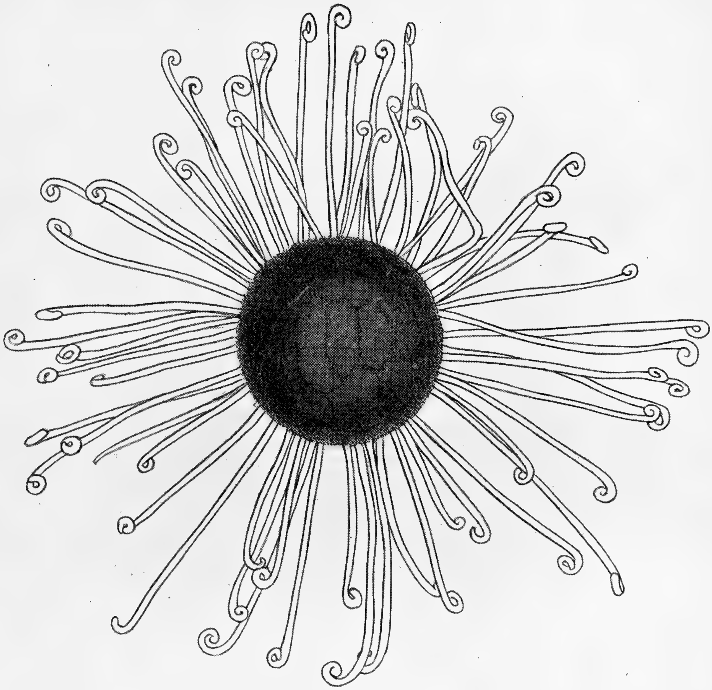


B

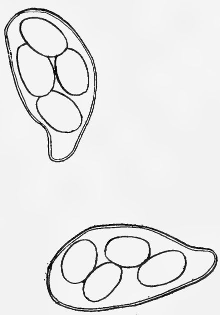


C

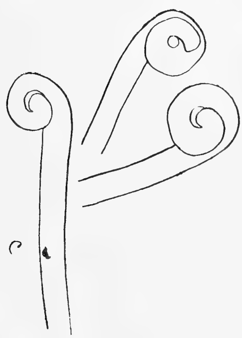
E. M. D. del. West, Newman imp.



A

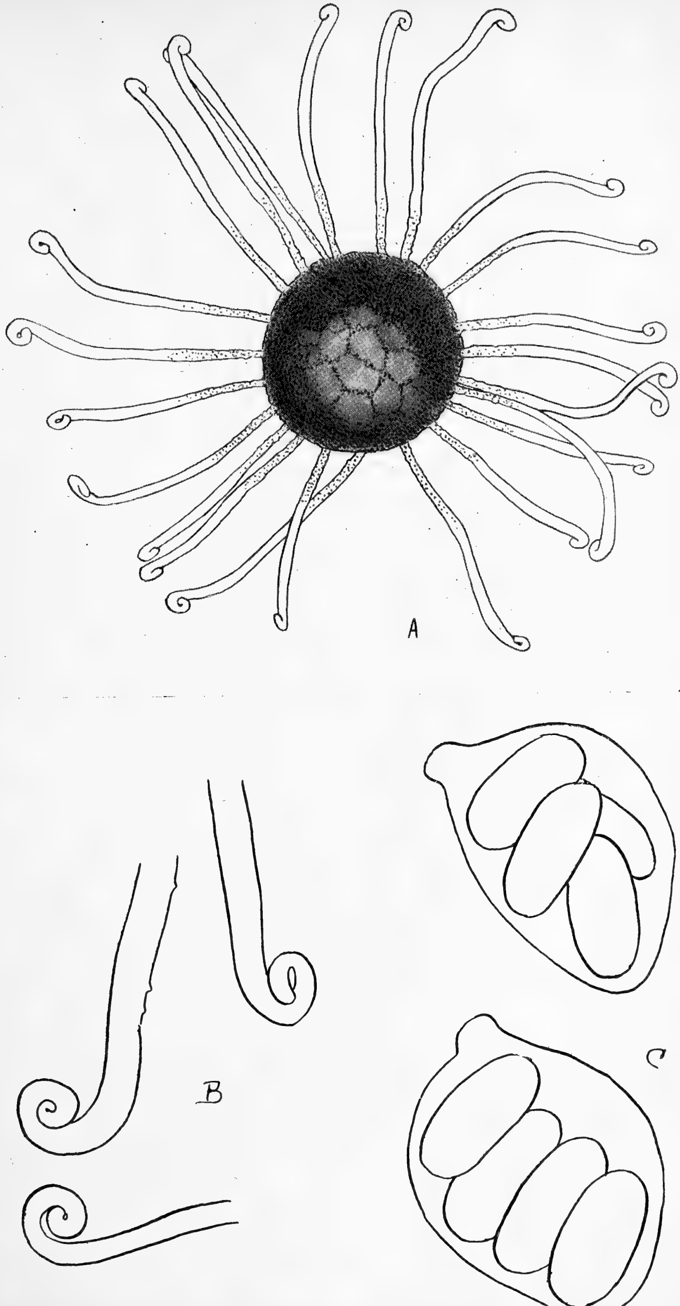


B

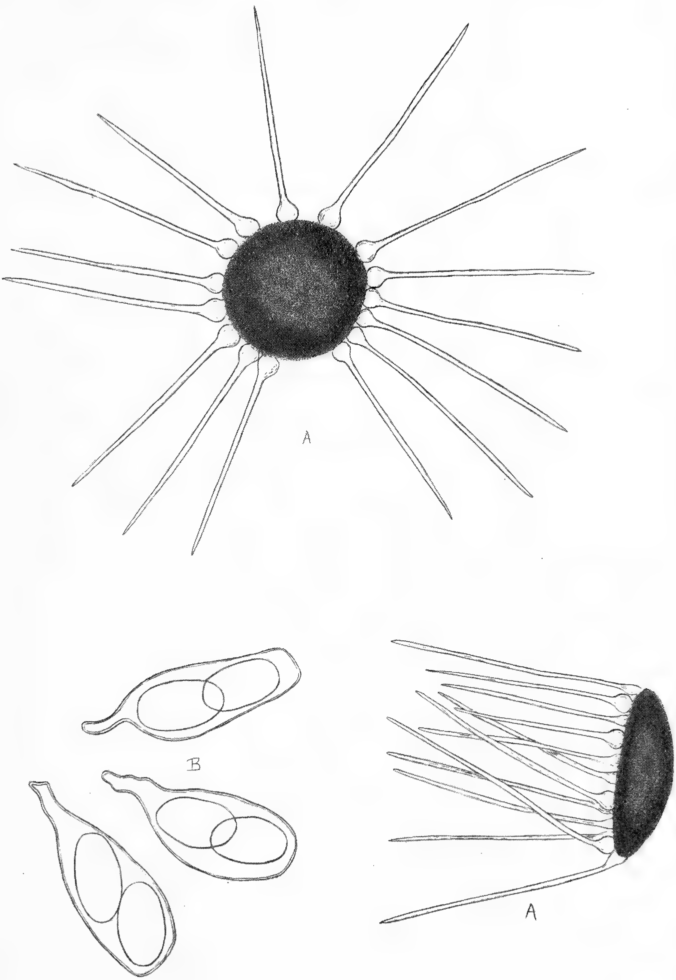


E. M. D. del.

West, Newman imp.

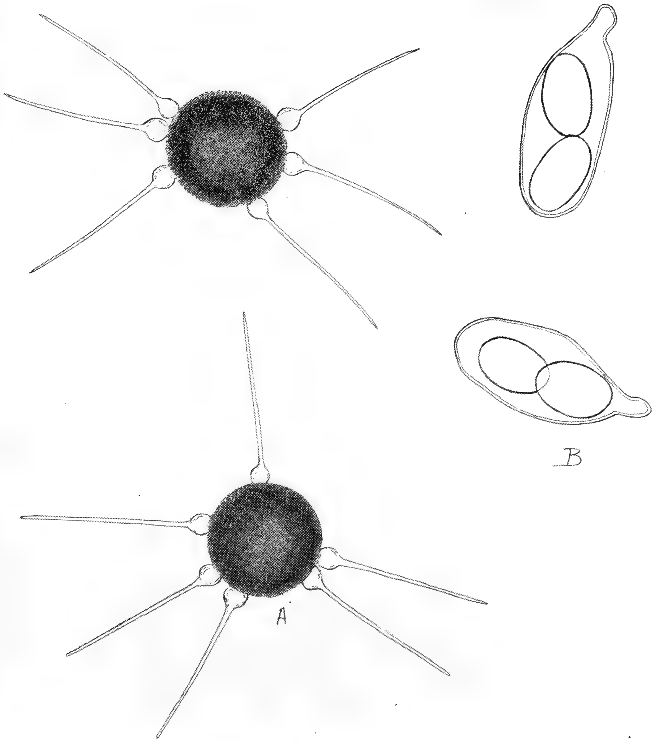



E. M. D. del. West Newman imp.




E. M. D. del.

West, Newman imp.




E. M. D. del.

West, Newman imp.

# GEITSI GUBIB, AN OLD VOLCANO.

By A. W. Rogers.

(Read April 21, 1915.)

Ever since I became acquainted with the volcanic necks at Saltpetre Kop and its neighbourhood, an account of which was laid before this Society in 1904, I had wanted to visit Geitsi Gubib, of which Dr. Schenck's short description seemed to show that it is a similar neck on a larger scale and with some remarkable characters not seen at Saltpetre Kop. Subsequently Dr. Scheibe gave the S.A. Museum some pieces of breccia from Geitsi Gubib which supported my suspicions.

During a journey in German South-West Africa in 1914, which the Union Government allowed me to undertake on the suggestion of Professor Penck, of Berlin, I had the opportunity of staying two days on the mountain, and the present paper is based on the notes taken then and on the examination of the rocks brought away.

I must thank the Government of German South-West Africa for the extremely liberal way in which transport was provided, and I especially wish to thank my friend Professor Hans von Staff, who was asked by that Government to accompany me, and who took the greatest trouble to make our journey as successful as possible. Dr. von Staff and I were at Geitsi Gubib together, and many of the facts recorded below were discussed on the spot. I regret that circumstances have made it impossible to discuss with him the results of the further examination of the rocks themselves.*

Though there are several books and papers † which mention Geitsi

* I deeply regret to learn that Dr. von Staff has died recently. Sept., 1915.

† Hans Schinz, in "Deutsch. Süd West Afrika" (preface dated 1891), p. 464, calls it a "Porphyrkegel." The late Mr. J. C. Watermeyer, who ascended the mountain in company with Dr. Rehbok in 1897, said that the "circular mountain chain . . . gives it the appearance of the crater of a huge extinct volcano. The rocks of this plateau are to a great extent basaltic," a mistake evidently due to the brown crust and pitted surface of some of the rock. (Trans. S.A. Phil. Soc., vol. xi., p. 28, 1899.)

Dr. Th. Rehbok in "Deutsch. Süd West Afrika, sein wirthschaftliche Erschliessung," Berlin, 1898, refers to it as a mountain of porphyry which his party was the first to ascend, forgetting Schenck's visit, pp. 16 and 35. In another publication, "Deutsch.

Gubib, only Dr. Schenck's accounts give any details, and other references to its structure are made in terms of his descriptions.

The earliest * of Dr. Schenck's descriptions is that Geitsi Gubib is a mountain of porphyritic rock; the next † is similar; the third ‡ gives the results of a microscopic examination of the rocks, which appeared to prove them to be porphyry-tuffs and the mountain to be a "porphyrischer Stratovulkan." He says that the ground mass apparently consists chiefly of siliceous cement with dust-like particles amongst which iron oxide is conspicuous, and that this matrix contains fragments of orthoclase, plagioclase, quartz, and magnetite; in the hard, compact rocks the latter decrease, but in the arkose-like types they are more abundant; many of the tuffs are said to contain pieces of granite. His description of the mountain itself is that it "rises as an isolated cone-shaped mass of rock from the Fish River plain, and has a basin-shaped depression in the middle towards which the outer wall slopes steeply, and which has a deep valley of erosion going south," so that the conclusion is that Geitsi Gubib is a stratified volcano with a still well-preserved crater "which retains its shape because the surface of the land has not suffered great changes since the volcano's origin, and because the tuffs are able to resist denudations strongly on account of their siliceous cement. Geitsi Gubib therefore may well be the oldest well-preserved stratified volcano, the age of which cannot be fixed (we can only say that it is post-Carboniferous), but so far as the nature of the rocks goes it is older than the known Tertiary and post-Tertiary volcanoes."

In another place § he calls the depression a caldera, and the outlet

Südwest Afrika," Berlin, 1898, a collection of 96 photographs and a map, Dr. Rehbok gives views of the lower waterhole in the valley leaving the mountain, a good view of the "crater" from the north, and one of the beacons on the top of the mountain.

In L. Schultze's "Aus Namaland and Kalahari," Jena, 1907, p. 139, there is a reference to the mountain in terms of Schenck's work, and there is a very good view of the mountain from the south on Plate VII., and another of the valley draining it, showing the inward dip of the Fish River beds and of the tuffs themselves; on p. 139 there is a view of the "crater." Dr. Paul Range on pp. 126–7 of Monatsb. d. deutsch. geol. Gesellsch., 1909, calls it a "Quarzporphyrstock," and remarks that fragments of the Karroo beds are apparently enclosed by the tuffs of the old "Stratovulkan"; and a similar reference by him is in Trans. Geol. Soc. S.A., 1910, p. 6. In "Geologie des deutschen Namalandes," Berlin, 1912, Dr. Range mentions the mountain again, quoting Schenck's description, and also the probable presence of Karroo rocks in the tuffs.

These appear to be the only references to the geology of Geitsi Gubib besides Dr. Schenck's descriptions, though the mountain itself must be mentioned frequently elsewhere. Its position is marked in the map attached to Chapman's "Travels in the Interior of South Africa," 1868, though somewhat too far west. The account in Stromer von Reichenbach's "Geologie des Deutschen Schutzgebiete in Afrika" is taken from Schenck.

* "Zeitschr. d. deutsch. geol. Gesellsch." 1886, p. 236.

† "Verhandl. d. Deutschen Geographentagen," 1893, p. 161.

‡ "Zeitschr. d. deutsch. geol. Gesellsch." 1901, p. 54.

§ "Verhandl. d. XIII. Deutsch. Geographentagen zu Breslau," 1901, p. 157.

valley a baranco, and compares the mountain with Rochlitz Berg in Saxony, but notes that the latter does not retain its original shape; otherwise this description is much the same as the one quoted above.

In another article ("Das Deutsche Kolonialreich," 1910, vol. ii.) he mentions it as an old volcanic cone made of porphyry-tuff.

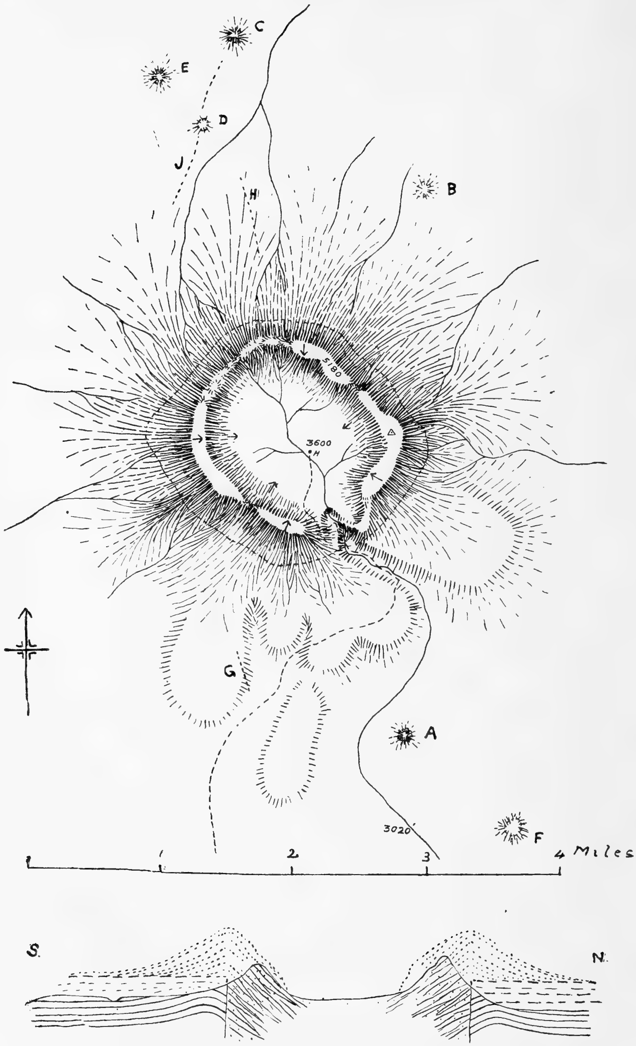
References to Rochlitz * show that there are beds and piles of hardened tuffs of Permian age there, and that the tuffs are made of lapilli of porphyry and crystal fragments set in a compact ground-mass. These features are not quite like those of the Geitsi Gubib rocks, as will be seen later.

Geitsi Gubib is a ring-shaped mountain rising about 5,200 feet above sea-level and 1,800 feet above the high plateau on which the village of Berseba stands. The mountain lies nine miles north of the village, and is a very conspicuous object from the railway north of Keetmanshoop. The plateau here is made of red sandstone and marls or shales belonging to the Fish River series, which is well exposed in the steep sides of the valley of the Fish River in this neighbourhood. The lowest beds of the Karroo system, Dwyka tillite and the overlying shales, are seen on the left side of the river near Dairacharab Drift, and tillite alone on the right side, resting on the nearly horizontal Fish River beds, but the Karroo rocks do not reach Berseba or Geitsi Gubib, where they have been removed by denudation.

The mountain itself is made of masses of fine-grained clastic rocks and breccias forming thick beds with steep dip towards the centre of the mountain (see Fig. 1 and section). The dip is often as high as 30°, and individual beds may be as much as 50 feet thick. Only the south-western, southern, eastern, and north-eastern sides were visited, but it seems that any one variety of rock has a limited distribution and is replaced within a few hundred yards by a slightly different variety, the difference being in colour, grain, and frequence of small angular fragments. A deep valley draining the central depression leads south-east to the surrounding plateau. The central depression, 1,500 feet below the highest point on the ridge, is flat and is covered with debris washed down from the steep wall round about it. A well had been sunk in approximately the middle of the depression, but it was partly filled in at the time of my visit. The material dug out of the well appears to have been soft and gritty, in fact the same kind of stuff as the fine-grained hard rocks of the wall but without the cement.

The contact of these fragmental rocks with the Fish River beds is well exposed in the walls of the valley cutting through the southern part of the ring. It is vertical or nearly so, and though this is the only place where

* J. Walther, "Geologie von Deutschland," 1910, p. 248; Rosenbusch, "Ergussgesteine," p. 871; and Zirkel's "Petrographie," vol. iii., p. 660.




Plan and N–S section through Geitsi Gubib. In the plan the outline of the tuffs is indicated by the circular broken line; the broken line to the south is a path. A, B, C, D, E are satellite pipes; G, H, J, are tuff dykes. In the section the dotted lines show a reconstruction of the mountain as it may have been at the close of the outburst.

the contact can be seen in section over 200 feet in height, no doubt the verticality of the junction is maintained all round the roughly circular area of fragmental rocks. The latter evidently occupy a "pipe" about 2 miles in diameter resembling a volcanic neck, but nowhere do they pass over this circular boundary. The Fish River beds near the boundary dip inwards towards it at a low angle, but at a distance of about 300 yards their inclination changes in direction and is outwards, so that the contact is surrounded by an anticline parallel to it in the Fish River beds and about 300 yards distant from it. Whether this structure is continued round the north-western side of the mountain is uncertain, but it exists in the west, south, and east. The outward dip decreases and disappears about a mile south of the southern contact.

## Petrography of the Rocks.

Fragments over an inch in length are rarely seen in the rocks of Geitsi Gubib itself, though much larger pieces go to form the satellite kopjes to the south. The coarser breccias of the mountain are generally brown or red, the finer-grained rocks red, yellowish, or white. The highest part of the mountain is made of brown breccia with fragments of hard shale and red and black jaspery rocks up to nearly an inch in length, cleavage faces of felspar are occasionally visible and there are also quartz grains, and calcite in small irregular cavities. In thin section (193 R, 194 R)* this rock is seen to be made of pieces of very fine-grained sedimentary rocks and a holocrystalline rock related to the quartz-gabbros, together with rounded and angular grains of quartz and of the felspar and augite from the gabbros. The plagioclase is fairly fresh, but the augite is usually stained yellowish red and is often considerably altered; in a few of the gabbro fragments wedges of micropegmatite are seen between the other constituents. The cementing material is mostly quartz and dusty stuff, but there are small cavities in the matrix lined with quartz crystals and filled in with calcite. The quartz-gabbro fragments differ from the rocks of similar mineral constitution intrusive in the Karroo beds in not being ophitic; they are more like some of the plagioclase-augite rocks of pre-Karroo age in the north of the Cape Province.

The red breccias of the eastern and south-western parts of the mountain differ from the brown rocks just described in having more abundant red ferruginous matter in the matrix (197 R and 198 R). In thin section some of the fragments are seen to be cherts with opaque dusty particles in small patches surrounded by a nearly clear matrix. Orthoclase fragments are present as well as pieces of gabbro and minerals derived from

* Figures in brackets refer to slides in the Cape Town office of the Geological Survey.

it, and there are pieces of sandstone and quartzite like some of the Fish River beds. These hard rocks are occasionally traversed by veins of very fine-grained brown, red, or black jaspery rock which is seen under a high power to consist of minutely crystalline quartz crowded with opaque ferruginous particles. The veins vary in thickness and may be as much as an inch in width; they can be traced for several yards across individual outcrops.

Some very fine-grained whitish rocks resembling porcellanite form part of the eastern wall. They are thin bedded and have a conchoidal fracture. In thin section (196 R) one of these rocks is a very fine-grained semi-opaque white material with numerous clear areas at most 0·02 mm. across and either roughly circular or polygonal in shape, showing the characters of chalcedony. A few very small splinters of quartz are enclosed in this matrix. The successive layers are due (1) to the greater or less abundance of the opaque dusty material, and (2) in some cases to the abundance of quartz splinters. A section through a hard red fine-grained rock from the southern side of the mountain (203 R) shows an abundant red ferruginous base with numerous rounded and angular grains of quartz up to 0·5 mm. in diameter, and a smaller number of grains of orthoclase, plagioclase, and fine-grained sedimentary rocks; this rock differs from the breccias above described only in the uniformly small size of the recognizable fragments in it.

A breccia from the south side of the mountain (199 R) contains pieces of microcline in addition to the minerals mentioned above; the matrix is in places formed by quartz grown on to rounded grains of quartz in crystalline continuity with them and enclosing fragments of sedimentary rocks and gabbro, etc.

The obvious character common to all these rocks is that they do not contain recognizable fragments of larva. Material of sedimentary origin forms by far the greater part of the breccias and tuffs—if the latter term can be used in this connection—and the recognizable igneous rocks and minerals present were derived from holocrystalline rocks of deep-seated origin, not from lavas or ordinary dyke rocks. Though the rocks described above are few in number they probably represent the material forming the ring-shaped mountain wall very fairly, for a careful search was made for different kinds of rock and the several varieties found were taken for more detailed examination. Igneous materials in these rocks have to be searched for, and the only place where they are at all conspicuous is one of the southern satellite pipes. I found it difficult to make sure that recognizable pieces of granite occur in the breccias of the mountain; some small fragments seen might have been granite, but that rock is certainly rare in the breccia, though the chief components of granite are abundant. Whether part of the matrix is derived from an acid volcanic rock is at present uncertain, it would be difficult from the specimens examined to prove either that it had such a source or not; one can only record the fact that no material seen hitherto in these breccias and tuffs resembles ordinary volcanic rocks or those unusual kinds met with in the Kimberlite pipes.

Porphyry-tuff is a misleading name for the rock; the fragments of felspar are not whole crystals, and they are inconspicuous components of the rock; augite is not noticeable in the hand-specimens. Neither in the field nor in the laboratory were any lapilli seen.

In the collection at the S.A. Museum there are two specimens of tuff labelled "Rochlitz" and "Rochlitzer Berg" respectively. They bear a superficial resemblance to the lighter-coloured red tuffs of Geitsi Gubib; the former are looser in texture, are crowded with quartz and orthoclase, and contain obvious fragments of quartz-porphyry. A thin section of a Rochlitz tuff is in the collection of the Geological Department of the S.A. College, and Professor Young kindly let me examine it; it has a fine-grained matrix with crystals and fragments of quartz which are often corroded after the manner of the quartz crystals in porphyry. These rocks clearly show no other point of resemblance to those of Geitsi Gubib than in being clastic rocks. Pieces of sediments and holocrystalline rocks, which together make up all the recognizable fragments at Geitsi Gubib, are absent from the Rochlitz specimens.

It is not easy to define the source of most of the fragments in the breccia. The most abundant types of rock are very fine-grained sediments, some of which, as stated by Dr. Range, may have come from the Karroo beds which possibly surrounded the pipe at a higher level than the present surface, but at present it is impossible to be certain of the identification. Fragments of quartzite and some shales are like some beds of the Nama formation pierced by the neck.

Joint planes and cracks in the breccias and tuffs are occasionally found coated with hyalite, water-clear opaline silica; small quartz veins are frequent, and a few thin veins of chalcopyrite and chrysocolla were seen in the tuffs exposed in the valley draining the central basin; barytes occurs rather frequently in small veins and cavities in all the varieties of tuffs and breccias.

In general appearance the Geitsi Gubib breccias and tuffs resemble the materials filling pipes and fissures at Saltpetre Kop,* Kobe River,† and Grenaat Kop,‡ in the Cape Province, though at all these latter localities the breccia is coarser than the Geitsi Gubib rocks, and several of

* Rogers and du Toit, Trans. Phil. Soc. S.A., vol. xv., 1904, pp. 61–83; and Ann. Rep. Geol. Com. for 1904, pp. 41–43.

† Ann. Rep. Geol. Com. for 1904, pp. 41–43.

‡ A. L. du Toit, Ann. Rep. Geol. Com. for 1908, p. 114.

them contain a greater variety of minerals derived from igneous rocks, while at some of the places mentioned there are fissures filled with igneous rocks.

The Kobe River neck is the only one of these occurrences in which minerals of probable igneous origin have not been found. But in each case the material from non-volcanic sources preponderate amongst the recognizable constituents of the rocks.

The occurrence of barytes at Geitsi Gubib is another point of resemblance to Saltpetre Kop, though the mineral seems to be more abundant at the latter place.

There are frequently slickensided surfaces in the tuffs produced by the local slipping of parts of the rocks after they were consolidated. The hardening of the rocks by deposition of silica is most marked in the peripheral part of the pipe; and this fact is certainly responsible for the ring shape of the mountain. The almost level floor of the central depression comes to an abrupt end where the stream-bed passes over the upper thick band of hard tuff which forms the higher of the two waterfalls in the valley; this strong bed can be followed easily up the mountain to the crest of the ridge on either side of the valley. The lower waterfall is caused by the presence of a second thick band of hardened tuff. These beds are fully exposed across the valley, and their unfractured condition proves that the valley owes its form to erosion alone and not to any radial crack through the wall of the neck.

The hardening due to the deposition of silica extends to the Fish River beds round the neck, for these are frequently traversed by small quartz veins and are more thoroughly quartzitic in the immediate neighbourhood than they are further away.

On the plan (p. 250) six small kopjes and three dykes are inserted. I only visited the two kopjes and the dyke south of the main mountain, the others were sketched in from the northern ridge of the mountain; they are conspicuous objects, and are almost certainly of the same nature as the southern ones.

The dyke G is a yellow ferruginous and calcareous rock, generally with fewer fragments in it than the breccias of the mountain contain. It is similar in general appearance to the tuff dykes of the Saltpetre Kop group. The kopje A is about 100 feet high and some 400 feet in diameter at the base; the contact of the breccia with the Fish River beds is hidden under debris. Kopje F is rather smaller and not more than 50 feet high, and the contact is again concealed. The breccias of these satellite pipes are much coarser than any seen in the mountain, large blocks of the Fish River sandstone and shales are the most abundant fragments, but whitish quartzites and granites are frequent and there is much fine-grained grey rock with the peripheral zones bleached. There are apparently no rounded pebbles or boulders in any of these rocks such as are found occasionally in the satellite pipes of Saltpetre Kop.

Barytes is rather more abundant in the two satellite pipes examined than in the mountain. At a spot on the edge of the terrace east of the dyke G and south of the path there is much calcareous yellow weathered material which may mark the position of another subsidiary neck.

It is extremely improbable that the present size and shape of the mountain bear any close approximation to what it was like when the great explosion produced it. The tuff and breccia wall projects over 1,000 feet above the highest remaining part of the Fish River beds and the thick layers of clastic material dip everywhere towards the interior. It is obviously impossible that they could have accumulated in such a position only, they must have extended outwards in the form of a cone about the orifice, but only that part is preserved which came within the area of deposition enclosed by the original vent within the old crater. The material which accumulated outside the vent has long since been washed away, and it appears likely, from the distribution of the hardened rocks, that the process of hardening was produced by liquids or vapours rising approximately along the walls of the vent, so that a more or less tubular column of hard tuff and breccia and hardened sandstone resulted, enclosing loose rock and surrounded by a ring of loose rock. The total height of tuff and breccia exposed in section in the valley and the mountain above is about 1,700 feet. The enclosed loose rock is still preserved under the flat bottom of the central depression, but the similar material which dropped outside the vent has disappeared (see Fig. 1). On this explanation the depression in the mountain is not a crater, though it happens to be in the same position as the old crater, which was larger than it; it is due entirely to the effects of erosion on a soft column of rock surrounded by a harder rock. The term caldera cannot be applied to it in any sense in which that term has been used by geologists who have described modern volcanos. The Spanish word "caldera" is the name given to the more or less complete circular basin surrounding a crater, but there have been various attempts to give it strict definition and explanation; according to one group of explanations it is a result of a violent explosion and subsequent partial filling in of the cavity produced, and according to another it was produced by the subsidence of a circular column of matter surrounding the crater. Professor Daly,* who has recently summed up the question, decides to limit the meaning to depressions considerably larger than the vent itself, and concludes that they are due to explosion or the melting down of material by the igneous rock rising from the vent. In the case of Geitsi Gubib we can see the walls of the vent in section, and the hollow within the mountain is much smaller

* "Volcanic Rocks and their Origin," 1914, pp. 144–150.

than it. Another possible explanation of the structure of Geitsi Gubib is that we have a ring-shaped fault forming a tube down which the upper part of the cone of fragmental rock has dropped either alone or carrying with it a casing of the Fish River beds. On this view one would expect to see more brecciation of the walls at the contact and a less regular arrangement of the contents of the pipe, but there is no evidence of faulting beyond local slickensides such as are found in many sedimentary rocks which have been slightly disturbed.

The description of Coon Butte in Arizona, written by G. K. Gilbert * seemed to offer an analogous example of a great explosion-crater unaccompanied by the appearance of ordinary volcanic rocks, and it is of more recent date. About a crater 1,300 yards wide in flat sedimentary beds there is a ring of fragmentary material, 200 feet high at most, composed of pieces of the sedimentary rocks, in this case limestone and sandstone. The depth of the crater floor below the ridge of fragments is 600 feet. The size of the fragments at Coon Butte is very much larger than anything seen at Geitsi Gubib, the larger blocks measuring in some cases 100 feet across. There has been no hardening of the breccia on the wall at Coon Butte, but it evidently presents some points of resemblance to Geitsi Gubib.

More recent information † got through extensive prospecting operations certainly shows that the alternative hypothesis considered and discarded by Gilbert may be correct, though it involves great difficulties. It is that a meteorite travelling very fast hit the earth there and smashed in the rocks, causing a sort of explosion violent enough to throw pieces of rock 50 tons in weight a mile from the point of impact. The chief evidence supporting the meteoric origin is briefly: (1) the finding of several tons' weight of meteoric nickel-iron fragments round the crater and in the rim; (2) the presence of nickeliferous magnetite and schreibersite fragments in the smashed rock at various depths down to 600 feet below the floor of the crater; (3) the supposed presence of an unbroken sheet of sedimentary rock under the crater at the depth of 700 feet or so; and (4) the absence of any volcanic rocks in the crater and in the ejected material. The third point is conclusive if correct,

* Fourteenth Ann. Rep. U.S. Geol. Survey, i., p. 187, and Presidential Address, Geol. Soc. of Washington, 1895.

† D. M. Barringer, Proc. Acad. Nat. Sc. Philadelphia, lvii., pp. 861–880; B. C. Tilghman, ibid. pp. 881–914; G. P. Merrill, Smithsonian Misc. Coll., l., pp. 461–489, and Proc. Australasian Ass. for Adv. Sci., 1909, vol. xii., p. 320. A later account of the work by Mr. Barringer was published separately at Philadelphia in 1909, but I have not seen it. Through the kindness of Mr. G. W. Lamplugh, who read the book in the Geol. Society's Library in London, I hear that in Mr. Barringer's opinion the "sandstone has been found to be in place, to be unaltered, and to be occupying a horizontal position." The proof that the sandstone met with is not a great block would appear to be still wanting.

and though the bore-hole records were for several reasons unsatisfactory, the facts quoted in the description make the volcanic hypothesis difficult to accept. Instances of large blocks in explosion-pipes, such as the piece of Waterberg beds 400 yards by 100 yards or less in area which has been followed to a depth of 260 feet in the Premier Mine,* show that the mere presence of what might be taken to be the floor of a pipe in a bore-hole does not prove that the rock encountered passes across it. No cementation by silica or other substances is recorded, though melting of comminuted sandstone took place locally. It is noticeable in the papers quoted below that the difficulties of the volcanic hypothesis seem to have had great effect in gaining the acceptance for the other in the authors' minds, especially the excessive comminution of the quartz grains of the broken sandstone and the absence of volcanic rocks. The lack of recognizable volcanic rocks is not decisive, nor would the minute splintering of the quartz seem to be, and the coincidence in place of a heavy meteorite fall and an explosion-crater is not impossible. At present, however, Coon Butte cannot be quoted as a case of an explosion-crater.

Though explosion-craters, or necks which led to them, from which no lava flowed, are known in many parts of the world, the materials filling them are usually fragmental volcanic rocks alone or mixed with debris from non-volcanic rocks. In certain regions necks have been described filled entirely with material derived from non-volcanic rocks so far as they are exposed, though in many such cases there must be some doubt on this point because no mention is made of the results of a microscopic examination of the rocks, and it sometimes happens that a rock which is apparently without fragments of lava is found to contain such fragments when examined in thin section.† In the Stormberg and Drakensberg region the volcanic vents of late Karroo age include many without apparent lava fragments, though there are probably more which are filled with tuffs of a normal type or at least contain some ordinary volcanic rock.‡ In the carboniferous volcanic area of Scotland many of the smaller necks and some of the larger ones are filled with non-volcanic material.§

Agglomerates of non-volcanic rocks are also found in Tertiary necks in

* Wagner, P. A., "The Diamond Fields of South Africa," 1914, Fig. 9 and p. 21, where several other instances are given from blue-ground pipes. An example from a large neck on Arran, where a mass of Triassic sediments "several acres in extent" is lying amongst volcanic material, is described by Messrs. Peach and Gunn, in Quart. Journ. Geol. Soc., London, lvii., p. 227.

† Cf. A. W. Rogers, Trans. Phil. Soc. S.A., vol. xvi., p. 193, and Ann. Rep. Geol. Com. for 1905, p. 36; tuffs thought to be of non-volcanic material proved, on microscopic examination, to have small lapilli in them.

‡ E. H. L. Schwarz, Ann. Rep. Geol. Com. for 1902, p. 54; A. L. du Toit, Ann. Rep. Geol. Com. for 1904, pp. 155, 165; do. for 1905, p. 130; do. for 1911, p. 125.

§ Sir A. Geikie, Trans. Roy. Edin., vol. xxix., p. 458: "Ancient Volcanoes of Great Britain," vol. i., pp. 57, 426–7; and "Geology of Eastern Fife," 1902, p. 204.

Raasay and in the Slieve Gullion area in Ireland, where they are in a fissure clearly associated with andesite and rhyolite.*

In such cases as those from Scotland it is supposed that the explosive force which opened the vents and filled them with fragments of the rocks surrounding the vents was directly connected with the magma which gave rise to other and more normal volcanic phenomena in the same neighbourhood, but that locally the force became exhausted in the effort before fragments of the magma itself could reach the surface. In the case of Geitsi Gubib, which is certainly a very large neck, it is difficult to understand how the results of so great an explosion could be deficient in fragments of volcanic rocks. It may be that such fragments are in the tuffs there in a minutely subdivided and unrecognizable form, or that they are to be found at a lower level than the present outcrops.

I saw no igneous rocks in the immediate neighbourhood of Geitsi Gubib, but pipes of blue-ground exist not far off, near Gibeon, and to the west and north-east of the mountain,† and Karroo dolerites occur 20 miles to the south-east at Baviaans Kranz.

As to the age of the mountain there is no satisfactory evidence as yet. The Karroo beds, so far as we know, do not lie close enough to the mountain to be affected by the outward dip of the strata in its immediate neighbourhood, but the road from Dairacharal Drift to Tses crosses a breccia dyke in those beds, and it is likely that this dyke was produced at the same time as Geitsi Gubib. The presence of fragments of Karroo beds in the breccia of the mountains is possible, but cannot be said to be proved, and there is no reason for suspecting that the Karroo beds on its site were thick at the time of the outburst. There are terraces at various levels round the mountain from which much information about its previous history will certainly be got, but my observations were too scanty and hurried to form the basis of a discussion. From the height of the upper terraces and their proximity to the neck, however, it seemed that the mountain need not have been very much higher than it is now when the outflowing stream began to cut through the Fish River beds at the south side of the neck.

* Sir A. Geikie, "Ancient Volcanoes," ii., pp. 423–4.

† Eighteen of them are marked in Dr. Range's map, and he states that over thirty are known, "Geologie des Deutschen Namalandes"; a brief description is given by Dr. Scheibe in "Der Blue-ground," Prog. d. Konigl. Berg. Akademie zu Berlin, 1906.

# ON SOME DINOSAUR REMAINS FROM BUSHMANLAND.

By S. H. Haughton, B.A., F.G.S.

(Read May 19, 1915.)

According to the nature of their fossilization the fossils collected by Dr. Rogers on the farm Kangnas, Bushmanland, Cape Province, can be divided into three groups. The first group comprises a single tooth lacking the end of the root, and an almost complete femur. These are highly calcified, but are weathered clean out of the original matrix, and have highly polished brown external surfaces. The femur has suffered a certain amount of superficial crushing. The second group comprises portions of other femora and of other bones of the hind leg, together with two vertebrae. These bones are highly calcified and compact, and were for the most part enclosed in a variable calcareous conglomerate which, in its harder parts, came away with difficulty from the bone surface. The third group consists of a number of fragments of vertebrae and bones of the foot, which are highly porous and cancellous in structure, and superficially appear to be from a different deposit from the bones of the other groups. All the remains, however, are Dinosaurian in character. Judging from their relative sizes, the bones of the first two groups belong to a single species of the Ornithopoda, which I propose to name *Kangnasaurus coetzeei*, n.g. et sp., after Mr. Coetzee, the owner of the farm Kangnas, by whom the remains were first brought to Dr. Rogers.

To avoid confusion the tooth to be described is taken as the type of this new form.

## Kangnasaurus coetzeei, n.g. et sp.

The only tooth obtained is a maxillary tooth of the right side (S.A.M. Cat., No. 2732). It has the crown partially worn down in an oblique manner so that the outer border of the worn surface forms a sharp crenulated cutting edge, and it lacks the extremity of the root. The root is cylindrical and tapers gradually from the base of the crown. It was supplied with a well-defined pulp-cavity, oval in cross-section. The outer surface of the crown is ornamented by a series of ridges. Two outer ridges and an approximately median ridge are much stronger than the others, and extend in a less well-defined manner along the outer surface of the root. The "median" ridge divides the outer crown surface into two unequal areas, of which the smaller is probably the posterior, as in *Camptosaurus*. The outer ridges do not form the anterior and posterior limits of the crown. They start from points approximately midway between the "median" ridge and these borders, and pass from the cingulum to the limiting edges of the crown, as shown in Fig. 1. In the areas lying between the "median" and outer ridges are a number of lesser ridges which do not pass on to the surface of the root. The smaller area carries

Fig. 1.

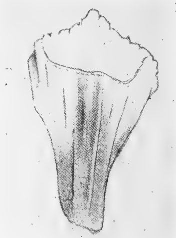


Fig. 2.

Maxillary Tooth of *Kangnasaurus coetzeei*. × 2·5.

Fig. 1.—Outer View.
Fig. 2.—Inner View.

7 ridges of various sizes, and the larger 8. The arrangement of these subsidiary ridges can best be understood from the figure. The majority of them pass on to the "median" ridge or the strong lateral ridges. The tooth is longitudinally curved. The inner surface of the crown is gently convex, and is supplied with a few slight longitudinal ridges, which cause the inner edge of the worn surface to be slightly sinuous.

While agreeing in the possession of the strong median ridge and lateral ridges with the teeth of *Camptosaurus*, *Hypsilophodon*, and *Mochlodon*, this tooth shows many differences from those genera. In *Mochlodon* and *Camptosaurus* the area between the median ridge and the outer ridge is U-shaped; and while in *Hypsilophodon* there is a slight angle at the base of the area, it is by no means so marked as in this new form, and the outer ridge is much more nearly parallel to the median ridge. In *Mochlodon* the secondary ridges are all parallel to the median ridge.

*Limb-bones and Vertebrae.*—Of the other parts of the skeleton the best-preserved are a nearly perfect right femur (2731), the proximal (2731*a*), and distal (2731*b*) portions of another right femur of almost the same size, the proximal end (2731*d*) of another and slightly larger

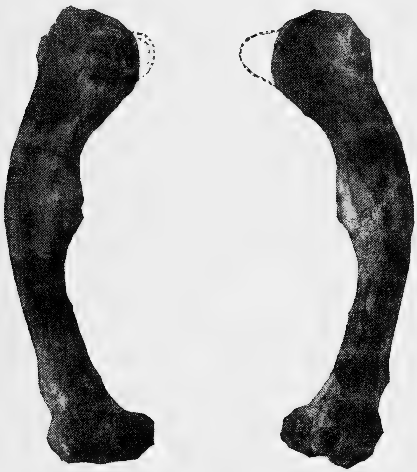


FIG. 3. FIG. 4.

RIGHT FEMUR OF *Kangnasaurus coetzeei.* × $\frac{1}{5}$ NEARLY.

FIG. 3.—Anterior View.
FIG. 4.—Posterior View.

right femur, the distal end (2731*c*) of a somewhat smaller left femur, the distal end of a left femur with the proximal end of a left tibia and what is probably part of the fibula (2731*e*), the distal end of a tibia and part of the tarsus and metatarsus (2731*j*), and some vertebrae (2731*f*). (The numbers in brackets refer to those in the South African Museum Catalogue.) Although no one femur is complete, a study of the remains enables one to restore the whole bone save for the inner trochanter. The bone on which the description is chiefly based is that numbered 2731.

The femur has a strongly curved shaft. The inner trochanter lies wholly on the proximal half of the shaft, and is compressed. Unfortunately it is incomplete, so that it is impossible to say whether it was of the pendent type characteristic of *Camptosaurus* or of the type seen in *Iguanodon*. The slender evidence available leads to the belief that it was not of the pendent type. Just in front of the trochanter on the inner side of the bone is a shallow depression with a rugose surface. The head is well developed and globular, and well seen in specimens 2731*a* and 2731*d*. Between the head and the remainder of the articular surface is a well-marked shallow groove. A lesser trochanter rises on the antero-external surface of the shaft, nearly to the height of the greater trochanter. It is compressed transversely, and, in all the specimens, owing to crushing, it is compressed on to the shaft. Before compression it must have been separated from the shaft posteriorly by a deep and narrow cleft. In the posterior upper surface of the shaft are two concave depressions, separated above by a prominent wide ridge. The inner of the grooves is just behind the head. The distal end shows the usual two condyles. The inner condyle is more robust than the other. Both have rugose articular surfaces. The anterior intercondylar groove is wide and shallow as in *Camptosaurus*. The posterior groove is deep and fairly wide, its shape being best understood from the outline figure given. The femoral remains show the presence of at least three, and possibly four, distinct individuals, but there is no doubt that they are all of the same species.

Only the proximal and distal ends of a tibia are present, so that it is impossible to give the relative lengths of the femur and tibia. The proximal end is very robust. The two condyles project posteriorly and are separated by an intercondylar groove. Of the two, the inner one is the larger and projects further back. The cnemial crest is very large and projects outwards in front of the external condyle from the top of the shaft. The broken end shows the proximal portion of the shaft to have been oval in cross-section, the longer diameter running in an antero-posterior direction. The distal end (2731*j*) of what is probably the same left tibia shows the usual malleoli, the outer being more slender and longer than the inner. They are separated on the anterior surface of the bone by a wide and shallow depression.

The astragalus, calcaneum, one tarsal, and the proximal ends of three metatarsals are all present in the specimen 2731*j*, but as far as displayed call for no special comment.

Specimen 2731*f* shows two posterior caudal vertebrae and portions of two others. The neural spines pass back behind the level of the front of the next succeeding centrum. The anterior zygapophyses are finger-like processes which pass forward along the base of the neural spine of the preceding vertebra. No chevrons are displayed.

The following table gives some of the chief measurements :—

| | |
|---|---|
| Greatest length of femur (2731) | 396 mm. |
| Greatest diameter of proximal end of femur (2731*d*) | 100 ,, |
| Greatest diameter of distal end of femur | 107 ,, |
| Greatest diameter of proximal end of tibia (2731*e*) | 106 ,, |
| Greatest diameter of distal end of tibia (2731*j*) | 65 ,, |
| Greatest length of caudal vertebra | 47 ,, |
| Greatest width of caudal vertebra | 30 ,, |
| Greatest height of caudal vertebra | 50 ,, |

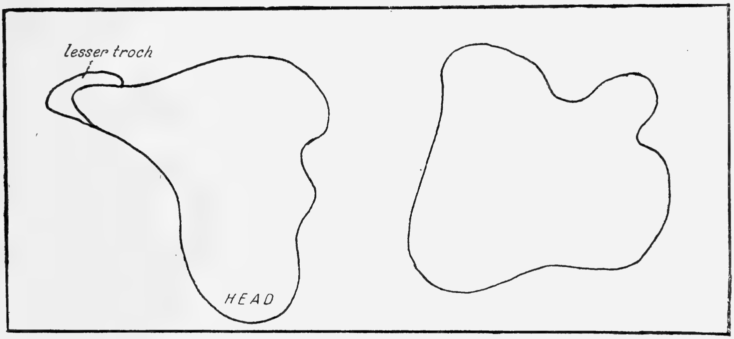



FIG. 5. FIG. 6.

*Kangnasaurus coetzeei.* × 0·44.

FIG. 5.—Outline of proximal end of femur.
FIG. 6.—Outline of distal end of femur.

*Affinities.*—The genera with which this form shows the most points of agreement are *Camptosaurus* and its allies of the American forms, and *Hypsilophodon* and *Mochlodon* of the European forms. Of these *Camptosaurus* is from the Upper Jurassic, *Hypsilophodon* from the Wealden, and *Mochlodon* from the Upper Cretaceous.

In the description given of the tooth, the chief peculiarities have already been described. Nopsca, in his discussion of *Mochlodon*, considers that a portion of the Ornithopoda, including the genera *Hypsilophodon, Mochlodon*, and *Camptosaurus*, have carried out a specialization of the teeth through the introduction of secondary ridges and simple and double notches. Comparing the teeth of *Mochlodon* and of *Camptosaurus* it seems that the former may be considered to be the more highly specialized in that all the secondary ridges are parallel to the median ridge and are continuous down the whole of the crown, thus providing a serrated cutting edge with a constant number of serrations throughout the life of the tooth. *Kangnasaurus* appears to occupy an intermediate place between *Mochlodon* and *Camptosaurus.* Some of the ridges continue to the base of the crown, while others die out by being joined to the median ridge. These latter, however, seem longer and more prominent than the shorter ridges in *Camptosaurus.*

The chief features of the femur are its curvature and the comparative smallness of the inner trochanter, which lies wholly on the proximal half of the shaft. In the position of the trochanter it agrees with *Camptosaurus leedsi*, *Dryosaurus*, and *Hypsilophodon*, and differs from the other species of *Camptosaurus.* The anterior intercondylar notch is wide and shallow, and agrees with that of *Camptosaurus* and *Hypsilophodon.* Nopsca considers that the more complex development of the tooth runs hand in hand with the diminution in size of the fourth trochanter. Unfortunately, the femur of *Mochlodon* is unknown.

Such facts as are at our disposal point to the conclusion that this form is a later type than *Camptosaurus*, but without further evidence speculation as to the exact age of the remains would be very premature. It must be remembered that Gilmore has described a new form closely allied to *Camptosaurus* from the Lance Formation of Wyoming—a deposit placed by some workers in the Upper Cretaceous and by others in the Lower Tertiary—and that Dinosaurs are also said to have been obtained *in situ* in the Eocene beds of Patagonia and of Colorado.* On the other hand, an Ornithopodous Dinosaur allied to *Laosaurus* and *Hypsilophodon*, and whose femur is about three-quarters the size of the one here described, has been found in the beds of Tendaguru, in German East Africa, which are undoubtedly of Cretaceous age.

* Matthew (Bull. Geol. Soc., America, 25, p. 401) points out that there is no *a priori* improbability in the survival of Dinosaurs in South America into Tertiary times, and after their extinction in the Northern Hemisphere, but adds that the evidence that they did so seems open to very serious question.

# THE OCCURRENCE OF DINOSAURS IN BUSHMANLAND.

By A. W. Rogers.

(Read May 19, 1915.)

In 1913 Mr. James Crozier, Superintendent of the Cape Copper Company, showed me some fragments of large bones in a mineralized condition which had been brought to O'okiep by Mr. Coetzee, a farmer in Bushmanland. The bones came from a well and were evidently of interest, so a few days later I took an opportunity very kindly offered by Mr. R. A. Good, of O'okiep, of driving out to Mr. Coetzee's farm, Kangnas, where the well was being sunk. The well is in a wide shallow valley leading to the Orange River at Henkries. At the time of my visit it was 112 feet deep and had two tunnels at the bottom. The material just under the surface is tufaceous limestone, such as crops out in the patches of hard veld in western Bushmanland, and is formed by the deposition of carbonate of lime where water which has sunk into the ground evaporates at the surface or in the soil near it. Below this limestone, which is about 5 feet thick and has no very definite lower limit, there is a sandy and slightly clayey material, loosely consolidated but strong enough to stand in the sides of the well, though it can be dug out with pick and spade. On the dump it breaks up rapidly into a sandy mass. This material is evidently derived from the gneiss which underlies the superficial deposits of western Bushmanland and forms all the hills there. In the well it is about 100 feet thick, and I could not see any difference in various parts of it. The gear at the well was of the usual sort used on farms, a windlass, wire rope, and bucket, and a systematic examination of the well section could not be made. The sides of the well are rather obscured by droppings from the bucket on its repeated journeys. However, Mr. Coetzee's account of the work and an examination of the dump confirmed the apparent absence of marked differences in the walls of the well. The last 10 feet or so differ from the rest in the presence of calcareous concretions, bones, and, at the bottom, subangular fragments of quartz and gneiss; there is some calcified and silicified wood, and there are thin layers of fibrous calcite and lignite streaks an inch or less thick. The calcareous concretions are in some cases flattened horizontally and have a rather close texture, in others they are irregular in shape, looser in texture, and more sandy, and in these masses some of the bones occur; other bones are lying in the sandy material which is the matrix of all the concretions and boulders. The silicified wood occurs both in the loose calcareous concretions and in the sandy clay. The bones in the concretions are calcified, and the hollow interior is lined with calcite crystals. Many bones in the sandy matrix are in a similar condition, but some of them in this position are free from any noticeable deposit of carbonate of lime. The matrix near the bottom of the well is very like the material above, perhaps rather more clayey. An examination of the calcareous grit in which the concretion and bones lie was made by dissolving as much as possible in dilute hydrochloric acid, washing off the considerable quantity of clayey material, and looking at the remainder under the microscope. Eliminating the grit of quartz and felspar a millimetre or over in diameter, the smaller fragments consist of quartz, microcline, and perthite, usually sharp-edged and very little weathered, and small lumps of opaque clayey stuff which break down into indeterminable dust. The smaller clayey pellets in the pale matrix of the rock consist of clay and grains of quartz and felspar without an appreciable quantity of carbonate of lime. The only difference I could detect in the last 10 feet and what lies above is due to the presence of the thin layers of fibrous calcite, concretions, wood, bones, and large fragments of bed-rock. The siliceous concretions are traversed by cracks lined with small crystals of quartz, sometimes arranged in a roughly radial manner rather like the cracks in calcareous "septarian" nodules from clays and shales.

There were two tunnels at the bottom of the well, each about 6 feet high, one was 30 feet long and the other 10 feet. The walls and roof of these presented an appearance similar to that of the corresponding part of the well. The longer tunnel has since been extended to the east side of the valley, where the gneiss was exposed.

The whole of the deposit appeared to be the result of the gradual filling in of the valley by local debris at a time when the rainfall no longer sufficed to keep the stream-bed free of detritus. At the time of my first visit no teeth had been found, and the fragments of bone, some of which were taken from the dump or had been brought to O'okiep, while others I extracted from the wall of the well and tunnels, did not fit together to make one complete bone. Mr. Coetzee said he would keep all fragments found till I could go there again. At the time it seemed that the bones might belong to a large buck, but on a second visit, in 1914, when the geological survey was extended to that area, Mr. Coetzee gave me a tooth which looked as if it were dinosaurian.* On this occasion there was

* Dr. Smith Woodward, to whom a cast of the tooth was sent, says it undeniably belongs to a herbivorous dinosaur.

water in the well, so that an examination of the further work below ground could not be made. More fragments of bone were found lying on the dump, and from these and the bones got in 1913 femurs with dinosaurian features have been put together. Mr. Haughton has written an account of the bones.

It being very probable that we have not got to do with an outlier of a formation containing dinosaurs covered discordantly by very much younger deposits, there remains to be considered whether the bones were derived from such a formation which used to exist, or still exists, in some part of Bushmanland, and are merely boulders in the bed of the valley like the fragments of gneiss and quartz. The bones are neither water-worn nor weathered; their condition differs very greatly from, for instance, that of the bones picked up in the Karroo after having been released from the Beaufort beds by weathering. The larger bones at Kangnas have in some cases been broken *in situ* and the fragments re-cemented by carbonate of lime, but the surfaces are in good condition and the ends are not battered. It seemed to me that the bones had been buried in the sandy mud, and that the history of the valley since then has been a more or less uniform process of in-filling by the material washed and blown into it.

So far as is known, dinosaurs became extinct in Cretaceous times, though in view of the discussions on the age of the later dinosaur-bearing beds in America that question is still an open one; so the age of the bones is not known, indeed the history of dinosaurs in Africa is at present most fragmentary. However, these bones must be very old in a geological sense, and their occurrence at Kangnas leads one to suspect that many similar finds may be made in the buried valleys of Bushmanland, the southern Kalahari, and part of Griqualand West.

No shells or other remains of animals than the bones have been found in the well, and the fossil wood has not yet been examined.

The nature of the material in the well reminds one very strongly of the deposits exposed in the ravines on the eastern flank of Kamies Berg and the adjoining part of Bushmanland, where rubble and sandy clay lie on the old gneiss, and where there are occasional masses cemented by limestone or silica. The occurrence of silicified wood recalls the curious deposits at Banker,* which, however, differ from the Kangnas rock in containing ilmenite and opal, and also in the curious bleaching of the gneiss and the distinct bedding of the sandy deposit.

It is important to note that no remains of the Karroo beds occur above the gneiss in the Kangnas well, nor were boulders derived from the Dwyka tillite found there; the rock fragments are of local origin. The lower part of the Karroo beds probably covered the whole of Bushman-

* Annual Report Geological Commission for 1911.

land at some former time, but at present Kangnas is 65 miles from the nearest outlier to the north and about 75 from the main Dwyka area to the south; the position of the Dwyka boundary to the east or south-east is not known exactly.

At the present day the only ways in which material can leave the interior of Bushmanland are (1) wind action, (2) solution by water which percolates underground towards lower levels and carries away the dissolved substances, and (3) by water action at the surface along the valleys. The third of these agents is certainly every insignificant, for one cannot see any channels in the valleys. No doubt every heavy rain moves some of the sand along the valleys, but owing to the porous nature of the ground and the dryness of the air in this region the low rainfall there cannot produce any appreciable effect by transport along the valleys, though it certainly tends to fill those valleys with sand. The removal of matter in solution is obviously a slow process, for the springs emerging where the bed-rock crops out at the edge of the sand-veld are few and small, though figures cannot be given. Wind action, like that of surface water, is much more efficacious in levelling up local valleys than in carrying material away from the district altogether.

A consideration of the conditions now in force in Bushmanland leads one to believe that the valleys now existing may well represent extremely old, even mesozoic, valleys which have changed only through having been filled up by locally derived material, provided that the climate has remained fairly constant throughout the intervening period. A condition of greater rainfall would have cleaned out the valleys, and a much diminished rainfall* would have been accompanied by the destruction of the vegetation, which is at present an efficient protection of the flat ground against the devastating effect of wind.

The vegetation in Bushmanland may be divided into two classes—that which appears soon after the rain and dies off completely after seeding, and the short, stubby bush which has great power of resisting drought and never disappears under present conditions unless stamped out by stock on paths or round watering-places; it is the second class that is of such great importance in protecting the ground from wind. The mere existence of this drought-resisting flora must be regarded as evidence of the great length of time during which the country has had a dry climate, though there are no means of correlating the adaptive changes in the plants with geological periods.

It is well to remember that we have no conception of the time

* There are no figures available for the interior of Bushmanland; the rainfall there probably lies between 3·79 (Pella) and 5·75 (Lilyfontein) inches per year, for which stations figures are given in Buchan's "Discussion of the Rainfall," etc., Cape Town, 1897.

View of Henkries Valley above the water, looking South-east.

The Hills, made up of Gneiss, Pyroxenite, and Pegmatites (white), rise steeply from the Valley, which is partly filled up with sand.

necessary for the reduction of any given tract of hilly country to a uniform surface through the action of wind and rain under semi-arid conditions. Figures have been obtained representing the rate of denudation in certain drainage basins, and an average rate of lowering of the land surface can be got from them; but the conditions vary so greatly * that even for the present time the value of such an average is quite uncertain. These estimates are based on the area of the basins and the volume and contents of the outflow, and they are the only measure of denudation yet attempted, but they are not applicable to a region like Bushmanland, where there is no outflow.

From the general surface features of the Kalahari region and the nature of the superficial deposits, Dr. Passarge † argued that the whole region owes its characters primarily to the prevalence of desert conditions during post-Karroo times, though wetter climates are supposed to have intervened. The evidence of fossils has hitherto been wanting, but the general truth of Passarge's views has not been questioned. The discovery at Kangnas affords some confirmation of those views and also grounds for expectation that abundant evidence bearing on the problem awaits discovery; though the facts at present do not support the hypothesis of markedly varying climates.

Bushmanland is really the southern end of the Kalahari region separated from the main portion by the valley of the Orange River, which is fed by a country with much higher rainfall far to the east, and it is very probable that under present conditions the river always loses more water by evaporation than it receives between the Hartebeest River and the Fish River, a distance of 340 miles; usually, in fact, that statement must also be true of the much longer stretch from the confluence of the Vaal and Orange down to the sea.

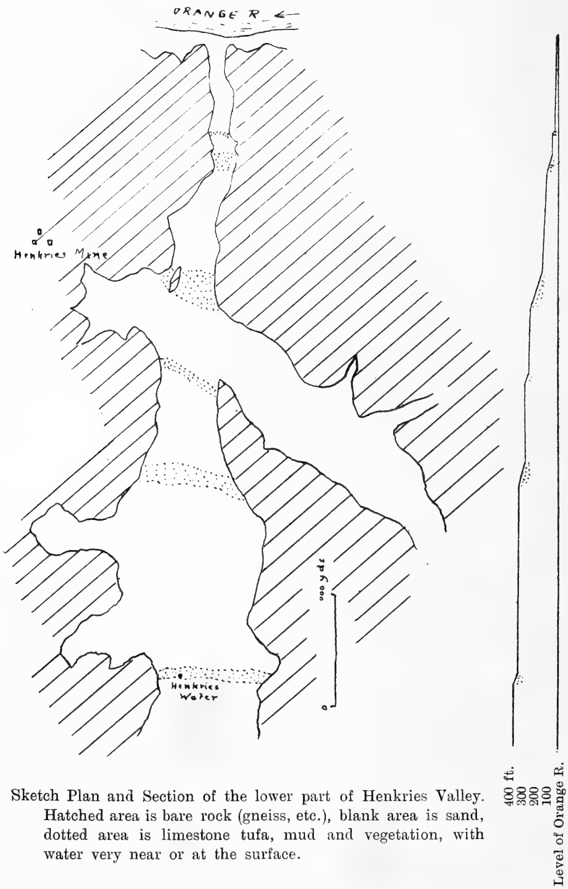
The fact that some unknown thickness of Karroo beds was removed by denudation over part of Bushmanland and that valleys were cut in the underlying gneiss before the dinosaur bones were buried proves that a wetter climate prevailed there before the valleys began to be filled up.

The Kangnas valley is a part of the river system which enters the Orange River at Henkries. The last 8 miles of the valley lie between steep, bare, rocky hills which rise abruptly from the surface, and small kopjes appear above the surface of the wide valley. From the relation of these hills and kopjes to the wide but sloping valley floor, it is obvious that bed-rock lies far below the present surface. (See Plate XXXVI.) The

* See the table of results for nine rivers in Chamberlin and Salisbury's "Geology," vol. i., p. 101, and the discussion in Penck, "Morphologie der Erdoberfläche," 379–385.

† See Passarge, "Die Kalahari," 1904, ch. xxxv.

sketch plan and section (see figure) along the last 3½ miles of the valley were made by pacing and anaeroid readings, but they illustrate its chief




Sketch Plan and Section of the lower part of Henkries Valley. Hatched area is bare rock (gneiss, etc.), blank area is sand, dotted area is limestone tufa, mud and vegetation, with water very near or at the surface.

features sufficiently closely for our purpose. The drop from the highest terrace (where Henkries water is situated) to the river is about 400 feet, or rather over 120 feet to the mile, which is a very steep slope for the lower end of a tributary draining at least 2,000 square miles of country. The slope of the valley above the water is also very great for the first 10 miles or so.

The surface of the ground in the valley is a coarse sand or grit derived from gneiss, but the narrow slopes between the terraces are made of damp, muddy, and calcareous sand, very often seen to be resting on calcareous tufa, which frequently crops out over hundreds of square yards. These damp belts are more or less covered with vegetation, especially rushes and mimosa thorns, while the sand between and above the damp belts is almost bare. Water is got on the bush-covered belts at a very shallow depth, and often appears at the surface, so there are swampy patches on them. The slope of the surface on the belts is great, while the stretches of sand between them are very gently inclined. The water of the top belt is brak, but quite good for drinking, though it leaves a distinct white efflorescence on the ground after evaporation; the waters below the top terrace become more and more salt as one goes down the valley, and at the time of my visit (May, 1913) that of the 4th belt and below seemed to be too salt to drink. A small stream issued from the 4th belt and made its way down to the river, being strengthened by additions from the 5th and 6th belts. This stream was finally half an inch deep and a foot wide, and it was the only stream seen entering the Orange River on the left bank between Raman's Drift and the mouth, a distance of nearly 200 miles along the river.

Outcrops of gneiss on the valley floor are first seen below the 5th belt. The calcareous tufa of the belts is a very sandy rock cemented by white limestone; in the larger outcrops where springs have cut channels it is seen to be roughly bedded, and it was evidently formed by the cementation of the sand of the valley at the places where there has been long-continued evaporation of brakwater. A good explanation of the formation of the terraces has not been found, but it seems clear that the progressive saltness of the water is due to evaporation at the surface in each belt; the water appearing at the 1st belt sustains loss by evaporation, sinks under the sand and reappears at the lower belts, each time with a greater proportion of salts in solution. Whether the position of the belts was determined by the shape of the rock floor is uncertain, but wherever the water flowing underground maintained a level very near the surface during former stages of the valley's history, plant growth must have been encouraged, and this growth checked the downward travelling of sand, thus tending to form the terraces of low slope between the belts. Evaporation of the water brought about deposition of carbonate of lime between the sand grains, and such action would obviously have been greater in the damp belts than in the terraces between them. Erosion by running water only takes place in the belts, for it stops when the water disappears in the sand of the succeeding terraces. The positions of the open springs and the short streams issuing from them change owing to the choking up of the springs by vegetation and, at the present time, owing to the opening of new water-holes, which develop into springs, for animals to drink at. Probably heavy rains in Bushmanland cause water to break out at fresh spots on the belts and to overflow at waters already open.

# TRANSACTIONS

OF THE

# South African Philosophical Society.

The following volumes have been published:—

| VOL. | | PUB. | s. | d. |
|---|---|---|---|---|
| I.— | Part 1 ...... | 1878 | | |
| | Part 2 ...... | 1879 | 2 | 6 |
| | Part 3 ...... | 1880 | 2 | 6 |
| II.— | Part 1 ...... | 1881 | 5 | 0 |
| | Part 2 ...... | 1881 | 2 | 6 |
| | Part 3 ...... | 1882 | 2 | 6 |
| III.— | Part 1 ...... | 1884 | 2 | 6 |
| | Part 2 ...... | 1885 | 10 | 0 |
| IV.— | Part 1 ...... | 1887 | 2 | 6 |
| | Part 2 ...... | 1888 | | |
| V.— | Part 1 ...... | 1888 | | |
| | Part 2 ...... | 1893 | 2 | 6 |
| VI.— | Part 1 ...... | 1890 | 2 | 6 |
| | Part 2 ...... | 1892 | 2 | 6 |
| VII.— | Part 1 ...... | 1893 | 10 | 0 |
| | Part 2 ...... | 1896 | 20 | 0 |
| VIII.— | Part 1 ...... | 1895 | 2 | 6 |
| | Part 2 ...... | 1896 | 5 | 0 |
| IX.— | Part 1 ...... | 1897 | 5 | 0 |
| | Part 2 ...... | 1898 | 7 | 6 |
| X.— | Part 1 ...... | 1897 | 15 | 0 |
| | Part 2 ...... | 1898 | 7 | 6 |
| | Part 3 ...... | 1899 | 7 | 6 |
| XI.— | Part 1 ...... | 1900 | 12 | 6 |
| | Part 2 ...... | 1900 | 12 | 6 |
| | Part 3 ...... | 1901 | 7 | 6 |
| | Part 4 ...... | 1902 | 12 | 6 |

| VOL. | | PUB. | s. | d. |
|---|---|---|---|---|
| XII.— | (Pp. 1–560) | 1901 | 25 | 0 |
| | (Pp. 561–896) | 1902 | 14 | 0 |
| | (Pp. 897–920) | 1903 | 2 | 0 |
| XIII.— | (Pp. 1–288) | 1904 | 12 | 6 |
| | (Pp. 289–546) | 1907 | 8 | 6 |
| | (Pp. 547–752) | 1908 | 10 | 0 |
| XIV.— | Part 1 ...... | 1903 | 5 | 6 |
| | Part 2 ...... | 1903 | 8 | 6 |
| | Part 3 ...... | 1903 | 11 | 0 |
| | Part 4 ...... | 1903 | 5 | 0 |
| | Part 5 ...... | 1904 | 3 | 0 |
| XV.— | Part 1 ...... | 1904 | 3 | 6 |
| | Part 2 ...... | 1904 | 3 | 6 |
| | Part 3 ...... | 1904 | 17 | 0 |
| | Part 4 ...... | 1905 | 7 | 6 |
| | Part 5 ...... | 1905 | 12 | 6 |
| XVI.— | Part 1 ...... | 1905 | 10 | 0 |
| | Part 2 ...... | 1905 | 10 | 0 |
| | Part 3 ...... | 1906 | 5 | 0 |
| | Part 4 ...... | 1906 | 15 | 0 |
| | Part 5 ...... | 1907 | 3 | 6 |
| XVII.— | Part 1 ...... | 1907 | | |
| | Part 2 ...... | 1908 | | |
| XVIII.— | Part 1 ...... | 1907 | 9 | 0 |
| | Part 2 ...... | 1908 | 12 | 0 |
| | Part 3 ...... | 1907 | 4 | 6 |
| | Part 4 ...... | 1909 | 7 | 0 |

Copies may be obtained from the Honorary Secretary of the Royal Society of South Africa; or from Messrs. WM. WESLEY & SON, 28, Essex Street, Strand, London.

*Members of the Society may obtain the publications, from the Secretary only, at half of the above prices.*

Part 1 of vol. I., Part 2 of vol. IV., Part 1 of vol. V., and vol. XVII., Parts 1 and 2, are out of print.

## TRANSACTIONS

OF THE

## ROYAL SOCIETY OF SOUTH AFRI[illegible]

| | | | |
|---|---|---|---|
| Vol. I. Part 1 | 1909 | Price | 1 [illegible] |
| ,, I. Part 2 | 1910 | Price | 0 10 [illegible] |
| ,, II. Part 1 | 1910 | Price | 0 [illegible] |
| ,, II. Part 2 | 1911 | Price | 0 [illegible] |
| ,, II. Part 3 | 1912 | Price | 0 [illegible] |
| ,, II. Part 4 | 1912 | Price | 0 [illegible] |
| ,, II. Part 5 | 1912 | Price | 0 [illegible] |
| ,, III. Part 1 | 1913 | Price | 0 [illegible] |
| ,, III. Part 2 | 1913 | Price | 0 [illegible] |
| ,, III. Part 3 | 1913 | Price | 0 10 [illegible] |
| ,, IV. Part 1 | [illegible] | Price | 0 10 [illegible] |
| ,, IV. Part 2 | 1914 | Price | 0 [illegible] |
| ,, IV. Part 3 | 1915 | Price | 0 12 [illegible] |
| ,, V. Part 1 | 1915 | Price | 0 12 [illegible] |
| ,, V. Part 2 | 1915 | Price | 0 10 [illegible] |
| ,, V. Part 3 | 1915 | Price | 0 10 6 |

Copies may be obtained from the Honorary Secretary [illegible]

Messrs. Wm. Wesley & Son, 28, Essex Street, Strand, Lond[illegible]

*Members of the Society may obtain the publicat[illegible]*

*Secretary only, at half of the above pric[illegible]*

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH AFRICA.



VOLUME V.—PART 4.
1916.

CAPE TOWN:
PUBLISHED BY THE SOCIETY.

1916.

[illegible] 20th, 1916.] [Price 12s. 6d.

## CONTENTS.

# A RECORD OF PLANTS COLLECTED IN SOUTHERN RHODESIA.

## Arranged on Engler's System.

Compiled by Fred. Eyles, F.L.S., 1915.

## Introduction.

When first I began to collect the plants of Southern Rhodesia, I found it difficult, with the small library at my disposal, to trace descriptions of my specimens or to discover the records of previous collectors. For my own information, I then started a card-index in which I registered all available records of plants taken in this country, and added, wherever possible, references to the Floras and other standard publications wherein the various Rhodesian plants were described.

From this beginning the following work has sprung, and I publish it now because I feel the Record, imperfect though it is, should be made accessible to students of African botany. I also hope it may be of assistance to workers in the Rhodesian field and encourage others to collect and study the plants of this country.

This Record includes representatives of 160 Families, 869 Genera, and 2397 Species, besides 112 Varieties.

The "flowering" plants are arranged on Dr. Engler's system as set out in the *Genera Siphonogamarum* of Dr. C. G. De Dalla Torre & Dr. H. Harms, 1900–1907.

The ferns and fern-allies are arranged in accordance with the system of Engler and Prantl as shown in the *Check List of Flowering Plants and Ferns of the Transvaal and Swaziland*, by Mr. J. Burtt-Davy, F.L.S., F.R.S.S.Afr., & Mrs. R. L. Pott, 1911.

With regard to the lower cryptogams, of which unfortunately there are but few records, I have endeavoured to follow the arrangement given in Dr. Strasburger's *Text Book of Botany*, 1903, English edition.

So far as the information is available, each plant record gives the following particulars in the order shown, but very few of the records are complete in each detail.

(1) A genus number is placed in left margin opposite the first species of each genus. This corresponds to the number of that genus given in the *Genera Siphonogamarum*. The cryptogams (Asiphonogama) have no genus numbers in this Record.

(2) The first species of each genus is given its full generic and specific names, with authority. For second and following species the genus name is expressed by its initial letter.

(3) A limited number of synonyms are given in *italics* within brackets next to the accepted names. They are also shown in the Alphabetical List in *italics*. Only such synonyms have been inserted as seem necessary to save confusion and facilitate study; as, for instance, where two collectors record the same plant under different names, and where changes of nomenclature have taken place since the publication of the earlier South African Floras.

(4) A considerable number of additional synonyms have been necessitated in order to keep the RECORD uniform with Torre & Harms' *Genera Siphonogamarum*. In no instance does this imply any expression of opinion on my part as to which is the more correct classification. The following example will show how a synonym of this kind appears. The genus *Chailletia* is included by Torre & Harms under the genus *Dichapetalum*. Therefore, "Chailletia cymosa, *Hook.*," is recorded thus:—

4283—Dichapetalum cymosum (*Hook.*), *Torre & Harms.*
(*Chailletia cymosa*, Hook.),

and is indexed under both names.

(5) Following the binomial, and synonyms if any, on a new line references are given to any works where descriptions of the species may be found. These references are not necessarily, or even generally, to original descriptions, but to such publications as are likely to be accessible to South African students.

(6) Finally, under each species are recorded such details as are known of its collection, in the following order: Locality, altitude, month of collection, collector's name, and herbarium number. NOTE.—A locality is named once only in each record, *e.g.* "Matopos, Nov. Marloth, 3588; Rogers, 5185." This means that Dr. Marloth's No. 3588 was taken in the Matopo Hills in November, and Archdeacon Rogers' 5185 was also taken in the Matopos, date unknown.

The names of between forty and fifty collectors appear in the RECORD. Many of these put themselves to great trouble to make and send me duplicate copies of their lists of identified plants. The records of others I have obtained from various publications. The following is a list of the names that are most frequent in the RECORD, together with the abbreviated forms used:—

Rand.—Dr. R. F. Rand, F.L.S., formerly of Rhodesia.

Allen.—Mr. C. E. F. Allen, formerly in charge of Forests for Rhodesian Government.

Oates.—The late Frank Oates, F.R.G.S.

Monro.—Mr. C. F. H. Monro, M.A., of Victoria.
Rogers.—Archdeacon Rogers, F.L.S., formerly of Rhodesia.
Swyn.—Mr. C. F. M. Swynnerton, F.L.S., of Melsetter.
Gibbs.—Miss L. S. Gibbs, F.L.S.
Eyles.—Mr. F. Eyles, F.L.S., of Mazoe.
Galpin.—Mr. E. E. Galpin, F.L.S., of Cape Province.
Marloth.—Dr. R. Marloth, Ph.D., M.A., F.R.S.S.Afr., of Capetown.
Kolbe.—Rev. F. C. Kolbe, B.A., D.D., of Capetown.
Flanagan.—Mr. H. G. Flanagan, of Cape Province.
Gardner.—Rev. Fr. Gardner, S.J., of Bulawayo.
Cecil.—Hon. Mrs. Evelyn Cecil.
Jeffreys.—Mr. Mervyn Jeffreys, of Bulawayo.
Craster.—Mrs. W. S. Craster, of Salisbury.
Chubb.—Mr. E. C. Chubb, F.Z.S., formerly Curator of Bulawayo Museum.
Bennett.—Mrs. Bennett, of Umtali.
Sr. Phil.—Sister Philomela, of Gwelo.
Noble.—Mr. H. J. Noble, of Gwanda.
Engler.—Dr. Engler, of Berlin.
Govt. Herb.—Herbarium of Government Botanist in Department of Agriculture, Salisbury.

It must be understood that where altitudes are given they are necessarily approximate. Localities also indicate the neighbourhood rather than a precise spot; *e.g.* "Salisbury" means the neighbourhood of Salisbury.

The following publications have been used in compiling the Record wherein references to them will be found in the abbreviated forms shown below:—

Harv. Gen. S.A. Pl.—The Genera of South African Plants, by W. H. Harvey, 2nd Edn., 1868.
Fl. Cap.—Flora Capensis.
Fl. Trop. Afr.—Flora of Tropical Africa.
Cat. Afr. Pl. Welw.—Catalogue of Dr. Welwitsch's African Plants.
Ferns of S.A.—Ferns of South Africa, by T. R. Sim, F.L.S., 1892 (illustrated).
For. Fl. Cape.—The Forests and Forest Flora of Cape Colony, by T. R. Sim, F.L.S., 1906 (illustrated).
For. Fl. P. E. Afr.—Forest Flora and Forest Resources of Portuguese East Africa, by T. R. Sim, F.L.S., 1909 (illustrated).
Nat. Pl.—Natal Plants, by J. M. Wood, A.L.S. (illustrated). The references are given to plate numbers.
Orchids of S.A.—Orchids of South Africa, by Dr. Harry Bolus, F.L.S. (illustrated).

Journ. Bot.—Journal of Botany.
Journ. Linn. Soc. Bot.—Journal of Linnean Society, Botany.
Kew Bull.—Kew Bulletin.
Trans. S.A. Phil. Soc.—Transactions of South African Philosophical Society.
Trans. R. S. S. Afr.—Transactions of Royal Society of South Africa.
Pro. Rhod. Sc. Assn.—Proceedings of Rhodesia Scientific Association.
Rhod. Agric. Journ.—The Rhodesia Agricultural Journal.

I am under great obligations to many friends for advice and assistance in preparing this record of Rhodesian plants, and wish particularly to acknowledge the following :—

Dr. Rendle and Staff of British Museum for identifying most of my collections.
The late Professor P. MacOwan, of Cape Town, for advice and identifications.
The late Dr. Harry Bolus, of Cape Town, for valuable suggestions, and for continuous and unwearied help in identifying plants and furnishing me with lists of Rhodesian collections made by other botanists.
Mr. T. R. Sim, for identifying ferns, etc.
Dr. Marloth, for help in identification and general encouragement.
Archdeacon Rogers, for adding a number of localities as well as of species to the present list. These additions, interpolated through the kindness of Dr. E. P. Phillips, of the Botanical Department of the South African Museum, are marked in the list with an asterisk. Dr. Phillips has besides looked through the proofs.
Mr. Swynnerton, for the trouble he took to annotate and correct for my benefit the 240 pages descriptive of his Gazaland collections in the Linnean Journal of October, 1911.
Dr. Rand, Miss Gibbs, Mrs. Craster, and Messrs. Allen, Monro, Jeffreys, Chubb, and Father Gardner for sending me lists of their collections.
Mr. J. Burtt-Davy for help and advice.
Also Messrs. Mundy & Walters, Botanists to the Rhodesian Government, have lent me willing aid and placed their herbarium at my disposal.

I am aware of many deficiencies in this Record, but venture to think it should be published without further delay in the belief that it will be useful to beginners, and in the hope that other workers in this field will point out its chief faults, contribute additions, and make suggestions for the improvement of any later edition if called for.

FRED. EYLES.

Mazoe, Rhodesia, 1915.

# Group I.—EMBRYOPHYTA ASIPHONOGAMA.

## Division I.—THALLOPHYTA.

### Class IV.—CYANOPHYCEAE.

**Nostoc commune,** *Vaucher.*
Victoria Falls, Rain Forest, etc. 3000 ft. Sep. Gibbs, 200.

### Class XI.—CHARACEAE.

**Chara capensis,** *E. Mey.*
Mazoe, Tatagura River, 4300 ft. July, Eyles, 384.

**Nitella hyalina,** *Ag.*
Matopos, Sep. Gibbs, 311.

### Class XII.—HYPHOMYCETES.

**Cronartium bresadoleanum,** *Henn.* var. **eucleae,** *Henn.*
Bulawayo, 4400 ft. Nov. Eyles, 1253. Parasitic on leaf of Euclea Kellau, *Hochst.*

**Polystictus sanguineus,** *Meyer.*
See Cat. Afr. Pl. Welw. ii. 467, *P. sanguineus, Fr.*
Victoria Falls, Sep. Gibbs, 165, on dead wood.

**Hymenochæte rubiginosa,** *Lév.*
Cat. Afr. Pl. Welw. ii. 471.
Victoria Falls, Sep. Gibbs, 262, on dead wood.

**Gibbera tinctoria,** *Massee.*
Kew Bull., 1911, 226.
Hunyani Valley, Allen, 734, on leaves of *Monotes glaber, Sprague.*

### Class XIII.—LICHENES.

**Leptogium sp.**
Bulawayo, Jan. Eyles, 1179.

**Parmelia sp.**
Matopos, Nov. Eyles, 1148.

**Physcia flavicans,** *DC.*
Chirinda, 3800 ft. Swyn. 883, on trees.

**Usnea barbata,** *Ach.*
Cat. Afr. Pl. Welw. ii. 396.
Matopos, March, Eyles, 1023.

**U. longissima,** *Ach.*
Cat. Afr. Pl. Welw. ii. 397.
Chirinda Forest, 3800 ft. Swyn. 430, hanging from tree branches; Chimanimani Mts. 6500 ft. Swyn. 617.

## Division II.—BRYOPHYTA.

### Class I.—HEPATICAE.

**Riccia fluitans,** *L.*
Matopos, Sep. Gibbs, 318, in streams.

**Fimbriaria marginata** *Nees.*
Mazoe, Sep. Eyles, 414.

**Marchantia polymorpha,** *L.*
Matopos, Nov. Eyles, 1181.

**Plagiochasma sp.** ?
Matopos, fr. Oct. Gibbs, 324.

**Madotheca capensis,** *Gottsche.*
Chirinda, 3800 ft. Swyn. 812, on trees.

### Class II.—MUSCI.

**Amblystegium varium,** *Lindb.*
Mazoe, Aug. 4600 ft. Eyles, 402, on stones by stream.

**Bartramia sp.**
Matopos, March, Eyles, 1050.

**Catharinea androgyna,** *C. Muell.*
Mt. Pene, 7000 ft. Swyn. 6021.

**Hypnum sp.**
Matopos, March, Eyles, 1026.

**Octodiceras julianum,** *Brid.*
Mazoe, 4600 ft. Aug. Eyles, 401, submerged.

**Orthotrichum sp.**
Matopos, March, Eyles, 1052.

**Racopilum sp.**
Victoria Falls, 3000 ft. May, Eyles, 112, in Rain Forest.

**Ulota crispa,** *Br. & Schimp.*
Matopos, March, Eyles, 1048.

# Division III.—PTERIDOPHYTA.

## Class I.—**FILICALES.**

## Order I.—FILICALES LEPTOSPORANGIATAE.

### Family I.—HYMENOPHYLLACEAE, *Sadebeck.*

**Hymenophyllum gracile,** *Bory.*
Ferns of S.A. 48.
Mt. Pene, 7000 ft. Swyn. 6016 ; Mazoe, 5100 ft. April, Eyles, 359.

### Family II.—CYATHEACEAE, *Diels.*

**Cyathea Dregei,** *Kunze.*
Ferns of S.A. 57.
Matopos, 4800 ft. May, Eyles, 72 ; Oct. Gibbs, 292 ; Penhalonga, Bennett ; Umtali, Holland ; Mt. Pene, 6500–7000 ft. Swyn. 816.

**C. manniana,** *Hook.*
Mt. Pene, 7000 ft. Swyn. 6030.

**C. Thomsoni,** *Bak.*
Journ. Bot. 1881, 180.
Chirinda, 3800 ft. Swyn. 817.

### Family III.—POLYPODIACEAE, *Diels.*

**Aspidium aculeatum,** *Swartz,* var. **pungens,** *Klf.*
Ferns of S.A. 166.
Umtali, Holland & Bennett.

**A. ammifolium,** *Poir.*
Mt. Pene, 6500–7000 ft. Swyn. 878, 6031, 6032.

**Nephrodium albo-punctatum,** *Desv.*
Ferns of S.A. 173; Cat. Afr. Pl. Welw. ii. 272.
Mazoe, 5200 ft. April, Eyles, 337; Sebakwe, 4110 ft. Dec. Eyles, 390 ; Matopos, Oct. Gibbs, 210 ; Chimanimani Mts. 7000 ft. Swyn. 857 ; Salisbury, Darling, Holland & Hole ; Umtali, Bennett.

**N. athamanticum,** *Hook.*
Ferns of S.A. 183 ; Cat. Afr. Pl. Welw. ii. 272.
Mazoe, Holland ; and at 4400 ft. Jan. Eyles, 562 ; Umtali, Bennett ; Chirinda, 3800 ft. Swyn. 875, 876 ; Lusitu Riv. 3000 ft. Swyn. 875*a*.

**N. bergianum,** *Baker.*
Ferns of S.A. 175.
Matopos, 4700 ft. April & May, Eyles, 63; Mazoe, 4500 ft. Feb. Eyles, 525; Umtali, Darling; Penhalonga, Bennett & Holland; Victoria Falls, Richards; Chirinda Forest, 3700–4000 ft. Swyn. 866, 870.

**N. catopteron,** *Hook.*
Ferns of S.A. 185.
Umtali, Bennett & Holland.

**N. cicutarium,** *Baker.* (*N. hippocrepis, Desv.*)
Ferns of S.A. 187; Cat. Afr. Pl. Welw. ii. 273.
Umtali, Darling, Holland & Bennett; Chirinda Forest, 3700–4000 ft. Swyn. 823; Mt. Pene, 6500–7000 ft. Swyn. 824*a*.

**N. Filix-mas,** *Rich.* var. **elongatum,** *Hook.*
Ferns of S.A. 180.
Umtali, Bennett & Darling; Lomagundi, Darling; Mazoe, 4600 ft. Jan. Eyles, 561; Chirinda, 3800 ft. Swyn. 874, 457.

**N. inæquale,** *Hook.*
Ferns of S.A. 182.
Lomagundi, Darling; Umtali, Holland.

**N. mauritianum,** *Fée.*
Ferns of S.A. 176.
Lomagundi, Darling; Mazoe, Holland; Victoria Falls, Holland.

**N. molle,** *Desv.*
Ferns of S.A. 177; Cat. Afr. Pl. Welw. ii. 273.
Victoria Falls, Rain Forest, 3000 ft. May, Eyles, 95; Allen, 2; Rogers, 5053; Chirinda Forest, 3700-4000 ft. Swyn. 864, 865, 867, 870; Chirinda, 3800 ft. Swyn. 868, 869; Umtali, Engler; Matabeleland, Oates.

var. **violaceum,** (*Link*) *Mett.*
Ferns of S.A. 177, a note under N. molle.
Victoria Falls, Palm Kloof, Engler.

**N. Thelypteris,** *Desv.*
Ferns of S.A. 179; Cat. Afr. Pl. Welw. ii. 272.
Matopos, 4600 ft. May, Eyles, 69; Rogers, 5197; Umtali, Darling & Bennett; Mazoe, Darling; Penhalonga, Holland; Rusapi, Engler.

**N. Thelypteris,** *Desv.*, var. **squamuligera,** *Schlechtend.*
See Ferns of S.A. 180.
Chirinda, 3800 ft. Swyn. 858, 859*a*.

**N. unitum,** *R. Br.*
Ferns of S.A. 178; Cat. Afr. Pl. Welw. ii. 273.
Victoria Falls, on island, Sep. Gibbs, 151; & Holland.

**Nephrolepis cordifolia,** *Presl.*
Trans. S.A. Phil. Soc. xvi. 288.
Matabeleland, Oates; Umtali, Darling; Victoria Falls, Rain Forest, Sep. Gibbs, 155; Holland, Richards & Engler; Chirinda, 3700–4000 ft. Swyn. 856.

**N. exaltata,** *Schott.*
Trans. S.A. Phil. Soc. xvi. 289; Cat. Afr. Pl. Welw. ii. 274.
Matabeleland, Oates; Victoria Falls, Rain Forest, 3000 ft. May, Eyles, 116; Sep. Gibbs, 148; Allen, 1 & Engler; Umtali, Darling.

**Davallia concinna,** *Schrad.*
Odzani River Valley, Umtali, Teague, 244.

**D. Hollandii,** *Sim.*
Trans. S.A. Phil. Soc. xvi. 274.
Umtali, Holland & Bennett.

**D. thecifera,** *H.B.K.*
Cat. Afr. Pl. Welw. ii. 265.
Mt. Pene, 7000 ft. Swyn. 6018.

**Lomaria attenuata,** *Willd.*
Ferns of S.A. 117.
Umtali, Darling & Bennett; Chimanimani Mts. 7000 ft. Swyn. 835*a*; Mt. Pene, 7000 ft. Swyn. 6023, 6024.

**L. Boryana,** *Willd.*
Ferns of S.A. 123; Cat. Afr. Pl. Welw. ii. 269.
Umtali, Bennett & Darling; Chimanimani Mts. 7000 ft. Swyn. 835; Mt. Pene, 7000 ft. Swyn. 6022.

**L. procera,** *Spreng.*
Ferns of S.A. 122.
Chirinda, 3700–4000 ft. Swyn. 832.

**L. punctulata,** *Kze.*
Ferns of S.A. 118.
Mazoe, 5000–5200 ft. April, Eyles, 342; Victoria Falls, Rogers, 5546.

**Asplenium adiantum-nigrum,** *L.*
Ferns of S.A. 148.
Umtali, Darling.

**A. anisophyllum,** *Kze.*
Ferns of S.A. 142.
Umtali, Bennett & Darling.

**A. aspidioides,** *Schl.*
Ferns of S.A. 162.
Umtali, Darling & Holland.

**A. cicutarium,** *Sw.*
Ferns of S.A. 155.
Umtali, Darling & Bennett.

var. **abyssinicum,** *Baker.*
Chirinda Forest, 3700–4000 ft. Swyn. 819.

**A. dregeanum,** *Kze.*
Ferns of S.A. 156.
Umtali, Darling.

**A. erectum,** *Bory.*
Ferns of S.A. 136; Cat. Afr. Pl. Welw. ii. 270.
Victoria Falls, Palm Kloof, Engler; Chirinda Forest, 3700–4000 ft. Swyn. 827.

var. **erectum,** *Bory.*
Ferns of S.A. 138.
Umtali, Bennett.

var. **lobatum,** (*P.* & *R.*) *Sim.*
Ferns of S.A. 139.
Umtali, Bennett & Holland.

var. **lunulatum,** (*Sw.*) *Sim.*
Ferns of S.A. 137.
Victoria Falls, Holland.

**A. Eylesii,** *Sim.*
Mazoe, 4500 ft. Jan. Eyles, 564.

**A. filix-fœmina,** *Bernh.*
Ferns of S.A. 160.
Penhalonga Forest, Bennett; Umtali, Holland.

**A. furcatum,** *Thunb.* (*A. adiantoides,* Lam.)
Ferns of S.A. 152; Cat. Afr. Pl. Welw. ii. 270.
Salisbury, Darling & Hole; Umtali, Holland & Bennett; Matopos, Sep. Gibbs, 28; Victoria Falls, Garbutt; Mazoe, 4500 ft. Dec. Eyles, 477; Chirinda Forest, 3700–4000 ft. Swyn. 845; Chimanimani Mts., 7000 ft. Swyn. 846*a*; Melsetter, 6000 ft. Swyn. 808; Mt. Pene, 7000 ft. Swyn 6026; Odzani River Valley, Umtali, Teague, 161.

var. **tripinnatum,** *Baker.*
Ferns of S.A. 154.
Umtali, Bennett & Darling; Mt. Pene, 7000 ft. Swyn. 846, 6027.

**A. gemmiferum,** *Schr.*
Ferns of S.A. 145.
Umtali, Bennett & Holland; Chirinda Forest, 3700–4000 ft. Swyn. 402, 853.

var. **flexuosum,** *Schr.*
Ferns of S.A. 145.
Umtali, Bennett.

var. **laciniatum,** *Mett.*
See note Ferns of S.A. 147.
Chirinda Forest, 3700–4000 ft. Swyn. 844, 844*a*.

**A. lætum,** *Swartz.*
Chirinda Forest, 3700–4000 ft. Swyn. 840, 840*b*.

**A. Mannii,** *Hook.*
Trans. S.A. Phil. Soc. xvi. 285.
Mt. Pene, 7000 ft. Swyn. 6015; Chipete Forest, 3800 ft. Swyn. 427.

**A. monanthemum,** *L.*
Ferns of S.A. 135.
Umtali, Bennett. Not common.

**A. protensum,** *Schrad.*
Ferns of S.A. 141.
Matopos, 5000 ft., March, Eyles, 1022; Umtali, Holland & Bennett; Chirinda Forest, 3700–4000 ft. Swyn. 879, 880.

**A. resectum,** *Smith.*
Cat. Afr. Pl. Welw. ii. 270.
Chirinda Forest, 3700–4000 ft. Swyn. 840*a*, 841.

**A. rutæfolium,** *Kze.*
Ferns of S.A. 158.
Umtali, Bennett & Holland.

**A. Sandersoni,** *Hook.*
Ferns of S.A. 132.
Umtali, Bennett.

**A. Schimperi,** *A. Br.*
Ferns of S.A. 161.
Salisbury, Darling.

**A. serra,** *Langs.* var. **natalensis,** *Baker.*
Ferns of S.A. 144.
Chimanimani Mts. 6500 ft. Swyn. 851.

**A. Thunbergii,** *Kze.*
Ferns of S.A. 157.
Chirinda Forest, 3700–4000 ft. Swyn. 806; Chipetzana source, 4000 ft. Swyn. 807; Mt. Pene, 7000 ft. Swyn. 6017.

**A. trichomanes,** *L.*
Ferns of S.A. 133.
Lomagundi, Sinoia Cave and Hunyani River, Hole.

**A. varians,** *Hk. & Gr.*
Ferns of S.A. 140.
Umtali, Darling.

**Gymnogramme argentea,** *Mett.* (*G. rosea*, Desv.)
Ferns of S.A. 214; Cat. Afr. Pl. Welw. ii. 276.
Chimanimani Mts., 7000 ft. Swyn. 677.

var. **aurea,** *Mett.*
Ferns of S.A. 214, 5.
Mazoe, 5200 ft. April, Eyles, 340.

**G. cordata,** *Schlecht.*
Ferns of S.A. 210; Cat. Afr. Pl. Welw. ii. 276.
Bulawayo, 4600 ft. Feb. Eyles, 392; Lomagundi, Darling; Salisbury, Darling; Matopos, 4800 ft. March, Eyles, 1021; Gibbs, Sep. 29.

var. **namaquensis,** *P. & R.*
Ferns of S.A. 211, 2.
Salisbury, Hole.

**G. lanceolata,** *Hook.*
Ferns of S.A. 215.
Umtali, Bennett; Chirinda, 3800 ft. Swyn. 814; Mt. Pene, 7000 ft. Swyn. 6020.

**G. leptophylla,** *Desv.*
Ferns of S.A. 212.
Mazoe, 4500 ft. Jan. Eyles, 563.

**Vittaria isœtifolia,** *Bory.* (*V. lineata,* Sw.)
Ferns of S.A. 216.
Chimanimani Mts. 7000 ft. Swyn. 802.

**Pellæa burkeana,** *Baker.* (*P. dura,* Hook.)
Ferns of S.A. 105; Cat. Afr. Pl. Welw. ii. 267.
Mazoe, 5000 ft. April, Eyles, 263; Darling; Salisbury, Darling & Hole; Umtali, Holland & Bennett, Odzani River Valley, Teague, 70.

**P. calomelanos,** *Link.*
Ferns of S.A. 104; Cat. Afr. Pl. Welw. ii. 267.
Matopos, 4700 ft. April, Eyles, 394; Holland; Salisbury, Hole; Umtali, Bennett; Odzani River Valley, Teague, 67; Chirinda, 3600 ft. Swyn. 850; Matabeleland, Fry.

**P. consobrina,** *Hook.*
Ferns of S.A. 97.
Mazoe, 5000 ft. April, Eyles, 357; Darling & Bennett; Umtali, Darling & Bennett; Odzani River Valley, Teague, 68; Chimanimani Mts., 7000 ft. Swyn. 852; Mt. Pene, 7000 ft. Swyn. 6028.

**P. Doniana,** *Hook.*
Trans. S.A. Phil. Soc. xvi. 279.
Umtali, Bennett.

**P. geraniæfolia,** *Fée.* (*Cheilanthes Kirkii,* Hook.)
Ferns of S.A. 92; Cat. Afr. Pl. Welw. ii. 266.
Matopos, 4800 ft. March, Eyles, 1044; Gibbs, Sep. 291; Victoria, Zimbabwe, Holland, Monro, 732; Umtali, Bennett.

**P. hastata,** *Link.*
S.A. Ferns, 101 ; Cat. Afr. Pl. Welw. ii. 267.
Matopos, 5000 ft. March, Eyles, 1018, April, 312; Sep. Gibbs, 89; Salisbury, Hole; Umtali, Bennett; Mazoe, Holland; Victoria, Holland.

var. **glauca,** *Sim.*
Ferns of S.A. 102.
Salisbury, Darling, Hole & Holland; Mazoe, Darling & Holland; Matabeleland, Fry.

var. **macrophylla,** *Hook.*
Ferns of S.A. 102.
Chirinda Forest, 3600–4000 ft. Swyn. 800; Victoria Falls, Garbutt.

**P. pectiniformis,** *Baker.*
Ferns of S.A. 95 ; Cat. Afr. Pl. Welw. ii. 267.
Matopos, Oct. Gibbs, 294 ; Mazoe, 5000 ft. March, Eyles, 250.

**Notochlæna Buchanani,** *Baker.*
Ferns of S.A. 207.
Matopos, Sep. Gibbs, 70.

**N. inæqualis,** *Kze.*
Ferns of S.A. 206 ; Cat. Afr. Pl. Welw. ii. 276.
Matopos, 5000 ft. March, Eyles, 1020 ; Salisbury, Holland & Darling ; Mazoe, 5200 ft. April, Eyles, 339.

**Chielanthes Bolusii,** *Baker.*
Ferns of S.A. 89 ; Trans. S.A. Phil. Soc. xvi. 277.
Mazoe, 5000 ft. March, Eyles, 247 ; Umtali, Holland.

**C. farinosa,** *Kaulf.*
Trans. S.A. Phil. Soc. xvi. 278 ; Cat. Afr. Pl. Welw. ii. 267.
Victoria Falls, Rain Forest, 3000 ft. May, Eyles, 121, 147 ; Sep. Gibbs, 6 ; Galpin, 7053 ; Allen, 13 ; Rogers, 5013, 5545 ; Engler, Richards & Holland ; Matabeleland, Oates.

**C. hirta,** *Swartz.*
Ferns of S.A. 83 ; Cat. Afr. Pl. Welw. ii. 266.
Matopos, 5000 ft. May, Eyles, 76 ; Sep. Gibbs, 90 ; Engler ; Bulawayo, 4500 ft. Feb. Eyles, 393 ; Umtali, Bennett ; Odzani River Valley, Teague, 160.

**C. multifida,** *Swartz.*
Ferns of S.A. 87.
Matopos, Sep. Gibbs, 69 ; 5000 ft. March, Eyles, 1019.

**Hypolepis anthriscifolia,** *Presl.*
Ferns of S.A. 76.
Chirinda Forest, 3700–4000 ft. Swyn. 820.

**H. bergiana,** *Hook.*
Ferns of S.A. 78.
Chimanimani Mts., 7000 ft. Swyn. 821.

**H. Schimperi,** *Sim.*
Trans. S.A. Phil. Soc. xvi. 276.
Mazoe, 4800–5300 ft. Dec. Eyles, 395; Darling & Holland; Salisbury, Darling, Holland & Hole.

**Crystopteris fragilis,** *Bernh.*
Ferns of S.A. 66.
Lomagundi, Hole.

**Adiantum æthiopicum,** *L.*
Ferns of S.A. 73.
Mazoe, 5100 ft. April, Eyles, 328; Holland; Salisbury, Holland; Umtali, in hills, Bennett; Matabeleland, Oates.

**A. capillus-Veneris,** *L.*
Ferns of S.A. 70; Cat. Afr. Pl. Welw. ii. 266.
Bulawayo, 4500 ft. May, Eyles, 68; Victoria Falls, Rain Forest, Sep. Gibbs, 20; May, Eyles, 113, 126; Allen, 11; Rogers, 5547; Engler & Holland; Umtali, Bennett & Darling; Mazoe, Darling.

**A. caudatum,** *L.*
Ferns of S.A. 69.
Sebakwe, 4000 ft., Nov. Eyles, 389; Victoria Falls, Sep. Gibbs, 180; Rogers, 5052; Allen, 17; Engler, Richards & Holland; Umtali, Darling & Bennett; Mazoe, Darling; Matopos, Gibbs, 316.

**A. lunulatum,** *Burm.*
Ferns of S.A. 70; Cat. Afr. Pl. Welw. ii. 265.
Victoria Falls, Rain Forest, 3000 ft. May, Eyles, 127; Allen, 9; Rogers, 5376, 5549; Richards & Holland; Mazoe, Darling; Umtali, Bennett; Matabeleland, Oates.

**A. Oatesii,** *Baker.*
In "Matabeleland and Victoria Falls," by Frank Oates, appendix by A. Rolfe, ed. i. p. 369; Ferns of S.A. 70.
Victoria Falls, Sep. Gibbs, 317; Allen, 20; Lomagundi, Darling; Matabeleland, Oates.

**Actiniopteris radiata,** *Link.*
Ferns of S.A. 163; Harv. Gen. S.A. Pl. 465; Cat. Afr. Pl. Welw. ii. 271.
Mazoe, 4400–4600 ft. March, Eyles, 259; Victoria Falls, Sep. Gibbs, 33; Allen, 91; Garbutt; Matopos, Engler & Gibbs; Salisbury, Darling & Hole; Umtali, Bennett; Odzani River Valley, Umtali, Teague, 63.

**Didymochlæna lunulata,** *Desv.* (*D. sinuosa*, Desv.)
Ferns of S.A. 164; Cat. Afr. Pl. Welw. ii. 271.
Mt. Pene Forest, 6500–7000 ft. Swyn. 815; Umtali, Bennett.

**Pteris aquilina,** *L.* (*Pteridium aquilinum,* Kuhn.)

Ferns of S.A. 113; Cat. Afr. Pl. Welw. ii. 268; Harv. Gen. S.A. Pl. 464.

Matopos, 4800 ft. May, Eyles, 79; Umtali, Darling; Odzani River Valley, Teague, 251; Salisbury, Hole; Mt. Hampden, Holland (a glabrous var.); Victoria Falls, Palm Kloof, Engler.

var. **lanuginosa,** *Hook.*

Ferns of S.A. 114, included under type; Cat. Afr. Pl. Welw. ii. 268.

Chirinda, 2800 ft. Swyn. 401 in part; Mt. Pene, 7000 ft. Swyn. 6029; throughout Melsetter Dist., Swyn.

**P. atrovirens,** *Willd.*

Cat. Afr. Pl. Welw. ii. 268.

Victoria Falls, Palm Kloof, Engler.

**P. brevisora,** *Baker.*

Chirinda Forest, 3700–4000 ft. Swyn. 871.

**P. cretica,** *L.*

Ferns of S.A. 107; Cat. Afr. Pl. Welw. ii. 268.

Mazoe, 4900 ft. Dec. Eyles, 498; Holland; Chirinda Forest, 3700–4000 ft. Swyn. 831; Umtali, Bennett; Salisbury, Hole.

**P. flabellata,** *Thunb.* (*P. arguta,* Sw.)

Ferns of S.A. 110; Cat. Afr. Pl. Welw. ii. 268.

Victoria Falls, Rogers, 5556; Penhalonga, Holland; Umtali, Bennett.

**P. longifolia,** *L.*

Ferns of S.A. 106; Cat. Afr. Pl. Welw. ii. 267.

Bulawayo, 4500 ft. May, Eyles, 66; Mazoe, Darling, Holland & Bennett; Umtali, Darling, Holland & Bennett.

**P. quadriaurita,** *Retz.*

Ferns of S.A. 108; Cat. Afr. Pl. Welw. ii. 268.

Victoria Falls, Rain Forest, 3000 ft. May, Eyles, 94; Allen, 181; Rogers, 5048; Gibbs; Richards; Matopos, Oct. Gibbs, 223; May, Eyles, 149; Umtali, Darling; Bennett; Lomagundi, Darling; Salisbury, Holland; Chirinda Forest, 3700–4000 ft. Swyn. 872; Matabeleland, Oates.

**Polypodium africanum,** *Mett.*

Ferns of S.A. 203.

Mazoe, 4500 ft. Jan. Eyles, 388; Chirinda Forest, 3700–4000 ft. Swyn. 425; Chipete Forest, 3800 ft. Swyn. 425a; Umtali, Bennett; Holland.

**P. incanum,** *Swartz.*

Ferns of S.A. 194.

Victoria, Zimbabwe, Holland; Chirinda Forest, 3700–4000 ft. Swyn. 809.

**P. irioides,** *Lam.*
Ferns of S.A. 204 ; Cat. Afr. Pl. Welw. ii. 275.
Macequece, Holland ; Umtali, Bennett.

**P. lanceolatum,** *L.* (*P. lepidotum,* Willd.)
Ferns of S.A. 201.
Umtali, Bennett; Melsetter, 6000 ft. Swyn. 811, epiphytic on *Brachystegia Randii* and other trees; Chipete Forest, 3800 ft. Swyn. 812; Chimanimani Mts. 7000 ft. Swyn. 813; Mt. Pene, 7000 ft. Swyn. 6008, 6019; Odzani River Valley, Umtali, Teague, 162.

**B. normale,** *Don.*
Ferns of S.A. 199.
Umtali, Bennett.

**P. obtusilobum,** *Desv.*
See Ferns of S.A. 174, 5. (Sim doubts validity of this species and does not distinguish it from *Nephrodium bergianum,* Baker.)
Victoria Falls, Allen, 3; Gwaai River, 3400 ft. Allen, 229.

**P. phymatodes,** *L.*
Ferns of S.A. 196; Cat. Afr. Pl. Welw. ii. 275.
Umtali, Bennett; Lusitu River, 2500 ft. Swyn. 661, 884.

**P. proliferum,** *Presl.*
Ferns of S.A. 192.
Hunyani Riv. Darling ; Mazoe, Holland; Umtali, Bennett.

**P. unitum,** *Hook.*
Ferns of S.A. 193.
Umtali, Bennett.

**Acrostichum latifolium,** *Swartz.*
Ferns of S.A. 220.
Umtali, Bennett ; Mt. Pene, 7000 ft. Swyn. 6009.

**A. lineare,** *Fée.*
Mt. Pene, 7000 ft. Swyn. 6014.

**A. viscosum,** *Sw.*
Ferns of S.A. 221.
Chimanimani Mts. 7000 ft. Swyn. 810.

**Platycerium alicorne,** *Desv.*
Trans. S.A. Phil. Soc. xvi. 293.
Macequece, Holland; Umtali, Bennett.

## Family IV.—GLEICHENIACEAE, *Diels.*

**Gleichenia dichotoma,** *Willd.*
Ferns of S.A. 45.
Umtali, Bennett.

**G. polypodioides,** *Smith.*
Ferns of S.A. 43; Cat. Afr. Pl. Welw. ii. 263.
Mazoe, 5200 ft. April, Eyles, 341; Chimanimani Mts. 6500 ft. Swyn. 676.

**G. umbraculifera,** *T. Moore.*
Ferns of S.A. 44.
Melsetter, 6000 ft. Swyn. 613; Lusitu Hills, 5000 ft. Swyn. 1497.

## Family V.—SCHIZAEACEAE, *Diels.*

**Aneimia anthriscifolia,** *Schrad.*
Trans. S.A. Phil. Soc. xvi. 294.
Umtali, Bennett & Holland.

**A. tomentosa,** *Sw.*
Odzani River Valley, Umtali, Teague, 69.

**Mohria caffrorum,** *Desv.*
Ferns of S.A. 233.
Matopos, 4800 ft. March, Eyles, 1042, May, 128; Gibbs, Oct. 235; Melsetter, 6000 ft. Swyn. 611; Mazoe, Eyles; Umtali, Bennett, Odzani River Valley, Teague, 140; Darling.

**M. lepigera,** *Baker.*
Chimanimani Mts. 7000 ft. Swyn. 611*a*.

**Lygodium Brycei,** *Baker.*
Kew Bull. 1901, 138.
Mashonaland, Bryce, nr. Portuguese border, drift of Renie Riv.

**L. Kerstenii,** *Kuhn.* (*L. subulatum*, Bojer.)
Trans. S.A. Phil. Soc. xvi. 296.
Penhalonga, Holland; Umtali, Bennett; South Melsetter District, abundant in wooded kloofs.

## Family VI.—OSMUNDACEAE, *Diels.*

**Osmunda regalis,** *L.*
Ferns of S.A. 227; Cat. Afr. Pl. Welw. ii. 278.
Matopos, 4600 ft. April, Eyles, 56; Rogers, 5193; Marloth; Chirinda, 3700 ft. Swyn. 828; Chipetzana source, 4000 ft. Swyn.; Umtali, Bennett, Odzani River Valley, Teague, 66; Darling; Mazoe, Hole; Salisbury, Holland.

**Todea africana,** *Willd.* (*T. barbara*, Moore.)
Ferns of S.A. 228.
Chimanimani Mts. 7000 ft. Swyn. 830.

### Family VII.—MARSILIACEA, *Sadebeck.*

**Marsilia biloba,** *Willd.*
Ferns of S.A. 258.
Gwelo, in vlei, Gardner, 28.

**M. capensis,** *A. Br.*
Ferns of S.A. 259.
Matopos, fr. Oct. Gibbs, 289.

**M. macrocarpa,** *Presl.* var. **lobata,** *Sim.*
Ferns of S.A. 259 (type).
Pasipas Mt. 4500 ft. June, Eyles, 26.

## Order II.—MARATTIALES.

### Family VIII.—MARATTIACEAE, *Bitter.*

**Marattia fraxinea,** *Smith.*
Ferns of S.A. 235; Cat. Afr. Pl. Welw. ii. 278.
Chirinda Forest, 3700–4000 ft. Swyn. 826; Mt. Pene Forest, 6500–7000 ft. Swyn. 826*a*, 6025; Umtali, Darling; Bennett; Penhalonga, Holland.

## Order III.—OPHIOGLOSSALES.

### Family IX.—OPHIOGLOSSACEAE, *Bitter.*

**Ophioglossum reticulatum,** *L.*
Ferns of S.A. 238; Cat. Afr. Pl. Welw. ii. 279.
Mazoe, 4800 ft. Jan. Eyles, 559.

**O. vulgatum,** *L.*
Ferns of S.A. 237.
Khami, Nov. Marloth, 3354; Matopos, Marloth.

# Class II.—EQUISETALES.

## Order I.—EU-EQUISETALES.

### Family X.—EQUISETACEAE, *Sadebeck.*

**Equisetum ramosissimum,** *Desf.*
Ferns of S.A. 240; Cat. Afr. Pl. Welw. ii. 279.
Matopos, 4800 ft. April, Eyles, 151; Umtali, Engler.

# Class III.—LYCOPODIALES.

## Order I.—LYCOPODIALES ELIGULATAE.

### Family XI.—LYCOPODIACEAE, *Pritzel.*

**Lycopodium carolinianum,** *L.*
Ferns of S.A. 246.
Matopos, 5000 ft. April, Eyles, 51; Oct. fr. Gibbs, 231.

**L. cernuum,** *L.*
Ferns of S.A. 244; Cat. Afr. Pl. Welw. ii. 263.
Chirinda, 3800 ft. Swyn. 458; Odzani River Valley, Umtali, Teague, 252.

**L. clavatum,** *L.* var. **inflexum,** *Spreng.*
Ferns of S.A. 245.
Mt. Pene, 6500–7000 ft. Swyn. 805.

**L. verticillatum,** *L.*
Ferns of S.A. 243.
Mt. Pene, 7000 ft. Swyn. 6010; Umtali, Holland.

**Psilotum triquetrum,** *Swartz.*
Ferns of S.A. 247; Harv. Gen. S.A. Pl. 470.
Victoria Falls, Rain Forest, 3000 ft. May, Eyles, 115; Engler.

## Order II.—LYCOPODIALES LIGULATAE.

### Family XII.—SELAGINELLACEAE, *Hieron.*

**Selaginella depressa,** *A. Braun.*
Ferns of S.A. 251.
Matopos, March, Eyles, 1043.

**S. imbricata,** *Spreng.*
Victoria Falls, dry edge of gorge, Galpin, 7054; Sep. Gibbs, 179; Allen, 90; Engler; April, Eyles, 546.

**S. kraussiana,** *A. Braun.*
Ferns of S.A. 252.
Chimanimani Mts. 7000 ft. Swyn. 803; Mt. Pene, 7000 ft. Swyn. 6013; Umtali, Darling.

**S. rupestris,** *Spreng.*
Ferns of S.A. 250; Cat. Afr. Pl. Welw. ii. 262.
Matopos, Sep. Gibbs, 4; Oct. Davy; Engler; Chimanimani Mts. 7000 ft. Swyn. 617*a*.

**S. sp.**
Matopos, 4800 ft. March, Eyles, 1043, cf. *S. kraussiana*, A. Braun.

# Group II.—EMBRYOPHYTA SIPHONOGAMA.

## Division I.—GYMNOSPERMAE.

### Class CONIFERAE.

#### Family V.—TAXACEAE, *Lindl.*

Genus No.
15—**Podocarpus milanjiana,** *Rendle.* (*P. Thunbergii,* Hook. var. *falcata.*)
See For. Fl. Cape, 332.
Chimanimani Mts. 7000 ft. male fl. Sep. Swyn. 1962; Mt. Pene, 7000 ft. Swyn. 6038.

#### Family VI.—PINACEAE, *Lindl.*

38—**Callitris Whytei** (*Rendle*), *Torre & Harms.* (*Widdringtonia Whytei,* Rendle; *W. Mahoni,* Masters.)
For. Fl. Port. E. Afr. 109.
Chimanimani Mts. 7000 ft. Swyn. 1964; Melsetter, 6000 ft. fr. Sep. Swyn. 1963; Hutchins mentions for Umtali, Melsetter and Inyanga; also see Journ. Bot. 1906, 190 for Umtali and Melsetter.

## Division II.—ANGIOSPERMAE.

### Class MONOCOTYLEDONEAE.

### Series PANDANALES.

#### Family VIII.—TYPHACEAE, *J. St. Hil.*

49—**Typha australis,** *Schumach. & Thonn.*
Fl. Trop. Afr. viii. 135; Fl. Cap. vii. 31.
Upper Buzi Riv. and Inyamadzi Riv. Swyn.

### Series HELOBIAE.

#### Family XI.—POTAMOGETONACEAE, *Engl.*

58—**Potamogeton fluitans,** *Roth.*
Fl. Cap. vii. 46; Fl. Trop. Afr. viii. 219; Cat. Afr. Pl. Welw. ii. 94.
Matopos, 4800 ft. April, Eyles, 36.

Genus No.

**P. natans,** *L.*

Fl. Cap. vii. 46; Harv. Gen. S.A. Pl. 387.

Matopos, streams, general, Sep. Gibbs, 94; Victoria Falls, common in river, Sep. Gibbs, 146; Salisbury, Rand, 540.

**P. pusillum,** *L.*

Fl. Cap. vii. 49; Fl. Trop. Afr. viii. 222.

Matopos, fl. & fr., Sep. Gibbs, 190, in streams.

### Family XIII.—APONOGETONACEAE, *Engl.*

65—**Aponogeton sp.**

No precise locality, Rand, 217.

### Family XV.—ALISMACEAE, *DC.*

80—**Burnatia enneandra,** *Micheli.*

Fl. Trop. Afr. vii. 213.

Matabeleland, Holub.

### Family XVII.—HYDROCHARITACEAE, *Aschers.*

86—**Hydrilla verticillata,** *Royle.*

Fl. Trop. Afr. vii. 2.

Victoria Falls, abundant in river, Sep. Gibbs, 136; Galpin, 7027.

90—**Blyxa sp.**

Salisbury, May, Flanagan, 3251, in ponds. "Distinct from *B. radicans*, Ridl. and probably new." H. Bolus.

95—**Ottelia paucifolia,** *A. Rich.*

Victoria Falls, Allen, 14.

**O. vesiculata,** *Ridl.*

Fl. Trop. Afr. vii. 7; Cat. Afr. Pl. Welw. ii. 2.

Matopos, 4800 ft. April, Eyles, 34.

## Series GLUMIFLORAE.

### Family XIX.—GRAMINEAE, *B. Juss.*

102—**Zea Mays,** *L.*

Universally cultivated.

109—**Imperata arundinacea,** *Cyr.* (*I. cylindrica,* Beauv.)

Fl. Cap. vii. 320; Nat. Pl. ii. 101; Cat. Afr. Pl. Welw. ii. 135.

Salisbury, Mundy; Matabeleland, Jeffreys, 49; may be new sp.

Genus No.

var **Thunbergii** *Hack.*

Fl. Cap. vii. 320.

North Melsetter, 4000–5000 ft. Swyn.; Bulawayo, Monro, 982; Marandellas, Engler; Umtali, Engler.

111—**Saccharum munroanum,** *Hack.*

Fl. Cap. vii. 321; Nat. Pl. ii. 102; Cat. Afr. Pl. Welw, ii. 136.

Matopos, Rogers, 5189.

112—**Erianthus teretifolius,** *Stapf.*

Journ. Linn. Soc. Bot. xxxvii. 478.

Victoria Falls, fl. & fr. Sep. Gibbs, 141; Rogers, 5098, 5315 Salisbury, Craster, 66.

**E. sp.**

Lochard, Govt. Herb. 2094, nr. *E. sorghum.*

113—**Pollinia villosa,** *Spreng.*

Fl. Cap. vii. 325; Nat. Pl. ii. 109; Cat. Afr. Pl. Welw. ii. 136.

Victoria Falls, Sep. Gibbs, 153; Rogers, 5810.

**P. sp.**

Salisbury, Craster, 18.

119—**Ischæmum fasciculatum,** *Brongn.*

Fl. Cap. vii. 327; Cat. Afr. Pl. Welw. ii. 141.

Victoria Falls, Engler.

var. **arcuatum,** *Hack.*

Fl. Cap. vii. 327; Nat. Pl. ii. 104.

Lusitu Riv. 3000 ft. Swyn. 1652; Victoria Falls, Rogers, 5088.

**I. spp.**

Salisbury, Craster, 37, 69.

126—**Rhytachne, sp.**

Salisbury, Craster, 56.

127—**Rottboellia compressa,** *L.*

Fl. Cap. vii. 329 (var.).

Salisbury, Mundy; Bulawayo, Rogers, 5868.

var. **fasciculata,** *Hack.*

Fl. Cap. vii. 329; Nat. Pl. ii. 105.

Heaney Jnctn. Jeffreys, 17; North Melsetter, 4000–6000 ft. Swyn.

**R. exalata,** *L. fil.*

Victoria Falls, Rogers, 7076*.

131—**Trachypogon polymorphus,** *Hack.*

Fl. Cap. vii. 331 (var.); Nat. Pl. ii. 107 (var.).

Salisbury, Mundy; Victoria Falls, Rogers, 5695; Bulawayo, Rogers, 5885.

Genus No.
132—**Elionurus argenteus,** *Nees.*
Fl. Cap. vii. 332; Nat. Pl. ii. 108.
Chirinda, 3700 ft. Jan. Swyn. 1694; Mt. Pene, 6500–7000 ft. Sep. Swyn. 1648; Somabula, Govt. Herb. 666; Umtali, Engler.
var. **thymidora,** Stapf.
Fl. Cap. vii. 333.
Bulawayo, Rogers, 5882.

134—**Andropogon amplectens,** *Nees.*
Fl. Cap. vii. 342; Nat. Pl. ii. 116.
Heaney Jnctn. Jeffreys, 8, and 21; Somabula, Govt. Herb. 668.

**A. ceresiæformis,** *Nees.*
Fl. Cap. vii. 337; Nat. Pl. ii. 112; Cat. Afr. Pl. Welw. ii. 145.
Between Lusitu and Nyahodi, 5000 ft. April, Swyn. 1656; Salisbury, Craster, 51.

**A. connatus,** *Chiov.*
Bulawayo, Rogers, 5918; Victoria Falls, Rogers, 5672.

**A. contortus,** *L.* (*Heteropogon contortus,* Roem. & Schult.)
Fl. Cap. vii. 350; Nat. Pl. ii. 121; Cat. Afr. Pl. Welw. ii. 153.
Bulawayo, in vlei, Jeffreys, 16; Rogers, 5900; Victoria, Monro, 907; Syringa, Matabeleland, Govt. Herb. 641, 642; Salisbury, Craster, 62.

**A. cymbarius,** *L.* (*Cymbopogon elegans,* Spreng.)
Fl. Cap. vii. 360; Nat. Pl. 130; Cat. Afr. Pl. Welw. ii. 157.
Nyahodi Riv. 4000 ft. April, Swyn. 1675.

**A. eucomis,** *Nees.*
Fl. Cap. vii. 338; Nat. Pl. 113.
Matopos, fl. & fr. Sep. Gibbs, 23; Heaney Jnctn. Jan. Jeffreys, 47.

**A. filipendulus,** *Hochst.* (*Cymbopogon filipendulus,* Rendle.)
Fl. Cap. vii. 362; Nat. Pl. 131; Cat. Afr. Pl. Welw. ii. 157.
Salisbury, March, Flanagan, 3003; Bulawayo, Rogers, 5898; 13508; Jeffreys, 69, forma *pilosior,* Hack.; North Melsetter, 4000–6000 ft. April, Swyn. 1687; Chirinda, 3500 ft. Jan. Swyn. 1640; Upper Buzi, 3000–3500 ft. April, Swyn. 985, 988, 990; Umtali, Engler.

**A. gayanus,** *Kunth.*
See Cat. Afr. Pl. Welw. ii. 148.
Victoria, Monro, 991; Chirinda, 3800 ft. April, Swyn. 967; Upper Buzi, 3000–3500 ft. April, Swyn. 984; Bulawayo, Rogers, 5865; Victoria Falls, Rogers, 5673.

**A. gazense** (*Rendle*), *Torre & Harms.* (*Cymbopogon gazense,* Rendle.)
Journ. Linn. Soc. Bot. xl. 226.
Chirinda, 3700 ft. Jan. Swyn. 1637.

Genus No.
134—**A. giganteus** (*Chiov.*), *Torre & Harms.* (*Cymbopogon giganteus*, Chiov.)
Chirinda, 3500 ft. Jan. Swyn. 1636; Upper Buzi, 3000–3500 ft. April, Swyn. 994.

**A. halapensis,** *Brot.*
Fl. Cap. vii. 346 (var.); Nat. Pl. 119 (var.)
Bulawayo, Rogers, 5880; Salisbury, Rogers, 5798.

**A. hirtiflorus**, *Kunth.* var. **semiberbis,** *Stapf.*
Fl. Cap. vii. 337; Nat. Pl. 111.
North Melsetter, 4000–6000 ft. April, Swyn. 1607; Chirinda, 3500 ft. Jan. Swyn. 1621.

**A. hirtus,** *L.*
Fl. Cap. vii. 355; Nat. Pl. 125.
Matopos, Oct. Gibbs, 288; Tabazinduna Mt. Jan. Jeffreys, 45; Upper Buzi, 3000–3500 ft. Swyn.; Victoria, Monro, 862,969; Victoria Falls, Rogers, 13278*.

**A. intermedius,** *R. Br.*
Fl. Cap. vii. 345; Cat. Afr. Pl. Welw. ii. 149; Nat. Pl. 118.
Victoria, Monro, 945*a*; Victoria Falls, Rogers, 1771*.

**A. Jeffreysii,** *Hack.*
Pro. Rhod. Sc. Assn. vii. pt. ii. 70.
Bulawayo, May, Jeffreys, 78.

**A. Lecomtei**, *Franch.*
Nyahodi Riv. 4000 ft. April, Swyn. 1660.

**A. marginalis,** *L.*
Govt. Herb. 634.

**A. monticola,** *Schult.* var. **Trinii,** *Hook.* (*A. Trinii*, Steud. var. *simplicior*, Hack.)
Heaney Jnctn. in vlei, Jeffreys, 26.

**A. Nardus,** *L.* var. **validus,** *Stapf.*
Fl. Cap. vii. 352; Nat. Pl. 122.
Salisbury, Mundy.

**A. pertusus,** *Willd.*
Fl. Cap. vii. 345; Nat. Pl. 466.
Bulawayo, in vlei, Dec. Jeffreys, 57; Rogers, 5899; Victoria, Monro, 945*a*, 983; North Melsetter, 4000–6000 ft. April, Swyn. 1613; Victoria Falls, Rogers, 7171.

**A. rufus,** *Kunth.* (*Cymbopogon rufus*, Rendle.)
Fl. Cap. vii. 358; Nat. Pl. 127; Cat. Afr. Pl. Welw. ii. 155.
Melsetter, 4000–6000 ft. April, Swyn. 1606, 1712; Lusitu Riv. 3500 ft. April, Swyn. 1655; Upper Buzi, 3000–3500 ft. April, Swyn. 993; Victoria Falls, Rogers, 5084; Southern Rhodesia, Rand, 411.

Genus. No.
134—var. **fulvicomus,** *Rendle.*
Upper Buzi, 3000–5000 ft. April, Swyn. 995.

**A. Ruprechti,** *Hack.* (*Cymbopogon Ruprechti*, Rendle.)
Fl. Cap. vii. 365 ; Nat. Pl. 132 ; Cat. Afr. Pl. Welw. ii. 160.
North Melsetter, 4000–5000 ft. April, Swyn. 1605, 1686 ; Nyahodi Riv. 4000 ft. April, Swyn. 1659*a* ; Upper Buzi, 3000–3500 ft. April, Swyn. 991 ; Matabeleland, Jeffreys, 4, 22.

**A. Schimperi,** *Hochst.* (*Cymbopogon Schimperi*, Rendle.)
Fl. Cap. vii. 357 ; Nat. Pl. 467 ; Cat. Afr. Pl. Welw. ii. 155.
Salisbury, March, Flanagan, 3000 ; North Melsetter, 4000–6000 ft. April, Swyn. 951 ; Upper Buzi, 3000–3500 ft. April, Swyn. 994*a*.

**A. schirensis,** *Hochst.*
Fl. Cap. vii. 340 (var.) ; Nat. Pl. 115 (var.) ; Cat. Afr. Pl. Welw. ii. 148.
Chirinda, 3500 ft. Dec. Swyn. 1624.

**A. Schœnanthus,** *L.* (*Cymbopogon Schœnanthus*, Spreng.)
Fl. Cap. vii. 354 (var.) ; Cat. Afr. Pl. Welw. ii. 154.
Salisbury, Mundy ; South Rhodesia, Rand, 410.

var. **densiflorus,** *Hack.*
Cat. Afr. Pl. Welw. ii. 154.
Melsetter, 6000 ft. April, Swyn. 2098.

var. **versicolor,** *Hack.*
Fl. Cap. vii. 354 ; Nat. Pl. 124.
North Melsetter, 4000–6000 ft. April, Swyn. 1689 ; Nyahodi Riv. 4000 ft. April, Swyn. 1676 ; Chirinda, 3500 ft. Jan. Swyn. 1641.

**A. serratus,** *Thunb.* var. **versicolor,** *Hack.*
Bulawayo, Jeffreys, 5.

**A. sorghum,** *Brot.* (*Sorghum vulgare*, Pers.)
Fl. Cap. vii. 347 ; Nat. Pl. 120 ; Cat. Afr. Pl. Welw. ii. 150.
A common cultivated crop.

**A. squarrosus,** *L. fil.* (*A. muricatum*, Beauv.).
Cat. Afr. Pl. Welw. ii. 153.
Victoria Falls, Allen, 261.

**A. tamba** (*Rendle*), *Torre & Harms.* (*Cymbopogon tamba*, Rendle.) (*A. lepidus*, Nees, var. *tamba*, Hack.) (*A. cymbarius*, L. var. *lepidus*, Stapf.)
Fl. Cap. vii. 361.
North Melsetter, 4000–6000 ft. April, Swyn. 950, 1690 ; Chirinda, 3800 ft. April, Swyn. 415 ; Victoria, Monro, 1058.

Genus No.

**A. spp.**

Salisbury, March, Flanagan, 3001.

Govt. Herb. 637.

Craster, 1, 59, 61, 63, 65, 72, 73, 74, 75.

Syringa, Matabeleland, Govt. Herb. 647.

Somabula, Govt. Herb. 669, nr. *Cymbopogon hirtus.*

135—**Cleistachne sorghoides,** *Benth.*

Mazoe, 4300 ft. March, Eyles, 283.

136—**Themeda triandra,** *Forsk.* (*Anthistiria imberbis,* Retz.)

Fl. Cap. vii. 366; Cat. Afr. Pl. Welw. ii. 161.

North Melsetter, 4000–6000 ft. Swyn.; Chirinda, 3500 ft. Swyn.; Lusitu Riv. 3000 ft. Swyn.; Nyahodi Riv. 4000 ft. Swyn.

var. **glauca,** *Hack.* (*T. Forskalii,* Hochst. var. *glauca,* Hack.)

Fl. Cap. vii. see note, p. 368.

Salisbury, Craster, 26; Bulawayo, Rogers, 5881, 5903; Mashonaland, Govt. Herb. 703.

var. **imberbis,** *Hack.*

Fl. Cap. vii. 366; Nat. Pl. 133; Cat. Afr. Pl. Welw. ii. 161.

Bulawayo, Nov. Jeffreys, 39; Salisbury, Darling in Herb. Bolus, 10790; Syringa, Matabeleland, Govt. Herb. 631.

**T. sp.**

Charter, Govt. Herb. 3012.

143—**Tragus racemosus,** *All.*

Fl. Cap. vii. 577; Nat. Pl. 404.

Victoria Falls, Allen, 269; Bulawayo, in vlei, Dec. Jeffreys, 59; Rogers, 5905, 5725; Salisbury, Mundy; Charter, Govt. Herb. 3013.

148—**Perotis indica,** *Schum.* (*P. latifolia,* Ait.)

Fl. Cap. vii. 575; Nat. Pl. 403; Cat. Afr. Pl. Welw. ii. 210; Harv. Gen. S.A. Pl. 439.

Victoria Falls, Allen, 262; Rogers, 5582; Gwai, April, Flanagan, 3221; Chirinda, 3700 ft. Swyn.; Salisbury, Craster, 53; Somabula, Govt. Herb. 657; Matabeleland, Jeffreys, 44.

153—**Arundinella Ecklonii,** *Nees.*

Fl. Cap. vii. 448; Nat. Pl. 183.

Heaney Jnctn. in vlei, Jeffreys, 31; Victoria Falls, Rogers, 5671*.

154—**Melinis minutiflora,** *Beauv.*

Fl. Cap. vii. 447; Nat. Pl. 182; Cat. Afr. Pl. Welw. ii. 199.

Chirinda, 3500 ft. Swyn. 1694 (? same number given for *Pennisetum hordeiforme*).

Genus No.
161—**Paspalum scrobiculatum,** *L.*

Fl. Cap. vii. 370; Nat. Pl. 134; Cat. Afr. Pl. Welw. ii. 162.

Bulawayo, Monro, 991; Victoria Falls, Rogers, 5719; Salisbury, Craster, 17; Mundy; Melsetter, Govt. Herb. 2077; Swyn.; Chirinda, 3700 ft. Swyn.

**P. semialatus** (*Hook. f.*), *Torre & Harms*, var. Ecklonii, *Stapf.* (*Axonopus semialatus*, Hk. f. var. *Ecklonii*, Stapf.)

Fl. Cap. vii. 418; Nat. Pl. 166.

Melsetter, 6000 ft. Oct. Swyn. 6034; Mt. Pene, 6500–7000 ft. Sep. Oct. Swyn. 1644; 6035.

**P. spp.**

Charter, Govt. Herb. 3014.

Salisbury, Craster, 3.

165—**Isachne albens,** *Trin.*

Chipete Forest, 3800 ft. April, Swyn. 406.

166—**Panicum bolbodes,** *Schweinf.*

Cat. Afr. Pl. Welw. ii. 170.

North Melsetter, 4000–6000 ft. April, Swyn. 1699.

**P. bizanthum,** *Hochst.*

Fl. Cap. vii. 386; Nat. Pl. 147; Cat. Afr. Pl. Welw. ii. 167.

Salisbury, Darling in Herb. Bolus, 10788; Craster, 29, 35; Victoria Falls, Rogers, 5699; North Melsetter, 4000–6000 ft. April, Swyn. 1602*a*; Nyahodi Riv. 4000 ft. April, Swyn. 1673; Chirinda, 3500 ft. Jan. Swyn. 1622; Enkeldoorn, Govt. Herb. 671.

**P. bulawayense,** *Hack.*

Pro. Rhod. Sc. Assn. vii. pt. ii. 69.

Bulawayo, Jeffreys, 28.

**P. capillare,** *L.*

Fl. Cap. vii. 407; Nat. Pl. 498.

Salisbury, Craster, 27; Bulawayo, Rogers, 5871*.

**P. colonum,** *L.*

Cat. Afr. Pl. Welw. ii. 173.

Victoria Falls, Rogers, 5575.

**P. coloratum,** *L.*

Fl. Cap. vii. 409.

Victoria Falls, Rogers, 5068*.

**P commutatum,** *Nees.* (*Digitaria eriantha*, Steud.)

Fl. Cap. vii. 375; Nat. Pl. 137.

Bulawayo, Rogers, 5873 ?; South Rhodesia, Rhod. Agric. Journ. June, 1906, p. 500.

Genus No.

166—**P. dregeanum,** *Nees.*

Fl. Cap. vii. 411 ; Nat. Pl. 161.

Salisbury, Craster, 77, 78.

**P. Helopus,** *Trin.*

Fl. Cap. vii. 392, var. ; Nat. Pl. 146, var.

Salisbury, Craster, 11; South Rhodesia, Rhod. Agric. Journ. June, 1906, p. 500.

**L. heterostachyum,** *Hack.*

Victoria Falls, Rogers, 7034*.

**P. Isachne,** *Roth.*

Fl. Cap. vii. 390 ; Nat. Pl. 149.

Matabeleland, Jeffreys, 11 ? ; Salisbury, Mundy.

**P. lævifolium,** *Hack.*

Fl. Cap. vii. 405 ; Nat. Pl. 157.

Salisbury, Craster, 34 ; Mundy.

**P. madagascariense,** *Spreng.*

Cat. Afr. Pl. Welw. ii. 182.

North Melsetter, 3000–6000 ft. April, Swyn. 1702.

**P. maximum,** *Jacq.*

Fl. Cap. vii. 404 ; Nat. Pl. 156 ; Cat. Afr. Pl. Welw. ii. 181.

Heaney Jnctn. by river, Jeffreys, 12 ; Tabainduna Mt. Jeffreys, 32 ; Salisbury, Craster, 67 ; Mundy ; Victoria Falls, Rogers, 7036, 7034, 5630 ; Chirinda, 3700–4000 ft. Swyn. ; Bulawayo, Rogers, 5872.

var. **trichoglume.**

Victoria Falls, Allen, 260.

**P. monodactylum,** *Nees.* (*Digitaria monodactyla,* Stapf.)

Fl. Cap. vii. 373 ; Nat. Pl. 136 ; Cat. Afr. Pl. Welw. ii. 162.

Somabula, Govt. Herb. 663.

**P. myosuroides,** *R. Br.*

Cat. Afr. Pl. Welw. ii. 174.

Mazoe, 4300 ft. April, Eyles, 320; Victoria Falls, Rogers, 6006 ?.

**P. nigropedatum,** *Munro.*

Fl. Cap. vii. 388.

Bulawayo, Nov. Jeffreys, 62 ; Rogers, 5901.

**P. ramosum,** *L.*

Victoria Falls, Rogers, 5720.

**P. repens,** *L.*

Fl. Cap. vii. 409.

Victoria Falls, Rogers, 5009*.

Genus No.

**P. sanguinale,** *L.* (*Digitaria sanguinalis*, Scop.)
Fl. Cap. vii. 378 ; Nat. Pl. 141 ; Cat. Afr. Pl. Welw. ii. 163.
Bulawayo, in vlei, Jeffreys, 2 ; South Rhodesia, Rhod. Agric. Journ. 1906, p. 500 ; Victoria Falls, Rogers, 5723*, 5901*.

var. **ciliare,** *Hook. f.*
Cat. Afr. Pl. Welw. ii. 163.
Victoria Falls, Allen, 271 ; Chirinda, 3800 ft. April, Swyn. 964.

**P. serratum,** *Spreng.*
Fl. Cap. vii. 388 ; Nat. Pl. 148.
Charter, Govt. Herb. 3007 ; Victoria Falls, Rogers, 7057*.

var. **holosericeum,** *Hack.*
See Fl. Cap. vii. 389.
Chirinda, 3800 ft. Jan. Swyn. 1623.

**P. staginum,** *Retz.*
Fl. Cap. vii. 394 ; Nat. Pl. 492.
Heaney Jnctn. by river, Jeffreys, 3 ; Salisbury, Mundy, 801 ; South Rhodesia, Rhod. Agric. Journ. 1906, p. 500.

**P. Swynnertonii,** *Rendle.*
Journ. Linn. Soc. Bot. xl. 230.
North Melsetter, 2000–6000 ft. April, Swyn. 1702*a*.

**P. trichopus,** *Hochst.*
Fl. Cap. vii. 391 ; Nat. Pl. 150.
Victoria Falls, Allen, 267 ; Salisbury, Mundy ; Bulawayo, Rogers, 5891*.

**P. uncinatum,** *Raddi.*
Cat. Afr. Pl. Welw. ii. 184.
Chipete Forest, 3800 ft. Swyn. ; Chirinda, 3700–4000 ft. Swyn.

**P. zizanioides,** *H. B. K.*
Fl. Cap. vii. 402 ; Nat. Pl. 154.
Salisbury, Craster, 22.

**P. spp.**
Victoria Falls, Rogers, 6006, nr. *P. hymeniochilum*, Nees.
Sebakwe, Govt. Herb. 2078, cf. *Digitaria ternata*, Stapf.
Matabeleland, Jeffreys, 68, n. sp. ? nr. *P. serrati*, R. Br.
Salisbury, Craster, 9, 19, 20, 23, 24, 81.

167*b*—**Stereochlæna Jeffreysii,** *Hack.*
Pro. Rhod. Sc. Assn. vii. pt. ii. pp. 65, 66.
Bulawayo, May, Jeffreys, 46, 83.

168—**Tricholæna glabra,** *Stapf.*
Fl. Cap. vii. 446 ; Nat. Pl. 181.
South Rhodesia, Rhod. Agric. Journ. 1906, p. 500.

Genus No.

**T. rhodesiana,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 232.

Chirinda Forest, 3700–4000 ft. Nov. Swyn. 1632; Nyahodi Riv. 4000 ft. April, Swyn. 1663.

var. **glabrescens,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 233.

North Melsetter, 4000–6000 ft. April, Swyn. 1685.

**T. rosea,** *Nees.*

Fl. Cap. vii. 443; Nat. Pl. 180; Cat. Afr. Pl. Welw. ii. 194.

Victoria Falls, Allen, 270; Mazoe, 4400 ft. March, Eyles, 270; Bulawayo, Nov. Jeffreys, 53; Rogers, 5516, 5492, 5907, 5874; Salisbury, Mundy, 769; Craster, 30, 31; Darling, in Herb. Bolus, 10789; Rusapi, Engler; North Melsetter, 4000–6000 ft. Swyn.; Nyahodi Riv. 4000 ft. Swyn.; Chirinda, 3500–3800 ft. Swyn.; Upper Buzi, 3000–3500 ft. Swyn.; Syringa, Matabeleland, Govt. Herb. 653; South Rhodesia, Rand, 409.

169—**Oplismenus africanus,** *Beauv.*

Fl. Cap. vii. 416; Nat. Pl. 165; Cat. Afr. Pl. Welw. ii. 184.

Chipete Forest, 3800 ft. Swyn.; Victoria Falls, Engler; Rogers, 7400.

**O. sp.**

Victoria Falls, Sep. Gibbs, 158.

171—**Setaria aurea,** *A. Br.*

Fl. Cap. vii. 426; Nat. Pl. 479.

Bulawayo, in vlei, Nov. Jeffreys, 37, 56; Salisbury, Mundy, 802; Craster, 13, 14?, 15?; Victoria Falls, Rogers, 7241; North Melsetter, 4000–6000 ft. Swyn.; Chirinda, 3000 ft. Swyn.; Upper Buzi, Swyn.; Charter, Govt. Herb. 3004; South Rhodesia, Rhod. Agric. Journ. 1906, p. 500; Somabula, Govt. Herb. 661, 658.

**S. flabellata,** *Stapf.*

Fl. Cap. vii. 425.

Salisbury, Mundy.

**S. Gerrardii,** *Stapf.*

Fl. Cap. vii. 424; Nat. Pl. 170.

Bulawayo, Rogers, 5917; Syringa, Matabeleland, Govt. Herb. 632; South Rhodesia, Rhod. Agric. Journ. 1906, p. 500.

**S. imberbis,** *Roem. & Schult.*

Fl. Cap. vii. 427; Nat. Pl. 173.

Matopos, March, Flanagan, 2996; Bulawayo, Rogers, 5879.

**S. italica,** *Beauv.*

Fl. Cap. vii. 428.

Bulawayo, Rogers, 5878.

Genus No.

**S. mauritiana,** *Spreng.*
Cat. Afr. Pl. Welw. ii. 187.
Chirinda Forest, 3700–4000 ft. April, Swyn. 417.

**S. nigrirostris,** *Dur. & Sch.*
Fl. Cap. vii. 423; Nat. Pl. 169.
North Melsetter, 4000–6000 ft. April, Swyn. 1693; Salisbury, Mundy.

**S. verticillata** (*L.*), *Beauv.*
Fl. Cap. vii. 429; Nat. Pl. 174; Cat. Afr. Pl. Welw. ii. 185.
Bulawayo, Jeffreys, 6, Rogers, 5896; Salisbury, Craster, 38; Mundy; Chirinda, 3500 ft. Swyn.; Chepete Forest, 3800 ft. Swyn.; Chipete Forest, 3800 ft. Swyn.

**S. spp.**
Charter, Govt. Herb. 3002, 3011.
Salisbury, Craster, 60.

175—**Pennisetum cenchroides,** *Rich.* (*P. ciliare,* Link.)
Fl. Cap. vii. 433; Cat. Afr. Pl. Welw. ii. 190.
Tabazinduna Mt. Jan. Jeffreys, 35; Bulawayo, Rogers, 5909.

**P. macrourum,** *Trin.* (*P. hordeiforme,* Spreng.)
Fl. Cap. vii. 434.
North Melsetter, 3000–6000 ft. April, Swyn. 1694 (? same number given for *Melinis minutiflora*); South Rhodesia, Rhod. Agric. Journ. 1906, p. 501.

**P. purpureum,** *Schumach.* (*P. Benthamii,* Steud.)
Kew Bull. 1912, 309; Cat. Afr. Pl. Welw. ii. 189.
North Melsetter, 3000–6000 ft. April, Swyn. 955; Lusitu Riv. 3000 ft. Swyn.; Umtali, Engler; Matabeleland, Govt. Herb. 1099.

**P. setosum,** *L. Rich.*
Cat. Afr. Pl. Welw. ii. 190.
Upper Buzi, 3000 ft. April, Swyn. 975; Nyahodi Riv. 4000 ft. April, Swyn. 1664.

**P. unisetum,** *Benth.* (*P. longisetum,* K. Schum.) (*P. dioicum,* A. Rich.)
Fl. Cap. vii. 437; Nat. Pl. 178; Cat. Afr. Pl. Welw. ii. 192.
Lusitu Riv. 3000 ft. April, Swyn. 1649; Upper Buzi, 3000–3500 ft. April, Swyn. 983; Chirinda, 3500 ft. Swyn. 414.

184—**Olyra latifolia,** *L.*
Fl. Cap. vii. 746; Nat. Pl. 464; Cat. Afr. Pl. Welw. ii. 255.
Chipete Forest, 3800 ft. Swyn.

187—**Leptaspis cochleata,** *Thw.*
Cat. Afr. Pl. Welw. ii. 256.
Chirinda, 3700–4000 ft. Dec. and Jan. Swyn. 410, 419, 6633.

Genus No.
208—**Aristida adscensionis,** *L.*
Fl. Cap. vii. 554 ; Cat. Afr. Pl. Welw. ii. 202.
North Melsetter, 4000 ft. Swyn. ; Syringa, Govt. Herb. 639 ; Bulawayo, Rogers, 5968 ; Victoria Falls, Rogers, 5863.

**A. æquiglumis,** *Hack.*
Fl. Cap. vii. 555 ; Nat. Pl. 197.
South Rhodesia, Rhod. Agric. Journ. 1906, p. 500.

**A. angustata,** *Stapf.*
Fl. Cap. vii. 556 ; Nat. Pl. 198.
Heaney Jnctn. Jeffreys, 10 ; Bulawayo, Rogers, 13510*.

**A. barbicollis,** *Trin. & Rupr.*
Fl. Cap. vii. 559 ; Nat. Pl. 401.
North Melsetter, 4000 ft. April, Swyn. 1717 ; Salisbury, Craster, 50 ; Bulawayo, Rogers, 5904, 5887.

**A. bipartita,** *Trin. & Rupr.*
Fl. Cap. vii. 558 ; Nat. Pl. 483.
Matabeleland, Jeffreys, 63 ; Victoria Falls, Rogers, 7040*.

**A. ciliata,** *Desf.*
Fl. Cap. vii. 563.
South Rhodesia, Rhod. Agric. Journ. 1906, p. 500.

**A. congesta,** *Roem. & Schult.*
Fl. Cap. vii. 558 ; Nat. Pl. 484.
Matabeleland, Jeffreys, 87.

**A. stipitata,** *Hack.* (*A. sieberiana*, Trin. var. *stipitata*, Stapf.)
Fl. Cap. vii. 560.
Matabeleland, Jeffreys, 23.

**A. stipoides,** *Lam.*
Fl. Cap. vii. 562.
Matopos, Engler ; North of Bulawayo, Engler.

**A. spp.**
Victoria Falls, Allen, 263.
Ingesi, Matabeleland, Govt. Herb. 679.
Charter, Govt. Herb. 3001, 3010.

230—**Sporobolus centrifugus,** *Nees.*
Fl. Cap. vii. 584 ; Nat. Pl. 406.
Mt. Pene, 6500–7000 ft. Sep. Swyn. 1647.

**S. festivus,** *Hochst.*
Cat. Afr. Pl. Welw. ii. 207.
Victoria Falls, Rogers, 5713 ; Syringa, Govt. Herb. 643 ; Salisbury, Craster, 8.

var. **fibrosus.**
Victoria Falls, Allen, 268.

Genus No.

var. **stuppeus,** *Stapf.*

Fl. Cap. vii. 582; Nat. Pl. 405; in Pro. Rhod. Sc. Assn. vii. pt. ii. p. 64, Hackel says, "A distinct species according to my opinion."

Heaney Jnctn. in vlei, Jan. Jeffreys, 34.

**S. fimbriatus,** *Nees.*

Fl. Cap. vii. 585; Nat. Pl. 486.

Victoria, Monro, 992; Salisbury, Rogers, 13509.

**S. indicus,** *R. Br.*

Fl. Cap. vii. 586; Nat. Pl. 408.

Salisbury, Darling, in Herb. Bolus, 10791; Mundy; Chirinda, 3700 ft. Jan. Swyn. 404.

var. **laxus,** *Stapf.* (*S. pyramidalis,* Nees.)

Fl. Cap. vii. 586.

Heaney Jnctn. Jeffreys, 24; Bulawayo, Rogers, 5877.

**S. panicoides,** *Rich.*

Bulawayo, Rogers, 5864.

**S. spp.**

Salisbury, Craster, 28, 33, 44, 80.

277—**Tristachya biseriata,** *Stapf.*

Fl. Cap. vii. 453; Cat. Afr. Pl. Welw. ii. 217.

North Melsetter, 3000–6000 ft. April, Swyn. 1708.

**T. leucothrix,** *Trin.*

Fl. Cap. vii. 453; Nat. Pl. 187.

Mt. Pene, 6500–7000 ft. Sep. Swyn. 1643.

278—**Trichopteryx gigantea,** *Stapf.*

South of Victoria Falls, Baines; Holub.

**T. simplex,** *Hack.*

Fl. Cap. vii. 450; Nat. Pl. 185.

North Melsetter, 4000–6000 ft. fr. April, Swyn. 1612, 1709; Nyahodi Riv. 4000 ft. April, Swyn. 1662; Chipetzana Source, 4000 ft. fr. April, Swyn. 974; Chirinda, 3700 ft. Jan. Swyn. 1618; Salisbury, Govt. Herb. 604; Matabeleland, Jeffreys, 15.

var. **minor,** *Stapf.*

Fl. Cap. vii. 450.

Salisbury, Craster, 21; Syringa, Govt. Herb. 649.

**T. spp.**

Salisbury, Craster, 55.

Engler, probably *T. simplex,* Hack.

Matapos, Rogers, 5194, probably n. sp.

280—**Danthonia inermis,** *Stapf.* (*Pentaschistis inermis.*)

Fl. Cap. vii. 534.

Victoria Falls, Rogers, 5671.

Genus No.

281—**Microchloa caffra,** *Nees.*

Fl. Cap. vii. 636 ; Nat. Pl. 431 ; Harv. Gen. S.A. Pl. 447.

Matabeleland, Jeffreys, 58.

282—**Cynodon Dactylon,** *Pers.*

Fl. Cap. vii. 634 ; Nat. Pl. 430 ; Cat. Afr. Pl. Welw. ii. 220.

Victoria Falls, Allen, 276 ; Rogers, 5718, 5876 ; Bulawayo, Dec. Jeffreys, 61 ; Rogers, 5514 ; Chubb, 92 ; Salisbury, Craster, 10 ; Mundy ; Chirinda, 3800 ft. Swyn.

**C. incompletus,** *Nees.*

Fl. Cap. vii. 635.

Salisbury, Mundy.

286—**Ctenium sp.**

Salisbury, Mundy.

288—**Chloris barbata,** *Sw.*

Cat. Afr. Pl. Welw. ii. 222.

Chirinda, 3500 ft. Swyn. ; North Melsetter, 4000 ft. Swyn.

**C. gayana,** *Kunth.* (*C. abyssinica*, Hochst.)

Fl. Cap. vii. 642 ; Nat. Pl. 437.

North Melsetter, 4000–6000 ft. April, Swyn. 1700 ; Salisbury, Mundy.

**C. petræa,** *Thunb.*

Fl. Cap. vii. 643 ; Nat. Pl. 438.

Matabeleland, Jeffreys, 52.

**C. pycnothrix,** *Trin.*

Fl. Cap. vii. 641 ; Nat. Pl. 435.

Victoria Falls, April, Flanagan, 3224 ; Chirinda, 3700 ft. Oct. and April, Swyn. 1629*a*, 1696 ; Salisbury, Craster, 25.

**C. virgata,** *Swartz.*

Fl. Cap. vii. 641 ; Nat Pl. 436.

Salisbury, Mundy, 768 ; Bulawayo, Rogers, 5875 ; Matabeleland, Jeffreys, 86 ; South Rhodesia, Rhod. Agric. Journ. 1906, p. 500.

var. **elegans,** *Stapf.*

Fl. Cap. vii. 642.

Salisbury, Craster, 7.

294—**Craspedorhachis rhodesiana,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 233.

North Melsetter, 3000–6000 ft. April, Swyn. 1697.

**C. sp.**

Salisbury, Craster, 79.

298—**Tripogon abyssinicus,** *Nees.*

Cat. Afr. Pl. Welw. ii. 223.

Matabeleland, Jeffreys, 41.

Genus No.

304—**Eleusine coracana,** *Gaertn.*

Fl. Cap. vii. 645; Nat. Pl. 440 ; Cat. Afr. Pl. Welw. ii. 224.

South Rhodesia, Rhod. Agric. Journ. 1905, p. 115. A common native crop.

**E. indica,** *Gaertn.*

Fl. Cap. vii. 645 ; Nat. Pl. 439 ; Cat. Afr. Pl. Welw. ii. 224.

Heaney Jnctn. Jeffreys, 29; Salisbury, Mundy, 738; Craster, 36; North Melsetter, 6000 ft. Swyn.; Chirinda, 3500 ft. Swyn.

305—**Dactyloctenium ægyptiacum,** *Willd.*

Fl. Cap. vii. 646; Nat. Pl. 441; Cat. Afr. Pl. Welw. ii. 224.

Heaney Jnctn. Jeffreys, 30; Victoria Falls, Rogers, 5592, 5726; North Melsetter, 4000–6000 ft. Swyn.; Bulawayo, Rogers, 5886.

309*b*—**Crossotropis grandiglumis,** *Rendle.*

Fl. Cap. vii. 649 ; Nat. Pl. 443 ; Cat. Afr. Pl. Welw. ii. 226.

Heaney Jnctn. Jeffreys, 1 ; Bulawayo, Rogers, 5883*.

310—**Pappophorum molle,** *Kunth.* (*Enneapogon mollis*, Lehm.)

Fl. Cap. vii. 655.

Victoria Falls, 5694.

312—**Schmidtia bulbosa,** *Stapf.*

Fl. Cap. vii. 658.

Victoria Falls, Rogers, 5724; Bulawayo, Rogers.

**S. pappophoroides,** *Steud.* (*Antoschmidtia pappophoroides*, Boiss.)

Cat. Afr. Pl. Welw. ii. 231; also see note under *S. bulbosa*, Stapf, Fl. Cap. vii. 658.

Victoria Falls, Allen, 273.

333—**Phragmites communis,** *Trin.* (*Trichoon Phragmites*, Rendle.)

Fl. Cap. vii. 541 ; Nat. Pl. 193 ; Cat. Afr. Pl. Welw. ii. 218.

Nyahodi Riv. 4000 ft. Swyn.; Lusitu Riv. 2500 ft. Swyn.; Salisbury, Craster, 68; Matopos, Rogers, 5196 (forma); Victoria Falls, Engler ; Umtali, Engler.

**P. sp.**

Victoria Falls, Rogers, 5317.

337—**Diplachne alopecuroides** (*Stapf*), *Torre & Harms.* (*Leptocarydion alopecuroides*, Stapf.)

Fl. Cap. vii. 649 ; Cat. Afr. Pl. Welw. ii. 225.

North Melsetter, 3000–6000 ft. April, Swyn. 1695 ; Victoria Falls, Rogers, 7029*.

**D. biflora,** *Hack.* var. **Buchananii,** *Stapf.*

Fl. Cap. vii. 593 ; Nat. Pl. 411.

Chirinda, 3500 ft. Jan. Swyn. 1619; Syringa, Govt. Herb. 651.

Genus No.

337*a*—**Pogonarthria Marlothii,** *Hack.* (*Eragrostis Marlothii,* Hack.; *Leptochloa falcata,* Hack.; *Pogonarthria falcata,* Rendle.) See note by Hackel in Pro. Rhod. Sc. Assn. vii. pt. ii. 64.

Fl. Cap. vii. 589; Nat. Pl. 409; Cat. Afr. Pl. Welw. ii. 232.

Victoria Falls, Rogers, 6013, 7043; North Melsetter, 3000–6000 ft. April, Swyn. 1609, 1706; Nyahodi Riv. 4000 ft. April, Swyn. 1674*a*; Upper Buzi, 3000–3500 ft. April, Swyn. 978, 981, 982; Salisbury, Craster, 52, 57, 71; North of Bulawayo, Engler; Matabeleland, Jeffreys, 27, 79.

341—**Eragrostis abyssinica ?.**

Govt. Herb. 2079.

**E. aspera,** *Nees.*

Fl. Cap. vii. 628; Nat. Pl. 424; Cat. Afr. Pl. Welw. ii. 232.

Chirinda, 3700–4000 ft. Swyn.; Victoria Falls, Rogers, 7038*.

**E. Atherstonei,** *Stapf.*

Fl. Cap. vii. 607; Nat. Pl. 426.

Somabula, Govt. Herb. 667; Matabeleland, Jeffreys, 19.

**E. barbinodis,** *Hack.*

Fl. Cap. vii. 621.

Bulawayo, March, Jeffreys, 51.

**E. brizoides,** *Nees.*

Fl. Cap. vii. 622; Nat. Pl. 422; Cat. Afr. Pl. Welw. ii. 251.

Mt. Pene, 6500 ft. Sep. Swyn. 1646; Charter, Govt. Herb. 3009; Salisbury, Mundy; Victoria Falls, Rogers; South Rhodesia, Rhod. Agric. Journ. 1906, p. 501.

**E. chalcantha,** *Trin.*

Fl. Cap. vii. 615; Nat. Pl. 418; Cat. Afr. Pl. Welw. ii. 248.

Victoria Falls, Allen, 274; Heaney Jnctn. by river, Jeffreys, 18; North Melsetter, 3000–6000 ft. Swyn.; Enkeldoorn, Govt. Herb. 672; Somabula, Govt. Herb. 662; Umtali, Engler.

**E. Chapelieri,** *Nees.*

Fl. Cap. vii. 614; Nat. Pl. 417; Cat. Afr. Pl. Welw. ii. 250.

North Melsetter, 3000–6000 ft. Swyn. 1707; Nyahodi Riv. 4000 ft. Swyn. 1674; Upper Buzi, 3000–3500 ft. April, Swyn. 980; Umtali, Engler; Matabeleland, Jeffreys, 20.

**E. chloromelas,** *Steud.*

Fl. Cap. vii. 602.

Bulawayo, Rogers, 5892.

**E. congesta,** *Oliv.*

Nyahodi Riv. 4000 ft. April, Swyn. 1665.

**E. curvula,** *Nees.*

Fl. Cap. vii. 599; Nat. Pl. 413; Cat. Afr. Pl. Welw. ii. 244.

Bulawayo, Rogers, 5515; Salisbury, Mundy.

Genus No.

341—**E. denudata,** *Hack.*

Fl. Cap. vii. 613.

Syringa, Govt. Herb. 650; Victoria Falls, Rogers, 5721*.

**E. gangetica,** *Steud.*

Fl. Cap. vii. 617; Nat. Pl. 419.

Victoria Falls, Rogers, 7044; Matopos, Rogers, 5694.

**E. gummiflua,** *Nees.*

Fl. Cap. vii. 629; Nat. Pl. 425.

Heaney Jnctn. in vlei, Jeffreys, 13; Bulawayo, Rogers, 5884; Salisbury, Mundy.

**E. hispida,** *K. Schum.*

Salisbury, Craster, 16.

**E. Jeffreysii,** *Hack.*

Pro. Rhod. Sc. Assn. vii. pt. ii. 68.

Bulawayo, March, Jeffreys, 42.

**E. Lappula,** *Nees*, var. **divaricata,** *Stapf*, forma macra, *Hack.*

Fl. Cap. vii. 628.

Matabeleland, Jeffreys, 75.

**E. lehmanniana,** *Nees.*

Fl. Cap. vii. 601.

Bulawayo, Rogers, 5895 ?; Somabula, Govt. Herb. 659.

**E. major,** *Host.*

Fl. Cap. vii. 620; Nat. Pl. 420; Cat. Afr. Pl. Welw. ii. 237.

North Melsetter, 4000–6000 ft. Swyn.; Upper Buzi, 3000–3500 ft. Swyn.; between Wankie and Victoria Falls, Rogers, 6005; Bulawayo, Rogers, 5869, 5867; Victoria Falls, Rogers, 5787 ?

**E. namaquensis,** *Nees.* (*E. interrupta*, Beauv. var. *namaquensis*, Dur. & Schinz.)

Fl. Cap. vii. 630; Cat. Afr. Pl. Welw. ii. 233.

North Melsetter, 4000–6000 ft. April, Swyn. 1608.

var. **robusta,** *Stapf.*

Fl. Cap. vii. 630; Nat. Pl. 429.

Matabeleland, Jeffreys, 25.

**E. patentipilosa,** *Hack.*

Pro. Rhod. Sc. Assn. vii. pt. ii. 67.

Bulawayo, May, Jeffreys, 33.

**E. plana,** *Nees.*

Fl. Cap. vii. 609; Nat. Pl. 416; Cat. Afr. Pl. Welw. ii. 251.

Melsetter, 6000 ft. April, Swyn. 1681; Chirinda, 3500 ft. Nov.–Jan. Swyn. 404*a*, 968, 1626.

**E. plumosa,** *Link.*

Matopos, Rogers, 5405; Bulawayo, Rogers, 5888.

Genus No.

**E. sclerantha,** *Nees,* var. **retinorrhœa,** *Steud.*
Fl. Cap. vii. 615, type.
Matopos, Engler.

**E. superba,** *Peyr.*
Fl. Cap. vii. 622; Nat. Pl. 421; Cat. Afr. Pl. Welw. ii. 251.
Bulawayo, in vlei, Dec. Jeffreys, 38, 50; Rogers, 5908; Charter, Govt. Herb. 3003; Salisbury, Mundy.

**E. tenella,** *Stapf,* var. **plumosa.**
Matopos, March, Flanagan, 2943.

**E. uniglumis,** *Hack.*
Pro. Rhod. Sc. Assn. vii. pt. ii. 66.
Heaney Jnctn. Jan. Jeffreys, 48; Salisbury, Mundy.

**E. viscosa,** *Trin.* (*E. tenella,* Beauv. var. *viscosa,* Stapf.)
Cat. Afr. Pl. Welw. ii. 233.
Heaney Jnctn., in vlei, Jeffreys, 14; Salisbury, Mundy.

**E. Wilmsii,** *Stapf.*
Fl. Cap. vii. 606.
Syringa, Govt. Herb. 640.

**E. spp.**
Victoria Falls, April, Flanagan, 3212, 3222.
Victoria Falls, Allen, 266, cf. *E. pilosa,* Beauv.
Victoria Falls, Rogers, 5418.
Syringa, Govt. Herb. 638, 644, 652, 655, 660, 682.
Charter, Govt. Herb. 3005, 3008.
Salisbury, Craster, 4, 5, 6, 32, 39, 54, 58, 64, 76.

346—**Kœleria cristata,** *Pers.*
Fl. Cap. vii. 468; Nat. Pl. 189.
Mt. Pene, 6500–7000 ft. Swyn.

361—**Pœcilostachys flaccidula,** *Stapf.*
Journ. Linn. Soc. Bot. xl. 231.
Chipete Forest, 3800 ft. April, Swyn. 409*a*.

385—**Festuca sp.**
Bulawayo, 4500 ft. Dec. Eyles, 1203, cf. *F. costata,* Nees.

395—**Lolium sp.**
Victoria, Munro, 492.

405—**Agropyrum lepidus,** ? var. **tamba.**
Victoria, Munro, 1058.

430—**Oxytenanthera abyssinica,** *Munro.*
Cat. Afr. Pl. Welw. ii. 256.
Victoria Falls, Rogers, 5603.

FAMILY XX.—CYPERACEAE, *J. St. Hil.*

Genus No.
452—**Lipocarpha argentea,** *R. Br.*
Fl. Cap. vii. 265; Fl. Trop. Afr. viii. 469; Cat. Afr. Pl. Welw. ii. 129.
Matopos, Rogers, 5262; Chirinda, 3500 ft. Swyn.

**L. monocephala,** *Turrill.*
Kew Bull. 1913, 307.
Victoria Falls, Rain Forest, Rogers, 6024.

454—**Ascolepis capensis,** (*Kunth.*), *Ridley.*
Fl. Cap. vii. 266; Fl. Trop. Afr. viii. 477; Cat. Afr. Pl. Welw. ii. 131.
Marandellas, Engler; Rogers, 4040; South. Rhodesia, Bryce.

**A. protea,** *Welw.*
Fl. Trop. Afr. viii. 474; Cat. Afr. Pl. Welw. ii. 130.
Victoria Falls, Allen, 22.

var. **bellidiflora,** *Welw.*
Fl. Trop. Afr. viii. 475; Cat. Afr. Pl. Welw. ii. 130.
Victoria, Monro, 905.

459—**Cyperus albostriatus,** *Schrad.*
Fl. Cap. vii. 176.
Mt. Pene, 7000 ft. Oct. Swyn. 6036.

**C. amabilis,** *Vahl.*
Fl. Trop. Afr. viii. 327; Cat. Afr. Pl. Welw. ii. 109.
Salisbury, Craster, 47; Victoria Falls, Rogers, 6011.

**C. aristatus,** *Rottb.*
Fl. Trop. Afr. viii. 348; Fl. Cap. vii. 179; Cat. Afr. Pl. Welw. ii. 110.
Victoria Falls, Allen, 286; Bulawayo, Rogers, 5816.

**C. auricomus,** *Spr. ?*
Bulawayo, Rogers, 5512.

**C. betschuanus,** *Boeck.* (*Pycreus betschuanus*, C. B. Cl.)
Fl. Trop. Afr. viii. 304; Fl. Cap. vii. 159.
Mashonaland, Bryce.

**C. compactus,** *Lam.*
Fl. Trop. Afr. viii. 319; Fl. Cap. vii. 168; Cat. Afr. Pl. Welw. ii. 112.
North Melsetter, 2000–6000 ft. April, Swyn. 916*b*; Mt. Pene, 6800 ft. Sep. Swyn. 916; Somabula, Govt. Herb. 665; Salisbury, Rogers, 4087; Matabeleland, Elliott.

var. **flavissimus,** *C. B. Cl.*
Fl. Trop. Afr. viii. 320; Cat. Afr. Pl. Welw. ii. 112.
Victoria, Monro, 676.

Genus No.
459—**C. denudatus,** *L. fil.*
Fl. Trop. Afr. viii. 338; Fl. Cap. vii. 173; Cat. Afr. Pl. Welw. ii. 114.
Matopos, fl. & fr. Sep. Gibbs, 56; Victoria Falls, on island, Kirk; Rogers, 5966.

**C. distans,** *L. fil.*
Fl. Trop. Afr. viii. 349; Fl. Cap. vii. 178; Cat. Afr. Pl. Welw. ii. 116.
Chirinda, 3700 ft. Swyn.; Victoria Falls, Rogers, 5600; Bulawayo, Rogers, 5813.

**C. esculentus,** *L.*
Fl. Trop. Afr. viii. 355; Fl. Cap. vii. 180; Cat. Afr. Pl. Welw. ii. 117.
Gwai, April, Flanagan, 3215 ?; Salisbury, Craster, 40, 41.

**C. globosus,** *Boeck.* (*Pycreus globosus,* Reichb. var. *nilagirica,* C. B. Cl.)
Fl. Trop. Afr. viii. 299; Fl. Cap. vii. 159.
Umtali, Engler.

**C. Haspan,** *L.*
Fl. Trop. Afr. viii. 332; Cat. Afr. Pl. Welw. ii. 114.
Victoria Falls, Engler; Rogers, 5081; Chirinda, 3500 ft. Swyn.

var. **americana,** *Boeck.*
Victoria Falls, on bog edge, fl. & fr. Sep. Gibbs, 167.

**C. hemisphæricus** (*C. B. Cl.*), *Torre & Harms.* (*Mariscus hemisphæricus,* C. B. Cl.)
Fl. Trop. Afr. viii. 400.
Chirinda, 3800 ft. April, Swyn. 412.

**C. margaritaceus,** *Vahl.*
Fl. Trop. Afr. viii. 321; Fl. Cap. vii. 169; Cat. Afr. Pl. Welw. ii. 112.
Gwai, April, Flanagan, 3216; Salisbury, Craster, 45; Rogers, 4087.

**C. Mundtii,** *Kunth.* (*Pycreus Mundtii,* Nees.)
Fl. Trop. Afr. viii. 294; Fl. Cap. vii. 157; Cat. Afr. Pl. Welw. ii. 106.
Victoria Falls, in bog, fl. & fr. Sep. Gibbs, 149; Engler.

**C. papyrus,** *L.*
Fl. Trop. Afr. viii. 374; Cat. Afr. Pl. Welw. ii. 118.
Victoria Falls, on island, Rogers, 5103; Matopos, Rogers.

**C. polystachyus,** *Rottb.* (*Pycreus polystachyus,* Beauv.)
Fl. Trop. Afr. viii. 296; Fl. Cap. vii. 157; Cat. Afr. Pl. Welw. ii. 108.
Sabi Riv. 1000 ft. Swyn.

Genus No.

var. **laxiflora,** *Benth.*

Fl. Trop. Afr. viii. 297; Fl. Cap. vii. 158.

Chirinda, 3500 ft. Swyn.

**C. pulcher,** *Thunb.* (*C. dregeanus*, Kunth.)

Fl. Cap. vii. 171.

Victoria Falls, Rogers, 5619.

**C. radiatus,** *Vahl.* (*Mariscus radiatus ?*)

Fl. Trop. Afr. viii. 369.

Victoria Falls, Rogers, 5574.

**C. sieberianus** (*Nees*), *Torre & Harms.* (*Mariscus sieberianus*, Nees.)

Fl. Trop. Afr. viii. 388; Fl. Cap. vii. 189.

Chirinda, 3800 ft. Swyn.

**C. sphærospermus,** *Schrad.*

Fl. Trop. Afr. viii. 336; Fl. Cap. vii. 172; Cat. Afr. Pl. Welw. ii. 115.

Salisbury, Craster, 48?

**C. textilis,** *Thunb.*

Fl. Cap. vii. 174.

Mazoe, 4300 ft. Sep. Eyles, 425; Bulawayo, Chubb, 30.

**C. Zollingeri,** *Steud.*

Fl. Trop. Afr. viii. 360; Cat. Afr. Pl. Welw. ii. 117.

Victoria Falls, Allen, 279.

**C. spp.**

Victoria Falls, April, Flanagan, 3213, cf. *C. nitens*, Retz.

Victoria Falls, April, Flanagan, 3214, cf. *C. aureobruneus*, C. B. Cl.

Gwai, April, Flanagan, 3220, cf. *C. amabilis*, Vahl. and 3217.

Matopos, March, Flanagan, 2983.

Victoria, Monro, 1057.

Bulawayo, Nov. Eyles, 1135, 1187.

South Rhodesia, Rand, 255, 256, 257, 258, 259, 406, 407.

461—**Courtoisia assimilis,** *C. B. Cl.*

Fl. Trop. Afr. viii. 404.

Matopos, Rogers, 5403.

**C. cyperoides,** *Nees.*

Fl. Trop. Afr. viii. 404.

Matabeleland, Holub.

462—**Kyllinga alba,** *Nees.*

Fl. Trop. Afr. viii. 271; Fl. Cap. vii. 151; Cat. Afr. Pl. Welw. ii. 105, Chirinda, 3800 ft. May, Swyn. 459; Bulawayo, Chubb, 384; banks of Zambesi, Holub.

**K. erecta,** *Schum.*

Fl. Cap. vii. 152; Cat. Afr. Pl. Welw. ii. 105.

Bulawayo, Rogers, 5513.

Genus No.

**K. spp.**

Salisbury, Darling, in Herb. Bolus, 2 spp.

Victoria Falls, Allen, 80.

467—**Fuirena glomerata,** *Lam.*

Fl. Trop. Afr. viii. 465; Cat. Afr. Pl. Welw. ii. 128.

Ngomi, April, Flanagan, 3218.

**F. hirta,** *Vahl.*

Fl. Cap. vii. 264.

Victoria Falls, Engler.

**F. Oedipus,** *C. B. Cl.*

Journ. Linn. Soc. Bot. xxxvii. 478.

Victoria Falls, Rain Forest, Sep. Gibbs, 125.

**F. pachyrrhiza,** *Ridl.*

Fl. Trop. Afr. viii. 464; Fl. Cap. vii. 262; Cat. Afr. Pl. Welw. ii. 129.

Salisbury, Craster, 49.

**F. pubescens,** *Kunth.*

Fl. Trop. Afr. viii. 463; Fl. Cap. vii. 261; Cat. Afr. Pl. Welw. ii. 128.

Chirinda, 3500 ft. Swyn.; Macheke, Rogers, 4050; Bulawayo, Rogers, 5517.

**F. stricta,** *Steud.*

Fl. Trop. Afr. viii. 465.

Matopos, fl. & fr. Sep. Gibbs, 92; Chirinda, 3700 ft. Jan. Swyn. 910.

**F. subdigitata,** *C. B. Cl.*

Journ. Linn. Soc. Bot. xxxvii. 477.

Matopos, Sep. Gibbs, 196.

**F. umbellata,** *Rottb.*

Fl. Trop. Afr. viii. 466.

Victoria Falls, Rogers, 5093*.

**F. welwitschii,** *Ridley.*

Fl. Trop. Afr. viii. 463.

Victoria Falls, Rogers, 13600*.

**F. spp.**

Bulawayo, Dec. Eyles, 1136.

Matopos, March, Flanagan, 2976.

Matopos, Sep. Gibbs, 54.

468—**Scirpus articulatus,** *L.*

Fl. Trop. Afr. viii. 453; Fl. Cap. vii. 228; Cat. Afr. Pl. Welw. ii. 126.

Victoria, Monro, 912.

Genus No.

**S. corymbosus,** *Roth.*

Fl. Trop. Afr. viii. 455; Fl. Cap. vii. 229; Cat. Afr. Pl. Welw. ii. 126.

Melsetter, 6000 ft. Sep. Swyn. 906; Inyamadzi Valley, 3000 ft. Oct. Swyn. 905.

**S. fluitans,** *L.*

Fl. Trop. Afr. viii. 449; Fl. Cap. vii. 213; Cat. Afr. Pl. Welw. ii. 126.

Matopos, in streams, fl. & fr. Sep. Gibbs, 211.

**S. paludicola,** *Kunth.*

Fl. Cap. vii. 230.

Victoria Falls, fl. & fr. Sep. Gibbs, 168; Engler.

**S. supinus,** *L.*

Fl. Trop. Afr. viii. 452.

Matopos, fl. & fr. Sep. Gibbs, 58.

469—**Heleocharis capitata,** *Boeck.* (*Eleocharis capitata,* R. Br.)

Fl. Trop. Afr. viii. 407.

Victoria Falls, Rain Forest, fl. & fr. Sep. Gibbs, 162; Engler.

**H. Kirkii** (*C. B. Cl.*), *Torre & Harms.* (*Eleocharis Kirkii,* C. B. Cl.)

Fl. Trop. Afr. viii. 410.

Victoria Falls, on island, Kirk.

471—**Fimbristylis Burchellii,** *Fic. & Hiern.* (*Bulbostylis Burchelli,* C. B. Cl.)

Fl. Trop. Afr. viii. 440; Fl. Cap. vii. 210; Cat. Afr. Pl. Welw. ii. 125.

Mazoe, Dec. Eyles, 483; Victoria Falls, April, Flanagan, 3223; Rogers, 7269; Salisbury, Craster, 42, 46; Bulawayo, Rogers, 5815; Ingesi, Govt. Herb. 675.

**F. diphylla,** *Vahl.*

Fl. Trop. Afr. viii. 415; Fl. Cap. vii. 200; Cat. Afr. Pl. Welw. ii. 122.

Chirinda, 3700 ft. Swyn.; Salisbury, Craster, 43.

**F. exilis,** *Roem. & Schl.*

Fl. Trop. Afr. viii. 418; Fl. Cap. vii. 201; Cat. Afr. Pl. Welw. ii. 123.

Victoria Falls, Allen, 265; Matopos, Rogers, 5170; Chirinda, 3000–6000 ft. Swyn.; Chimanimani Mts. 7000 ft. Swyn.; Upper Buzi, Swyn.

**F. rhodesiana,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 222.

Upper Buzi, 4000–3500 ft. April, Swyn. 920.

Genus No,

**F. schœnoides** (*Kunth.*). *Torre & Harms.* (*Bulbostylis schœnoides,* Kunth.)

Fl. Cap. vii. 206.

Marandellas, Rogers, 4035.

**F. spp.**

Matopos, Sep. Galpin, 7072; March, Flanagan, 2984.

Mazoe, Dec. Eyles, 482.

512—**Eriospora villosula,** *C. B. Cl.*

Fl. Trop. Afr. viii. 513.

Chimanimani Mts. 7000 ft. Sep. Swyn. 918.

515—**Scleria Buchanani,** *Boeck.*

Fl. Trop. Afr. viii. 499; Fl. Cap. vii. 295.

Salisbury, Craster, 12; Victoria, Monro, 633.

**S. foliosa,** *A. Rich.*

Fl. Trop. Afr. viii. 503.

Victoria Falls, Rogers, 7169.

**S. sp.**

Matopos, 5000 ft. Nov. Eyles, 1107.

525—**Carex condensata,** *Nees.*

Fl. Trop. Afr. viii. 521; Fl. Cap. vii. 305.

Mt. Pene, 6500–7000 ft. Sep. Swyn. 903.

**C. spicato-paniculata,** *C. B. Cl.*

Fl. Trop. Afr. viii. 520; Fl. Cap. vii. 304.

Chirinda, 3000 ft. June, Swyn. 413.

## Series PRINCIPES.

### Family XXI.—PALMAE, *Linn.*

528—**Phoenix dactylifera,** *L.*

Fl. Trop. Afr. viii. 102; For. Fl. Port. E. Afr. 110.

Chirinda, 3500 ft. fl. & fr. Oct. Swyn. 666.

**P. reclinata,** *Jacq.*

For. Fl. Cape, 341; Cat. Afr. Pl. Welw. ii. 82; Fl. Cap. vii. 29; Fl. Trop. Afr. viii. 103; For. Fl. Port. E. Afr. 110.

Victoria Falls, Davy; Palm Grove, Engler.

553—**Hyphæne crinita,** *Gaertn.*

Fl. Trop. Afr. viii. 121; Fl. Cap. vii. 30; For. Fl. Port. E. Afr. 111.

Gwanda, Noble, 77.

**H. ventricosa,** *Kirk.*

Fl. Trop. Afr. viii. 122.

Victoria Falls, Kirk; Engler.

## Series SPATHIFLORAE.

### Family XXIII.—ARACEAE, *Neck.*

Genus No.
690—**Culcasia scandens,** *Beauv.*
Fl. Trop. Afr. viii. 174; Cat. Afr. Pl. Welw. ii. 90.
Chirinda Forest, 3700–4000 ft. fl. & fr. Jan. Swyn. 98.

723—**Amorphophallus mossambicensis,** *Klotzsch.*
Fl. Trop. Afr. viii. 150.
Victoria Falls, Allen, 42.

**A. sp.**
Mazoe, Mundy.

748—**Zantedeschia melanoleuca,** *Engl.* var. **tropicalis,** *N. E. Br.* (*Richardia melanoleuca*, Hook. f.)
Fl. Trop. Afr. viii. 168; Fl. Cap. vii. 38.
Salisbury, Cecil, 149.

## Series FARINOSAE.

### Family XXIX.—XYRIDACEAE, *Lindl.*

826—**Xyris capensis,** *Thunb.*
Fl. Trop. Afr. viii. 13; Fl. Cap. vii. 6; Cat. Afr. Pl. Welw. ii. 68.
Matopos, 4800 ft. March, Eyles, 1031; Sep. Gibbs, 85.

**X. dispar,** *N. E. Br.*
Fl. Trop. Afr. viii. 12.
Salisbury, Cecil, 152.

**X. Hildebrandtii,** *Nilss.* (*X. Umbilonis*, Nilss.)
Fl. Trop. Afr. viii. 24; Fl. Cap. vii. 4; Cat. Afr. Pl. Welw. ii. 67.
Matopos, 4800 ft. March, Eyles, 1029.

**X. multicaulis,** *N. E. Br.*
Fl. Trop. Afr. viii. 20.
Victoria Falls, Rain Forest, Galpin, 7040; Sep. Gibbs, 169; Engler.

**X. obscura,** *N. E. Br.*
Fl. Trop. Afr. viii. 16.
Salisbury, Cecil, 152*a*.

**X. spp.**
Matopos, March, Flanagan, 2970.
South Rhodesia, Rand, 248.

## Family XXX.—ERIOCAULACEAE, *Lindl.*

Genus No.
828—**Eriocaulon africanum,** *Hochst.*
Fl. Cap. vii. 56.
Odzani River Valley, Umtali; Teague, 239.

**E. amphibium,** *Rendle.*
Journ. Linn. Soc. Bot. xxxvii. 475.
Matopos, Gibbs.

**E. bifistulosum,** *Van Heurck.*
Fl. Trop. Afr. viii. 239.
Mazoe, 4300 ft. April, Eyles.

**E. lacteum,** *Rendle.*
Fl. Trop. Afr. viii. 245; Cat. Afr. Pl. Welw. ii. 99.
Mashonaland, Bryce.

**E. matopense,** *Rendle.*
Journ. Linn. Soc. Bot. xxxvii. 475.
Matopos, Gibbs.

**E. submersum,** *Welw.*
Fl. Trop. Afr. viii. 240; Cat. Afr. Pl. Welw. ii. 100.
Matopos, 4800 ft. April, Eyles, 65.

**E. subulatum,** *N. E. Br.*
Fl. Trop. Afr. viii. 255.
Victoria Falls, Kirk; May, Eyles, 125; Davy; Sep. Gibbs, 175; Engler; July, Kolbe, 3141; Rogers, 5806.

830—**Pæpalanthus Wahlbergii,** *Körn.*
Fl. Trop. Afr. viii. 263; Fl. Cap. vii. 59; Cat. Afr. Pl. Welw. ii. 102.
Matopos, Sep. Gibbs, 86.

## Family XXXIII.—COMMELINACEAE, *Reichb.*

896—**Commelina africana,** *L.*
Fl. Cap. vii. 9; Fl. Trop. Afr. viii. 45.
Salisbury, Rogers, 5805*.

**C. Bainesii,** *C. B. Cl.*
Fl. Trop. Afr. viii. 57; Cat. Afr. Pl. Welw. ii. 79.
Mangwe Riv. Baines.

**C. benghalensis,** *L.*
Fl. Trop. Afr. viii. 41; Fl. Cap. vii. 9; Cat. Afr. Pl. Welw. ii. 76.
Matabeleland, Elliott; Victoria Falls, Rogers, 7249*; Salisbury, Rogers, 5803*; Matopos, Rogers, 5636*.

Genus No.

**C. Cecilae,** *C. B. Cl.*
Fl. Trop. Afr. viii. 51.
Gwelo, Cecil.

**C. Forskalei,** *Vahl.*
Fl. Trop. Afr. viii. 44 ; Cat. Afr. Pl. Welw. ii. 77.
Victoria Falls, Allen, 93 ; Matabeleland, Elliott.

**C. krebsiana,** *Kunth.*
Fl. Trop. Afr. viii. 47 ; Fl. Cap. vii. 10.
Matabeleland, Elliott.

**C. Livingstoni,** *C. B. Cl.*
Fl. Trop. Afr. viii. 59 ; Fl. Cap. vii. 11.
Matabeleland, Elliott.

**C. nudiflora,** *L.*
Fl. Trop. Afr. viii. 36 ; Fl. Cap. vii. 8 ; Cat. Afr. Pl. Welw. ii. 74.
Victoria Falls, Sep. Gibbs, 120.

**C. spectabilis,** *C. B. Cl.*
Fl. Trop. Afr. viii. 51 ; Cat. Afr. Pl. Welw. ii. 78.
Victoria Falls, Allen, 223.

**C. zambesica,** *C. B. Cl.*
Fl. Trop. Afr. viii. 43.
Victoria Falls, Rogers, 7249*, 7266*.

**C. spp.**
Victoria Falls, Allen, 282, cf. *C. purpurea,* C. B. Cl.
Victoria Falls, April, Flanagan, 3160.
Bulawayo, 4500 ft. Eyles, 100, cf. *C. ecklonia͏na,* Kunth.
South Rhodesia, Rand, 251, 252, 253.

899—**Aneilema æquinoctiale,** *Kunth.* (*A. adhaerens,* Kunth.)
Fl. Trop. Afr. viii. 65 ; Fl. Cap. vii. 12 ; Nat. Pl. 284 ; Cat. Afr. Pl. Welw. ii. 79.
Bulawayo, 4600 ft. Dec. Eyles, 77 ; March, Monro ; Salisbury to Bulawayo, Cecil, 81 ; Matabeleland, Elliott.

**A. dregeana,** *Kunth.*
Fl. Trop. Afr. viii. 70 ; Fl. Cap. vii. 13.
Gwelo, Jan. Gardner.

**A. Johnstoni,** *K. Schum.*
Fl. Trop. Afr. viii. 67.
Gwai Forest, Allen, 237 ; Nr. Luia Riv. Nicholson.

**A. Nicholsoni,** *C. B. Cl.*
Fl. Trop. Afr. viii. 70.
Nr. Luia Riv. Nicholson.

**A. nyasense,** *C. B. Cl.*
Fl. Trop. Afr. viii. 66.
Odzani River Valley, Umtali, Teague, 124.

Genus No.

**A. sinicum,** *Lindl.*

Fl. Trop. Afr. viii. 63 ; Fl. Cap. vii. 12 ; Nat. Pl. 294 ; Cat. Afr. Pl. Welw. ii. 79.

Malindi, Gwai Forest, 3600 ft. Allen, 249 ; Chirinda Forest, 3700–4000 ft. May, Swyn. 765 ; Odzani River Valley, Umtali, Teague, 120.

var. **longifolia,** *C. B. Cl.*

Salisbury, Cecil, 148.

**A. sp.**

South Rhodesia, Rand, 254.

904—**Cyanotis fœcunda,** *Hassk.*

Fl. Trop. Afr. viii. 80.

Matabeleland, Elliott.

**C. nodiflora,** *Kunth.*

Fl. Trop. Afr. viii. 82 ; Fl. Cap. vii. 14 ; Cat. Afr. Pl. Welw. ii. 80.

Inyanga, Cecil, 211 ; Bulawayo, March, Monro ; Victoria Falls, Rogers, 5379.

908—**Floscopa glomerata,** *Hassk.*

Fl. Trop. Afr. viii. 86 ; Fl. Cap. vii. 15 ; Cat. Afr. Pl. Welw. ii. 80.

Victoria Falls, Sep. Gibbs, 297 ; Engler ; Kirk ; Rogers, 5080 ; Chirinda, 3700 ft. fl. & fr. June, Swyn. 764 ; Upper Buzi, 3000 ft. fl. & fr. April, Swyn. 761 ; Odzani River Valley, Umtali, Teague, 209.

**F. sp.**

Victoria Falls, Rain Forest, Sep. Galpin, 7033, cf. *F. glomerata*, Hassk.

## Series LILIIFLORAE.

### Family XXXVI.—JUNCACEAE, *Vent.*

936—**Juncus Fontanesii,** *J. Gay.*

Fl. Trop. Afr. viii. 94.

Matopos, fl. & fr. Sep. Gibbs, 57.

### Family XXXVIII.—LILIACEAE, *Hall.*

963—**Gloriosa superba,** *L.*

Fl. Trop. Afr. vii. 563 ; Fl. Cap. vi. 526 ; Cat. Afr. Pl. Welw. ii. 65.

Bulawayo, 4500 ft. Jan. Eyles, 1054 ; Matopos, Marloth ; 4800 ft. Jan. Eyles, 32 ; Selukwe, Gardner, 37 ; Chipetzana Riv. 3000 ft. April, Swyn. ; Chirinda, 3800 ft. Dec. Swyn. 6057, 6509 ; Victoria Falls, Rogers, 5622 ; South Rhodesia, Rand, 244.

Genus No.

**G. virescens,** *Lindl.* (*G. simplex,* L.)

Fl. Trop. Afr. vii. 563; Fl. Cap. vi. 526; Nat. Pl. 396; Cat. Afr. Pl. Welw. ii. 65.

Victoria Falls, Allen, 117; Odzani River Valley, Umtali, Teague, 2.

**G. sp.**

Mazoe, 4800 ft. Dec. Eyles, 493.

969—**Androcymbium subulatum,** *Baker.* (*A. melanthioides,* Willd. var.)

Fl. Trop. Afr. vii. 559; Fl. Cap. vi. 517.

Matabeleland, Oates; Umsweswe Riv. Baines.

973—**Ornithoglossum glaucum,** *Salisb.*

Fl. Trop. Afr. vii. 561; Fl. Cap. vi. 525.

Bulawayo, Eyles; Chubb, 389.

var. **grandiflorum,** *Baker.*

Fl. Trop. Afr. vii. 561; Fl. Cap. vi. 525.

Bulawayo, March, Monro.

989—**Anthericum anceps,** *Baker.*

Fl. Trop. Afr. vii. 482; Fl. Cap. vi. 382.

Matabeleland, Elliott.

**A. elongatum,** *Willd.* (*A. filiforme,* Thunb.)

Fl. Trop. Afr. vii. 491; Fl. Cap. vi. 389.

Bulawayo, 4500 ft. Nov. Eyles, 17; Chipetzana Riv. 3000 ft. April, Swyn. 773.

**A. hispidum,** *L.*

Fl. Cap. vi. 393.

Bulawayo, Rogers, 11323.

**A. longistylum,** *Baker* ex. descr.

Fl. Cap. vi. 381.

Bulawayo, Eyles, 572.

**A. matabelense,** *Baker.*

Fl. Trop. Afr. vii. 484.

Matengwe ? Riv. Holub.

**A. Oatesii,** *Baker.*

Fl. Trop. Afr. vii. 491; Journ. Bot. 1878, 324.

Matabeleland, Oates; Elliott.

**A. recurvifolium,** *Baker.*

Kew Bull. 1906, 28.

Salisbury, Cecil, 143.

**A. rhodesianum,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 216.

Melsetter, 6000 ft. Oct. Swyn. 6056.

Genus No.

**A. spp.**

Bulawayo, 4500 ft. Nov. Eyles, 9 ; Dec. Eyles, 1207.
Sebakwe, 4000 ft. Dec. Eyles, 102, cf. *A. pubirachis*, Baker.
Victoria, Monro, 903.
Victoria Falls, Kolbe, 4344.

990—**Chlorophytum andongense,** *Baker.*

Fl. Trop. Afr. vii. 506 ; Cat. Afr. Pl. Welw. ii. 54.
Matopos, Rogers, 13801.

**C. blepharophyllum,** *Schweinf.*

Fl. Trop. Afr. vii. 501.
Chirinda, 3500 ft. Oct. Swyn. 329.

**C. elatum,** *R. Br.* var. Burchelli, *Baker.*

Fl. Cap. vi. 399.
Victoria Falls, Allen, 58.

**C. gazense,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 216.
Chirinda Forest, 3700–4000 ft. fl. & fr. April, May, Swyn. 318, 527.

**C. polystachyum,** *Baker.*

Fl. Trop. Afr. vii. 509.
Mazoe, 5200 ft. Jan. Eyles, 521.

**C. sp.**

Victoria, Monro, 629, cf. *C. gallabatense*, Schweinf.

1010—**Schizobasis angolensis,** *Baker.*

Fl. Trop. Afr. vii. 470 ; Cat. Afr. Pl. Welw. ii. 48.
Victoria, Monro, 442.

1011—**Bowiea volubilis,** *Harv.*

Fl. Cap. vi. 367 ; Nat. Pl. 303 ; Harv. Gen. S.A. Pl. 401.
Mazoe, 4400 ft. fr. April, Eyles, 364 ; fl. Jan. 556.

1012—**Eriospermum Cecili,** *Baker.*

Kew Bull. 1906, 28.
Inyanga, 6000–7000 ft. Cecil, 204.

**E. spp.**

Victoria, Monro, 784, cf. *E. flexuosum*, Welw.
Victoria, Monro, 433*a*, 439, cf. *E. parvifolium*, Jacq.

1024—**Kniphofia rhodesiana,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 214.
Nyahodi Riv. 5000 ft. April, Swyn. 723.

**K. sp.**

Salisbury, May, Flanagan, 3265, cf. *K. Grantii*, Baker.

1026—**Aloe excelsa,** Berger.

Matopos, Nov. Marloth, 3888 ; Gwanda, Noble, 69.

Genus No.

**A. rhodesiana,** *Rendle.*
Journ. Linn. Soc. Bot. xl. 215.
Melsetter, 6000 ft. fl. & fr. Oct. Swyn. 6047 ; Mt. Pene, 6000 ft. Swyn. 6048 ; Umvumvumvu Riv. Swyn.

**A. Swynnertonii,** *Rendle.*
Journ. Linn. Soc. Bot. xl. 215.
Chipetzana Riv. 3500 ft. April, Swyn.

**A. spp.**
Victoria, Monro, 339, cf. *A. zebrina,* Baker.
Victoria Falls, on island, Rogers, 5288.
Matopos, Rogers, 5361.

1047—**Tulbaghia acutiloba,** *Harv.*
Fl. Cap. vi. 404.
Victoria, Monro, 630.

**T. alliacea,** *L. fil.*
Fl. Trop. Afr. vii. 515 ; Fl. Cap. vi. 405.
Mazoe, 4300 ft. Dec. Eyles, 229.

**T. campanulata,** *N. E. Br.*
Mazoe, 4800 ft. Nov. Eyles, 194.

**T. sp.**
Salisbury, Rand, 1379.

1079—**Albuca caudata,** *Jacq.*
Fl. Trop. Afr. vii. 529 ; Fl. Cap. vi. 458.
Matopos, Oct. Gibbs, 287.

**A. Melleri,** *Baker.*
Fl. Trop. Afr. vii. 532.
Victoria Falls, Rogers, in Herb. Bolus, 13457.

**A. tayloriana,** *Rendle.*
Fl. Trop. Afr. vii. 530.
Victoria, Monro, 433*b* ; Bulawayo, Chubb, 363*.

**A. Wakefieldii,** *Baker.*
Fl. Trop. Afr. vii. 531.
Bulawayo, March, Monro.

**A. spp.**
Bulawayo, March, Monro, cf. *A. setosa,* Jacq.
Victoria, Monro, 433*c*, 498, 584*a*.
Khami, Oct. Eyles, 1157.
Victoria Falls, Rogers, 5055, 5295.

1080—**Urginea altissima,** *Baker.*
Fl. Trop. Afr. vii. 538; Fl. Cap. vi. 470.
Bulawayo, Eyles ; Victoria Falls, Allen, 52 ; Chirinda, 3800 ft. fl. & fr. April, Swyn. 321*a*.

Genus No.

**U. sanguinea,** *Schinz.*
Fl. Trop. Afr. vii. 538.
Victoria Falls, Sep. Galpin, 7051; fl. & fr. Sep. Gibbs, 147; Victoria, Monro, 469.

**U. spp.**
Bulawayo, March, Monro.
Victoria, Monro, 1026*a*, cf. *U. comosa*, Welw.
Victoria, Monro, 630, 839.
Victoria Falls, Rogers, 5294.
South Rhodesia, Rand, 250.

1084—**Dipcadi anthericoides,** *Engl.*
Matopos, 4700 ft. Jan. Eyles, 27.

**D. hyacinthoides,** *Baker.*
Fl. Cap. vi. 446.
Victoria, Monro, 440.

**D. viride,** *Mœnch.* (*D. filamentosum*, Medic.)
Fl. Trop. Afr. vii. 523; Fl. Cap. vi. 449; Nat. Pl. 239.
Bulawayo, March, Monro; Chirinda, 3500–3800 ft. Oct. Swyn. 59.

**D. spp.**
Victoria, Monro, 625.
Victoria Falls, Rogers, 5398.

1086—**Scilla ciliata,** *Baker.*
Kew. Bull. 1906, 29.
Inyanga, Cecil, 165.

**S. indica,** *Baker.*
Fl. Trop. Afr. vii. 551.
Mt. Pene, 6500–7000 ft. Sep. Oct. Swyn. 767, 6055.

**S. lanceæfolia,** *Baker.*
Fl. Trop. Afr. vii. 557; Fl. Cap. vi. 487; Nat. Pl. 202; Cat. Afr. Pl. Welw. ii. 63.
Matopos, Oct. Gibbs, 191.

**S. maesta,** *Baker.*
Fl. Trop. Afr. vii. 552.
Mazoe, 4300–4800 ft. Nov. Eyles, 449.

**S. rigidifolia,** *Kunth.* (*S. hispidula*, Baker.)
Fl. Trop. Afr. vii. 549; Fl. Cap. vi. 481; Cat. Afr. Pl. Welw. ii. 61.
Victoria, Monro, 464, 546; North Melsetter, 5000–6000 ft. Oct. Swyn. 6053, 6226; Mt. Pene, 7000 ft. fl. & fr. Oct. Swyn. 6054.

**S. sp.**
Victoria, Monro, 501, cf. *S. tayloriana*, Rendle.

1088—**Eucomis undulata,** *Ait.*
Fl. Cap. vi. 476.
Salisbury, Darling, in Herb. Bolus, 10792.

Genus No.

**E. zambesiaca,** *Baker.*
Fl. Trop. Afr. vii. 528.
Victoria, Monro, 858.

**E. spp.**
Mazoe, 4900 ft. Dec. Eyles, 495.
Salisbury, Mundy, cf. *E. zambesiaca,* Baker.
South Rhodesia, Rand, 247.

1090—**Drimiopsis maculata,** *Lindl.*
Fl. Cap. vi. 473; Nat. Pl. 304.
Bulawayo, March, Monro.

1109—**Dracæna fragrans,** *Gawl.*
Fl. Trop. Afr. vii. 440; Cat. Afr. Pl. Welw. ii. 47.
Chirinda Forest, 3700–4000 ft. Dec. Swyn. 724, 6520.

**D. gazensis,** *Rendle.*
Journ. Linn. Soc. Bot. xl. 214.
Chirinda, 3800 ft. Oct. Swyn.

**D. spp.**
Victoria, Monro, 347, 445.

1110—**Sansevieria cylindrica,** *Bojer.* (*S. angolensis,* Welw.)
Fl. Trop. Afr. vii. 335; Cat. Afr. Pl. Welw. ii. 25.
Victoria Falls, Galpin; Engler; Mangwe Riv. Baines.

**S. senegalensis ?**
South Rhodesia, Rand, 299.

**S. spp.**
Victoria Falls, Allen, 396, cf. *S. sulcata,* Bojer.
Victoria Falls, Rogers, 5059, 5287, cf. *C. sulcata,* Bojer.

1113—**Asparagus æthiopicus,** *L.*
Fl. Trop. Afr. vii. 434; Fl. Cap. vi. 271.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1092.

**A. africanus,** *Lam.*
Fl. Trop. Afr. vii. 433; Fl. Cap. vi. 265; Cat. Afr. Pl. Welw. ii. 42.
Umtali, Engler.

**A. angolensis,** *Baker.*
Fl. Trop. Afr. vii. 432; Cat. Afr. Pl. Welw. ii. 42.
Chirinda, 3800 ft. May, Swyn. 520.

**A. asiaticus,** *L.*
Fl. Trop. Afr. vii. 432; Fl. Cap. vi. 265.
Chipetzana Riv. 3000 ft. Oct. Swyn. 239*a*; Upper Buzi, Swyn.; Bulawayo, Eyles, 33.

**A. falcatus,** *L.*
Fl. Trop. Afr. vii. 435; Fl. Cap. vi. 271.
Chipete Forest, 3800 ft. April, Swyn. 91.

Genus No.

**A. laricinus**, *Burch.*

Fl. Trop. Afr. vii. 433 ; Fl. Cap. vi. 267.

Matopos, by streams, Sep. Gibbs, 18 ; Gwelo, Jan. Gardner, 76.

**A. medeoloides**, *Thunb.*

Fl. Trop. Afr. vii. 435 ; Fl. Cap. vi. 272.

Chipete Forest, 3800 ft. fl. & fr. April, May, Swyn. 89 ; Mt. Pene, 7000 ft. Swyn. 6058.

**A. pilosus**, *Baker.*

Fl. Trop. Afr. vii. 427.

Matabeleland, Oates.

**A. plumosus**, *Baker.*

Fl. Trop. Afr. vii. 430 ; Fl. Cap. vi. 260.

Umtali, Engler ; Chirinda, 3700–4000 ft. Swyn. 240.

**A. racemosus**, *Willd.*

Fl. Trop. Afr. vii. 434 ; Fl. Cap. vi. 269 ; Cat. Afr. Pl. Welw. ii. 43.

Victoria Falls, Allen, 6 ; Gwai, Engler ; South Rhodesia, Rand, 242.

**A. stipulaceus**, *Lam.*

Fl. Cap. vi. 264.

Bulawayo, Rogers, 4486.

**A. virgatus**, *Baker.*

Fl. Trop. Afr. vii. 426 ; Fl. Cap. vi. 259.

Chipete, 3800 ft. Oct. Swyn. 239.

**A. spp.**

Bulawayo, Jan. Gardner, 74, cf. *A. bechuanicus*, Baker.

Bulawayo, Rand, 545.

Gwelo, Jan. Gardner, 75, cf. *A. bechuanicus*, Baker.

Victoria, Monro, 333, 1000, cf. *A. stipulaceus*, Lam.

South Rhodesia, Rand, 404, 405.

1147—**Behnia reticulata**, *Didr.*

Fl. Cap. vi. 274.

Chimanimani Mts. 7000 ft. Sep. Swyn. 1098 ; Mt. Pene, 7000 ft. Swyn. 6057 ; Chirinda Forest, 4000 ft. fl. & fr. Oct. Swyn. 90 ; Chipete Forest, fl. & fr. Oct. Swyn.

1149—**Hymenocallis senegambica**, *Kunth. & Bouché.*

Fl. Trop. Afr. vii. 408.

Victoria Falls, Rogers, 7258*.

1151—**Smilax kraussiana**, *Meisn.*

Fl. Trop. Afr. vii. 424 ; Fl. Cap. vi. 256 ; Nat. Pl. 339 ; Cat. Afr. Pl. Welw. ii. 41.

Victoria Falls, Palm Kloof, Engler ; Chirinda, 3500–5900 ft. fl. & fr. Nov. Dec. Swyn. 212 ; Chimanimani Mts. 7000 ft. Swyn. 1099 ; Melsetter Dist. common, Swyn.

FAMILY XL.—AMARYLLIDACEAE, *Lindl.*

Genus No.

1167—**Hæmanthus Cecilae,** *Baker.*

Kew Bull. 1906, 28.

Between Salisbury and Bulawayo, Cecil, 76.

**H. multiflorus,** *Martyn.*

Fl. Trop. Afr. vii. 388; Cat. Afr. Pl. Welw. ii. 34.

Matabeleland, Oates; Victoria Falls, Allen, 44; Bulawayo, March, Monro; Chirinda, 3800 ft. Oct. Swyn. 359.

**H. zambesiacus,** *Baker.*

Fl. Trop. Afr. vii. 387.

Salisbury, Darling, in Herb. Bolus, 11197.

1168—**Buphane disticha,** *Herb.* (*B. toxicaria,* Herb.)

Fl. Trop. Afr. vii. 392; Fl. Cap. vi. 242; Nat. Pl. 595; Cat. Afr. Pl. Welw. ii. 35.

Matopos, Oct. Gibbs, 208; Salisbury, Mundy, 934.

1177—**Brunsvigia, sp.**

Mazoe, 4800 ft. Sep. Eyles, 551, cf. *B. Kirkii,* Baker.

South Rhodesia, Rand, 224, 654.

1189—**Crinum Harmsii,** *Baker.*

Victoria Falls, Allen, 43.

**C. Kirkii,** *Baker.*

Fl. Trop. Afr. vii. 402.

Chirinda, 3800 ft. Swyn.

**C. zeylanicum,** *L.*

Fl. Trop. Afr. vii. 401.

Victoria Falls, Allen, 136.

**C. spp.**

Sebakwe, 4000 ft. Dec. Eyles, 170.

South Rhodesia, Rand, 228.

1190—**Ammocharis falcata,** *Herb.*

Fl. Cap. vi. 204.

Bulawayo, Chubb, 7.

1191—**Cyrtanthus angustifolius,** *Ait.*

Fl. Cap. vi. 223; Nat. Pl. 5.

Mazoe, 4400 ft. Sep. Eyles, 416.

**C. rhodesianus,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 211.

Chimanimani Mts. 7000 ft. Sep. Oct. Swyn. 769.

1202—**Pancratium trianthum,** *Herb.* (*P. Chapmanni,* Harv.)

Fl. Trop. Afr. vii. 407; Harv. Gen. S.A. Pl. 384.

Chirinda, 3800 ft. Swyn. 322; Victoria Falls, Rogers, 7470*, 7544*, 8671*.

Genus No.

**P. sp.**

Bulawayo, 4500 ft. Nov. Eyles, 1248, cf. *P. trianthum,* Herb.

1208—**Hippeastrum equestre,** *Herb.*

Victoria Falls, Allen.

1230—**Hypoxis angustifolia,** *Lam.*

Fl. Trop. Afr. vii. 378 ; Fl. Cap. vi. 180.

Victoria, Monro, 866.

**H. rigidula,** *Baker.*

Fl. Cap. vi. 186 ; Nat. Pl. 552.

Bulawayo, 4500 ft. Jan. Eyles, 59 ; Mazoe, 4300–4800 ft. Nov. Eyles, 455.

var. **pilosissima,** *Baker.*

Fl. Cap. vi. 186.

Bulawayo, Jan. Eyles.

**H. Rooperii,** *Moore.*

Fl. Cap. vi. 188.

Salisbury, Darling.

**H. villosa,** *L. fil.*

Fl. Trop. Afr. vii. 379 ; Fl. Cap. vi. 184.

Matabeleland, Oates ; Matopos, Oct. Gibbs, 192 ; Victoria, Monro, 654 ; North Melsetter, 5000–6000 ft. Oct. Swyn. 6215 ; Mt. Pene, 6000–7000 ft. Sep. Oct. Swyn. 770, 6082, 6204 ; Chirinda, 3800 ft. May, Oct. Swyn. 332 ; Marendellas ? Rogers, 4043.

**H. spp.**

South Rhodesia, Rand, 225, 226, 227, 237.

1231—**Walleria nutans,** *Kirk.*

Fl. Trop. Afr. vii. 568 ; Fl. Cap. vi. 528.

Bulawayo, 4500 ft. Dec. Eyles, 39.

**W. sp.**

South Rhodesia, Rand, 246.

## Family XLI.—VELLOZIACEAE, *Drude.*

1246—**Vellozia equisetoides,** *Baker.* (*Barbacenia equisetoides,* Engl.)

Fl. Trop. Afr. vii. 411 ; Fl. Cap. vi. 245.

Semokwe ? Riv. Baines ; Matabeleland, Scott-Elliott ; Victoria Falls, Allen, 41 ; Matopos, Engler ; 5000 ft. Jan. Eyles, 25 ; Mazoe, 5000 ft. Oct. Eyles, 439 ; 4700 ft. Jan. Eyles, 516 ? ; South Rhodesia, Rand, 270 ; Odzani River Valley, Umtali ; Teague, 236.

Genus No.

**V. humilis,** *Baker.*

Fl. Trop. Afr. vii. 409 ; Fl. Cap. vi. 246.

Fig-tree, Dec. Eyles, 157 ; Matabeleland, Elliott.

**V. retinervis,** *Baker.*

Fl. Cap. vi. 244.

Matopos, Nov. Marloth, 3415.

**V. spp.**

Victoria Falls, Galpin, 7058.

Mazoe, 4300–5000 ft. Oct. Eyles, 440, cf. *V. æquatorialis,* Rendle.

Mazoe, 5300 ft. Jan. Eyles, 517, cf. *V. acuminata,* Baker.

Goromanzi, Mundy, cf. *V. retinervis,* Baker.

Victoria, Monro, 800, cf. *V. trichophylloides,* Hemsl.

Victoria, Monro, 801.

Salisbury, Mundy.

Harvest Valley, Rogers.

## Family XLII.—TACCACEAE, *Lindl.*

1248—**Tacca pinnatifida,** *Forst.*

Fl. Trop. Afr. vii. 413 ; Cat. Afr. Pl. Welw. ii. 36.

Victoria Falls, on island, Allen, 251 ; Salisbury and Umtani, Rogers, 5767*.

## Family XLIII.—DIOSCOREACEAE, *Lindl.*

1252—**Dioscorea beccariana,** *Mart.*

Fl. Trop. Afr. vii. 420.

Gwai Forest, 3800 ft. Allen, 232 ; Victoria Falls, Rogers, 5381 ; Chirinda, 3800 ft. Dec. Swyn. 1091*a*, 6630 ; Bulawayo, Chubb, 18.

**D. Buchanani,** *Benth.*

Fl. Trop. Afr. vii. 415.

Chirinda, 3800 ft. July, Swyn. 1091.

**P. dumetorum,** *Pax.* (*D. quartiniana,* A. Rich.)

Fl. Trop. Afr. vii. 419; Cat. Afr. Pl. Welw. ii. 40.

Bulawayo, 4500 ft. Dec. Eyles, 1141 ; Chirinda, 3700 ft. young fr. March, Swyn. 215.

**D. sativa,** *L.*

Fl. Trop. Afr. vii. 415 ; Cat. Afr. Pl. Welw. ii. 38.

Chirinda Forest, 3800 ft. (wild), May, Swyn. 531.

**D. schimperiana,** *Hochst.*

Fl. Trop. Afr. vii. 419 (var.).

Chirinda, 3700–4000 ft. fl. & fr. Feb. Swyn. 214 ; Chipete, Swyn.

Genus No.

var. **vestita,** *Pax.*
Fl. Trop. Afr. vii. 419.
Mazoe, 4300 ft. Jan. Eyles, 503.

**D. sylvatica,** *Eckl.* (*Testudinaria sylvatica*, Benth.)
Fl. Cap. vi. 253.
Mazoe, 4300 ft. Dec. Eyles, 212 ; Bulawayo, Chubb, 9.

**D. spp.**
Victoria Falls, Rogers, 5372[1], cf. *D. rubiginosa*, Benth.
South Rhodesia, Rand, 432.

Family XLIV.—IRIDACEAE, *Lindl.*

1265—**Moræa edulis,** *Ker.*
Fl. Cap. vi. 20.
Victoria, Monro, 677.

**M. iridioides,** *L.*
Fl. Trop. Afr. vii. 342 ; Nat. Pl. 299.
Chirinda Forest, 3700–4000 ft. fl. & fr. Oct. Dec. Swyn. 399, 6508; Mt. Pene, 7000 ft. Oct. Swyn. 6067; Chipete Forest, Swyn.

**M. spp.**
Bulawayo, Jan. Gardner, 2; Victoria, Monro, 601 ; Matopos, 5000 ft. Nov. Eyles, 1144 ; Salisbury, Mundy ; South Rhodesia, Rand, 236.

1272—**Ferraria Randii,** *Rendle.* (*Moræa Randii*, Rendle.)
Journ. Bot. 1898, 144.
South Rhodesia, Rand, 233 ; Bulawayo, 4500 ft. Jan. Eyles, 158.

1284—**Bobartia sp.**
Victoria, Monro, 755.

1295—**Aristea compressa,** *Buching.*
Fl. Cap. vi. 50.
North Melsetter, 6000 ft. fl. & fr. Oct. Swyn. 6060.

**A. zombensis,** *Baker.*
Fl. Trop. Afr. vii. 346.
Chipete Forest, 3700–4000 ft. fr. Oct. Swyn. 399*a*; Chipete Forest, 3800 ft. fr. April, Swyn. 399.

1301—**Hesperantha matopensis,** *Gibbs.*
Journ. Linn. Soc. Bot. xxxvii. 471.
Matopos, Sep. Gibbs, 44.

1303—**Dierama pendula,** *Baker.*
Fl. Trop. Afr. vii. 349.
Melsetter, 6000 ft. Oct. Swyn. 6064, 6065.

[1] Rogers has this plant named *D. rubiginosa*, Benth.

Genus No.
1306—**Tritonia aurea,** *Pappe.* (*Crocosmia aurea,* Planch.)
Fl. Trop. Afr. vii. 355; Fl. Cap. vi. 129; Nat. Pl. 519.
Chirinda, 3600 ft. March, Swyn. 323.

1310—**Babiana Bainesii,** *Baker.*
Fl. Cap. vi. 107.
Matopos, 5000 ft. April, Eyles, 38; March, Flanagan, 2949; Salisbury, May, Flanagan, 3249.

1311—**Gladiolous atropurpureus,** *Baker.*
Fl. Trop. Afr. vii. 364.
Victoria Falls, Allen, 198.

**G. brevicaulis,** *Baker.*
Fl. Trop. Afr. vii. 366; Cat. Afr. Pl. Welw. ii. 28.
Victoria, Monro, 647.

**G. brevifolius,** *Jacq.*
Fl. Cap. vi. 143.
Matabeleland, Oates.

**G. dracocephalus,** *Hook. f.*
Fl. Cap. vi. 157.
Matopos. March, Flanagan, 2966.

**G. gazensis,** *Rendle.*
Journ. Linn. Soc. Bot. xl. 210.
Melsetter, 6000 ft. Swyn.; Chirinda, 3700–4000 ft. Swyn.; Mt. Pene, 6500–7000 ft. Swyn.; in fl. Sep. Swyn. 779.

**G. Melleri,** *Baker.*
Fl. Trop. Afr. vii. 362.
Matopos, Oct., Gibbs, 202; Mazoe, 4400 ft. Sep. Eyles, 417; Matabeleland, Oates; Salisbury, Rogers, 4057; Victoria, Monro, 485.

**G. Oatesii,** *Rolfe.*
Fl. Trop. Afr. vii. 373.
Matabeleland, Oates; Victoria Falls, Allen, 193; Bulawayo, Jan. Gardner, 78.

**G. permeabilis,** *Delar.*
Fl. Cap. vi. 162.
Mazoe, 4300 ft. Dec. Eyles, 488; Bulawayo, Chubb, 11.

**G. primulinus,** *Baker.*
Victoria Falls, Allen, 18; Sep. Gibbs, 323; Rogers, 5397; Monro.

**G. quartinianus,** *A. Rich.*
Fl. Trop. Afr. vii. 371; Cat. Afr. Pl. Welw. ii. 29.
Bulawayo, March, Monro.

Genus No.

**G. spp.**

Salisbury, May, Flanagan, 3252 ; Rand, 541.
Victoria, Monro, 967, cf. *G. psittacinus*, Hook.
Victoria, Monro, 1091.
Bulawayo, 4500 ft. Nov. Eyles, 1224.
South Rhodesia, Rand, 230, 234, 235, 656.

1312—**Antholyza sp.**

Victoria, Monro, 301.

1314—**Lapeyrousia caudata,** *Schinz.*

Fl. Trop. Afr. vii. 352.
South Rhodesia, Rand, 229.

**L. cruenta,** *Bkr.*

Fl. Cap. vi. 96 ; Fl. Trop. Afr. vii. 354.
Bulawayo, Rogers, 13586*.

**L. cyanescens,** *Baker.*

Fl. Trop. Afr. vii. 354 ; Cat. Afr. Pl. Welw. ii. 28.
South Rhodesia, Rand, 232.

**L. grandiflora,** *Baker.*

Fl. Trop. Afr. vii. 355 ; Fl. Cap. vi. 96 ; Nat. Pl. 526.
Bulawayo, Dec. Eyles ; Mazoe, 4300–5300 ft. Jan. Eyles, 1134.

**L. odoratissima,** *Baker.*

Fl. Trop. Afr. vii. 354 ; Cat. Afr. Pl. Welw. ii. 28.
Victoria Falls, Rogers, 5395.

**L. porphyrosiphon,** *Baker.*

Fl. Trop. Afr. vii. 353.
Victoria Falls, Allen, 146 ; Rogers, 5415.

**L. rhodesiana,** *N. E. Br.*

Kew Bull. 1906, 169.
Between Salisbury and Umtali, Cecil, 154.

**L. Sandersoni,** *Baker.*

Fl. Trop. Afr. vii. 352 ; Fl. Cap. vi. 95.
Bembesi, Jan. Gardner, 7 ; Victoria Falls, Rogers, 5536 ; Victoria, Monro, 678, 674 ; Bulawayo, Rogers, common ; Matabeleland, Scott-Elliott.

**L. Welwitschii,** *Baker.*

Fl. Trop. Afr. vii. 352 ; Cat. Afr. Pl. Welw. ii. 27.
Matopos, 5000 ft. Feb. Eyles, 1173.

**L. spp.**

Bulawayo, 4500 ft. Jan. Eyles, 75 ; Nov. 91.
South Rhodesia, Rand, 231.

## Series SCITAMINEAE.

### Family XLV.—MUSACEAE, *J. St. Hil.*

Genus No.
1318—**Musa Ensete,** *Gmel.*
Fl. Trop. Afr. vii. 329.
Marandellas, Engler.

### Family XLVI.—ZINGIBERACEAE, *L. C. Rich.*

1329—**Kæmpferia Carsoni,** *Baker.*
Fl. Trop. Afr. vii. 296.
Victoria Falls, Allen, 104.
**K. Kirkii,** *K. Schum.* var. **elatior,** *Stapf.*
Fl. Trop. Afr. vii. 294 (type).
Salisbury, H. J. Elwes, F.R.S., see Kew Bull. 1908, 196.
**K. sp.**
Victoria Falls, Rogers, 5390.
1344—**Amomum sp.**
Salisbury, Darling, in Herb. Bolus, 10793.

### Family XLVII.—CANNACEAE, *Link.*

1363—**Canna indica,** *L.*, subsp. **C. orientalis,** *Rosc.*
Fl. Trop. Afr. vii. 328 ; Cat. Afr. Pl. Welw. ii. 24.
Victoria, Monro, 736, 1044 ; Chirinda, 3800 ft. March, Swyn. 398 ; Matabeleland, Rand.

## Series MICROSPERMAE.

### Family XLIX.—BURMANNIACAE, *Blume.*

1382—**Burmannia bicolor,** *Mart.* var. **africana,** *Ridl.*
Fl. Trop. Afr. vii. 11 ; Cat. Afr. Pl. Welw. ii. 2.
Matopos, 5000 ft. Eyles, 52.

### Family L.—ORCHIDACEAE, *Lindl.*

1408—**Holothrix grandiflora,** *Reichb. f.*
Fl. Cap. V. iii. 110.
Umtali, Engler.

Genus No.

**H. Randii**, *Rendle.*
Journ. Bot. 1899, 208.
Salisbury, Sep. Rand, 596.

1422—**Habenaria antennifera** (*Rolfe*), *Torre & Harms.* (*Bonatea antennifera,* Rolfe.)
Fl. Cap. V. iii. 142.
Bulawayo, March, Monro.

**H. malacophylla,** *Reichb. f.*
Fl. Trop. Afr. vii. 230 ; Fl. Cap. V. iii. 126.
Victoria Falls, 3000 ft. Rain Forest, May, Eyles, 92 ; Allen, 4 ; Flanagan, 3299 ; Rogers, 5129.

**H. pedicellaris,** *Reichb. f.*
Fl. Trop. Afr. vii. 244.
Upper Buzi, 3000 ft. April, Swyn. 744 ; South Rhodesia, Rand, 269.

**H. Rehmanni,** *Bolus.*
Fl. Cap. V. iii. 129.
Victoria, Monro, 904, 890, 865, 868.

**H. spp.**
Victoria Falls, Allen, 139, cf. *H. subarmata,* Reichb. f.
Mazoe, 4400 ft. Dec. Eyles, 499, cf. *H. Galpinii,* Bolus.
Matopos, 5000 ft. March, Eyles, 1037, 1064.

1428—**Brachycorythis acutiloba,** *Rendle.*
Journ. Linn. Soc. Bot. xl. 208.
Chirinda, 3800 ft. Dec. Swyn. 6632.

**B. hispidula ?**
South Rhodesia, Rand, 266.

1430—**Satyrium Buchananii,** *Schlechter.*
Fl. Trop. Afr. vii. 572.
Lusitu Riv. 5000 ft. April, Swyn. 754 ; South Rhodesia, Rand, 267.

**S. macrophyllum,** *Lindl.*
Fl. Cap. V. iii. 166 ; Orchids of S.A. i. 74.
Mazoe, 4300 ft. April, Eyles, 305 ; March, Flanagan, 3027 ; Matopos, 5000 ft. March, Eyles, 1036.

**S. speciosum,** *Rolfe.*
Fl. Trop. Afr. vii. 270 & 574.
Chirinda, 3800 ft. Dec. Swyn. 331 ; Upper Buzi, 3000 ft. April, Swyn. 745.

**S. trinerve,** *Lindl.* (*S. occultum,* Rolfe.)
Fl. Trop. Afr. vii. 273 ; Cat. Afr. Pl. Welw. ii. 16 ; Orchids of S.A. ii. 61.
Chirinda, 3800 ft. Jan. Swyn. 750.

Genus No.
1431—**Schizochilus Cecili,** *Rolfe.*
Kew Bull. 1906, 168.
Inyanga, Cecil, 202.

1434—**Disa equestris,** *Reichb. f.*
Fl. Trop. Afr. vii. 284 ; Cat. Afr. Pl. Welw. ii. 18.
Rhodesia, Lord Rothschild, see Kew Bull. 1908, 86; South Rhodesia, Rand, 268.

**D. hamatopetala,** *Rendle.*
Fl. Trop. Afr. vii. 286.
Mt. Pene, 6500–7000 ft. fl. & fr. Sep. Swyn. 753.

1565—**Polystachya Hislopii,** *Rolfe.*
Kew Bull. 1914, 375.
Rusapi, A. Hislop.

1568—**Ansellia africana,** *Lindl.*
Fl. Trop. Afr. vii. 101 ; Cat. Afr. Pl. Welw. ii. 7 ; Orchids of S.A. ii. 29.
Matopos, Sep. Oct. Gibbs, 270, epiphytic ; Engler.

**A. humilis,** *Bull.*
Fl. Trop. Afr. vii. 102.
Victoria Falls, Allen, 45.

**A. spp.**
Gatooma, Rogers, 5521, cf. *A. confusa,* N. E. Br.
Victoria Falls, Rogers, 7235, cf. *A. confusa,* N. E. Br.

1631—**Calanthe natalensis,** *Reichb. f.*
Victoria Falls, Engler ; Rogers, 5697.

**C. sanderiana ?**
Victoria Falls, Allen, 140.

**C. sp.**
Salisbury, March, Flanagan, 3016, in marshy places.

1647—**Lissochilus arenarius,** *Lindl.* (*L. dilectus,* Reichb. f. *Eulophia arenaria,* Bol.)
Fl. Trop. Afr. vii. 82 ; Fl. Cap. v. iii. 61 ; Cat. Afr. Pl. Welw. ii. 5.
Matabeleland, Oates; Victoria Falls, Allen, 88 ; Chirinda, 3500 ft. Nov. Swyn. 751 ; South Rhodesia, Rand, 262 ; Odzani River Valley, Umtali, Teague.

**L. Buchanani,** *Reichb. f.* (*Eulophia Buchananii,* Bolus.)
Fl. Cap. V. iii. 60 ; Orchids of S.A. ii. 23.
Matopos, Rogers, 5656 ; Victoria, Jan. Miss Krige, in Herb. Bolus, 10715 ; Victoria Falls, Rogers, 13070*.

**L. Eylesii,** *Rendle.*
Journ. Bot. 1905, 53.
Matopos, 5000 ft. Feb. Eyles, 150.

Genus No.

**L. livingstonianus,** *Reichb. f.*
Fl. Trop. Afr. vii. 81.
Mazoe, 4300–4800 ft. Nov. Eyles, 445; Victoria, Monro, 785.

**L. microceras,** *Reichb. f.*
Fl. Trop. Afr. vii. 74.
Umtali, Engler.

**L. milanjianus,** *Rendle.*
Fl. Trop. Afr. vii. 98.
Umtali, Engler.

**L. Oatesii,** *Rolfe.*
Fl. Trop. Afr. vii. 89.
Matabeleland, Oates.

**L. papilinaceus,** *Rendle.*
Fl. Trop. Afr. vii. 91.
Chirinda, 3700 ft. March, Swyn. 227.

**L. Wakefieldii,** *Reichb. f. & S. Moore.*
Fl. Trop. Afr. vii. 95; Fl. Cap. V. iii. 60.
Victoria Falls, Allen, 70.

1648—**Eulophia clitellifer,** *Bolus.* (*Lissochilus clitellifer,* Reichb. f.)
Fl. Cap. V. iii. 55.
Mazoe, 4300–4800 ft. Sep. Eyles, 418; Umtali, Engler; Victoria, Monro, 461, 438.

**E. dregeana,** *Lindl.*
Fl. Cap. V. iii. 36; Orchids of S.A. ii. 9.
Mazoe, 4800–5100 ft. Dec. Eyles, 497.

**E. Krebsii,** *Bolus.* (*Lissochilus Krebsii,* Reichb. f.)
Fl. Trop. Afr. vii. 91; Fl. Cap. V. iii. 58.
Matopos, Oct. Gibbs, 254; Mazoe, 4500 ft. Dec. Eyles, 480; Salisbury, Rand, 1377; South Rhodesia, Rand, 263; Odzani River Valley, Umtali, Teague.

**E. milanjiana,** *Rendle.*
Fl. Trop. Afr. vii. 63.
Chirinda, 3800 ft. Oct. Swyn. 328.

**E. saccatus,** *Rendle.* (*Lissochilus saccatus,* Rendle.)
Fl. Trop. Afr. vii. 98.
South Rhodesia, Rand, 647.

**E. speciosa,** *Bolus.* (*Lissochilus speciosus,* R. Br.)
Fl. Cap. V. iii. 59; Orchids of S.A.
Mazoe, 4800 ft. Nov. Eyles, 463.

**E. Swynnertonii,** *Rendle.*
Journ. Linn. Soc. Bot. xl. 207.
Mt. Pene, 6500–7000 ft. Sep. Oct. Swyn. 752, 6050.

Genus No.

**E. undulata?**

Bulawayo, March, Monro, n. sp.? ined.

**E. Welwitschii,** *Rolfe.*

Fl. Trop. Afr. vii. 61; Cat. Afr. Pl. Welw. ii. 4.

South Rhodesia, Rand, 261.

**E. spp.**

Gwelo, Jan. Gardner, 27.

Salisbury, Rand, 542, 543.

Mazoe, 4300–4800 ft. Dec. Eyles, 474, 491.

Matopos, 5000 ft. Nov. Eyles, 1226, 1227.

Victoria, Monro, 476, 899.

Victoria, Monro, 661, cf. *E. Shupangae,* Kränzl.

South Rhodesia, Rand, 264, 265.

1651—**Pteroglossaspis sp.**

Mazoe, 4300 ft. Jan. Eyles, 501.

1822—**Saccolabium sp?.**

Mazoe, 4700 ft. Dec. Eyles, 476.

1828—**Angrecum leonis?.**

Mazoe, 4700 ft. Nov. Eyles, 465.

**A. rhodesianum,** *Rendle.*

Journ. Linn. Soc. Bot. xl. 208.

Melsetter, 6000 ft. fr. Sep. Swyn. 755, epiphytic on *Brachystegia Randii.*

1837—**Mystacidium sp.**

Mazoe, 4700–5000 ft. Nov. Eyles, 466.

## Class DICOTYLEDONEAE.

## Sub-Class ARCHICHLAMYDEAE.

### Series PIPERALES.

### Family LIII.—PIPERACEAE, *L. C. Rich.*

1862—**Piper capense,** *L.*

Fl. Trop. Afr. VI. i. 146.

Chirinda Forest, 3700–4000 ft. June, Swyn. 66; Mt. Pene, 6500 ft. Swyn. 1097.

1866—**Peperomia brachytrichoides,** *Engl.*

Victoria Falls, in Palm Kloof, Engler.

**P. mascharena,** *C. DC.*

Chipete Forest, 3800 ft. May, Swyn. 426; Chirinda Forest, Swyn.

Genus No.

**P. reflexa,** *A. Dietr.*

Fl. Trop. Afr. VI. i. 155.

Chipete Forest, 3800 ft. May, Swyn. 426*a* ; Chirinda Forest, Swyn.

**P. spp.**

Victoria Falls, in Palm Kloof, April, Flanagan, 3298.

Melsetter, Johnson, 181, cf. *P. arabica,* C. DC.

## Series SALICALES.

### Family LVI.—SALICACEAE, *Lindl.*

1873—**Salix capensis,** *Thunb.*

For. Fl. Cape, 328.

Matopos, Sep. Gibbs, 21 ; March, Flanagan, 2953 ; Mazoe, 4300 ft. April, Eyles, 316 ; Govt. Herb. 924 ; Odzani River Valley, Umtali, Teague, 125.

**S. ramiflora,** *R. v. Seem.*

Victoria Falls, Engler.

**S. Safsaf,** *Forsk.*

Victoria Falls, Oct. Davy.

**S. spp.**

South Rhodesia, Rand, 219, 403.

## Series MYRICALES.

### Family LVII.—MYRICACEAE, *Lindl.*

1874—**Myrica æthiopica,** *L.*

For. Fl. Port. E. Afr. 107 ; For. Fl. Cape, 330.

Victoria Falls, on island, Engler ; Rogers, 7454 ; Odzani River Valley, Umtali, Teague, 109.

**M. pilulifera,** *Rendle.*

Mt. Pene, 6500 ft. fl. July, fr. Sep. Swyn. 530, 1735.

var. **puberula** *Rendle.*

Journ. Bot. 1903, 86.

Melsetter, 6000 ft. fr. Sep. Oct. Swyn. 610, 610*a* ; Nyahodi Riv. 5500 ft. Swyn. 623 ; Mt. Pene, 7000 ft. Swyn. 6084.

## Series URTICALES.

### Family LXIII.—ULMACEAE, *Mirb.*

1898—**Celtis dioica,** *S. Moore.*

Journ. Linn. Soc. xl. 204.

Chirinda Forest, 3700–4000 ft. Oct. Swyn. 108, fr. May.

**C. rhamnifolia,** *Presl.* (*C. kraussiana,* Bernh.)
Nat. Pl. 28; For. Fl. Cape, 306.
Mazoe, 4600 ft. Aug. Eyles, 399.

**C. spp.**
Gwanda, Noble, 62.
Lomagundi, Govt. Herb. 993.

1902—**Trema guineensis,** *Priemer.*
Chirinda, 3800 ft. April, Swyn. 129.

FAMILY LXIV.—MORACEAE, *Lindl.*

1960—**Bosquiea Phoberos,** *Baill.*
Chipete Forest, 3800 ft. Swyn.; Chirinda Forest, 3500 ft. Swyn.

1961—**Ficus caffra,** *Miq.*
Victoria Falls, Rogers, 5978, 7464, 7455.

**F. capensis,** *Thunb.*
For. Fl. Port. E. Afr. 101; For. Fl. Cape, 307; Cat. Afr. Pl. Welw. i. 1016.
Victoria Falls, Engler; Rogers, 5984; Chirinda Forest, 3700–4000 ft. early fr. June, Swyn. 434; Melsetter, Swyn.

**F. capreæfolia,** *Del.*
Sabi Riv. 1000 ft. fr. Dec. Swyn. 1101.

**F. exasperata,** *Vahl.*
Cat. Afr. Pl. Welw. i. 1010.
Chirinda Forest, 3700–4000 ft. fl. & fr. Aug. Oct. Swyn. 601.

**F. lutea,** *Vahl.*
Matopos, fr. Oct. Gibbs, 285; Rogers, 5411; Victoria Falls, Engler; Umtali, Engler.

**F. maschonae,** *Warb.*
Umtali, Engler.

**F. matabelae,** *Warb.*
Matopos, Engler; Salisbury, Engler.

**F. natalensis,** *Hochst.*
For. Fl. Port. E. Afr. 98; For. Fl. Cape, 307.
Matopos, Nov. Marloth, 3404.

**F. Rehmannii,** *Warb.*
Matopos, Engler.

**F. rhodesiaca,** *Warb.*
Salisbury, Engler.

**F. salicifolia,** *Vahl.* var. **australis,** *Warb.*
Matopos, Engler.

**F. Sonderi,** *Miq.*
Matopos, fr. Oct. Gibbs, 26; March, Flanagan, 2977; Rogers, 5251; Bulawayo, Rogers, 6203.

Genus No.

var. **villosa,** *Warb.*

South Rhodesia, Marloth.

**F. subcalcarata,** *Warb. & Schweinf.*

South Melsetter, Swyn.

**F. Victoriae,** *Warb.*

Victoria Falls, Engler.

**F. spp.**

Victoria Falls, April, Flanagan, 3303, cf. *F. Victoriae,* Warb.
Victoria Falls, Allen, 183; Rogers, 5125.
Salisbury, March, Flanagan, 3017, cf. *F. lutea,* Vahl.
Salisbury, Rand, 537, 538.
Victoria, Monro, 361, cf. *F. trachyphylla,* Fenzl.
Victoria, Monro, 390.
Matopos, Rogers, 5198, cf. *F. caffra,* Miq.
Matopos, Rogers, 5354, 5357; Govt. Herb. 899.
Lomagundi, Govt. Herb. 975.
South Rhodesia, Rand, 398, 399.

1966—**Myrianthus arboreus,** *Beauv.*

Cat. Afr. Pl. Welw. i. 995.

Chirinda Forest, 3700–4000 ft. Sep. Swyn. 111, 111*a*; Mt. Pene, 6500–7000 ft. Dec. Swyn. 1052.

## Family LXV.—URTICACEAE, *Endl.*

1978—**Urera obovata,** *Benth.*

Cat. Afr. Pl. Welw. i. 986.

Chirinda Forest, 3700–4000 ft. Jan. Swyn. 1518.

1982—**Fleurya capensis,** *Wedd.*

Nat. Pl. 577.

Chirinda Forest, 3700–4000 ft. fl. April, fr. May, Swyn. 338, 793.

1992—**Pouzolzia hypoleuca,** *Wedd.*

Victoria, Monro, 645, 892; Bulawayo, Chubb, 11*a*; Matopos, Rogers, 5362.

# Series PROTEALES.

## Family LXVI.—PROTEACEAE, *J. St. Hil.*

2034—**Faurea racemosa,** *Farmar.*

Fl. Trop. Afr. VI. i. 208; Kew Bull. 1908, 58.

Chimanimani Mts. 7000 ft. Sep. Swyn. 639; Mt. Pene, 7000 ft. Oct. Swyn. 6096.

Genus No.

**F. saligna,** *Harv.*

Fl. Trop. Afr. VI. i. 209; Fl. Cap. V. i. 640; Cat. Afr. Pl. Welw. i. 921; For. Fl. Cape, 297.

Fig-tree, 4500 ft. Dec. Eyles, 156; Matopos, Marloth; Hutchins; Oct. Davy; Oct. Gibbs, 313; Engler; Rusapi, Engler; Victoria, Monro, 782; 617; Kocwe Hills, Govt. Herb. 953; Chirinda, 3500 ft. Sep. Swyn. 42; Chimanimani Mts. 7000 ft. Nov. Swyn. 1796; Odzani River Valley, Umtali, Teague, 139.

**F. speciosa,** *Welw.*

Fl. Trop. Afr. VI. i. 211; Fl. Cap. V. i. 642; Cat. Afr. Pl. Welw. i. 922.

Mazoe, 4800 ft. Sep. Eyles, 415; Salisbury, March, Flanagan, 3005; Melsetter, 6000 ft. Sep. Oct. Swyn. 625, 626; between Melsetter and Umvumvumvu Riv. Swyn.; Odzani River Valley, Umtali, Teague, 138.

var. **lanuginosa,** *Hiern.*

Cat. Afr. Pl. Welw. i. 922.

Salisbury, Engler.

**F. usambarensis,** *Engl.*

Fl. Trop. Afr. VI. i. 210.

Umtali, Engler.

2035—**Protea abyssinica,** *Willd.*

Fl. Trop. Afr. VI. i. 199; Fl. Cap. V. i. 581.

Matopos, Galpin, 7090; fl. & fr. Oct. Gibbs, 59; Rogers, 153; Nov. Marloth, 3229; Kolbe, 3615; Bulawayo, Kolbe; Chimanimani Mts. Johnson, 131?; Salisbury, Cecil, 260; Umgusa Riv. Baines; Umzingwani Riv. Baines; Odzani River Valley, Umtali, Teague, 272.

**P. angolensis,** *Welw.* var. **albiflora,** *Engl.*

Odzani River Valley, Umtali, Teague, 93.

**P. grandiflora,** *Thunb.*

Fl. Cap. V. i. 580; For. Fl. Cape, 296.

Sengwe Riv. Govt. Herb. 955.

**P. madiensis,** *Oliv.*

Fl. Trop. Afr. VI. i. 204.

Melsetter, 6000 ft. Sep. Swyn. 629; Chimanimani Mts. 7000 ft. Oct. Swyn. 6097.

**P. maschonica,** *Engl.*

Hartley, Engler; Umtali, Engler.

**P. mellifera,** *Thunb.*

Fl. Cap. V. i. 576; For. Fl. Cape, 296.

Bulawayo, Engler.

Genus No.

**P. Swynnertonii,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 184.
Melsetter, 6000 ft. April, Swyn. 1411.

**P. uhehensis,** *Engl.*
Fl. Trop. Afr. VI. i. 202.
Chimanimani Mts. 4000 ft. Johnson, 131 ? ; Chirinda, 3800 ft. Feb. Swyn. 190.

**P. spp.**
Mazoe, Jan. Eyles, 515, cf. *P. abyssinica,* Willd.
Gwanda, Noble, 74.
South Rhodesia, Rand, 394.

2036—**Leucospermum saxosum,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 185.
Chimanimani Mts. 7000 ft. Sep. Swyn. 652.

## Series SANTALALES.

### Family LXVII.—LORANTHACEAE, *D. Don.*

2074—**Loranthus bulawayensis,** *Engl.* (*L. kraussianus,* Gibbs.)
Fl. Trop. Afr. VI. i. 364.
Bulawayo, on *Combretum* sp. Marloth, 3378; Chubb, 400; Matopos, Gibbs, 274 ; Umvumvumvu Riv. 4000 ft. Oct. Swyn. 6001 ; Victoria, Monro, 717 ; Victoria Falls, Rogers, 5564.

**L. Cecilae,** *N. E. Br.*
Fl. Trop. Afr. VI. i. 373 ; Kew Bull. 1906, 168.
Bulawayo, Cecil, 96.

**L. Dregei,** *Eckl. & Zeyh.*
Fl. Trop. Afr. VI. i. 311 ; Fl. Cap. ii. 575 ; Nat. Pl. 312.
Matopos, Engler ; Sebakwe, 4000 ft. Oct. Eyles, 177.

var. **subcuneifolius,** *Sprague.*
Fl. Trop. Afr. VI. i. 312.
Matopos, Oct. Gibbs, 181.

**L. erianthus,** *Sprague.*
Fl. Trop. Afr. VI. i. 359.
Bulawayo, Chubb, 14*a* ; Rogers, 5643 ; Sebakwe, Rogers ; Victoria, Monro, 316, 827 ?

**L. Eylesii,** *Sprague.*
Fl. Trop. Afr. VI. i. 343 ; Kew Bull. 1911, 146.
Bulawayo, 4500 ft. Feb. Eyles, 1194 ; Victoria, Monro, 808.

**L. guttatus,** *Sprague.*
Fl. Trop. Afr. VI. i. 350 ; Kew Bull. 1911, 147.
Mazoe, 4700 ft. April, Eyles, 369.

Genus No.

**L. kalachariensis,** *Schinz.* (*L. curviflorus*, Schinz.)
Fl. Trop. Afr. VI. i. 280.
Bulawayo, 4500 ft. May, on *Acacia* sp. Eyles, 78; Chubb, 313; Rand, 393; Rogers, 5644?; Matopos, Davy; Tuli Riv. Penther, 1626; Victoria Falls, July, Kolbe, 3184.

**L. kraussianus,** *Meisn.*
Fl. Cap. ii. 577; Nat. Pl. 76.
Mazoe, 4800 ft. April, Eyles, 301.

**L. mweroensis,** *Baker.*
Fl. Trop. Afr. VI. i. 304.
Salisbury, on *Protea* sp. Rand, 532.

**L. namaquensis,** *Harv.* (*L. Meyeri*, Presl.)
Fl. Trop. Afr. VI. i. 361; Fl. Cap. ii. 577; Cat. Afr. Pl. Welw. i. 932.
Victoria Falls, April, Flanagan, 3280; on *Salix* sp. Rogers, 5391. 7225, 5588; Bulawayo, Rogers, 5822.

**L. quinquangulus,** *Engl. & Schinz*, var. **pedicellatus,** *Sprague.* (*L. zambesicus*, Gibbs.)
Fl. Trop. Afr. VI. i. 362; Journ. Linn. Soc. Bot. xxxvii. 467.
Victoria Falls, Allen, 138; fl. & fr. Sep. Gibbs, 140.

**L. Swynnertonii,** *Sprague.*
Fl. Trop. Afr. VI. i. 390; Journ. Linn. Soc. Bot. xl. 188.
Chirinda Forest, 3700–4000 ft. on *Vernonia podocoma*, Sch. Bip. Dec. Swyn. 141; also parasitic on peach-trees, Swyn.

**L. virescens,** *N. E. Br.*
Fl. Trop. Afr. VI. i. 309; Kew Bull. 1906, 168.
Salisbury, Rand, 1374, on *Grewia* sp.; Cecil, 147.

**L. spp.**
Mazoe, March, Flanagan, 3022; Govt. Herb. 930.
Inyoka, Govt. Herb. 950.
Lomagundi, Govt. Herb. 989.
South Rhodesia, Rand, 222, 391.

2093—**Viscum combreticola,** *Engl.* (*V. dichotomum*, Don.)
Fl. Trop. Afr. VI. i. 404; Fl. Cap. ii. 581.
Mazoe, 5000 ft. fr. Nov. Eyles, 456; Harvest Valley, Rogers, 13577.

**V. matabelense,** *Engl.*
Fl. Trop. Afr. VI. i. 410.
Matopos, 5000 ft. Engler, 2846*a*.

**V. Menyharthii,** *Engl. & Schinz.*
Fl. Trop. Afr. VI. i. 410.
Matopos, on *Croton gratissimus*, Burch. Gibbs, 16.

Genus No.

**V. tuberculatum,** *A. Rich.*
Fl. Trop. Afr. VI. i. 396.
Matopos, Engler.

**V. verrucosum,** *Harv.*
Fl. Trop. Afr. VI. i. 408; Fl. Cap. ii. 581.
Matopos, Galpin, 7087; fl. & fr. Sep. Gibbs, 65; Bulawayo, 4500 ft. Dec. on *Acacia* sp. Eyles, 1139; Rogers, 5642.

**V. sp.**
South Rhodesia, Rand, 393.

## Family LXIX.—SANTALACEAE, *R. Br.*

2104—**Colpoon compressum,** *Berg.*
For. Fl. Cape, 303.
Matopos, Oct. Gibbs, 183; Engler; Govt. Herb. 891; Lomagundi, Govt. Herb. 974.

2108—**Osyris abyssinica,** *Hochst.*
Fl. Trop. Afr. VI. i. 433; Cat. Afr. Pl. Welw. i. 938.
Melsetter, 6000 ft. Sep. Swyn. 622; North Melsetter, 5000–6000 ft. fr. Oct. Swyn. 6102; Victoria, Monro, 643; Bulawayo, Rogers, 13677*.

2118—**Thesium brevibarbatum,** *Pilger.*
Fl. Trop. Afr. VI. i. 416.
Umtali, 3900 ft. Sep. Engler, 3176.

**T. goetzeanum,** *Engl.*
Fl. Trop. Afr. VI. i. 418.
Between Hartley & Gadzema, 5000 ft. Engler, 3013; Matopos, 5000 ft. Nov. Eyles, 1146; Salisbury, Marshall.

**T. gracile,** *A. W. Hill.*
Fl. Trop. Afr. VI. i. 419; Kew Bull. 1910, 185.
Sebakwe, 4000 ft. Dec. Eyles, 85.

**T. multiramulosum,** *Pilger.*
Fl. Trop. Afr. VI. i. 419.
Umtali, 3900 ft. Engler, 3138, 3146.

**T. rhodesiacum,** *Pilger.*
North of Hartley, Engler.

**T. Rogersii,** *A. W. Hill.*
Fl. Trop. Afr. VI. i. 1059; Kew Bull. 1913, 78.
Victoria Falls, on island, Rogers, 5467.

**T. scabridulum,** *A. W. Hill.*
Fl. Trop. Afr. VI. i. 424; Journ. Linn. Soc. Bot. xl. 189.
Melsetter, 6000 ft. fl. & fr. Sep. Swyn. 2124.

Genus No.

**T. sp.**

South Rhodesia, Rand, 206.

FAMILY LXXI.—OPILIACEAE, *Valeton.*

2122—**Opilia amentacea,** *Roxb.*

Fl. Trop. Afr. i. 352; For. Fl. Port. E. Afr. 30; Cat. Afr. Pl. Welw. i. 142.

Sabi Riv. 1000 ft. Nov. Swyn. 1204.

FAMILY LXXII.—OLACACEAE, *Lindl.*

2131—**Olax dissitiflora,** *Oliv.*

Fl. Trop. Afr. i. 350; For. Fl. Port. E. Afr. 30.

Matopos, Oct. Gibbs, 263; Victoria Falls, Gibbs; Rogers, 7462; Victoria Monro, 560.

2136—**Ximenia americana,** *L.*

Fl. Trop. Afr. i. 346; For. Fl. Port. E. Afr. 30.

Victoria Falls, Sep. Galpin, 7060; Rogers, 5997; Chirinda, 3500 ft. Oct. Swyn. 175; Bulawayo, Monro, 64; Chubb, 332, 354; Rand, May, 423, cf. var. *microphylla*, Welw.

**X. caffra,** *Sond.*

Fl. Cap. i. 235; For. Fl. Port. E. Afr. 30.

Victoria Falls, Sep. Gibbs, 130; Allen, 159; Rogers, 5468, 5985; Matopos, Engler; Gibbs; Gwanda, Noble, 46; Victoria, Monro, 640; Bulawayo, Monro, 37, 82.

**X. spp.**

Bulawayo, Monro, 1; Chubb, 340.

Umtali, Swyn. 6619, cf. *X. americana*, L.

## SERIES ARISTOLOCHIALES.

FAMILY LXXV.—RAFFLESIACEAE, *Dumort.*

2179—**Pilostyles æthiopica,** *Welw.*

Fl. Trop. Afr. VI. i. 131; Cat. Afr. Pl. Welw. i. 908.

Victoria, Monro, 962, 457, on *Brachystegia* sp.

FAMILY LXXVI.—HYDNORACEAE, *Solms-Laub.*

2182—**Hydnora africana,** *Thunb.*

Fl. Cap. V. i. 486; Cat. Afr. Pl. Welw. i. 910.

Bulawayo, Monro.

## SERIES POLYGONALES.

### FAMILY LXXVII.—POLYGONACEAE, *Lindl.*

Genus No
2195—**Rumex abyssinicus,** *Jacq.*
Fl. Trop. Afr. VI. i. 114; Cat. Afr. Pl. Welw. i. 905.
Melsetter, 6000 ft. April, Swyn. 1506.

**R. nepalensis,** *Spreng.*
Fl. Trop. Afr. VI. i. 117; Fl. Cap. V. i. 473.
Salisbury, Rogers, 4085.

2201—**Polygonum acuminatum,** *H. B. & K.*
Fl. Trop. Afr. VI. i. 112.
Upper Buzi, 3000 ft. June, Swyn. 356; Chirinda Forest, 3700–4000 ft. Dec. Swyn. 1512.

**P. aviculare,** *L.*
Fl. Trop. Afr. VI. i. 105; Fl. Cap. V. i. 464.
Bulawayo, 4500 ft. Aug. Eyles, 1245; Rogers, 5518, 13622; Chubb, 35; Victoria, Monro, 85.

**P. barbatum,** *L.*
Fl. Trop. Afr. VI. i. 109; Fl. Cap. V. i. 467.
Victoria Falls, Engler; Salisbury, Rogers, 4083 ?; Bulawayo, Rogers, 13620.

**P. plebeium,** *R. Br.* (*P. herniarioides*, Del.)
Fl. Trop. Afr. VI. i. 105.
Matopos, Sep. Gibbs, 63; Gwelo, Jan. Gardner, 44.

**P. serrulatum,** *Lag.*
Fl. Trop. Afr. VI. i. 107; Fl. Cap. V. i. 467.
Victoria Falls, Rogers, 5030, 5575, 5578, 6016; Salisbury, Rogers, 4084; Odzani River Valley, Umtali, Teague, 183.

**P. tomentosum,** *Willd.*
Fl. Trop. Afr. VI. i. 110; Fl. Cap. V. i. 468; Cat. Afr. Pl. Welw. i. 905.
Matopos, March, Flanagan, 2959; Rogers, 5647; Victoria Falls, Rogers, 5625, 7176; Salisbury, Marshall.

**P. sp.**
South Rhodesia, Rand, 223.

2204—**Oxygonum alatum,** *Burch.*
Fl. Trop. Afr. VI. i. 99; Fl. Cap. V. i. 460; Cat. Afr. Pl. Welw. i. 902.
Victoria Falls, Allen, 287.

**O. dregeanum,** *Meisn.*
Fl. Cap. V. i. 461.
Redbank, April, Flanagan, 3183.

Genus No.

**O. pubescens,** *C. H. Wright.*

Fl. Trop. Afr. VI. i. 101 ; Kew Bull. 1909, 187.

Between Salisbury and Headlands, Cecil, 155 ; between Salisbury and Umtali, Cecil, 44 ; Umtali, Cecil, 235*a*.

**O. Zeyheri,** *Sond.*

Fl. Cap. V. i. 460.

Bulawayo, Jan. Gardner, 61.

**O. spp.**

Victoria Falls, Rogers, 7198, probably n. sp.

Between Bulawayo and Plumtree, April, Flanagan, 3182.

## Series CENTROSPERMAE.

### Family LXXVIII.—CHENOPODIACEAE, *Less.*

2223—**Chenopodium Botrys,** *L.*

Fl. Trop. Afr. VI. i. 79 ; Fl. Cap. V. i. 439.

Matopos, Rogers ; Odzani River Valley, Umtali, Teague, 199.

**C. schraderianum,** *Roem. & Schultes.* (*C. fœtidum,* Schrad. ; *C. graveolens,* Lag. & Rodr.)

Fl. Trop. Afr. VI. i. 80 ; Fl. Cap. V. i. 439 ; Cat. Afr. Pl. Welw. i. 898.

Melsetter, 6000 ft. April, Swyn. 1507.

**C. sp.**

Mazoe, 4700 ft. Aug. Eyles, 180.

2240—**Kochia decumbens** (*Hochst.*), *Torre & Harms.* (*Pentodon decumbens,* Hochst.)

Victoria, Monro, 925.

### Family LXXIX.—AMARANTACEAE, *Juss.*

2292—**Celosia trigyna,** *L.*

Fl. Trop. Afr. VI. i. 19 ; Fl. Cap. V. i. 404 ; Cat. Afr. Pl. Welw. i. 884.

Matopos, March, Flanagan, 2941, 2951 ; Victoria Falls, April, Flanagan, 3294 ; Rogers, 7141 ; May, Eyles, 143 ; between Wankie and Victoria Falls, Rogers, 5272 ; Chipete Forest, 3800 ft. April, May, Swyn. 507 ; Upper Buzi, 3000 ft. Swyn. 1514 ; Matabeleland, Holub.

**C. sp.**

South Rhodesia, Rand, 201.

Genus No.

2293—**Hermbstædtia elegans,** *Moq.*

Fl. Trop. Afr. VI. i. 26; Fl. Cap. V. i. 407.

Bulawayo, Rogers, 5928.

2299—**Amarantus græcizans,** *L.* (*A. Thunbergii,* Moq.)

Fl. Trop. Afr. VI. i. 34; Fl. Cap. V. i. 411; Cat. Afr. Pl. Welw. i. 887.

Matopos, Rogers, 5247; Gwelo, Sr. Phil. 6; Chirinda, 3800 ft. May, Swyn. 463; Salisbury, Govt. Herb. 605.

**A. viridis,** *L.*

Fl. Trop. Afr. VI. i. 33; Fl. Cap. V. i. 411; Cat. Afr. Pl. Welw. i. 888.

Victoria Falls, Rogers, 7066.

2309—**Cyphocarpa angustifolia,** *Lopr.* (*Sericocoma angustifolia,* Hook. f.)

Fl. Trop. Afr. VI. i. 53; Fl. Cap. V. i. 415; Cat. Afr. Pl. Welw. i. 889.

Bulawayo, 4500 ft. Dec. Eyles; Gardner, 87; Victoria Falls, April, Flanagan, 3204; Victoria, Monro, 927.

2312—**Cyathula cylindrica,** *Moq.*

Fl. Trop. Afr. VI. i. 46; Fl. Cap. V. i. 420.

Mazoe, 5000 ft. March, Eyles, 249.

**C. prostrata,** *Blume.*

Fl. Trop. Afr. VI. i. 43.

Chirinda Forest, 3700–4000 ft. April, May, Swyn. 269*a*, 340.

2317—**Ærva lanata,** *Juss.*

Fl. Trop. Afr. VI. i. 39; Fl. Cap. V. i. 426.

Bulawayo, 4500 ft. Eyles, 83.

**Æ. leucura,** *Moq.*

Fl. Trop. Afr. VI. i. 39; Fl. Cap. V. i. 426.

Mazoe, 4500 ft. March, Eyles, 276; Matopos, March, Flanagan, 2952; Rogers, 5165; Plumtree, April, Flanagan, 3208; Salisbury, May, Flanagan, 3271; Victoria, Monro, 372; Odzani River Valley, Umtali, Teague, 107.

**Æ. sp.**

South Rhodesia, Rand, 203.

2324—**Psilotrichum gracilentum,** *C. B. Cl.*

Fl. Trop. Afr. VI. i. 59.

Umvumvumvu Riv. 4000 ft. April, Swyn. 777; North Melsetter, 5000–6000 ft. Oct. Swyn. 6640.

2328—**Achyranthes aspera,** *L.*

Fl. Trop. Afr. VI. i. 63; Fl. Cap. V. i. 428; Cat. Afr. Pl. Welw. i. 893.

Bulawayo, 4700 ft. Feb. Eyles, 105; Victoria Falls, fl. & fr. Sep. Gibbs, 171; Engler; Rogers, 5056; Mazoe, March, Eyles, 299.

Genus No.

var. **argentea,** *C. B. Cl.* (*A. argentea,* Lam.)

Fl. Trop. Afr. VI. i. 63.

Mazoe, 4800 ft. March, Eyles, 298; Odzani River Valley, Umtali, Teague, 81.

var. **pinguispicata,** *C. B. Cl.*

Matabeleland, Oates.

**A. bidentata,** *Blume.*

Fl. Trop. Afr. VI. i. 64; Cat. Afr. Pl. Welw. i. 894.

Chirinda Forest, 3700–4000 ft. June, Swyn. 1510.

**A. leptostachya,** *E. Mey.* (*Achyropsis leptostachya,* Hook. f.)

Fl. Trop. Afr. VI. i. 66; Fl. Cap. V. i. 430.

Shashi Riv. Holub.

**A. sp.**

Mazoe, 5200 ft. Jan. Eyles, 520.

2335—**Alternanthera echinata,** *Smith.* (*A. achyrantha,* R. Br.)

Fl. Trop. Afr. VI. i. 74; Fl. Cap. V. i. 432; Cat. Afr. Pl. Welw. i. 896.

Victoria Falls, Rogers, 7193; Bulawayo, Rogers, 13621; Hartley, Mundy.

**A. nodiflora,** *R. Br.*

Fl. Trop. Afr. VI. i. 73.

Victoria, Monro, 944; Salisbury, Rogers.

**A. sessilis,** *R. Br.*

Fl. Cap. V. i. 432.

Victoria Falls, Sep. Gibbs, 121.

## Family LXXX.—NYCTAGINACEAE, *Lindl.*

2349—**Boerhavia pentandra,** *Burch.* (*B. grandiflora,* A. Rich.)

Fl. Trop. Afr. VI. i. 7; Fl. Cap. V. i. 396.

Bulawayo, 4500 ft. Dec. Eyles, 19; Aug. 1228; Gwelo, Sr. Phil. 56; Victoria Falls, Rogers, 7419?

**B. plumbaginea,** *Cav.* (*B. dichotoma,* Vahl.)

Fl. Trop. Afr. VI. i. 7; Cat. Afr. Pl. Welw. i. 883.

Gwelo, Gardner, 20; Mazoe, 5100 ft. April, Eyles, 333.

**B. repens,** *L.* var. **diffusa,** *Hook. f.*

Fl. Trop. Afr. VI. i. 5; Fl. Cap. V. i. 395.

Victoria Falls, Rogers, 5628?

## Family LXXXIII.—PHYTOLACCACEAE, *Lindl.*

2376—**Limeum fenestrata** (*Fenzl.*), *Torre & Harms.* (*Semonvillea fenestrata,* Fenzl.)

Fl. Cap. i. 152.

North of Bulawayo, 3400 ft. Dec. Eyles, 1133; Victoria Falls, April, Flanagan, 3307; Rogers, 5607, 7264, 7436, 7207.

Genus No.

**L. viscosum,** *Fenzl.*

Fl. Trop. Afr. ii. 595; Cat. Afr. Pl. Welw. i. 421.

Shashi Riv. Jan. Rand, 57; Salisbury, March, Flanagan, 3006.

2380—**Phytolacca dodecandra,** *L'Hérit.* (*P. abyssinica,* Hoffm.)

Fl. Trop. Afr. VI. i. 97; Fl. Cap. i. 157, & V. i. 457; Nat. Pl. 263; Cat. Afr. Pl. Welw. i. 901.

Salisbury, Engler; Lusitu Riv. 3000 ft. fl. & fr. Sep. Oct. Swyn. 2118; Victoria Falls, Rogers, 7255*.

**P. sp.**

Salisbury, March, Flanagan, 2998.

2382—**Giesekia pharnaceoides,** *L.*

Fl. Trop. Afr. ii. 593; Cat. Afr. Pl. Welw. i. 419,

Shashi Riv. Jan. Rand. 56; Gwai, April, Flanagan, 3289; Victoria Falls, April, Flanagan, 3242; Rogers, 7263, 7005; Victoria, Monro, 881.

**G. spp.**

Bulawayo, Jan. Gardner, 4; Malindi, Jan. Allen, 235.

### Family LXXXIV.—AIZOACEAE, *A. Br.*

2387—**Mollugo Cerviana,** *Seringe.*

Fl. Trop. Afr. ii. 591; Fl. Cap. i. 138; Cat. Afr. Pl. Welw. i. 417.

Salisbury, Rogers.

**M. hirta,** *Thunb.* var. **virens,** *Fenzl.* (*M. Glinus,* A. Rich.; *Glinus lotoides,* L.)

Fl. Trop. Afr. ii. 590; Fl. Cap. i. 137; Cat. Afr. Pl. Welw. i. 416.

Bulawayo, May, Rand, 331.

**M. nudicaulis,** *Lam.*

Fl. Trop. Afr. ii. 591; Cat. Afr. Pl. Welw. i. 417.

Victoria Falls, Rogers, 5701.

2388—**Glinus sp.**

Victoria Falls, Allen, 284, cf. *G. Bainesii,* Pax.

2389—**Pharnaceum verrucosum,** *E. & Z.* (*P. salsoloides,* Burch; *Hypertelis verrucosa,* Fenzl.)

Fl. Trop. Afr. ii. 592; Fl. Cap. i. 144; Cat. Afr. Pl. Welw. i. 418.

Victoria, Monro, 850; Salisbury, Rogers, 5520.

**P. Zeyheri,** *Sond.*

Fl. Cap. i. 141.

Matopos, Sep. Oct. Gibbs, 45; Engler.

2393—**Orygia decumbens,** *Forsk.*

Fl. Trop. Afr. ii. 589; Fl. Cap. i. 136; Cat. Afr. Pl. Welw. i. 415.

Bulawayo, 4500 ft. Dec. Eyles, 30.

Genus No.
2405—**Mesembrianthemum Mahoni,** *N. E. Br.*
Gard. Chron. 1902, ii. 190.
Odzani River Valley, Umtali, Teague.

**M. sp.**
Matopos, Nov. Eyles, 1190.

FAMILY LXXXV.—PORTULACACEAE, *Reichb.*

2406—**Talinum caffrum,** *E. & Z.* (*Portulaca caffra,* Thunb.)
Fl. Trop. Afr. i. 150; Fl. Cap. ii. 385; Nat. Pl. 593; Cat. Afr. Pl. Welw. i. 54.
Bulawayo, Dec. Gardner, 67; Rogers, 5913; Victoria Falls, Rogers, 5623.

2412—**Anacampseros rhodesica,** *N. E. Br.*
Kew Bull. 1914, 132.
Matopos, J. G. McDonald & W. E. Dowsett; Salisbury, Mundy.

FAMILY LXXXVII.—CARYOPHYLLACEAE, *Reichb.*

2455—**Polycarpæa corymbosa,** *Lam.* (*Polia arenaria,* Lour.)
Fl. Trop. Afr. i. 145; Fl. Cap. i. 133; Cat. Afr. Pl. Welw. i. 51.
Bulawayo, May, Rand, 350; Victoria Falls, April, Flanagan, 3030; Rogers, 7028; Mazoe, 4400 ft. April, Eyles, 310; Victoria, Monro, 952; Chimanimani Mts. 7000 ft. Sep. Swyn. 1804.

2467—**Pollichia campestris,** *Ait.*
Fl. Trop. Afr. VI. i. 10; Fl. Cap. i. 133, & V. i. 399.
Victoria Falls, on islands, Sep. Gibbs, 118; Engler.

2469—**Corrigiola drymarioides,** *Bak. f.*
Journ. Linn. Soc. Bot. xl. 181.
Chimanimani Mts. 7000 ft. fl. & fr. Sep. Swyn. 2159.

**C. litoralis,** *L.*
Fl. Trop. Afr. VI. i. 12; Fl. Cap. i. 132, and V. i. 401.
Bulawayo, 4500 ft. Aug. Eyles, 1241; Macheke, Engler; Victoria, Monro, 364; Salisbury, Rogers.

2490—**Silene Burchellii,** *Otth.*
Fl. Trop. Afr. i. 139; Fl. Cap. i. 128; Cat. Afr. Pl. Welw. i. 49.
Gwelo, Jan. Gardner, 23; Salisbury, Engler; Rand, 1389; Mt. Pene, 7000 ft. Oct. Swyn. 6069; Harvest Valley, Rogers.

## Series RANALES.

### Family LXXXVIII.—NYMPHAEACEAE, *DC.*

Genus No.
2513—**Nymphæa lotus,** *L.*

Fl. Trop. Afr. i. 52 ; Cat. Afr. Pl. Welw. i. 22.
North of Bulawayo, Engler.

**N. stellata,** *Willd.* (*N. malabarica,* Poir.)

Fl. Trop. Afr. i. 52 ; Fl. Cap. i. 14 ; Nat. Pl. 33 ; Cat. Afr. Pl. Welw. i. 22 ; also see note in Kew Bull. 1906, 183.
Matopos, Marloth ; 4600 ft. April, Eyles, 35 ; Rogers ; Bulawayo, Engler ; Salisbury, May, Flanagan, 3248 ; South Rhodesia, Rand, 16.

### Family XCI.—RANUNCULACEAE, *Juss.*

2541—**Anemone peneensis,** *E. G. Baker.*

Journ. Linn. Soc. Bot. xl. 16.
Mt. Pene, 6500 ft. Sep. Swyn. 783.

2542—**Clematis brachiata,** *Thunb.*

Fl. Cap. i. 2.
Bulawayo, Chubb, 19.

**C. Kirkii,** *Oliv.*

Fl. Trop. Afr. i. 5.
Salisbury, Darling, in Herb. Bolus, 10797 ; between Bulawayo and Victoria Falls, Davy ; Mazoe, May, Flanagan, 3200 ; Chirinda, Swyn. ; Odzani River Valley, Umtali, Teague, 23.

**C. orientalis,** *L.*

Cat. Afr. Pl. Welw. i. 3.
Victoria, Monro, 1002.

**C. simensis,** *Fres.* (*C. orientalis,* L. var. *simensis,* O. Kuntze.)

Fl. Trop. Afr. i. 6 ; Cat. Afr. Pl. Welw. i. 3.
Chirinda, Swyn.

**S. Stanleyi,** *Hook.* (*C. villosa,* DC.)

Fl. Trop. Afr. i. 6 ; Fl. Cap. i. 2 ; Cat. Afr. Pl. Welw. i. 2.
Salisbury, Dec. Rand, 1 and 436 ; Bulawayo, 4500 ft. Eyles, 1121 ; Monro, 108 ; Matopos, 4500 ft. Feb. Eyles, 1172 ; Rogers, 5266 ; Umtali, Engler ; Chirinda, Swyn. ; South Rhodesia, Rand, 289.

**C. Thunbergii,** *Steud.* (*C. orientalis,* L. var. *Thunbergii,* O. Kuntze.)

Fl. Trop. Afr. i. 6 ; Fl. Cap. i. 2 ; Cat. Afr. Pl. Welw. i. 3.
Victoria Falls, April, Flanagan, 3244, 3238 ; Mazoe, 4300 ft. April, Eyles, 326 ; Victoria, Monro, 1002 ; Odzani River Valley, Umtali, Teague, 210.

Genus No.

**C. virona,** *L.*
South Rhodesia, Rand, 288.

**C. wightiana,** *Wall.*
Chirinda, Swyn.

**C. spp.**
Gwelo, Jan. Gardner, 9, cf. *C. Kirkii*, Oliv.
Mazoe, 4800–5000 ft. March, Eyles, 281, probably n. sp.
Salisbury, May, Flanagan, 3199 (same as Eyles 281).
Victoria Falls, Rogers, 5077.

2546—**Ranunculus pinnatus,** *Poir.* (*R. pubescens*, Thunb.)
Fl. Trop. Afr. i. 9; Fl. Cap. i. 6; Cat. Afr. Pl. Welw. i. 4.
Salisbury, Dec. Rand, 79; July, Rand, 435; Bulawayo, May, Rand, 287; Gwelo, Jan. Gardner, 25; Mazoe, 4500 ft. Nov. Eyles, 450.

**R. plebeius,** *R. Br.*
Fl. Cap. i. 6.
Chirinda Forest, 3700–4000 ft. Swyn. 345.

2548—**Thalictrum rhynchocarpum,** *Dill. & Rich.*
Fl. Trop. Afr. i. 8.
Chipete and Chirinda, Swyn.

## Family XCIV.—MENISPERMACEAE, *DC.*

2570—**Cocculus villosus,** DC. (*Cebatha hirsuta*, O. Kuntze.)
Fl. Trop. Afr. i. 45; Cat. Afr. Pl. Welw. i. 18.
Sabi Riv. 1000 ft. fr. Nov. Swyn. 1756*a*.

2574—**Cissampelos Pareira,** *L.*
Fl. Trop. Afr. i. 45; Fl. Cap. i. 11; Cat. Afr. Pl. Welw. i. 18.
North of Hartley, Engler; Victoria Falls, Rogers, 5616.

var. **mucronata,** *Engl.* (*C. mucronata*, A. Rich.)
Matopos, Oct. Gibbs, 243; Chipete Forest, 3800 ft. Jan. Swyn. 220; Chirinda, Swyn.

**C. torulosa,** *E. Mey.*
Fl. Trop. Afr. i. 46; Fl. Cap. i. 11.
Chipete Forest, 3800 ft. Jan. Swyn. 218, 219.

2577—**Tiliacora funifera,** *Oliv.*
Fl. Trop. Afr. i. 44.
Victoria Falls, Rain Forest, male, Sep. Gibbs, 302; Kirk; Chirinda, Swyn.

2594—**Dioscoreophyllum chirindense,** *Swyn.*
Journ. Linn. Soc. Bot. xl. 19.
Chirinda Forest, 3700–4000 ft. fl. Jan. and March, Swyn. 100, 100*a*, fr. Dec. Swyn. 6521.

## Family XCVIII.—ANONACEAE, *L. C. Rich.*

Genus No.

2673—**Uvaria gazensis,** *Swyn. & E. G. Baker.*
Journ. Linn. Soc. Bot. xl. 17.
Chirinda, 3700–4000 ft. Oct. Swyn. 1326.

2691—**Popowia obovata,** *Engl. & Diels.*
Victoria Falls, Allen, 144; Rogers, 7081, 5540, 5618; Sebawke, 4000 ft. Dec. Eyles, 162; Chikore, 3000 ft. April, Swyn. 187.

2716—**Hexalobus senegalensis,** *A. DC.*
Fl. Trop. Afr. i. 27.
Matopos, Oct. Gibbs, 217; Sep. Galpin, 7086.

2724—**Artabotrys brachypetala,** *Benth.*
Fl. Trop. Afr. i. 28; For. Fl. Port. E. Afr. 8.
Matopos, Oct. Gibbs, 252; Victoria, Monro, 795.

**A. Monteiroae,** *Oliv.*
Chimanimani Mts. 7000 ft. Sep. Swyn. 1764.

2729—**Anona senegalensis,** *Pers.*
Fl. Trop. Afr. i. 16; Fl. Cap. ii. 583; Cat. Afr. Pl. Welw. i. 8; For. Fl. Port. E. Afr. 7.
Matopos, Davy; Oct. Gibbs, 256; Gwai Forest, 3600 ft. Allen, 240; Hartley, Engler; Salisbury, Rand, 1342; Victoria, Monro, 305, 565; Chirinda, 3500 ft. Swyn. 191.

var. **rhodesiaca,** *Engl. & Diels.*
Salisbury, Sep. Engler, 3080; Matopos, Nov. Marloth, 3376.

## Family CI.—MONIMIACEAE, *Dumort.*

2759*a*—**Xymalos monospora,** *Baill.*
Fl. Trop. Afr. VI. i. 169; Fl. Cap. V. i. 493; For. Fl. Cape, 288.
Chirinda Forest, 3700–4000 ft. June, 663; Chimanimani Mts. 7000 ft. Sep. Swyn. 1112; Chipete Forest, Swyn.

## Family CII.—LAURACEAE, *Lindl.*

2825—**Cassytha ciliolata,** *Nees.* (*C. capensis*, Meisn.)
Fl. Cap. V. i. 501.
Victoria Falls, April, Flanagan, 3275.

**C. filiformis,** *L.*
Fl. Trop. Afr. VI. i. 188; Fl. Cap. V. i. 500; Cat. Afr. Pl. Welw. i. 915.
Victoria Falls, Rogers, 5596.

### Family CIII.—HERNANDIACEAE, *Dumort.*

Genus No.
2830—**Gyrocarpus sp.**
Victoria Falls, Allen, 401. This "may possibly belong to *G. asiaticus*, Willd. The fruits, however, differ in being glabrous." Fl. Trop. Afr. VI. i. 190.

## Series RHOEADALES.

### Family CIV.—PAPAVERACEAE, *B. Juss.*

2852—**Argemone mexicana,** *L.*
Fl. Trop. Afr. i. 54; Cat. Afr. Pl. Welw. i. 23.
Bulawayo, Rogers.

### Family CV.—CRUCIFERAE, *B. Juss.*

2875—**Heliophila sp.**
South Rhodesia, Rand, 96.

2949—**Brassica spp.**
Mazoe, 4800 ft. March, Eyles, 295; Bulawayo, Rogers, 5756; Salisbury, Rogers, 5770.

2965—**Nasturtium fluviatile,** *E. Mey.*
Fl. Cap. i. 21; Harv. Gen. S.A. Pl. 7.
Bulawayo, Jan. Rand, 21.

### Family CVII.—CAPPARIDACEAE *Lindl.*

3082—**Cleome hirta,** *Oliv.*
Fl. Trop. Afr. i. 81; Cat. Afr. Pl. Welw. i. 28.
Victoria Falls, Allen, 108; Rogers, 7257, 6007; Bulawayo, Jan. Gardner, 59; Matopos, Rogers, 5151, 5161*a*.

**C. maculata,** *Szyszyl.* (*Tetratelia maculata,* Sond.)
Fl. Cap. i. 58.
Shashi Riv. Jan. Rand, 22.

**C. monophylla,** *L.*
Fl. Trop. Afr. i. 76; Fl. Cap. i. 156.
Bulawayo, Dec. Rand, 73; Chubb, 13*a*; Dec. Eyles, 8; Rogers, 5757; Matopos, Flanagan, 2986; Redbank, April, Flanagan, 3185; Victoria, Monro, 817; Victoria Falls, Rogers, 5579.

Genus No.
3087—**Gynandropsis pentaphylla,** *DC.* (*Pedicellaria pentaphylla,* Schrank.)

Fl. Trop. Afr. i. 82; Fl. Cap. i. 55.

Bulawayo, 4500 ft. Dec. Eyles, 1126; Jan. Rand, 23; Rogers, 5912; Victoria Falls, April, Flanagan, 3206; Chimanimani Mts. Swyn.

3101—**Capparis tomentosa,** *Lam.*

Fl. Trop. Afr. i. 96; Cat. Afr. Pl. Welw. i. 31.

Victoria Falls, fl. & fr. Sep. Gibbs, 138; Allen, 170; Sebakwe, 4000 ft. Oct. Eyles, 173; Victoria, Monro, 318, 563, 829, 521; Bulawayo, Chubb, 342.

**C. spp.**

Victoria, Monro, 448, 432.

3108—**Courbonia decumbens,** *Brongn.*

Fl. Trop. Afr. i. 88; For. Fl. Port. E. Afr. 10.

Sabi Riv. 1000 ft. fr. Nov. Swyn. 1207, 1384.

3109—**Cadaba juncea,** *Hook.* (*Schepperia juncea,* DC.)

Fl. Cap. i. 59; For. Fl. Cape, 121.

Bulawayo, Chubb, 347.

**C. natalensis,** *Sond.*

Fl. Cap. i. 59; Nat. Pl. 261; For. Fl. Cape, 121.

Bulawayo, 4500 ft. Oct. Eyles, 1087; Monro, 101.

3112—**Mærua arenicola,** *Gilg.*

Victoria, Monro, 789.

**M. caffra** (*Bernh.*), *Pax.* (*Niebuhria triphylla,* Wendl.)

Bulawayo, Engler.

**M. maschonica,** *Gilg.*

Umtali, Engler.

**M. nervosa,** *Oliv.* (*Niebuhria nervosa,* Hochst.)

Fl. Trop. Afr. i. 84; Nat. Pl. 260; For. Fl. Port. E. Afr. 9; Fl. Cap. i. 60.

Matopos, Galpin, 6967; Sabi Riv. Swyn.; Victoria, Monro, 302, 432, 448; Bulawayo, Monro, 85, 86.

var. **flagellaris,** *Oliv.*

Fl. Trop. Afr. i. 84.

Bulawayo, Rand, Sep. 576; Matopos, Oct. Gibbs, 205; Victoria, Monro, 364.

**M. sp.**

Victoria, Monro, 318.

3113—**Thylachium verrucosum,** *Klotzsch.* (*T. africanum,* Lour.)

Fl. Trop. Afr. i. 82; For. Fl. Port. E. Afr. 9.

Sabi Riv. 1000 ft. fr. Nov. Swyn. 1206.

## Series SARRACENIALES.

### Family CXII.—DROSERACEAE, *DC.*

Genus No.
3136—**Drosera burkeana,** *Planch.*
Fl. Cap. i. 76; Fl. Trop. Afr. ii. 402.
Victoria Falls, Rogers*.
**D. indica,** *L.*
Fl. Trop. Afr. ii. 402.
Victoria, Monro, 1032.
**D. ramentacea,** *Burch.*
Fl. Trop. Afr. ii. 403; Fl. Cap. i. 77.
Matopos, 5000 ft. April, Eyles, 53.
**D. sp.**
Matopos, 4500 ft. Nov. Eyles, 1099.

## Series ROSALES.

### Family CXIII.—PODOSTEMONACEAE, *L. C. Rich.*

3140—**Tristicha alternifolia,** *Tul.*
Victoria Falls, fl. & young fr. Sep. Gibbs, 321; Engler.
**T. trifaria,** *Tul.*
Fl. Trop. Afr. VI. i. 121.
Victoria Falls, Livingstone Island, Sep. Gibbs, 320.
3151—**Dicræa tenax,** *C. H. Wright.*
Fl. Trop. Afr. VI. i. 121; Kew Bull. 1909, 213.
Victoria Falls, Livingstone Island, July, Kolbe, 3149.
3159—**Sphærothylax sp.**
Victoria Falls, fr. Sep. Gibbs, 322.

### Family CXIV.—HYDROSTACHYACEAE, *Warm.*

3160—**Hydrostachys polymorpha,** *Klotzsch.*
Fl. Trop. Afr. VI. i. 130.
North Melsetter, 4000 ft. Swyn. 818.

### Family CXV.—CRASSULACEAE, *DC.*

3166—**Kalanchoe crenata,** *Haw.* (*K. ægyptiaca*, DC.)
Fl. Trop. Afr. ii. 394; Fl. Cap. ii. 379; Cat. Afr. Pl. Welw. i. 328.
Victoria Falls, Rogers, 5000*a*.

Genus No.

**K. glandulosa,** *Hochst.*

Fl. Trop. Afr. ii. 396; Cat. Afr. Pl. Welw. i. 328.

Victoria Falls, Rogers, 7443.

var. **rhodesica,** *Baker f.*

Journ. Bot. 1899, 434.

Salisbury, July, Rand, 465; Engler; Umtali, Engler; Gwelo, Sr. Phil. 8 and 14.

**K. paniculata,** *Harv.*

Fl. Cap. ii. 380.

Bulawayo, May, Rand, 321; Victoria Falls, Rogers, 7444.

**K. pilosa,** Baker.

Victoria Falls, Rogers, 5235, 5058, 7213.

**K. rotundifolia,** *Haw.*

Fl. Cap. ii. 379; Nat. Pl. 94.

Bulawayo, May, Rand, 319; Matopos, Rogers, 5265; Victoria, Monro, 1010; Odzani River Valley, Umtali, Teague, 254.

**K. thyrsiflora,** *Harv.*

Fl. Cap. ii. 380.

Bulawayo, Rogers, 13723*.

**K. spp.**

Matopos, April, Flanagan, 3172, cf. *K. glandulosa*, Hochst.

Victoria Falls, Rogers, 5236; South Rhodesia, Rand, 320.

3168—**Crassula campestris,** *E. & Z.* (*Tillæa pharnaceoides*, Hochst.)

Fl. Trop. Afr. ii. 387; Fl. Cap. ii. 351.

Matopos, 4500–5000 ft. March, Eyles, 1027.

**C. nivalis,** *E. & Z.*

Fl. Cap. ii. 356.

Victoria Falls, Galpin, 7369.

**C. sarcolipes,** *Harv.*

Fl. Cap. ii. 355.

Victoria, Monro, 917.

**C. subulata,** *Hook.* (*Tillæa subulata*, Benth. & Hook. f.)

Fl. Trop. Afr. ii. 387; Fl. Cap. ii. 352; Cat. Afr. Pl. Welw. i. 325.

Victoria, Monro, 1072.

## Family CXVII.—SAXIFRAGACEAE, *DC.*

3201—**Vahlia capensis,** *Thunb.*

Fl. Trop. Afr. ii. 384; Fl. Cap. ii. 306; Cat. Afr. Pl. Welw. i. 324; Harv. Gen. S.A. Pl. 98.

Bulawayo, May, Rand, 334; Eyles; Jan. Gardner, 83; Victoria Falls, Allen, 119; Matopos, Oct. Gibbs, 308; March, Flanagan, 2962; Engler; Matabeleland, Oates.

Genus No.

var. **linearis,** *E. Mey.*

Bulawayo, Dec. Rand, 63; Rogers, 5484.

**V. oldenlandioides,** *Roxb.*

Fl. Trop. Afr. ii. 384.

Between Wankie and Victoria Falls, Rogers, 5271.

3241—**Choristylis shirensis,** *Baker f.*

Melsetter, 6000 ft. Sep. Swyn. 607; Chirinda, 3800 ft. Swyn. 202, 203; Mt. Pene, 7000 ft. Oct. Swyn. 6202.

### Family CXVIII.—PITTOSPORACEAE, *Lindl.*

3252—**Pittosporum viridiflorum,** *Sims.*

Fl. Cap. i. 443; Cat. Afr. Pl. Welw. i. 41; For. Fl. Cape, 140 Harv. Gen. S.A. Pl. 20.

Mazoe, 4200 ft. Dec. Eyles, 206, 207; Mt. Pene Forest, 6500–7000 ft. fr. Sep. Swyn. 671.

### Family CXXI.—MYROTHAMNACEAE, *Niedenzu.*

3282—**Myrothamus flabellifolia,** *Welw.*

Fl. Trop. Afr. ii. 404; Cat. Afr. Pl. Welw. i. 331; see also Fl. Cap. ii. 597, under *Cliffortia? flabellifolia.*

Gwelo, Dec. Rand, 5; Fort Gibbs, Matabeleland, Rand, 600 and 601; Victoria Falls, Allen, 92; Matopos, Galpin, 6952; Eyles, 1208; Engler; Nov. Marloth, 3416; Sep. Gibbs, 309; Victoria, Monro, 901.

### Family CXXVI.—ROSACEAE, *B. Juss.*

3353—**Rubus Mundtii,** *Cham. & Schlecht.* (*R. rigidus,* Smith, var. *Mundtii,* Harv.)

Fl. Cap. ii. 287.

Melsetter, Sep. Swyn. 2077.

**R. rigidus,** *Smith.*

Fl. Trop. Afr. ii. 375; Fl. Cap. ii. 287.

Salisbury, July, Rand, 464; Mazoe, 4500 ft. Nov. Eyles, 472; Chirinda, May, Swyn. 454.

3379—**Leucosidea sericea,** *E. & Z.*

Fl. Cap. ii. 289; For. Fl. Cape, 216.

Melsetter, 6000 ft. Sep. Swyn. 605.

3388—**Cliffortia linearifolia,** *E. & Z.*

Fl. Trop. Afr. ii. 379; Fl. Cap. ii. 301; For. Fl. Cape, 137.

Melsetter, 6000 ft. Swyn. 2078.

Genus No.
3393—**Pygeum africanum,** *Hook. f.*

Fl. Trop. Afr. ii. 373; Cat. Afr. Pl. Welw. i. 322; For. Fl. Port. E. Afr. 60; For. Fl. Cape, 215.

Chipete Forest, 4000 ft. April, Swyn. 1344; Chirinda, 3700–4000 ft. April, Swyn. 107.

3405—**Parinarium capense,** *Harv.*

Fl. Trop. Afr. ii. 368; Fl. Cap. ii. 597; Cat. Afr. Pl. Welw. i. 321; Harv. Gen. S.A. Pl. 94.

Salisbury, Sep. Rand, 620, 559; North of Hartley, Engler; Marandellas, Engler; Sengwe Riv. Govt. Herb. 948; Lomagundi, Govt. Herb. 972.

**P. curatellæfolium,** *Planch.*

Fl. Trop. Afr. ii. 368.

Chikore Hills, 3500 ft. bud, Nov. Swyn. 30; Chirinda, 3700 ft. Swyn. 306.

**P. Gilletii,** *De Wild.*

Chirinda, Oct. Swyn. 555, 1303.

**P. Mobola,** *Oliv.*

Fl. Trop. Afr. ii. 368; For. Fl. Port. E. Afr. 61; Cat. Afr. Pl. Welw. i. 320.

Salisbury, Sep. Rand, 548, 630; Matopos, fr. Nov. Marloth, 3375; fl. & fr. Oct. Gibbs, 64; Davy; Engler; Govt. Herb. 894; North of Hartley, Engler; Marandellas, Engler; Gwanda, Noble, 43; Victoria, Monro, 454, 537, North of Sengwe Riv. Govt. Herb. 945.

## Family CXXVII.—CONNARACEAE, *R. Br.*

3419—**Agelæa nitida**, *Solander.*

Chirinda, 3800 ft. fl. Oct. fr. Feb. Swyn. 228, 228*a*.

3421—**Brysocarpus coccineus,** *Schum. & Thonn.*

Fl. Trop. Afr. i. 452.

Victoria Falls, Rogers, 5469.

var. **parvifolius,** *Planch.*

Fl. Trop. Afr. i. 452.

Victoria Falls, Sep. Gibbs, 154.

3424—**Rourea sp.**

Victoria Falls, Allen, 414.

3428—**Cnestis natalensis,** *Planch. & Sond.*

Fl. Cap. i. 528.

Chirinda, 3700–4000 ft. Dec. Swyn. 166.

FAMILY CXXVIII.—LEGUMINOSAE, *Juss.*

Genus No.
3443—**Albizzia amara,** *Boiv.*
Fl. Trop. Afr. ii. 356.
Bulawayo, 4500 ft. Oct. Eyles, 1090.

**A. anthelmintica,** *Bron.*
Fl. Trop. Afr. ii. 357; Cat. Afr. Pl. Welw. i. 314; For. Fl. Port. E. Afr. 60.
Sabi Riv. 1000 ft. fr. Nov. Swyn. 1005; Victoria Falls, Rogers, 5319; Allen, 174; Matopos, Rogers, 5343.

**A. Antunesiana,** *Harms.*
Salisbury, Engler.

**A. fastigiata,** *E. Mey.* (*Zygia fastigiata*, E. Mey.)
Fl. Trop. Afr. ii. 361; For. Fl. Port. E. Afr. 59; For. Fl. Cape, 213; Nat. Pl. 27; Cat. Afr. Pl. Welw. i. 317; Fl. Cap. ii. 285.
Chirinda Forest, Swyn. 54 (forma).

var. **chirindensis,** *Swyn.*
Journ. Linn. Soc. Bot. xl. 65.
Chirinda Forest, 3700–4000 ft. Oct. Swyn. 52; and West of Mt. Mpengo, Swyn.

**A. Harveyi,** *Fourn.* (*A. hypoleuca*, Oliv.; *A. pallida*, Harv.)
Victoria Falls, Allen, 64; Rogers, 8675; Sabi Riv. 1000 ft. bud, Nov. Swyn. 1216; Bulawayo, Monro, 386, 377, 310; Victoria, Monro, 558.

**A. mozambicensis,** *Sim.*
For. Fl. Port. E. Afr. 59.
Plumtree, Govt. Herb. 2044.

**A. versicolor,** *Welw.*
Fl. Trop. Afr. ii. 359; Cat. Afr. Pl. Welw. i. 315.
Victoria Falls, Rogers, 5470.

**A. spp.**
Matopos, fl. & fr. Oct. Gibbs, 198, 187.
Galpin, Sep. 7082.
Lomagundi, Govt. Herb. 978.

3446—**Acacia albida,** *Del.*
Fl. Trop. Afr. ii. 339; For. Fl. Port. E. Afr. 54; Cat. Afr. Pl. Welw. i. 310.
Victoria Falls, Allen, 399; Inyoka, Govt. Herb. 947.

**. caffra,** *Willd.*
Fl. Trop. Afr. ii. 345; Fl. Cap. ii. 282; For. Fl. Port. E. Afr. 56; For. Fl. Cape, 210; Cat. Afr. Pl. Welw. i. 311.
Victoria, Monro, 681; South Melsetter, Swyn.

Genus No.
3446—**A. farnesiana,** *Willd.*
Fl. Trop. Afr. ii. 346; Cat. Afr. Pl. Welw. i. 312.
Victoria Falls, Allen, 98; Gwanda, Noble, 4.

**A. giraffae,** *Burch.*
Fl. Cap. ii. 280; For. Fl. Cape, 213.
North of Bulawayo, Engler; South Rhodesia, Marloth.

**A. horrida,** *Willd.*
Fl. Cap. ii. 281; For. Fl. Port. E. Afr. 57; For. Fl. Cape, 211.
North of Bulawayo, Engler; Umtali, Engler; Umvumvumvu Riv. 2000 ft. April, Swyn. 59*a*; South Rhodesia, Marloth.

**A. mimosoides,** *L.*
Bulawayo, Monro, 20.

**A. natalitia,** *E. Mey.*
Fl. Cap. ii. 281; For. Fl. Port. E. Afr. 57.
Swynnerton in MSS. refers to this species as the common *Acacia* of his district, occurring at Chipete, Chirinda, South Chirinda and South Melsetter.

**A. nigrescens,** *Oliv.*
Fl. Trop. Afr. ii. 340; For. Fl. Port. E. Afr. 54.
Matopos, Davy; Victoria Falls, Davy; Allen, 417; Rogers, 5297, 5299; South of Zambesi, Engler; Victoria, Monro, 1083; Leopard's Mine, Govt. Herb. 959; Lomagundi, Govt. Herb. 992.

var. **pallida,** *Oliv.*
North of Bulawayo, Engler.

**A. pennata,** *Willd.*
Fl. Trop. Afr. ii. 345; Fl. Cap. ii. 283; Cat. Afr. Pl. Welw. i. 312; Nat. Pl. 244; For. Fl. Port. E. Afr. 56.
Chirinda Forest, 3700–4000 ft. Jan. Swyn. 84; Chipete Forest, Swyn.

**A. rehmanniana,** *Schinz.*
Bulawayo, Davy; Rogers, 5488 ?

**A. Rovumae,** *Oliv.*
Fl. Trop. Afr. ii. 353.
Matopos, Rogers, 5346 ?

**A. Seyal,** *Del.*
Fl. Trop. Afr. ii. 351; For. Fl. Port. E. Afr. 57.
Bulawayo, Jan. Rand, 72.

var. **multijuga,** *Schweinf.*
Bulawayo, Dec. Rand, 37.

**A. Suma,** *Kurz.*
Victoria Falls, Allen, 68.

Genus No.

**A. Verek,** *Guill. & Perr.* (*A. Senegal*, Willd.)

Fl. Trop. Afr. ii. 342; Cat. Afr. Pl. Welw. i. 311.

Bulawayo, Rogers, 5741; Victoria Falls, Rogers, 5544.

**A. Welwitschii,** *Oliv.*

Fl. Trop. Afr. ii. 341; For. Fl. Port. E. Afr. 55.

Victoria Falls, Sep. Gibbs, 128.

**A. xanthophlœa,** *Benth.*

For. Fl. Port. E. Afr. 58.

Wankie, Davy.

**A. spp.**

Victoria Falls, April, Flanagan, 3093; Rogers, 5120, 5583, 5584.

Bulawayo, Dec. Gardner, 89; Monro, 26, 32, 34, 116; Rand, 449, 450; Eyles, 1088; Rogers, 5490, 5510.[1]

Salisbury, Rand, 4, 35, 70, 434.

Victoria, Monro, 453, 769, 388, 325, 488.

Lomagundi, Govt. Herb. 971, 981.

Charter, Govt. Herb. 3020.

South Rhodesia, Rand, 597, 598.

3449—**Mimosa asperata,** *L.*

Fl. Trop. Afr. ii. 335.

Victoria Falls, Allen, 65; April, Flanagan, 3111; Rogers, 5069, 7404.

3452—**Dichrostachys nutans,** *Benth.*

Fl. Trop. Afr. ii. 333; Fl. Cap. ii. 278; Nat. Pl. 243; For. Fl. Port. E. Afr. 53.

Bulawayo, Jan. Rand, 35; Eyles, Dec. 1212; Rogers, 5507; Victoria, Monro, 388; Gwanda, Noble, 67; Chirinda, 3500 ft. Oct. Swyn. 162; 2000 ft. Dec. Swyn. 1013; Chikore Hills, 3500 ft. Oct. Swyn. 1015; South Melsetter, 2000–3500 ft. Nov. Swyn. 1016; Lusitu Riv. Swyn. 1019; Victoria Falls, Rogers, 5394, 7449.

**D. spp.**

Bulawayo, Monro, 29.

Rusapi, Mundy, cf. *D. nutans*, Benth.

Charter, Govt. Herb. cf. *D. nutans*, Benth.

South Rhodesia, Rand, 314.

3457—**Tetrapleura sp.**

Victoria Falls, Allen, 424, cf. *T. andongensis*, Welw.

3458—**Amblygonocarpus Schweinfurthii,** *Harms.*

Victoria Falls, Galpin, 6949.

**A. obtusangulus,** *Harms.*

Victoria Falls, Rogers, 5970*.

[1] According to Rogers, his No. 5510 is *Acacia robusta*, Burch.

Genus No.

3463—**Piptadenia Buchanani,** *Baker.*

Upper Buzi, 3500 ft. Oct. Swyn. 1018; South of Lusitu Riv. Swyn.; between Inyamadzi and Buzi, Swyn.

**P. spp.**

Victoria, Monro, 798.

3467—**Elephantorrhiza Burchellii,** *Benth.*

Fl. Cap. ii. 277.

Matopos, Marloth; Engler; Rogers, 5335; Umtali, Engler; Lomagundi, Govt. Herb. 970; Victoria Falls, Rogers, 5783; Victoria, Monro, 543, 488.

**E. Burkei,** *Benth.*

Matopos, Davy

**E. rubescens,** *Gibbs.*

Journ. Linn. Soc. Bot. xxxvii. 441.

Matopos, Oct. Gibbs, 184; Victoria Falls, Galpin, 7062.

3468—**Entada sp.**

South Melsetter, Swyn. cf. *E. abyssinica,* Steud.

3471—**Erythrophlœum pubistamineum,** *Henn.*

Victoria Falls, Allen, 168; Rogers, 5303.

3474—**Burkea africana,** *Hook.*

Fl. Trop. Afr. ii. 320; Fl. Cap. ii. 271; Cat. Afr. Pl. Welw. i. 304; Harv. Gen. S.A. Pl. 90.

Matopos, Galpin, 7059; Marloth, 3410; Davy; Gibbs; Victoria Falls, Galpin; Gibbs, Oct. 143; Rogers, 7439, 6028; Bulawayo, 4500 ft. Oct. Eyles, 1093; Engler; Umtali, Govt. Herb. 847; Marandellas, Govt. Herb. 873; Chirinda and Chikore Hills, Swyn.

**B. sp.**

Victoria Falls, Allen, 48.

3490—**Copaifera coleosperma,** *Benth.*

Fl. Trop. Afr. ii. 314; For. Fl. Port. E. Afr. 52.

Victoria Falls, Galpin, 7014; fr. Sep. Gibbs, 144; Rogers, 7250, 7219; Allen, 155; North of Bulawayo, Engler; Hartley, Engler; Salisbury, Rand, 456, 460.

**C. mopane,** *Kirk.*

Fl. Trop. Afr. ii. 315; For. Fl. Port. E. Afr. 51.

Bulawayo, Dec. Rand, 12; Engler; between Malindi and Victoria Falls, Galpin, 7011; South of Matopos, leaf, Oct. Gibbs, 204; Matopos, Engler; Rogers, 5161; Melsetter Dist. Swyn.

3504—**Brachystegia appendiculata,** *Benth.*

Fl. Trop. Afr. ii. 305.

Sebakwe, 4000 ft. Sep. Eyles; Victoria Falls, Sep. Gibbs, 145; Allen, 165; Matopos, Flanagan, 3096; Gwanda, Noble, 33; Marandellas, Govt. Herb. 871.

Genus No.

**B. Bragæi,** *Harms.*

Journ. Linn. Soc. Bot. xl. 63.

Melsetter, 5000 ft. Sep. Swyn. 657.

**B. globiflora,** *Hook.*

Victoria, Monro, 541, 970; Melsetter, March, Swyn. 164; Chirinda, Jan. Swyn. 6586.

**B. Goetzei,** *Harms.*

Hartley, Engler; Rusapi, Engler.

**B. Randii,** *E. G. Baker.*

Journ. Bot. 1899, 433.

Salisbury, Sep. Rand, 610, 611; Rogers, 5796; Victoria, Monro, 456, 468, 526, 664; Matopos, Govt. Herb. 872; Victoria Falls, Rogers, 7456; Sebakwe, Rogers.

**B. spicæformis,** *Benth.*

Fl. Trop. Afr. ii. 306; For. Fl. Port. E. Afr. 49; Cat. Afr. Pl. Welw. i. 298 & 300; Journ. Linn. Soc. Bot. xl. 63.

Hartley, Engler; Salisbury, Engler; May, Flanagan, 3149; Umtali, Engler.

**B. tamarindoides,** *Welw.*

Fl. Trop. Afr. ii. 307; For. Fl. Port. E. Afr. 50; Cat. Afr. Pl. Welw. i. 301.

Matopos, 5000 ft. Oct. Eyles, 1250.

**B. spp.**

Victoria Falls, Galpin, 7057.

Victoria, Monro, 329, 330, 373.

Umtali, Govt. Herb. 849.

Lomagundi, Govt. Herb. 976, 987.

Marandellas, Govt. Herb. 916.

3506—**Schotia brachypetala,** *Sond.*

Fl. Cap. ii. 274; Nat. Pl. 390; For. Fl. Port. E. Afr. 51.

Victoria, Monro, 443.

**S. latifolia,** *Jacq.*

Fl. Cap. ii. 274; For. Fl. Cape, 206.

Abercorn, Govt. Herb. 933.

**S. sp.**

Victoria, Monro, 381.

3507—**Baikiæa plurijuga,** *Harms.*

Victoria Falls, Allen, 147; Rogers, 5715, 7256, 7163; North Bulawayo, Engler; Dec. Eyles, 1122.

**B. sp.**

Between Malindi and Victoria Falls, 7047.

Genus No.
3509—**Afzelia cuanzensis,** *Welw.* (*Intsia cuanzensis*, O. Kuntze.)
Fl. Trop. Afr. ii. 302; For. Fl. Port. E. Afr. 48; Cat. Afr. Pl. Welw. i. 299.
Wankie, Hutchins; Matopos, Galpin, 7079; Marloth; Davy; Oct. Gibbs, 275; Victoria Falls, Galpin; Allen, 36; Gwanda, Noble, 24; Victoria, Monro, 568; Lomagundi, Govt. Herb. 988.

3511—**Pahudia quangensis,** *Prain.*
Lusitu Riv. 2500 ft. bud, Sep. Swyn. 1447; Chikore Hills, Swyn.

3516—**Berlinia Eminii,** *Taub.*
East of Salisbury, Engler; Umtali, Engler.

**B. paniculata,** *Benth.*
Fl. Trop. Afr. ii. 295; Cat. Afr. Pl. Welw. i. 298.
Victoria Falls, Rogers, 5396; Galpin, 7047?

3528—**Bauhinia articulata,** *DC.* (*B. reticulata*, DC.)
Fl. Trop. Afr. ii. 290; Cat. Afr. Pl. Welw. i. 296; For. Fl. Port. E. Afr. 48.
Salisbury, mature pod, May, Flanagan, 3148; Bulawayo, Rogers, 5494; Chirinda, 3600 ft. bud, March, Swyn. 165; Victoria Falls, Galpin, 7068; Hartley, Engler; Matabeleland, Marloth.

**B. fassoglensis,** *Kotschy.*
Fl. Trop. Afr. ii. 286.
Matabeleland, Oates; Bulawayo, Dec. Rand, 78; Jan. Gardner, 77; Rogers, 5503; Chubb, 2; Salisbury, Darling, in Herb. Bolus, 11189; Rand, 1343, 1344; Gwanda, Noble, 15; Matopos, Rogers, 5161*b*; Umtali, Swyn.

**B. Galpini,** *N. E. Br.*
Umtali, Engler; Lomagundi, Govt. Herb.; Victoria Falls, Rogers, 5328; between Salisbury and Portuguese border, Rogers, 12924; Chirinda, 3500 ft. Dec. Swyn. 192; Chikore Hills, Swyn.; between Melsetter and Umtali, Swyn.; Bulawayo, Eyles, 571.

**B. macrantha,** *Oliv.*
Fl. Trop. Afr. ii. 289.
Victoria Falls, Rogers, 5576, 7247; North of Bulawayo, Eyles, 340.

**B. petersiana,** *Bolle.*
Fl. Trop. Afr. ii. 288.
Shashi Riv. Dec. Rand, 2; Victoria Falls, Rogers, 5141; between Melsetter and Umtali, Swyn.

**B. spp.**
Sebakwe, 4000 ft. Nov. Eyles, 172.
Victoria Falls, Allen, 137.
South Rhodesia, Rand, 315.

Genus No.
3530—**Dialium guineense,** *Willd.*

Fl. Trop. Afr. ii. 283 ; Cat. Afr. Pl. Welw. i. 294.

Victoria Falls, Rogers, 5307.

3536—**Cassia abbreviata,** *Oliv.*

Fl. Trop. Afr. ii. 271.

Matopos, Nov. Marloth, 3383 ; Engler ; Mazoe, 4700 ft. Sep. Eyles, 435 ; Victoria Falls, Allen, 35 ; Inyoka, Govt. Herb. 949 ; Lomagundi, Govt. Herb. 979 ; Salisbury, Govt. Herb. 936 ; Bulawayo, Chubb, 359 ; Sebakwe, Rogers, 6199.

**C. Absus,** *L.*

Fl. Trop. Afr. ii. 279 ; Cat. Afr. Pl. Welw. i. 292.

Victoria Falls, April, Flanagan, 3095, 3130 ; Rogers, 5728 ?[1].

**C. arachoides,** *Burch.*

Fl. Cap. ii. 272.

Bulawayo, Rand, 3 and 42 ; Rogers, 5824 ; Dec. Eyles, 48 ; Nov. Eyles, 1108 ; Matabeleland, Marloth.

**C. didymobotrya,** *Fres.*

Fl. Trop. Afr. ii. 276 ; Cat. Afr. Pl. Welw. i. 292.

Bulawayo, July, Rand, 451 ; Victoria, Monro, 379 ; Salisbury, Mundy, Chirinda, 3500 ft. June, Swyn. 1419.

**C. fistula,** *L.*

Crescens Block, Matabeleland, Govt. Herb. 957.

**C. goratensis,** *Fres.*

Fl. Trop. Afr. ii. 273 ; Cat. Afr. Pl. Welw. i. 291.

Victoria Falls, Rogers, 5152 ; Salisbury, Govt. Herb. 759 ; Bulawayo, Govt. Herb. 917 ; Victoria, Monro, 362.

**C. granitica,** *E. G. Baker.*

Journ. Bot. 1905, 45.

Bulawayo, 4500 ft. Sep. Eyles, 1080 ; Matopos, Sep. Galpin, 7061 ; Davy ; Oct. Gibbs, 97 ; Victoria Falls, Galpin ; Davy.

**C. mimosoides,** *L.*

Fl. Trop. Afr. ii, 280 ; Fl. Cap. ii. 273 ; Cat. Afr. Pl. Welw. i. 293.

Matopos, fl. & fr. Oct. Gibbs, 251 ; Victoria Falls, Allen, 8 ; Rogers, 5044 ; Victoria, Monro, 882, 1046 ; Salisbury, Rogers, 4073 ; Chirinda, Swyn. ; Bulawayo, Rogers, 2824.

**C. occidentalis,** *L.*

Fl. Trop. Afr. ii. 274 ; Fl. Cap. ii. 272 ; Cat. Afr. Pl. Welw. i. 291.

Victoria Falls, April, Flanagan, 3112 ; Rogers, 5727 ; Victoria, Monro, 896*a* ; Salisbury, Kolbe, 4234.

[1] Rogers has this number named *C. Tora*, L.

Genus No.

**C. petersiana,** *Bolle.*

Fl. Trop. Afr. ii. 272.

Umtali, Engler; Melsetter, 3700 ft. April, Swyn. 199; 6000 ft. Sep. Swyn. 673; Umvumvumvu Mts. 4000 ft. April, Swyn. 1155; Salisbury, Govt. Herb. 759; Odzani River Valley, Umtali, Teague, 115.

**C. tettensis,** *Bolle.*

Fl. Trop. Afr. ii. 273.

Mazoe, 4300–4800 ft. June, Eyles, 372; April, Flanagan, 3102; Queque, Rogers, 6198*; Victoria Falls, Rogers, 7533*a**.

**C. Tora,** *L.*

Fl. Trop. Afr. ii. 275; Cat. Afr. Pl. Welw. i. 292; Victoria Falls, Rogers, 7031*; 7441*, 13305*.

**C. spp.**

Bulawayo, Monro, 63; Chubb, 361; Govt. Herb. 939.

Victoria, Monro, 449.

North of Bulawayo, Dec. Eyles, 1123.

Chikore Hills, 4500 ft. Nov. Swyn. 1472 (cf. *C. abbreviata*, Oliv.).

3544—**Gleditschia africana,** *Welw.*

Fl. Trop. Afr. ii. 265; Cat. Afr. Pl. Welw. i. 289, 315.

Victoria Falls, Sep. Gibbs, 137; Rogers, 7458, 5972.

3553—**Peterolobium lacerans,** *R. Br.* (*Cantuffa exosa*, Gmelin.)

Fl. Trop. Afr. ii. 264.

Matopos, Sep. Gibbs, 81; April, Flanagan, 3097; Engler; Mazoe, 4300 ft. March, Eyles, 282; fr. April, Flanagan, 3098; North Melsetter, 2000–6000 ft. fr. April, Swyn. 1044; South Rhodesia, Rand.

3591—**Peltophorum africanum,** *Sond.*

Fl. Trop. Afr. ii. 260; Fl. Cap. ii. 270; Cat. Afr. Pl. Welw. i. 287; For. Fl. Port. E. Afr. 47.

Bulawayo, Rand, 10 and 318 p.p.; Nov. Eyles, 1213; Rogers, 5476; Marloth; Galpin, 7009; Matopos, Hutchins; Oct. Gibbs, 307; Engler; Victoria Falls, Allen, 66; Inyamadzi Valley, 3300 ft. Dec. Swyn. 156; Chirinda, 3500 ft. fr. Jan. Swyn. 1020; Chikore Hills, Swyn.; South Melsetter, Swyn.

3574—**Swartzia madagascariensis,** *Desv.*

Fl. Trop. Afr. ii. 257; For. Fl. Port. E. Afr. 46.

Salisbury, Rand, 1364; Victoria, Monro, 574; Mrewas, Govt. Herb. 867; Lomagundi, Govt. Herb. 994; Umtali, Swyn.; Umvumvumvu Mts. Swyn.; Charter, Govt. Herb. 3018; Victoria Falls, Rogers, 7232.

**S. sp.**

Mazoe, fr. April, Flanagan, 3147.

Genus No.

3597—**Ormosia angolensis,** *Baker.*

Fl. Trop. Afr. ii. 255; Cat. Afr. Pl. Welw. i. 286.

Chikore Hills, 3500 ft. fr. March, Swyn. 1473; Chirinda, 3000 ft. Swyn.; Victoria Falls, Rogers, 7475*, 7520*.

3601—**Castanospermum australe,** *A. Cunn.*

Salisbury, Govt. Herb. 2043.

3602—**Sophora? zambesiaca,** *Baker.*

Fl. Trop. Afr. ii. 253.

Sabi Riv. 1000 ft. Nov. Swyn. 1452.

3607—**Calpurnia aurea,** *Baker.* (*C. lasiogyne*, E. Mey.)

Fl. Trop. Afr. ii. 253; Fl. Cap. ii. 267; Cat. Afr. Pl. Welw. i. 286; Nat. Pl. 4; For. Fl. Cape, 205.

Chirinda, 3700–4000 ft. May, Swyn. 79; Chipete Forest, 3800 ft. Swyn.

3607*a*—**Bolusanthus speciosus** (*Bolus*), *Harms.* (*Lonchocarpus speciosus?*)

For. Fl. Port. E. Afr. 44.

Victoria Falls, Sep. Gibbs, 126; Allen, 169; Rogers, 5314, 7239; Matopos, Oct. Gibbs; Bulawayo, Chubb, 301; Rogers, 5500; Mazoe, Govt. Herb. 928; Umtali, Govt. Herb. 823; Umvumvumvu Riv. 4000 ft. Oct. Swyn. 6167.

**B. spp.**

Sebakwe, 4000 ft. Sep. Eyles, 176.

Victoria, Monro, 512.

Bulawayo, 4500 ft. Sep. Eyles, 1079; Dec. Chubb, 300.

3612—**Baphia spp.**

Salisbury, Govt. Herb. 1022.

Victoria Falls, Rogers, 5586, 7270, 7233.

3657—**Lotononis aristata,** *Schinz,* var. **gazensis,** *Baker f.*

Journ. Linn. Soc. Bot. xl. 51.

Chimanimani Mts. 7000 ft. Sep. Swyn. 1418; Melsetter, 6000 ft. Oct. Swyn. 6196.

**L. Leobordea,** *Benth.*

Fl. Trop. Afr. ii. 5; Fl. Cap. ii. 61.

Bulawayo, May, Rand, 308, 309; Matopos, Sep. Gibbs, 19; Victoria Falls, April, Flanagan, 3087.

3658—**Listia heterophylla,** *E. Mey.*

Fl. Cap. ii. 66; Harv. Gen. S.A. Pl. 74.

Bulawayo, May, Rand, 312; Rogers, 5485; between Bulawayo and Salisbury, April, Flanagan, 3125; Matopos, Gibbs; Engler; Umtali, Engler; Rogers, 4028.

3659—**Rothia hirsuta,** *Baker.*

Fl. Trop. Afr. ii. 7; Cat. Afr. Pl. Welw. i. 195.

Bulawayo, April, Flanagan, 3088.

Genus No.
3664—**Dichilus lebeckoides,** *DC.*
Fl. Cap. ii. 77.
Bulawayo, 4400 ft. Dec. Eyles, 1004.

3669—**Crotalaria anthyllopsis,** *Welw.*
Fl. Trop. Afr. ii. 15; Cat. Afr. Pl. Welw. i. 197; Journ. Linn. Soc. Bot. xlii. 263.
Salisbury, May, Flanagan, 3101.

**C. Barnabassii,** *Dinter.*
Journ. Linn. Soc. Bot. xlii. 356.
Victoria Falls, Rogers, 5598.

**C. brevidens,** *Benth.*
Fl. Trop. Afr. ii. 37; Journ. Linn. Soc. Bot. xlii. 329.
Salisbury, April, Flanagan, 3118.

**C. capensis,** *Jacq.*
Fl. Trop. Afr. ii. 38; Fl. Cap. ii. 46; Nat. Pl. 92; Journ. Linn. Soc. Bot. xlii. 405.
Matopos, Govt. Herb. 900 (cultivated); Victoria Falls, Rogers, 5599.

**C. cephalotes,** *Steud.*
Fl. Trop. Afr. ii. 23; Cat. Afr. Pl. Welw. i. 199; Journ. Linn. Soc. Bot. xlii. 277.
Salisbury, fr. July, Rand, 463*a*, p.p.; Mazoe, 4600 ft. April, Eyles, 370; Enterprise, April, Flanagan, 3104.

**C. chirindae,** *Baker f.*
Journ. Linn. Soc. Bot. xlii. 377.
Chirinda, 3800 ft. Swyn. 397, 1498.

**C. cylindrostachys,** *Welw.*
Fl. Trop. Afr. ii. 15; Cat. Afr. Pl. Welw. i. 197; Journ. Linn. Soc. Bot. xlii. 257.
Victoria, Monro, 1045.

**C. flavicarinata,** *Baker f.*
Journ. Linn. Soc. Bot. xxxvii. 437, and xlii. 333.
Victoria Falls, Sep. Gibbs, 168; Allen, 31; Rogers, 5123.

**C. gazensis,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 51, and xlii. 396.
Nyahodi Riv. 5000 ft. fl. & fr. April, Swyn. 1493.

**C. intermedia,** *Kotschy.*
Fl. Trop. Afr. ii. 37; Cat. Afr. Pl. Welw. i. 203; Journ. Linn. Soc. Bot. xlii. 327.
Mazoe, 4800 ft. March, Eyles, 274; Salisbury, April, Flanagan, 3119; South Rhodesia, Rand, 44.

Genus No.
3669—**C. laburnifolia,** *L.*

Journ. Linn. Soc. Bot. xlii. 318.

Shashi Riv. Jan. Rand, 45; Bulawayo, 4500 ft. Feb. Eyles, 1061; Victoria Falls, Allen, 107, 125; Rogers, 5612; Victoria, Monro, 737; Manica, Johnston, in Herb. Kew.

**C. lachnocarpa,** *Hochst.* (*C. elata,* Welw.)

Fl. Trop. Afr. ii. 29; Cat. Afr. Pl. Welw. i. 201; Journ. Linn. Soc. Bot. xlii. 404.

Chirinda, 3500 ft. April, Swyn. 373.

**C. lanceolata,** *E. Mey.* (*C. mossambicensis,* Klotsch.)

Fl. Trop. Afr. ii. 36; Fl. Cap. ii. 43; Nat. Pl. 291; Journ. Linn. Soc. Bot. xlii. 343.

Chirinda, 3700–4000 ft. fl. & fr. May, Swyn. 479.

**C. natalitia,** *Meisn.* (*C. kilimandscharica,* Taub.)

Fl. Trop. Afr. ii. 34; Fl. Cap. ii. 46; Cat. Afr. Pl. Welw. i. 203; Journ. Linn. Soc. Bot. xlii. 410.

Salisbury, Rogers, 4024; Chipete Forest, 3800 ft. May, Swyn. 478; Nyahodi Riv. 5000 ft. April, Swyn. 1494; Victoria, Monro, 1779; Odzani River Valley, Umtali, Teague, 22.

**C. orthoclada,** *Welw.*

Fl. Trop. Afr. ii. 29; Cat. Afr. Pl. Welw. i. 201; Journ. Linn. Soc. Bot. xlii. 369.

Salisbury, Govt. Herb. 756.

**C. petiolaris,** *Franch.* var. **australis,** *Baker f.*

Journ. Linn. Soc. Bot. xlii. 319.

Victoria, Monro, 651.

**C. pisicarpa,** *Welw.*

Fl. Trop. Afr. ii. 16; Cat. Afr. Pl. Welw. i. 197; Journ. Linn. Soc. Bot. xlii. 303.

Bulawayo, April, Flanagan, 3091.

**C. podocarpa,** *DC.*

Fl. Trop. Afr. ii. 17; Fl. Cap. ii. 593; Journ. Linn. Soc. Bot. xlii. 406.

Bulawayo, Jan. Rand, 43; April, Flanagan, 3092; Victoria Falls, April, Flanagan, 3128.

**C. recta,** *Steud.*

Fl. Trop. Afr. ii. 40; Journ. Linn. Soc. Bot. xlii. 352.

Salisbury, April, Flanagan, 3120; Chirinda, 3800 ft. Nov. Swyn. 365.

**C. Rogersii,** *Baker f.*

Journ. Linn. Soc. Bot. xlii. 347.

Salisbury, Rogers, 4011; Darling, in Herb. Kew 10771; Rand, 455; Mazoe, 4300 ft. Aug. Eyles, 181.

Genus No.

**C. sericifolia,** *Harms.*, var. **gweloensis,** *Baker f.*
Journ. Linn. Soc. Bot. xlii. 398.
Gwelo, fl. & fr. Jan. Rand, 50.

**C. spartioides,** *DC.*
Fl. Cap. ii. 40; Journ. Linn. Soc. Bot. xlii. 270.
Bulawayo, 4500 ft. Feb. Eyles, 1192; Victoria Falls, Allen, 226.

**C. sphærocarpa,** *Guill. & Perr.*
Fl. Trop. Afr. ii. 23; Journ. Linn. Soc. Bot, xlii. 289.
Victoria Falls, Rogers, 5123*a*, 7170; Bulawayo, Rogers, 5921.[1]

var. **angustifolia,** *Hochst.* (*C. nubica*, Benth.)
Fl. Trop. Afr. ii. 23; Fl. Cap. ii. 45.
Bulawayo, April, Flanagan, 3090; Victoria Falls, Rogers, 5555, 7197.

**C. striata** *DC.*
Fl. Trop. Afr. ii. 38; Fl. Cap. ii. 44; Cat. Afr. Pl. Welw. i. 203; Nat. Pl. 532; Journ. Linn. Soc. Bot. xlii. 345.
Salisbury, Engler.

**C. spp.**
Victoria Falls, April, Flanagan, 3110.
Gwelo, Jan. Gardner, 38, cf. *C. stenoptera*, Welw.
Redbank, 4000 ft. March, Eyles, 4.
Sebakwe, 4000 ft. Dec. Eyles, 74.
Bulawayo, 4500 ft. Dec. Eyles, 84, cf. *C. obscura*, DC.; Monro, 99.
Victoria, Monro, 1047.
Salisbury, Govt. Herb. 757.
Charter, Govt. Herb. 3022.

3673—**Argyrolobium andrewsianum,** *Steud.*
Fl. Cap. ii. 75.
Chirinda, Swyn.; Melsetter, Swyn.

**A. collinum,** *E. & Z.*
Fl. Cap. ii. 72.
Umtali, Rogers, 4029.

**A. spp.**
Bulawayo, 4500 ft. Feb. Eyles, 1175.
South Rhodesia, Rand, 60.

3702—**Indigofera adenoides,** *Baker f.*
Matopos, April, Flanagan, 3136.

**I. arrecta,** *Hochst.*
Fl. Trop. Afr. . 97; Nat. Pl. 287.
Salisbury, April, Flanagan, 3142; Chikore Hills, 3500 ft. March, Swyn. 266; Bulawayo, Rogers, 6201.

[1] According to Rogers this is *C. squarrosa*, Schinz, var. *Dinteri*, Bkr. fil.

Genus No.
3702—**I. Cecili,** *N. E. Br.*
Kew Bull. 1906, 101.
Inyanga, Cecil, 186 ; Chirinda, 3800 ft. fl. & fr. Nov. Swyn. 262 ; fl. & fr. April, Swyn. 263.

**I. cryptantha,** *Benth.*
Fl. Cap. ii. 195.
Matopos, fr. Sep. Gibbs, 303.

**I. daleoides,** *Benth.*
Fl. Trop. Afr. ii. 95 ; Fl. Cap. ii. 200 ; Cat. Afr. Pl. Welw. i. 214.
Bulawayo, 4500 ft. Nov. Eyles, 1218 ; Matopos, April, Flanagan, 3135 ; between Plumtree & Bulawayo, fr. April, Flanagan, 3134.

**I. diphylla,** *Vent.*
Fl. Trop. Afr. ii. 74.
Victoria Falls, April, Flanagan, 3132, 3145 ; Rogers, 7417.

**I. emarginella,** *Steud.*
Fl. Trop. Afr. ii. 99 ; Cat. Afr. Pl. Welw. i. 216.
Chikore Hills, 3500 ft. March, Swyn. 1471.

**I. endecaphylla,** *Jacq.*
Fl. Trop. Afr. ii. 96 ; Fl. Cap. ii. 199 ; Cat. Afr. Pl. Welw. i. 214.
Chirinda, 3800 ft. fr. April, Swyn. 371 ; fr. May, Swyn. 480 ; Victoria Falls, Rogers, 7109*.

**I. filipes,** *Benth.*
Fl. Cap. ii. 198.
Victoria Falls, April, Flanagan, 3094

**I. Flanagani,** *Bolus, MS.*
Victoria Falls, Rogers, 7206.

**I. flavicans,** *Baker.*
Fl. Trop. Afr. ii. 73.
Victoria Falls, Rogers, 7267, 5730.

**I. goniodes,** *Hochst.*
Fl. Trop. Afr. ii. 85.
Bulawayo, Jan. Rand, 38

**I. hedyantha,** *E. & Z.*
Fl. Cap. ii. 188.
Mt. Pene, 7000 ft. Sep. Swyn. 2094.

**I. heptaphylla,** *Hiern.*
Cat. Afr. Pl. Welw. i. 209.
Bulawayo, Rogers, 5922, 5923 ?

**I. heterotricha,** *DC.*
Fl. Cap. ii. 189.
Bulawayo, 4500 ft. Nov. Eyles, 1095 ; Monro, 61 ; Rogers, 5676, 5487, 5823 ; Matopos, Rogers, 5407.

Genus No.
3702—var. **rhodesiana,** *Baker f.*
Journ. Bot. 1903, 262.
Bulawayo, Dec. Rand, 62.

**I. hilaris,** *E. & Z.*
Fl. Cap. ii. 188.
Salisbury, Aug. Rand, 445 ; Matopos, 4500 ft. Nov. Eyles, 1158 ; Umtali, Engler ; Marandellas, Rogers, 4038 ; Melsetter, 5000–6000 ft. Oct. Swyn. 6187, 6189 ; Chirinda, 3500 ft. May, Swyn. 477.

**I. hirsuta,** *L.*
Fl. Trop. Afr. ii. 88 ; Fl. Cap. ii. 194 ; Cat. Afr. Pl. Welw. i. 212.
Victoria Falls, April, Flanagan, 3133 ; Rogers, 7042, 7105, 5729 ; Victoria, Monro, 1046*a*.

**I. inyangana,** *N. E. Br.*
Kew Bull. 1906, 102.
Inyanga, Cecil, 174.

**I. Lyallii,** *Baker.*
Chimanimani Mts. 7000 ft. fr. Sep. Swyn. 1458.

**I. oxalidea,** *Welw.*
Fl. Trop. Afr. ii. 86 ; Cat. Afr. Pl. Welw. i. 210.
Melsetter, Govt. Herb. 751.

**I. pentaphylla,** *L.*
Fl. Trop. Afr. ii. 82.
Salisbury, Engler.

**I. procera,** *Schum. & Thonn.*
Fl. Trop. Afr. ii. 71 ; Cat. Afr. Pl. Welw. i. 207.
Chipetzana, 3000 ft. fr. April, Swyn. 1485.

**I. Schimperi,** *Jaub. & Spach.*
Fl. Trop. Afr. ii. 93.
Bulawayo, Dec. Rand, 39 (forma) ; Victoria Falls, Rogers, 5567.

**I. secundiflora,** *Poir.*
Fl. Trop. Afr. ii. 94.
South Rhodesia, Rand, 609.

**I. senegalensis,** *Lam.*
Fl. Trop. Afr. ii. 102.
Victoria Falls, April, Flanagan, 3139 ; Rogers, 6010 ; between Bulawayo and Plumtree, April, fr. Flanagan, 3131.

**I. sericea,** *Benth.* forma **australis,** *E. G. Baker.*
Journ. Bot. 1903, 235 ; Fl. Trop. Afr. ii. 76 (type).
Bulawayo, Rand, 59.

**I. strobilifera,** *Hochst.*
Fl. Trop. Afr. ii. 75.
Victoria Falls, Rogers, 7026*.

Genus No.

**I. transvaalensis,** *Bk. fil.*
Bulawayo, Rogers, 13672*.

**I. spp.**
Victoria Falls, April, Flanagan, 3138, 3137, 3144; Rogers, 6020, 6014, 6023.
Salisbury, April, Flanagan, 3143; Darling in Herb. Bolus 11188; Govt. Herb. 755.
Bulawayo, Jan. Gardner, 62, 57, 11, 58.
Matopos, April, Flanagan, 3140; Rogers, 5686.
Mazoe, 4300–4700 ft. Nov. Eyles, 444.
Chikore Hills, Swyn. 267.
Melsetter, Swyn. 1459, 1460.
Chipetzana Riv. Swyn. 1486.

3703—**Psoralea foliosa,** *Oliv.* var. **gazensis,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 52.
Melsetter, 6000 ft. Sep. Swyn. 1417.

3718—**Tephrosia Apollinea,** *DC.*
Fl. Trop. Afr. ii. 124.
Victoria Falls, Allen, 258.

**T. Forbesii,** *Baker.*
See note Fl. Trop. Afr. ii. 116.
Bulawayo, Dec. Eyles, 1206.

**T. grandiflora,** *Pers.*
Fl. Cap. ii. 209.
Chirinda, 3800 ft. fl. & fr. April, Swyn. 369

**T. lupinifolia,** *DC.*
Fl. Trop. Afr. ii. 107; Fl. Cap. ii. 204.
Victoria Falls, April, Flanagan, 3127: Rogers, 5716, 5605.

var. **digitata,** *DC.*
Fl. Trop. Afr. ii. 107.
Matopos, 4500–5000 ft. Nov. Eyles, 1154

**T. lurida,** *Sond.*
Fl. Cap. ii. 208.
Bulawayo, Jan. Rand, 41; Dec. Rand, 51; Matopos, fl. & young fr. Oct. Gibbs, 249; Rogers, 5682; Mazoe, 4700 ft. March, Eyles, 265.

**T. nyasae,** *Baker f.*
Chimanimani Mts. 7000 ft. Sep. Swyn. 1464.

**T. polystachya,** *E. Mey.*
Fl. Cap. ii. 206.
Victoria Falls, Rogers, 5626, 5558.

Genus No.

**T. purpurea,** *Pers.*
Fl. Trop. Afr. ii. 124.
Victoria Falls, Rogers, 7041*.

**T. radicans,** *Welw.*
Fl. Trop. Afr. ii. 121.
Matopos, April, Flanagan, 3099 ; Bulawayo, Rogers, 5486.

var. **rhodesiaca,** *Baker f.*
Journ. Bot. 1899, 430.
Bulawayo, fl. & fr. Dec. Rand, 52.

**T. spp.**
Bulawayo, Dec. Gardner, 95, cf. *T. bracteolata,* Guill. & Perr. Feb. Eylès, 1062.
Victoria, Monro, 840.

3719—**Mundulea suberosa,** *Benth.*
Fl. Trop. Afr. ii. 126 ; Cat. Afr. Pl. Welw. i. 225.
Bulawayo, Dec. Rand, 77 ; Nov. Eyles, 1183 ; Monro, 96 ; Rogers, 5742 ; Khami, Nov. Marloth, 3400 ; Sabi Riv. 1000 ft. Swyn. 1453 ; Victoria, Monro, 464, 550 ; Matopos, Davy.

3721—**Schefflerodendron gazense,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 55.
Chirinda Forest, 3700-4000 ft. Oct. Swyn. 13 ; Buzi Riv. Swyn.

3746—**Microcharis sp.**
Matopos, April, Flanagan, 1341, cf. *M. Galpinii,* N. E. Br.

3747—**Sesbania ægyptiaca,** *Pers.*
Fl. Trop. Afr. ii. 134.
Gwelo, Sr. Phil. 55.

**S. cinerascens,** *Welw.*
Fl. Trop. Afr. ii. 134 ; Cat. Afr. Pl. Welw. i. 231.
Victoria Falls, April, Flanagan, 3084, 3113.

**S pubescens,** *DC.*
Fl. Trop. Afr. ii. 135 ; Cat. Afr. Pl. Welw. i. 231.
Victoria Falls, Engler ; South of Zambesi, Engler ; Matopos, Rogers, 5159 ?, 5099.

**S. punctata,** *DC.*
Fl. Trop. Afr. ii. 133 ; Cat. Afr. Pl. Welw. i. 230.
Bulawayo, July, Rand, 448 ; Victoria Falls, July, Kolbe, 3132 ; Rogers, 7407 ; Mazoe, April, Flanagan, 3122 ; Odzani River Valley, Umtali, Teague, 15.

**S. tetraptera,** *Hochst.*
Fl. Trop. Afr. ii. 136.
Victoria Falls, April, Flanagan, 3109.

Genus No.

**S. spp.**

Victoria Falls, Allen, 7, cf. *S. pubescens*, DC. ; May, Eyles, 144. Salisbury, April, Flanagan, 3121.

3756—**Lessertia pauciflora,** *Harv.*

Fl. Cap. ii. 222.

Matopos, fl. & young fr. Sep. Gibbs, 104.

**L. stipulata,** *E. G. Baker.*

Journ. Bot. 1899, 430.

Salisbury, fl. & young fr. Sep. Rand.

**L. sp.**

South Rhodesia, Rand, 614.

3766—**Astragalus burkeanus,** *Benth.*

Fl. Cap. ii. 224 ; Harv. Gen. S.A. Pl. 80.

Salisbury, Engler.

3792—**Ormocarpum trichocarpum** (*Taub.*), *Torre & Harms.* (*Diphaca trichocarpa*, Taub.)

Bulawayo, Dec. Rand, 31.

**O. spp.**

Bulawayo, Eyles, 93 ; Chubb, 78 ; Gardner, 69, cf. *O. bibracteatum*, Baker.

3793—**Æschynomene cristata,** *Vatke.*

Victoria Falls, fl. & fr. Sep. Gibbs ; Engler ; April, Flanagan, 3085.

**A. elaphroxylon,** *Desv.*

Victoria Falls, Rogers, 5632 ?

**A. gazensis,** *Baker f.*

Journ. Linn. Soc. Bot. xl. 56.

Melsetter, 6000 ft. Sep. Swyn. 1457.

**A. grandistipulata,** *Harms.*

Chimanimani Mts. 7000 ft. Swyn. 1499 ; W. Johnson, 232.

**A. mimosifolia,** *Vatke.*

North of Hartley, Engler ; Victoria Falls, Kolbe, 4243 ; Victoria, Monro, 783 ; Umtali, Rogers, 4056 ; Salisbury, April, Flanagan, 3116 ; Darling in Herb. Bolus, 10766.

**A. nodulosa,** *Baker f.* (*Smithia nodulosa*, Baker.) (*A. shirensis*, Taub.)

Fl. Trop. Afr. ii. 153 ; Journ. Linn. Soc. Bot. xl. 56.

Melsetter, 6000 ft. Sep. Swyn. 619.

**A. nyassana,** *Taub.*

Matopos, 4500–5000 ft. Nov. Eyles, 1117.

**A. oligantha,** *Welw.*

Fl. Trop. Afr. ii. 146 ; Cat. Afr. Pl. Welw. i. 234.

Victoria Falls, April, Flanagan, 3129.

Genus No.

**A. uniflora,** *E. A. Mey.*
Fl. Cap. ii. 226; Fl. Trop. Afr. ii. 146.
Victoria Falls, Rogers, 7062*.

**A. spp.**
Bulawayo, Jan. Gardner, 17, cf. *A. heuchiana,* Baker.
Salisbury, Rand, 459.
Mazoe, 4300 ft. Jan. Eyles, 241, cf. *A. Ruppellii,* Baker; 5300 ft. Jan. Eyles, 523.
Victoria Falls, Allen, 280.

3796—**Smithia strigosa,** *Benth.* (*Damapana strigosa,* O. Kuntze.)
Fl. Trop. Afr. ii. 154; Cat. Afr. Pl. Welw. i. 237.
Chirinda, 3800 ft. April, Swyn. 264; Chipetzana Riv. 3000 ft. April, 1483; Mt. Pene, 7000 ft. Oct. Swyn. 6180.

**S. thymodora,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 56.
Melsetter, 6000 ft. Swyn. 655.

3802—**Stylosanthes erecta,** *Beauv.*
Fl. Trop. Afr. ii. 156; Cat. Afr. Pl. Welw. i. 238.
Bulawayo, May, Rand, 310.

**S. mucronata,** *Willd.*
Fl. Trop. Afr. ii. 157.
Bulawayo, Rogers, 13076*, 13811*.

**S. sp.**
Victoria, Monro, 854.

3803—**Arachis hypogea,** *L.*
Fl. Trop. Afr. ii. 158; Fl. Cap. ii. 227; Cat. Afr. Pl. Welw. i. 239.
South Rhodesia, Rhod. Agric. Journ. April, 1904, 135; a common native crop of cultivation.

3804—**Zornia diphylla,** *Pers.*
Fl. Trop. Afr. ii. 158; Cat. Afr. Pl. Welw. i. 239.
Redbank, April, Flanagan, 3187.

**Z. tetraphylla,** *Michx.*
Fl. Trop. Afr. ii. 159; Fl. Cap. ii. 225.
Bulawayo, Jan. Rand, 61; Gwai, April, Flanagan, 3123; Victoria, Monro, 908; Victoria Falls, Rogers, 5706; Chirinda, Swyn.

3807—**Desmodium dimorphum,** *Welw.* (*Meibomia dimorpha,* O. Kuntze.)
Fl. Trop. Afr. ii. 161; Cat. Afr. Pl. Welw. i. 240.
Victoria Falls, Rogers, 7152.

**D. lasiocarpum,** *DC.* (*D. latifolium,* DC.) (*Meibomia lasiocarpa,* O. Kuntze.)
Fl. Trop. Afr. ii. 162; Cat. Afr. Pl. Welw. i. 241.
Chirinda, Swyn.

Genus No.

**D. paleaceum,** *Guill. & Perr.* (*Meibomia oxybractea,* O. Kuntze.)
Fl. Trop. Afr. ii. 166 ; Cat. Afr. Pl. Welw. i. 242.
Victoria Falls, Engler ; Rogers, 5026 ; July, Kolbe, 3152; April, Flanagan, 3115.

**D. Scalpe,** *DC.* (*Meibomia repanda,* O. Kuntze.)
Fl. Trop. Afr. ii. 164 ; Cat. Afr. Pl. Welw. i. 242.
Salisbury, April, Flanagan, 3106 ; Chirinda, Swyn.

**D. sp.**
Victoria Falls, April, Flanagan, 3124, cf. *D. spirale,* DC.

3808—**Pseudarthria Hookeri,** *Wight & Arn.*
Fl. Trop. Afr. ii. 168 ; Nat. Pl. 219 ; Cat. Afr. Pl. Welw. i. 244.
Matopos, 4500 ft. Feb. Eyles, 1167 ; Rogers, 4067 ; Victoria, Monro, 979 ; Salisbury, Darling ; Chirinda, Swyn. ; Odzani River Valley, Umtali, Teague, 10.

3810—**Alysicarpus rugosus,** *DC.* (*A. Wallichii,* Wight and Arn.) (*Fabricia rugosa,* O. Kuntze.)
Fl. Trop. Afr. ii. 171 ; Fl. Cap. ii. 230 ; Cat. Afr. Pl. Welw. i. 246.
Bulawayo, 4500 ft. Eyles, 86 ; Gwelo, Jan. Gardner, 29 ; Umtali. Engler ; Salisbury, April, Flanagan, 3117.

**A. Zeyheri,** *Harv.* (*Fabricia Zeyheri,* O. Kuntze.)
Fl. Trop. Afr. ii. 170 ; Fl. Cap. ii. 230 ; Cat. Afr. Pl. Welw. i. 246.
Bulawayo, Rogers, 5520 ; 5483.

3821—**Dalbergia dekindtiana,** *Harms.*
Umtali, Engler.

**D. lactea,** *Vatke.*
Lusitu Riv. 3000 ft. Sep. Swyn. 1468.

**D. melanoxylon,** *Guill. & Perr.*
Fl. Trop. Afr. ii. 233 ; For. Fl. Port. E. Afr. 41.
Sabi Riv. 1000 ft. Nov. Swyn. 2093.

**D. Swynnertonii,** *Baker f.*
Journ. Linn Soc. Bot. xl. 60.
Nyahodi Riv. 4000 ft. Sep. Swyn. 1316.

**D. spp.**
Sabi Riv. Swyn. 1201, cf. *D. arbutifolia,* Baker.
Victoria Falls, Rogers, 5477.

3828—**Pterocarpus erinaceus,** *Poir.* (*P. echinatus,* DC.) (*P. angolensis,* A. DC.)
Fl. Trop. Afr. ii. 239 ; For. Fl. Port. E. Afr. 44 ; Cat. Afr. Pl. Welw. i. 279.
Matopos, Davy ; Galpin, 6950 ; Oct. Gibbs, 207 ; Engler ; Gwanda, Noble, 26 ; North of Bulawayo, Dr. F. E. Weiss ; Bulawayo, Engler ; Salisbury, Engler ; Lomagundi, Govt.

Genus No.

Herb. 984; Chirinda, 3300 ft. Oct. Swyn. 41; Nyahodi Riv. 5000 ft. Swyn. 1439; South Melsetter, Swyn.; South. Rhodesia, Rand; Upper Buzi, Swyn.

**P. melliferus,** *Welw.*

Fl. Trop. Afr. ii. 239; Cat. Afr. Pl. Welw. i. 277.

Victoria, Monro, 604, 750.

**P. sericeus,** *Benth.*

Fl. Cap. ii. 264.

Khami Riv. Feb. Eyles, 1195; Matopos, Hutchins; Gwanda, Noble, 19; Umtali, Govt. Herb. 833; Salisbury, Govt. Herb. 932; Chirinda, 3500 ft. Jan. Swyn. 28; South of Chirinda, Swyn.

**P. spp.**

Victoria Falls, Allen, 85, cf. *P. Antunessii*?

Victoria, Monro, 581.

Salisbury, Rand, 1392.

3834—**Lonchocarpus capassa,** *Rolfe.* (*L. laxiflorus*, Guill. and Perr.) (*L. Philenoptera*, Benth.) (*L. violaceus*, Oliv.) (*Derris violacea*, Harms.)

Fl. Trop. Afr. ii. 242; Cat. Afr. Pl. Welw. i. 281.

Matabeleland, Oates; Victoria Falls, Allen, 47; Gwanda, Noble, 9; Matopos, Govt. Herb. 887; Lomagundi, Govt. Herb. 991; North of Bulawayo, Engler; Sabi Riv. 1000 ft. young fr. Nov. Swyn. 1451, 1397?

3856—**Abrus precatorius,** *L.*

Fl. Trop. Afr. ii. 175; Fl. Cap. ii. 262; For. Fl. Port. E. Afr. 42; Cat. Afr. Pl. Welw. i. 247.

Sebakwe, 4000 ft. Dec. Eyles, 41; Victoria Falls, Galpin, 6944; fr. Sep. Gibbs, 306; Engler; Rogers; Marandellas, Govt. Herb. 883.

3861—**Dumasia villosa,** *DC.*

Fl. Cap. ii. 234.

Salisbury, April, Flanagan, 3146; Mazoe, 4500 ft. April, Eyles, 353; Chipete Forest, Swyn.

3864—**Glycine javanica,** *L.*

Fl. Trop. Afr. ii. 178; Cat. Afr. Pl. Welw. i. 249.

Victoria Falls, fr. April, Flanagan, 3114; Rogers, 5136; Mazoe, April, Flanagan, 3082; Chirinda, Swyn.

3866—**Teramnus labialis,** *Spreng.*

Fl. Trop. Afr. ii. 180; Fl. Cap. ii. 235; Cat. Afr. Pl. Welw. i. 249.

Umtali, Rogers, 4032.

Genus No.
3870—**Erythrina humeana,** *Spreng.* (*E. Humei*, E. Mey.)

Fl. Trop. Afr. ii. 182 ; Fl. Cap. ii. 237 ; For. Fl. Port. E. Afr. 43 ; For. Fl. Cape, 202.

Chirinda, 3500 ft. fr. June, Swyn. 603 ; also by Swyn. at Chipete, Chipetzana, Mt. Pene, and between Melsetter and Haroni Riv.

**E. tomentosa,** *R. Br.* (*E. latissima*, E. Mey.)

Fl. Trop. Afr. ii. 184 ; Fl. Cap. ii. 238 ; Nat. Pl. 384, 385 ; For. Fl. Port. E. Afr. 43 ; For. Fl. Cape, 201.

Salisbury, July, Rand, 462 ; Engler ; Matopos, Davy ; Nov. Marloth, 3374 ; fl. & fr. Oct. Gibbs, 73 ; Engler ; Gwanda, Noble, 8 ; Victoria, Monro, 416, 455 ; Mazoe, 4500 ft. July, Eyles, 381 ; Melsetter, fl. & young fr. Sep. Swyn. 154 ; fl. Oct. Swyn. 668 ; Umtali, Rogers, 4017.

**E. sp.**

Victoria, Monro, 415.

3877—**Mucuna coriacea,** *Baker.*

Fl. Trop. Afr. ii. 187.

Mazoe, 4500–4800 ft. April, Eyles, 361 ; Chirinda, 3500 ft. May, Swyn. 450 ; Chipetzana Riv. 3000 ft. April, Swyn. 1487 ; Nyahodi Riv. 5000 ft. April, Swyn. 1488.

3879—**Calopogonium lacerans,** *R. Br.*

Matopos, Rogers, 5167.

3882—**Galactia sp.**

Bulawayo, Dec. Gardner, 93, 94.

3891—**Canavalia ensiformis,** *DC.* (*C. incurva*, P. Thouars.)

Fl. Trop. Afr. ii. 190 ; Cat. Afr. Pl. Welw. i. 254.

Victoria Falls, Allen, 130 ; Rogers, 5137 ; Salisbury, Govt. Herb. 760 ; Chirinda, Swyn.

3897—**Rhynchosia adenodes,** *E. & Z.*

Fl. Cap. ii. 254.

Mazoe, April, Flanagan, 3083.

**R. antennulifera,** *Baker.*

See note Fl. Trop. Afr. ii. 223.

Salisbury, July, Rand, 453.

**R. caribaea,** *DC.* (*Dolicholus caribaeus*, Hiern.)

Fl. Trop. Afr. ii. 220 ; Cat. Afr. Pl. Welw. i. 267.

Mazoe, April, Flanagan, 3103.

**R. clivorum,** *S. Moore.*

Chimanimani Mts. 7000 ft. Sep. Swyn. 1461 ; Mt. Pene, 7000 ft. Swyn. 6184.

**R. congensis,** *Baker.* (*Dolicholus angolensis*, Hiern.)

Fl. Trop. Afr. ii. 217 ; Cat. Afr. Pl. Welw. i. 266.

Victoria Falls, April, Flanagan, 3107 (var.).

Genus No.
3897—**R. cyanosperma,** *Benth.*
Fl. Trop. Afr. ii. 218.
Chikore Hills, 3500 ft. Feb. Swyn. 226.

**R. flavissima,** *Hochst.*
Fl. Trop. Afr. ii. 219.
Chirinda, 3700–4000 ft. Oct. Swyn. 448.

**R. Memnonia,** *DC.* var. **prostrata,** *Harv.*
Fl. Trop. Afr. ii. 220; Fl. Cap. ii. 253; Nat. Pl. 349. All of type.
Victoria, Monro, 644.

**R. minima,** *DC.*
Fl. Trop. Afr. ii. 219; Fl. Cap. ii. 254.
Salisbury, Aug. Rand, 454; Victoria Falls, April, Flanagan, 3108; Rogers, 5540, 5543, 5606; Bulawayo, Chubb, 73.

**R. monophylla,** *Schlechter.*
Rusapi, Engler; Chirinda, 3800 ft. Feb. Swyn. 390, 451, 1162; Melsetter, 6000 ft. Swyn. 6190; Mt. Pene, 6500–7000 ft. Sep. Swyn. 1466.

**R. Orthodanum,** *Benth.*
Fl. Cap. ii. 257; Nat. Pl. 220.
Umtali, Engler; Chipete, 3800 ft. Oct. Swyn. 1500.

**R. puberula,** *Harv.*
Fl. Cap. ii. 255.
Bulawayo, Jan. Rand, 46.

**R. resinosa,** *Hochst.*
Fl. Trop. Afr. ii. 218.
Salisbury, July, Rand, 457; Matopos, Sept.–Oct. Gibbs, 68; April, Flanagan, 3100; Rogers, 5181; Victoria, Monro, 1068.

**R. Totta,** *DC.*
Fl. Cap. ii. 255.
Victoria Falls, Rogers, 7213; Bulawayo, Rogers, 13686*.

**R. viscidula,** *Steud.*
Fl. Cap. ii. 251.
Victoria, Monro, 549.

**R. spp.**
Gwelo, Jan. Gardner, 5.
Bulawayo, Jan. Gardner, 82; Oct. Eyles, 1086.
Victoria Falls, April, Flanagan, 3089.
Salisbury, April, Flanagan, 3105, same as Bolus, 10773; Salisbury, Darling, in Herb. Bolus, 10773, 10774, 11186, 11187; Rand, 452; Rogers, 4051, 4014.
Mazoe, 4300 ft. Aug. Eyles, 182; 4800 ft. June, Eyles, 375.
South Rhodesia, Rand, 608.

Genus No.

3898—**Eriosema Burkei,** *Benth.*

Fl. Cap. ii. 260.

Salisbury, Rogers, 4014; Selukwe, Rogers, 4092.

**E. cajanoides,** *Hook. f.* (*E. psoraleoides*, G. Don.)

Fl. Trop. Afr. ii. 227; Fl. Cap. ii. 261; Cat. Afr. Pl. Welw. i. 272.

Bulawayo, Jan. Rand, 49; fr. July, 447; Dec. Eyles, 28; Victoria Falls, Allen, 134; Umtali, Engler; Odzani River Valley, Teague, 7; Victoria, Monro, 926; Crocodile Riv. Holub; Chirinda, Swyn.; Chikore Hills, Swyn.; Salisbury, Rogers, 4066.

**E. ellipticum,** *Welw.*

Fl. Trop. Afr. ii. 227; Cat. Afr. Pl. Welw. i. 274.

Melsetter, 6000 ft. Sep. Swyn. 624.

**E. Engleri,** *Harms.*

North of Hartley, Engler, 3012; Salisbury, Engler, Sep. 3023; Macheke, Rogers, 4044, 4061; Bulawayo, Rogers, 10773*.

**E. montanum,** *Baker f.*

Chirinda, 3800 ft. Sep. Swyn. 361, not typical form.

**E. oblongum,** *Benth.*

Fl. Cap. ii. 259.

Salisbury, fl. & fr. Sep. Rand, 590; Rogers, 4004; North of Bulawayo, 3400 ft. Dec. Eyles, 1131; Gwelo, Sr. Phil. 22.

**E. parviflorum,** *E. Mey.*

Fl. Cap. ii. 260; Fl. Trop. Afr. ii. 225.

Bulawayo, Rogers, 13674*.

**E. polystachyum,** *Baker.*

Fl. Trop. Afr. ii. 225.

Bulawayo, Jan. Rand, 48.

**E. shirense,** *Baker f.*

Lusitu Hills, 5000 ft. April, Swyn. 1497.

**E. spp.**

Bulawayo, 4500 ft. Sep. Eyles, 104, cf. *E. parviflora*, E. Mey.

Salisbury, Aug. Rand, 458, cf. *E. Engleri*, Harms, and *E. insigne*, O. Hoffm.

Victoria, Monro, 533, 553.

Mazoe, 4300–4800 ft. Nov. Eyles, 530.

Gwelo, Sr. Phil. 38.

3899—**Flemingia rhodocarpa,** *Baker.*

Fl. Trop. Afr. ii. 231.

Mazoe, 4600–4800 ft. July, Eyles, 382; Chirinda, 3700–4000 ft. July, Swyn. 1048.

Genus No.
3901—**Phaseolus lunatus,** *L.*

Fl. Trop. Afr. ii. 192 ; Cat. Afr. Pl. Welw. i. 255.

Umtali, Rogers, 4055 ; South Rhodesia, Rhod. Agric. Journ. April, 1906, 362. Native crop of cultivation.

**P. sp.**

Bulawayo, Dec. Gardner, 88.

3905—**Vigna Buchneri,** *Harms.*

North of Hartley, Engler.

**V. Burchelli,** *Harv.*

Fl. Trop. Afr. ii. 196 ; Fl. Cap. ii. 239.

Bulawayo, Rogers, 5497.

**V. cærulea,** *Baker.*

Fl. Trop. Afr. ii. 203.

Gwai Riv. 3200 ft. Allen, 247.

**V. luteola,** *Benth.* (*V. glabra,* Savi.)

Fl. Trop. Afr. ii. 205 ; Fl. Cap. ii. 241 ; Cat. Afr. Pl. Welw. i. 260.

Victoria Falls, April, Flanagan, 3086 ; Salisbury, Rogers, 5522 ? ; Chimanimani Mts. 7000 ft. Sep. Swyn. 1467 ; Mt. Pene, 7000 ft. Oct. Swyn. 6192.

var. **villosa,** *Baker.*

Fl. Trop. Afr. ii. 206 ; Cat. Afr. Pl. Welw. i. 260.

Victoria Falls, Sep. Gibbs, 142 ; Rogers, 7453, 5968.

**V. nilotica,** *Hook. fil.*

Fl. Trop. Afr. ii. 204.

Victoria Falls, Rogers, 7110*.

**V. nuda,** *N. E. Br.*

Kew Bull. 1901, 121.

Mashonaland, Bryce ; Salisbury, Darling in Herb. Bolus, 10772 ; Bulawayo, Rogers.

**V. triloba,** *Walp.*

Fl. Trop. Afr. ii. 204 ; Fl. Cap. ii. 241 ; Cat. Afr. Pl. Welw. i. 259.

Matopos, Sep. Gibbs, 206, forma ; Victoria Falls, April, Flanagan, 3126 ; Rogers, 7111.

**V. vexillata,** *Benth.* (*V. hirta,* Hook.) (*V. capensis,* Walp.)

Fl. Trop. Afr. ii. 199 ; Fl. Cap. ii. 240 ; Cat. Afr. Pl. Welw. i. 257.

Salisbury, Sep. Rand, 589 ; Umtali, Engler ; Victoria, Monro, 1013 ; Chirinda, 3800 ft. April, Swyn. 363 ; Umvumvumvu Riv. 4000 ft. Oct. Swyn. 6191.

**V. spp.**

Victoria Falls, Allen, 160 ; May, Eyles, 139.

Gwai Forest, Jan. Allen, 245.

Matopos, 4500–5000 ft. Nov. Eyles, 1145.

Genus No.

3907—**Sphenostylis marginata,** *E. Mey.* (*Vigna marginata,* Benth.)

Fl. Trop. Afr. ii. 202; Fl. Cap. ii. 240.

Salisbury, Rand, 461; Engler; Rogers, 4059?; Victoria Falls, Allen, 176; Victoria, Monro, 766; Chirinda, 3800 ft. April, Swyn. 364; South Melsetter, 3500 ft. Oct. Swyn. 6624.

3910—**Dolichos euryphyllus,** *Harms,* forma **lobata.**

Sebakwe, 4000 ft. Dec. Eyles, 165.

**D. falciformis,** *E. Mey.*

Fl. Cap. ii. 246.

Victoria Falls, Galpin, 7336.

**D. gibbosus,** *Thunb.*

Fl. Cap. ii. 244.

Bulawayo, Eyles.

**D. Hendrickxii,** *Wildem.*

Without locality, Rogers*.

**D. Lablab,** *L.*

Fl. Trop. Afr. ii. 210; Fl. Cap. ii. 243.

Matopos, Rogers, 5163; Mazoe, 4500 ft. Feb. Eyles, 526?

**D. lupiniflorus,** *N. E. Br.*

Kew Bull. 1906, 102.

Chirinda, 3500 ft., Nov. Swyn. 1045.

**D. stipulosus,** *Welw.* var. **Randii,** *Baker f.*

Journ. Bot. 1899, 432; Fl. Trop. Afr. ii. 212 (type).

Salisbury, Dec. Rand, 80.

**D. tricostatus,** *Baker f.*

Journ. Bot. 1899, 431.

Bulawayo, Jan. Rand, 82.

**D. spp.**

Bulawayo, Monro, 62.

Mazoe, 4800 ft. Dec. Eyles, 494.

South Rhodesia, Rand, 311.

3911—**Adenodolichos?**

Victoria, Monro, 673, 999.

## Series GERANIALES.

### Family CXXIX.—GERANIACEAE, *J. St. Hil.*

3924—**Geranium caffrum,** *E. & Z.*

Fl. Cap. i. 258.

Melsetter, 6000 ft. fl. & fr. Sep. Swyn. 790.

**G. Thodei,** *R. Kunth.*

Matopos, Galpin, 6591.

Genus No

3925—**Monsonia biflora,** *DC.*

Fl. Trop. Afr. i. 290; Fl. Cap. i. 255; Nat. Pl. 96; Cat. Afr. Pl. Welw. i. 108.

Bulawayo, Dec. Rand, 19; Jan. Eyles, 70.

**M. burkeana,** *Planch.*

Fl. Cap. i. 255.

Salisbury, Aug. Rand, 441; Matopos, Oct. Gibbs, 222; Macheke, Rogers, 4049; Victoria, Monro, 852?

**M. ovata,** *Cav.*

Fl. Cap. i. 255; Nat. Pl. 97 (var.).

Bulawayo, 4500 ft. Jan. Eyles; Rogers, 5929; Matabeleland, Marloth.

**M. spp.**

Bulawayo, Feb. Eyles, 1174, 1193; Monro, 14.

South Rhodesia, Rand, 95.

3928—**Pelargonium aconitophyllum,** *E. & Z.* (forma).

Fl. Cap. i. 276.

Mt. Pene, 7000 ft. Oct. Swyn. 6099.

**P. sp.**

Bulawayo, Jan. Gardner, 64.

## Family CXXX.—OXALIDACEAE, *Lindl.*

3936—**Oxalis corniculata,** *L.* var. **stricta,** *Oliv.*

Fl. Trop. Afr. i. 297; Cat. Afr. Pl. Welw. i. 109; Fl. Cap. i. 351 (type).

Bulawayo, May, Rand, 296.

**O. semiloba,** *Sond.*

Fl. Trop. Afr. i. 296; Fl. Cap. i. 350; Cat. Afr. Pl. Welw. i. 109.

Salisbury, Rogers, 5773; Melsetter, Swyn.

**O. spp.**

Bulawayo, 4500 ft. Dec. Eyles, 73, cf. *O. caprina,* L.

Mazoe, 5000 ft. Dec. Eyles, 210; April, Eyles, 344.

Selukwe, Jan. Gardner, 50.

## Family CXXXII.—LINACEAE, *Dumort.*

3945—**Linum Thunbergii,** *E. & Z.*

Fl. Cap. i. 310.

Matopos, Nov. Eyles, 1098; Matabeleland, Marloth.

FAMILY CXXXIV.—ERYTHROXYLACEAE, *Lindl.*

Genus No.
3956—**Erythroxylon monogynum,** *Roxb.* (*E. pictum,* E. Mey.) (*E. caffrum,* Sond.) (*E. emarginatum,* Schum. & Thonn.)

Sim places these all under *E. monogynum,* Roxb., see For. Fl. Cap. 149, and For. Fl. Port. E. Afr. 21.

Fl. Trop. Afr. i. 274; Fl. Cap. i. 233, 234, and ii. 591.

Victoria Falls, Rogers, 5375, 5539, 5560.

var. **caffrum,** *O. E. Schultz.*

Chipete Forest, 3800 ft. Dec. Swyn. 133; Oct. Swyn. 692; Chimanimani Mts. 7000 ft. bud Sep. Swyn. 1364, 1465.

FAMILY CXXXV.—ZYGOPHYLLACEAE, *Lindl.*

3965—**Zygophyllum simplex,** *L.*

Fl. Trop. Afr. i. 285; Fl. Cap. i. 357; Cat. Afr. Pl. Welw. i. 106.

Crocodile Riv. Oates.

**Z. sp.**

Victoria, Monro, 826.

3978—**Tribulus terrestris,** *L.*

Fl. Trop. Afr. i. 283; Fl. Cap. i. 352; Cat. Afr. Pl. Welw. i. 105.

Bulawayo, 4500 ft. Dec. (*Collector ?*) 7; Khami Riv. March, Eyles, 11; Bulawayo, Rogers, 5736; Victoria Falls, Rogers, 5395.

FAMILY CXXXVII.—RUTACEAE, *Juss.*

3990—**Xanthoxylum capense,** *Harv.*

Fl. Cap. i. 446.

Victoria, Monro, 791.

4014—**Thamnosma africanum,** *Engl.*

Matopos, Engler; Rogers, 5176.

var. **rhodesicum,** *Bak. f.*

Journ. Bot. 1899, 426.

Bulawayo, fl. & young fr. Jan. Rand, 83; fr. May, Rand? 297; Matopos, Sep.–Oct. Gibbs, 310; Rogers, 5255.

4076—**Vepris paniculata,** *Lam.*

Victoria, Monro, 739 ?

4077—**Toddalia aculeata,** *Pers.*

Chipete Forest, fl. & fr. Nov. Swyn. 213; Chirinda Forest, Swyn.

**T. lanceolata,** *Lam.* (*Vepris lanceolata,* A. Juss.)

Fl. Trop. Afr. i. 307; Fl. Cap. i. 447; For. Fl. Port. E. Afr. 24; For. Fl. Cape, 156.

Matopos, Rogers, 5409.

Genus No.
4085—**Teclea natalensis,** *Engl.* (*Toddalia natalensis*, Sond.)
Fl. Cap. i. 447.
Chimanimani Mts. 7000 ft. bud Sep. Swyn. 1322.

**T. Swynnertonii,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 35.
Chirinda Forest, Swyn. 12.

4100—**Citrus aurantium,** *L.*
Cat. Afr. Pl. Welw. i. 118.
Chirinda Forest, 3700–4000 ft. Swyn. 672; Lusitu Riv. Swyn.

**C. medica,** *L.* var. **limonium,** *Risso.*
South Rhodesia, Rhod. Agric. Journ. Sep. 1904, 8; Mazoe, Eyles.

### Family CXXXVIII.—SIMARUBACEAE, *Lindl.*

4128—**Kirkia acuminata,** *Oliv.*
Fl. Trop. Afr. i. 311; For. Fl. Port. E. Afr. 24.
Victoria Falls, Allen, 51, 96; Umtali, Engler; Gwanda, Noble, 12; Victoria, Monro, 637; Mazoe, Govt. Herb. 922; Abercorn, Govt. Herb. 935.

### Family CXXXIX.—BURSERACEAE, *Kunth.*

4151—**Commiphora acutidens,** *Engl.*
Bulawayo, Engler.

**C. edulis?**
Victoria Falls, Rogers, 5788.

**C. Fischeri,** *Engl.*
Sabi Riv. 1000 ft. Nov. Swyn. 1208, 1450.

**C. spp.**
Matopos, Oct. Gibbs, 197; Rogers, 5341.
Gwanda, Noble, 51.
Victoria, Monro, 355; 637 cf. *C. natalense*, Sparm.
Bulawayo, Oct.-Dec. Chubb, 319.
Shashi, Baines.

### Family CXL.—MELIACEAE, *Vent.*

4159—**Khaya nyasica,** *Stapf.*
Journ. Linn. Soc. Bot. xl. 42.
Chirinda Forest, Swyn. 15; between Chirinda and Chikore, Swyn.

4171—**Turræa Eylesii,** *Baker f.*
Journ. Bot. 1905, 45.
Matopos, 5000 ft. Jan. Eyles, 29; Davy.

Genus No.

**T. nilotica,** *Kotschy. & Peyr.* (Vide *T. Randii*, Bak. f. below.)
Fl. Trop. Afr. i. 331; For. Fl. Port. E. Afr. 25.
Victoria Falls, Dr. Meller; Allen, 400; Matopos, Engler; Salisbury, Engler.

**T. obtusifolia,** *Hochst.*
Fl. Trop. Afr. i. 331; Fl. Cap. i. 245; For. Fl. Cape, 159.
Matopos, Cecil, 105; Victoria, Monro, 731, 1070, 1100*a*.

var. **matopensis,** *Baker f.*
Journ. Bot. 1905, 45.
Matopos, 5000 ft. Jan. Eyles, 154.

**T. Randii,** *Baker f.* (Engler says same as *T. nilotica*, K. & P.)
Journ. Bot. 1899, 427.
Salisbury, July, Rand, 562; Matopos, Sep. Galpin, 7086; fl. & fr. Oct. Gibbs, 2; Victoria, Monro, 360, 507; Bulawayo, Oct.–Dec. Chubb, 320 p.p.; Victoria Falls, Rogers, 7228; Sebakwe, Rogers.

**T. spp.**
Victoria Falls, Allen, 16; Rogers, 5135.
Victoria, Monro, 731*a*.
Mazoe, 4800 ft. July, Eyles, 385.

4175—**Melia azedarach,** *L.*
Fl. Trop. Afr. i. 332; Fl. Cap. i. 245.
Salisbury, Govt. Herb. 920, cultivated.

4193—**Ekebergia arborea,** *Baker f.*
Journ. Bot. 1899, 427.
Salisbury, Sep. Rand, 612; Victoria, Monro, 479; Chirinda, 3700–4000 ft. fl. & fr. Oct. Swyn. 25; Chikore, Swyn.

**E. Meyeri,** *Presl.*
Fl. Cap. i. 247; Nat. Pl. 6.
Chirinda Forest, 3700–4000 ft. Oct. Swyn. 18; Chirinda, 3000 ft. Swyn.

**E. sp.**
Victoria, Monro, 587.

4195—**Trichilia chirindensis,** *Swyn. & Baker f.*
Journ. Linn. Soc. Bot. xl. 39.
Chirinda Forest, 3700–4000 ft. Swyn.

**T. emetica,** *Vahl.*
Fl. Trop. Afr. i. 335; Nat. Pl. 80; For. Fl. Port. E. Afr. 26; For. Fl. Cape, 160; Cat. Afr. Pl. Welw. i. 134.
Victoria Falls, Sep. Galpin, 7019; Sep. Gibbs, 110; Allen, 61; Rogers, 5119; Inyoka, Govt. Herb. 941.

Genus No.
4198—**Lovoa Swynnertonii,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 41.
Chirinda Forest, 3700–4000 ft. Jan. Swyn. 16.

## Family CXLI.—MALPIGHIACEAE, *Vent.*

4219—**Sphedamnocarpus Galphimiæfolius,** *Szyszyl.* (*Acridocarpus Galphimiæfolius,* Juss.)
Fl. Cap. i. 232.
Matopos, Oct. Gibbs, 281.

**S. pruriens,** *Planch.* (*Acridocarpus pruriens,* Juss.)
Fl. Cap. i. 232; Nat. Pl. 400.
Matabeleland, Oates; Bulawayo, May, Rand, 431; Eyles, 96; Monro, 46; Matopos, Galpin, 6951; Engler; March, Flanagan, 2975; Rogers, 5051; between Plumtree and Bulawayo, April, Flanagan, 3181; Victoria, Monro, 780, 781; Gwelo, Sr. Phil. 20; Selukwe, Rogers, 4097; Chirinda, 3800 ft. fl. & fr. May, Swyn. 211 (forma); Chipete, 3800 ft. April, Swyn. 211*a* (forma).

**S. pulcherimus,** *Gilg.*
Matopos, 5000 ft. March, Eyles, 108.

**S. sp.**
Victoria, Monro, 875.

4237—**Tricomaria macrocarpa ?.**
South Rhodesia, Rand, 639.

## Family CXLV.—POLYGALACEAE, *Lindl.*

4273—**Polygala abyssinica,** *Fresn.* (*P. hottentotta,* Presl.)
Fl. Trop. Afr. i. 130; Fl. Cap. i. 86.
Bulawayo, Dec. Rand, 14; Salisbury, Sep. Rand, 599; Matopos, Oct. Gibbs, 194; Victoria, Monro, 835, 861; Mt. Pene, 7000 ft. Dec. Swyn. 6154; Melsetter, 6000 ft. Oct. Swyn. 6157.

**P. africana,** *Chod.* (*P. micrantha,* Guill. & Perr.)
Fl. Trop. Afr. i. 131; Cat. Afr. Pl. Welw. i. 42.
Matopos, March, Eyles, 1030.

**P. amatymbica,** *E. & Z.*
Fl. Cap. i. 93.
Bulawayo, Rogers, 13547*, 13731*.

Genus No.
4273—**P. arenaria,** *Willd.*
Fl. Trop. Afr. i. 128; Cat. Afr. Pl. Welw. i. 43.
Matopos, March, Flanagan, 2968; Bulawayo, Monro, 90; Gwelo, Sr. Phil. 19; Chirinda, 3800 ft. May, Swyn. 282; Victoria Falls, Rogers; Odzani River Valley, Umtali, Teague, 182.

**P. capillaris,** *E. Mey.*
Fl. Trop. Afr. i. 131; Fl. Cap. i. 93; Nat. Pl. 83.
Matopos, March, Flanagan, 2972.

**P. erioptera,** *DC.* (*P. retusa,* Hochst.) (*P. triflora,* L.)
Fl. Trop. Afr. i. 128; Cat. Afr. Pl. Welw. i. 46.
Bulawayo, May, Rand, 290; Chubb, 12*a*.

**P. gazensis,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 24.
Chimanimani Mts. 7000 ft. Sep. Swyn. 632.

**P. latipetala,** *N. E. Br.*
Kew Bull. 1906, 98.
Between Umtali and Salisbury, Cecil, 45.

**P. livingstoniana,** *Chod.*
Cat. Afr. Pl. Welw. i. 44.
Salisbury, Rand, 463*b*.

**P. persicariæfolia,** *DC.*
Fl. Trop. Afr. i. 129; Cat. Afr. Pl. Welw. i. 43.
Bulawayo, 4500 ft. Dec. Eyles, 45; Mazoe, 4300 ft. April, Eyles, 302; Victoria Falls, April, Flanagan, 3169; Rogers, 5667.

**P. petitiana,** *Rich.*
Fl. Trop. Afr. i. 133.
Salisbury, May, Flanagan, 3256.

**P. rarifolia,** *DC.* (*P. tenuifolia,* Link.)
Fl. Trop. Afr. i. 132; Cat. Afr. Pl. Welw. i. 47
Mazoe, 4300 ft. Dec. Eyles, 484.

**P. rigens,** *A. DC*
Matopos, Oct. Gibbs, 82; Feb. Eyles, 1113; Victoria, Monro, 953.

**P. virgata,** *Thunb.*
Fl. Cap. i. 85.
Crocodile Riv. Oates; Salisbury, July, Rand, 437; Mazoe, 4200 ft. Dec. Eyles, 198; Chirinda, Dec. Swyn. 284; Melsetter, 6000 ft. Oct. Swyn, 6158; Chimanimani Mts. 7000 ft. Sep. Swyn. 2042.

var. **decora,** *Harv.*
Fl. Cap. i. 85.
Salisbury, April, Flanagan, 3262; Odzani River Valley, Umtali, Teague, 95.

Genus No.

**P. spp.**

Victoria Falls, Allen, 101; Rogers, 5698.

Victoria, Monro, 534; 1030 cf. *P. filicaulis*, Baill.

South Rhodesia, Rand, 15.

4275—**Securidaca longipedunculata,** *Fres.*

Fl. Trop. Afr. i. 134; Cat. Afr. Pl. Welw. i. 47; For. Fl. Port. E. Afr. 14.

Victoria Falls, Allen, 423; Salisbury, Rand, 1365; Lomagundi, Govt. Herb. 982; Matopos, Flanagan, 3009; Victoria, Monro, 328.

var. **parvifolia,** *Oliv.* (Perhaps same as *S. spinosa*, Sim.)

Fl. Trop. Afr. i. 134; For. Fl. Port. E. Afr. 14.

Matopos, fl. & fr. Oct. Gibbs, 244; Umtali, Engler; Chikore Hills, 3500 ft. Swyn, 2038; Umvumvumvu Riv. Swyn. 6155; South Umtali, 2000–3000 ft. Swyn. 6613; South Melsetter, Swyn.

**S. spp.**

Victoria, Monro, 520, 567, 570.

Mazoe, Govt. Herb. 2085.

## Family CXLVI.—DICHAPETALACEAE, *Engl.*

4283—**Dichapetalum cymosum** (*Hook.*), *Torre & Harms.* (*Chailletia cymosa*, Hook.)

Fl. Cap. i. 450; Harv. Gen. S.A. Pl. 49.

Crocodile Riv.?, Oates; Bulawayo, Govt. Herb. 938.

**D. rhodesicum,** *Sprague & Hutch.*

Kew Bull. 1908, 433.

Gwai Forest, Allen, 234.

## Family CXLVII.—EUPHORBIACEAE, *J. St. Hil.*

4295—**Pseudolachnostylis Dekindtii,** *Pax.*

Fl. Trop. Afr. VI. i. 673.

Victoria Falls, Rogers, 5304; Allen, 164, 166; Wankie, Rogers, 5991; Bulawayo, Chubb, 80.

**P. maprouneæfolia,** *Pax.*

Fl. Trop. Afr. VI. i. 672.

Victoria, Monro, 724; Matopos, Rogers, 5334; Gibbs, 276 ♂; Umvumvumvu Riv. 4000 ft. fr. April, Swyn. 2128.

**P. spp.**

Matopos, Govt. Herb. 896.

Matabeleland, Monro, 207, 436.

Genus No.
4297—**Securinega verrucosa** (*Th.*), *Benth.*
Victoria Falls, Rogers, 5562.

4298—**Flüggea microcarpa,** *Blume.*
Fl. Trop. Afr. VI. i. 736; Cat. Afr. Pl. Welw. i. 961.
Sabi Riv. 1000 ft. Swyn. 1911; Umswirizwi Riv. 1000 ft. Nov. Swyn. 1727; Bulawayo, Rogers, 5491.

4299—**Phyllanthus floribundus,** *Müll. Arg.*
Fl. Trop. Afr. VI. i. 701; Cat. Afr. Pl. Welw. i. 957.
South of Zambesi, Engler; Victoria, Monro, 916; Wankie Rogers, 5991*.

**P. graminicola,** *Hutch.*
Fl. Trop. Afr. VI. i. 708; Journ. Linn. Soc. Bot. xl. 191.
Chirinda, 3800 ft. Feb. Swyn. 261.

**P. hutchinsonianus,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 192.
Chimanimani Mts. 7000 ft. fl. & fr. Sep. Swyn. 1524.

**P. maderaspatensis,** *L.* (*P. longifolius*, Sond.)
Fl. Trop. Afr. VI. i. 722: Cat. Afr. Pl. Welw. i. 959.
Mazoe, 4200 ft. Jan. Eyles, 245; Chirinda, Feb. Swyn. 333; Bulawayo, 4500 ft. Dec. Eyles, 6; Rogers, 5765; Victoria Falls, Rogers, 5563.

**P. myrtaceus,** *Sond.*
Fl. Trop. Afr. VI. i. 726; For. Fl. Cape, 325.
Mt. Pene, 6500–7000 ft. Sep. Swyn. 1522, 1523; Chimanimani Mts. 7000 ft. fr. Oct. Swyn. 6155*a*.

**P. Niruri,** *L.*
Fl. Trop. Afr. VI. i. 731; Cat. Afr. Pl. Welw. i. 960.
Matopos, Oct. Gibbs, 314.

**P. nummulariæfolius,** *Poir.*
Fl. Trop. Afr. VI. i. 710.
Victoria, Monro, 712, 757; Mazoe, 4800–5000 ft. March, Eyles, 292.

**P. pentandrus,** *Schum. & Thonn.*
Fl. Trop. Afr. VI. i. 710; Cat. Afr. Pl. Welw. i. 957.
Victoria Falls, Rogers, 5564, 5703.

**P. reticulatus,** *Poir.*
Fl. Trop. Afr. VI. i. 700; Cat. Afr. Pl. Welw. i. 958.
Victoria Falls, fl. & fr. Sep. Gibbs, 129; Rogers, 5473; Sep. Galpin, 7016; Matopos, Rattray in Herb. Galpin, 6969.

**P. spp.**
Igusi, April, Flanagan, 3190; Matopos, Davy; Victoria, Monro, 347, 457, 804; Victoria Falls, Rogers, 5148; South Rhodesia, Rand, 210, 211, 212.

Genus No.
4325—**Hymenocardia acida,** *Tul.*

Fl. Trop. Afr. VI. i. 651; Cat. Afr. Pl. Welw. i. 966.
Chikore Hills, fl. Nov. fr. March, Swyn. 1214, 1519.

4327—**Antidesma membranaceum,** *Müll. Arg.*

Fl. Trop. Afr. VI. i. 645; Cat. Afr. Pl. Welw. i. 965.
Chirinda, 5300 ft.; Chipetzana, 3000 ft.; Mt. Pene, 6500 ft.; fl. Sep.–Dec. fr. April, Swyn. 169, 169*a*, 631, 1111, 2011.

**A. venosum,** *Tul.*

Fl. Trop. Afr. VI. i. 646; Cat. Afr. Pl. Welw. i. 965.
South of Zambesi, Engler; Victoria, Monro, 762, 1059; Victoria Falls, Rogers, 5373.

4329—**Uapaca kirkiana,** *Müll. Arg.*

Fl. Trop. Afr. VI. i. 636.
Salisbury, Engler; Marandellas, Engler; Umtali, Engler; Melsetter, 4000 ft. Johnson, 128; Chirinda, 3500 ft. Jan. Swyn. 49; also by Swynnerton South of Umtali, Chimanimani Mts. and throughout Melsetter Dist.

**U. sansibarica,** *Pax.*

Fl. Trop. Afr. VI. i. 636.
Melsetter and Chirinda, Jan.–April, Swyn. 155, 6513.

4345—**Bridelia atroviridis,** *Müll. Arg.*

Fl. Trop. Afr. VI. i. 617; Cat. Afr. Pl. Welw. i. 953.
Chipete Forest, 3800 ft. fr. April, Swyn. 535.

**B. cathartica,** *Bertol. f.*

Fl. Trop. Afr. VI. i. 617; For. Fl. Port. E. Afr. 106.
Victoria Falls, Rogers, 5071, 7181; Galpin, 7015.

**B. micrantha,** *Baill.*

Fl. Trop. Afr. VI. i. 620.
Chirinda, 3500 ft. Nov. Swyn. 536; also throughout South Melsetter, Swyn.

**B. mollis,** *Hutch.* (*B. stipularis,* Müll. Arg.)

Fl. Trop. Afr. VI. i. 613; For. Fl. Port. E. Afr. 106; Kew Bull. 1912, 101.
Victoria, Monro, 684, 790, 643*a*; Bulawayo, Rogers, 5499.

**B. Niedenzui,** *Gehrm.*

Fl. Trop. Afr. VI. i. 616.
Mazoe, 4300–4500 ft. March, Eyles, 273; Umvumvumvu Riv. 2000 ft. fl. & fr. April, Swyn. 1736.

**B. scandens,** *Willd.* (*B. stipularis,* Blume.)

Cat. Afr. Pl. Welw. i. 955; For. Fl. Port. E. Afr. 106.
Bulawayo, Rogers, 5499.

**B. sp.**

Victoria Falls, April, Flanagan, 3154.

Genus No.
4348—**Croton barotsensis,** *Gibbs.*
Fl. Trop. Afr. VI. i. 767 ; Journ. Linn. Soc. Bot. xxxvii. 469.
Victoria Falls, Sep. Gibbs, 109 ; Allen, 175, 416 ; Rogers, 5474 ; Galpin, 7049.

**C. gratissimus,** *Burch.*
Fl. Trop. Afr. VI. i. 1051 ; For. Fl. Cape, 311.
Victoria Falls, Sep.–Oct. Galpin, 6989 ; Matopos, Oct. Gibbs, 209 ; Rogers, 5410 ; South of Zambesi, Engler ; Victoria, Monro, 322, 306, 810.

**C. Gubouga,** *S. Moore.*
Fl. Trop. Afr. VI. i. 766.
Sabi Riv. 1000 ft. Nov. Swyn. 1123.

**C. rivularis,** *Müll. Arg.*
For. Fl. Cape, 311.
South of Zambesi, Engler.

**C. sylvaticus,** *Hochst.*
Fl. Trop. Afr. VI. i. 771 ; For. Fl. Cape, 310.
Chirinda Forest, 3700–4000 ft. Nov. Swyn. 4.

**C. Zambesicus,** *Müll. Arg.* (*C. Welwitschianus,* Müll. Arg.)
Fl. Trop. Afr. VI. i. 758 ; Cat. Afr. Pl. Welw. i. 970.
Victoria Falls, Rogers, 5146 ; Allen, 418 p.p. ; South of Zambesi, Engler ; Matopos, Rogers, 5252*.

4354—**Tannodia Swynnertonii,** *Prain.* (*Croton Swynnertonii,* S. Moore.)
Fl. Trop. Afr. VI. i. 827 ; Journ. Linn. Soc. Bot. xl. 194 ; see Journ. Bot. 1912, 127.
Chirinda Forest, 3700–4000 ft. Sep.–Dec. Swyn. 109, 6519.

4386—**Argomuellera macrophylla,** *Pax.*
Fl. Trop. Afr. VI. i. 925.
Chirinda Forest, 3700–4000 ft. May, Oct., Nov. Swyn. 114.

4395—**Neoboutonia Melleri,** *Prain.* (*Mallotus Melleri,* Müll. Arg.)
Fl. Trop. Afr. VI. i. 922.
North of Lusitu Riv. Swyn. ; Chirinda, Swyn.

4400—**Macaranga mellifera,** *Prain.*
Fl. Trop. Afr. VI. i. 943 ; Journ. Linn. Soc. Bot. xl. 201.
Chirinda, 3700–4000 ft. Oct. Swyn. 5 and 2120 ; Mt. Pene, 7000 ft. Oct. Swyn. 6039.

4407—**Acalypha Allenii,** *Hutch.*
Fl. Trop. Afr. VI. i. 889 ; Kew Bull. 1911, 229.
Gwai Forest, Allen, 238 ; North of Bulawayo, 3400 ft. Dec. Eyles, 1130 ; Salisbury, Rand, 1385, 1386 ; Bulawayo, Chubb, 106.

Genus No.
4407 —**A. caperonioides,** *Baill.*

Fl. Trop. Afr. VI. i. 884, as *A. peduncularis*, Meisn. p.p. see Kew Bull. 1913, 23.

Inyanga, 6000-7000 ft. Cecil, 179, 182; between Umtali and Inyanga, Cecil, 167; Salisbury, Cecil, 68; Engler, 3052; Rogers, 4003; Gwelo, Jan. Gardner, 33; Matopos, 5000 ft. Nov. Eyles, 1153; Gibbs, 227 ?; Melsetter, 6000 ft. Oct. Swyn. 2015?; Melsetter, 5000–6000 ft. Oct. Swyn. 2015?; North Melsetter, 5000–6000 ft. Dec. Swyn. 6040 ?, 6227 ?

**A. chirindica,** *S. Moore.*

Fl. Trop. Afr. VI. i. 885; Journ. Linn. Soc. Bot. xl. 199.

Chirinda, 3800 ft. Dec. Swyn. 380, 381.

**A. ciliata,** *Forsk.*

Fl. Trop. Afr. VI. i. 901.

Salisbury, Rand, 1388; Chirinda, 3700–4000 ft. June, Swyn. 734; Victoria, Monro, 946.

**A. indica,** *L.*

Fl. Trop. Afr. VI. i. 903; Cat. Afr. Pl. Welw. i. 978.

Victoria Falls, Rogers, 5386; North Melsetter, 2000–6000 ft. Dec. Swyn. 2014.

**A. ornata,** *Hochst.*

Fl. Trop. Afr. VI. i. 890; Cat. Afr. Pl. Welw. i. 976.

Victoria Falls, Rogers, 5417, 5550.

**A. paniculata,** *Miq.*

Fl. Trop. Afr. VI. i. 886; Cat. Afr. Pl. Welw. i. 976.

Melsetter, Johnson, 172.

**A. petiolaris,** *Hochst.*

Victoria Falls, April, Flanagan, 3192; Odzani River Valley, Umtali, Teague, 77.

**A. punctata,** *Meisn.*

Fl. Trop. Afr. VI. i. 884, as *A. peduncularis*, Meisn. p.p. see Kew Bull. 1913, 23.

Upper Buzi, 3000 ft. Swyn. 383; Sep. Swyn. 739?

**A. segetalis,** *Müll. Arg.*

Fl. Trop. Afr. VI. i. 904; Cat. Afr. Pl. Welw. i. 979.

Victoria Falls, Rogers, 5386*a*.

**A. senensis,** *Klotzsch.* (*A. zambesica*, Müll. Arg.)

Fl. Trop. Afr. VI. i. 888.

Matopos, Oct. Gibbs, 225; Victoria Falls, Allen, 197; Bulawayo, Jan. Gardner, 56; Chubb, 353; Chirinda, Swyn. 382.

Genus No.

**A. villicaulis,** *Hochst.*

Fl. Trop. Afr. VI. i. 893.

Salisbury, Engler; Rand, 1384; Bulawayo, Oct.–Dec. Chubb, 369; Chirinda, 3500–4000 ft. April, Swyn. 382, 383; Upper Buzi, 3000 ft. Dec. Swyn. 1153.

**A. spp.**

North of Bulawayo, 3400 ft. Dec. Eyles, 1120.

South Rhodesia, Rand, 204, 205.

4416—**Tragia dioica,** *Sond.*

Fl. Trop. Afr. VI. i. 993.

Bulawayo, Kolbe, in Herb. Bolus, 4109.

**T. Gardneri,** *Prain.*

Fl. Trop. Afr. VI. i. 994; Kew Bull. 1909, 52.

Gwelo, Jan. Gardner, 34.

**T. kirkiana,** *Müll. Arg.*

Fl. Trop. Afr. VI. i. 998.

Bulawayo, Rogers, 5915; Victoria Falls, Rogers, 5594.[1]

**T. natalensis,** *Sond.* (*T. ambigua*, S. Moore, and var. *urticans*, S. Moore.)

Fl. Trop. Afr. VI. i. 974; Journ. Linn. Soc. Bot. xl. 202.

Chirinda Forest, 3700–4000 ft. June, Swyn. 795; May, Swyn. 446.

**T. Okanyua,** *Pax.* (*T. angustifolia*, Pax.)

Fl. Trop. Afr. VI. i. 986.

Bulawayo, Jan. Gardner, 55; Chubb, 66; Victoria Falls, Rogers, 5594*.

**T. rhodesiae,** *Pax.*

Fl. Trop. Afr. VI. i. 979.

Salisbury, Sep. Engler, 3073; Rand, 644, 1387; Marshall.

4424—**Ricinus communis,** *L.*

Fl. Trop. Afr. VI. i. 945; Cat. Afr. Pl. Welw. i. 983.

South Rhodesia, Rhod. Agric. Journ. 1904, 135. Naturalized. Odzani River Valley, Umtali, Teague, 269.

4436—**Hevea sp.**

Matopos, Govt. Herb. 901, cultivated.

4444—**Manihot Glaziovii,** *Müll. Arg.*

Fl. Trop. Afr. VI. i. 839.

Salisbury, Govt. Herb. 765, cultivated.

4448—**Cluytia inyangensis,** *Hutch.*

Fl. Trop. Afr. VI. i. 804.

Inyanga, 6000–7000 ft. Cecil, 181.

[1] Rogers had this number named *T. okanyua*, Pax, by Mr. Spencer Moore.

Genus No.

**C. monticola,** *S. Moore.*
Fl. Trop. Afr. VI. i. 803; Journ. Linn. Soc. Bot. xl. 197.
Mt. Pene, 6500–7000 ft. Sep.–Oct. Swyn. 2012, 6159.

**C. Paxii,** *Knauf.* (*C. phyllanthoides*, S. Moore.)
Fl. Trop. Afr. VI. i. 809; Journ. Linn. Soc. Bot. xl. 198.
Melsetter, 6000 ft. Sep. Swyn. 1120, 1722.

**C. robusta,** *Pax.*
Fl. Trop. Afr. VI. i. 811.
Melsetter, Swyn. 1530; Mt. Pene, Swyn. 6042; Chirinda, Swyn. 1531*a*.

**C. stelleroides,** *S. Moore.*
Fl. Trop. Afr. VI. i. 804; Journ. Linn. Soc. Bot. xl. 198.
North Melsetter, 5000–6000 ft. Oct. Swyn. 6214.

**C. Swynnertonii,** *S. Moore.*
Fl. Trop. Afr. VI. i. 811; Journ. Linn. Soc. Bot. xl. 197.
Chipete and Chirinda, 3700–4000 ft. May–June, Swyn. 197, 530*a*, 530*b*, 530*c*.

**C. volubilis,** *Hutch.*
Fl. Trop. Afr. VI. i. 809.
Chimanimani, Johnson, 188.

4463—**Ricinodendron Rautanenii,** *Schinz.*
Fl. Trop. Afr. VI. i. 746.
Victoria Falls, Kirk; Allen, 191.

4464—**Gelonium procerum,** *Prain.*
Fl. Trop. Afr. VI. i. 948; Journ. Linn. Soc. Bot. xl. 201.
Chirinda Forest, 3700–4000 ft. Oct. Swyn. 104; Chimanimani Mts. 7000 ft. Swyn. 1115.

4478—**Excœcaria sp.**
Gwanda, Noble, 23.

4483—**Sapium madagascariense,** *Prain.* (*Excœcaria sylvestris*, S. Moore.)
Fl. Trop. Afr. VI. i. 1010; Journ. Linn. Soc. Bot. xl. 204.
Chirinda Forest, 3700–4000 ft. Oct. Jan. Swyn. 72, 72*a*.

**S. Mannianum,** *Benth.*
Fl. Trop. Afr. VI. i. 1016; Cat. Afr. Pl. Welw. i. 986.
Chipete Forest, 3800 ft. March, Swyn. 103; Chirinda, 3800 ft. Sep. Swyn. 741.

4498—**Euphorbia abyssinica,** *Gmelin.*
Fl. Trop. Afr. VI. i. 588.
South Rhodesia, Rand.

**E. angularis,** *Klotzsch.*
Fl. Trop. Afr. VI. i. 584.
Matopos, Nov. Marloth, 3418.

Genus No.
4498—**E. crotonoides,** *Boiss.*
Fl. Trop. Afr. VI. i. 518.
Redbank, Flanagan, 3186.

**E. cyparissioides,** *Pax.* (*E. ericoides,* Lam.)
Fl. Trop. Afr. VI. i. 542; Cat. Afr. Pl. Welw. i. 951.
Rusapi, Engler, 3112; North Melsetter, Swyn. 6217.

var. **minor,** *N. E. Br.*
Fl. Trop. Afr. VI. i. 542.
North Melsetter, 6000 ft. Sep. Swyn. 6043, 6044; Haroni Riv. 5000 ft. Oct. Swyn. 1529; Macheke, Rogers, 4027.

**E. depauperata,** *Hochst.*
Fl. Trop. Afr. VI. i. 537.
Mt. Pene, 7000 ft. Sep. Swyn. 6041; Haroni Riv. 5500 ft. Oct. Swyn. 1528.

**E. espinosa,** *Pax.*
Fl. Trop. Afr. VI. i. 547.
Bulawayo, Chubb, 345; Victoria, Monro, 319.

**E. Eylesii,** *Rendle.*
Fl. Trop. Afr. VI. i. 512; Journ. Bot. 1905, 52.
Deka, 2400 ft. May, Eyles, 130; Kesi, April, Flanagan, 3284; Victoria, Monro, 910; Victoria Falls, Rogers, 5559*, 7138*.

**E. grandidens,** *Haw.*
For. Fl. Port. E. Afr. 105; For. Fl. Cape, 317.
Matopos, Davy.

**E. griseola,** *Pax,* var. **robusta,** *Pax.*
Fl. Trop. Afr. VI. i. 578.
Matopos, 5000 ft., Engler, 2860*b*.

**E. helioscopia,** *L.*
Bulawayo, 4500 ft. Jan. Eyles, 62.

**E. livida,** *E. Mey. ?*
Victoria Falls, Galpin, 7351.

**E. matabelensis,** *Pax.* (*E. jægeriana,* Pax, *E. trifurca,* N. E. Br.)
Fl. Trop. Afr. VI. i. 546.
Matopos, Sep. Gibbs, 24; Engler; Victoria Falls, Galpin, 7056; Rogers, 5306; Victoria, Monro, 424; between Umtali and Melsetter and other parts of Mashonaland, Swyn. 691, 6611; Matabeleland, Penther, 944; Chirinda, 3500 ft. Oct. Swyn. 691.

**E. mozambicensis,** *N. E. Br.*
Fl. Trop. Afr. VI. i. 509.
Victoria Falls, Rogers, 7002*.

Genus No.

**E. Oatesii,** *Rolfe.*
Fl. Trop. Afr. VI. i. 522.
Matabeleland, Oates; Gwelo, Rand, 218.

**E. Reinhardtii,** *Volk.*
Fl. Trop. Afr. VI. i. 590.
Bulawayo, Nov. Marloth, 3417; Matopos, Davy; Engler.

**E. rubriflora,** *N. E. Br.*
Fl. Trop. Afr. VI. i. 509.
Victoria Falls, Rogers, 5565; Allen.

**E. Schimperiana,** *Scheele.*
Fl. Trop. Afr. VI. i. 533.
Chirinda, 3700–4000 ft. Swyn. 1531.

var. **Buchanani,** *N. E. Br.*
Fl. Trop. Afr. VI. i. 534.
Chirinda Forest, 3800 ft. Sep. Swyn. 238.

**E. Schinzii,** *Pax.*
Fl. Trop. Afr. VI. i. 567.
Bulawayo, 4500 ft. Eyles, 1247; Rand, 396.

**E. tettensis,** *Klotzsch.*
Fl. Trop. Afr. VI. i. 494.
Igusi, April, Flanagan, 3191.

**E. tortistyla,** *N. E. Br.*
Fl. Trop. Afr. VI. i. 569.
Victoria, Monro, 490.

**E. trichadenia,** *Pax.* (*E. benguellensis*, Pax.)
Fl. Trop. Afr. VI. i. 523.
Matopos, Oct. Gibbs, 234; Victoria, Monro, 141.

**E. whyteana,** *Baker f.*
Fl. Trop. Afr. VI. i. 540.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1526.

**E. spp.**
Gwai Forest, Allen, 264.
Mazoe, 4400 ft. April, Eyles, 314, cf. *E. Eylesii*, Rendle.
Mazoe, 4400 ft. April, Eyles, 365.
Victoria Falls, April, Flanagan, 3246.
South Rhodesia, Rand, 395, 397.

4500—**Synadenium gazenae,** *N. E. Br.*
Fl. Trop. Afr. VI. i. 467; Journ. Linn. Soc. Bot. xl. 190.
Chipetzana Riv. 3000 ft. April, Swyn. 1505.

## SERIES SAPINDALES.

### FAMILY CLIII.—ANACARDIACEAE, *Lindl.*

Genus No.
4558—**Sclerocarya caffra,** *Sond.*

Fl. Trop. Afr. i. 449; Fl. Cap. i. 525; For. Fl. Port. E. Afr. 39; Cat. Afr. Pl. Welw. i. 176; Harv. Gen. S.A. Pl. 64; Nat. Pl. 307.

Matopos, Davy; Oct. Gibbs, 261; Bulawayo, Engler; Chubb, 321; Gwanda, Noble, 10; Umtali, Govt. Herb. 843; Sabi Riv. fr. Nov. Swyn. 1210; Melsetter, Swyn.; Victoria, Monro, 531.

4563—**Lannea discolor** (*Sond.*), *Engl.* (*Odina discolor*, Sond.)

Fl. Cap. i. 504.

Umtali, Engler; Salisbury, Engler.

**L. edulis** (*Sond.*), *Engl.* (*Odina edulis*, Sond.)

Fl. Cap. i. 503.

Matopos, fl. Sep. fr. Oct. Gibbs, 71; Salisbury, Darling; Chirinda, 3800 ft. fl. & fr. Oct. Swyn. 441; South Melsetter, Swyn.; Charter, Govt. Herb. 3017; Victoria, Monro, 523; North of Bulawayo, Engler.

var. **integrifolia,** *Engl.*

Salisbury, Engler.

**L. Schimperi** (*Hochst.*), *Engl.* (*Odina Schimperi*, Hochst.)

Fl. Trop. Afr. i. 445.

Matopos, Oct. ♂ Gibbs, 268.

**L. Stuhlmanni** (*Engl.*), *Torre & Harms.* (*Odina Stuhlmanni*, Engl.)

Sabi Riv. 1000 ft. Nov. Swyn. 1205.

**L. Wodier,** *Roxb.* var. **brevifolia,** *Engl.*

Victoria, Monro, 745.

**L. spp.**

Victoria, Monro, 552; 587, 641.

Mazoe, 4300–4800 ft. Sep. Eyles, 422.

Bulawayo, Oct.–Dec. Chubb, 306.

4589—**Heeria insignis,** *O. Kuntze,* var. **reticulata,** *Baker f.*

Journ. Bot. 1899, 428.

Bulawayo, Jan. Rand, 64; fr. May, Rand, 307; between Mt. Pene and Haroni Riv. 6000 ft. fr. Sep. Swyn. 680.

**H. paniculosa,** *Engl.*

Matopos, Rogers, 5412.

Genus No.

**H. pulcherrima** (*Schweinf.*), *O. Kuntze.* (*Rhus pulcherrima*, **Oliv.**
Fl. Trop. Afr. i. 436.
Matopos, Engler; Salisbury, Rogers, 5769; Charter, Govt. Herb. 3016.

**H. reticulata** (*Baker*), *Engl.*
Salisbury, Engler; Victoria, Monro, 695; Matopos, Rogers, 5363.

**H. spp.**
Victoria, Monro, 332, 437.

4594—**Rhus bulawayensis,** *Diels.*
Bulawayo, Sep. Engler, 2923.

**R. chirindensis,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 49.
Chirinda, 3800 ft. Swyn. 168.

**R. erosa,** *Thunb.*
Fl. Cap. i. 516; For. Fl. Cape, 194.
Victoria, Monro, 307.

**R. lævigata,** *L.*
Fl. Cap. i. 514; For. Fl. Cape, 195.
Victoria, Monro, 739.

**R. lancea,** *L. f.*
Fl. Cap. i. 514; For. Fl. Cape, 194.
Bulawayo, July, Rand, 444; May, Rand, 302, 304; Chubb, 41, 45, 51, 315; Matopos, Sep. Galpin, 7066; Davy; fl. & fr. Sep. Gibbs, 1; Gwanda, Noble, 36.

**R. lanceolata?**
Matopos, Govt. Herb. 895; Salisbury, Govt. Herb. 937.

**R. leptodictya,** *Diels.*
Bulawayo, Sep. Engler, 2915.

**R. lucida,** *L.*
Fl. Cap. i. 517.
Chimanimani Forest, 6500 ft. fl. & young fr. Sep. Swyn. 635.

**R. mucronifolia,** *Sond.* (*R. salicifolia*, Presl.)
Fl. Cap. i. 521; For. Fl. Cape, 193.
Gwanda, Noble, 65; Mazoe, Govt. Herb. 2089?

**R. paniculosa,** *Sond.* (*Anaphrenium paniculosum*, Engl.)
Fl. Cap. i. 522.
Bulawayo, 4500 ft. Dec. Eyles, 13; Rogers, 5508; Matopos, March, Flanagan, 2945; Rogers, 5413, 5639.

**R. rehmannia,** *Engl.*
Bulawayo, Chubb, 4*a*.

**R. Sonderi,** *Engl.*
Chirinda, 3500 ft. fl. & fr. Oct. Swyn. 174; Chipete Forest, 3800 ft. Oct. Swyn. 174*a*.

Genus No.

var. **pilosa,** *Engl.*

Melsetter, 6000 ft. Swyn. 6165.

**R. tenuinervis,** *Engl.*

Cat. Afr. Pl. Welw. i. 182.

Bulawayo, May, Rand, 306.

**R. tomentosa,** *L.*

Fl. Cap. i. 508; For. Fl. Cape, 195.

Melsetter, 6000 ft. Sep. Swyn. 667.

**R. trifoliolata,** *Baker f.*

Journ. Bot. 1899, 429.

Bulawayo, Dec. Rand, 66.

**R. villosa,** *L. f.*

Fl. Trop. Afr. i. 439; Fl. Cap. i. 510; Cat. Afr. Pl. Welw. i. 182; For. Fl. Cape, 196.

Bulawayo, Jan. Rand, 65; Rogers, 5506; Matopos, Oct. Gibbs, 247; Engler; Mazoe, 4600 ft. Aug. Eyles, 398; Salisbury, Engler; Victoria, Monro, 1004.

**R. Welwitschii,** *Engl.* var. **angustifolia,** *Baker f.*

Journ. Bot. 1899, 429.

Bulawayo, Jan. Rand, 97.

**R. spp.**

Victoria Falls, fr. April, Flanagan, 3211.

Victoria, Monro, 314.

Salisbury, Rogers, 5574.

Lomagundi, Govt. Herb. 985.

Umvukwe Hills, Govt. Herb. 1090.

Mazoe, Govt. Herb. 2082.

South Rhodesia, Rand, 303, 305.

## Family CLVII.—AQUIFOLIACEAE, *DC.*

4614—**Ilex capensis,** *Sond. & Harv.* (*I. mitis*, Radl.)

Fl. Trop. Afr. i. 359; Fl. Cap. i. 473; For. Fl. Port. E. Afr. 22; For. Fl. Cape, 151; Cat. Afr. Pl. Welw. i. 143.

Mt. Pene, 7000 ft. Oct. Swyn. 6210; Mazoe, 4300 ft. Sep. Eyles, 436.

## Family CLVIII.—CELASTRACEAE, *Lindl.*

4625—**Celastrus concinnus,** *N. E. Br.*

Kew Bull. 1906, 16.

Chirinda, 3700–4000 ft. fl. & fr. Oct. Swyn. 118.

Genus No.

**C. mossambicensis,** *Klotzsch.*
Fl. Trop. Afr. i. 362.
Chikore Hills, 3500 ft. April, Swyn. 185.

**C. polyacanthus,** *Sond.*
Fl. Cap. i. 455.
Victoria, Monro, 1100.

4627—**Gymnosporia buxifolia** (*Sond.*), *Szyszyl.* (*Celastrus buxifolius*, L.
Fl. Cap. i. 459; Nat. Pl. 535; For. Fl. Cape, 185.
Matopos, Engler; Victoria, Monro, 1023; Bulawayo, Rogers 13520*.

**G. senegalensis,** *Loes.* (*Celastrus senegalensis*, Lam.)
Fl. Trop. Afr. i. 361; Cat. Afr. Pl. Welw. i. 145.
Matopos, Engler; fr. Sep. Galpin, 7077; Rogers, 5244; Victoria Falls, Engler; Rogers, 7420; Victoria, Monro, 382; Upper Buzi, 3500 ft. May, Swyn. 2069.

var. **inermis ?.**
Bulawayo, May, Rand, 298; Victoria Falls, July, Allen, 411.

var. **spinosa ?.**
Bulawayo, May, Rand, 413; Mazoe, 4800 ft., June, Eyles, 374.

**G. spp.**
Victoria, Monro, 386, 738*a*.
South Rhodesia, Rand, 324, 442.

4629—**Catha edulis,** *Forsk.*
Fl. Trop. Afr. i. 365; For. Fl. Cape, 181; Harv. Gen. S.A. Pl. 53.
Salisbury, fr. July, Rand, 567; Chipete, 3800 ft. April, Swyn. 102; Chirinda Forest, 3700–4000 ft. May, Swyn. 102? Chirinda, 3500 ft. fr. Oct. Swyn. 1342; Odzani River Valley, Umtali, Teague, 112.

4630—**Pterocelastrus rostratus,** *Walp.*
Fl. Cap. i. 463; For. Fl. Port. E. Afr. 36; For. Fl. Cape, 187.
Mt. Pene Forest, 6500 ft. Sep. Swyn. 1301; Chimanimani Mts. 7000 ft. Sep. Swyn. 1302.

4640—**Elæodendron capense,** *E. & Z.*
Fl. Cap. i. 468; For. Fl. Cape, 190.
Chikore, 3600 ft. March, Swyn. 167; Chirinda, 3700–4000 ft. Oct. Swyn. 1174.

**E. matabelicum,** *Loes.*
Matopos, Sep. Engler, 2835; Oct. Gibbs, 365; Victoria, Monro, 738, 844.

**E. sp.**
South Rhodesia, Rand, 427.

FAMILY CLIX.—HIPPOCRATEACEAE, *H. B. & K.*

Genus No.
4661—**Hippocratea Buchanani,** *Loes.*
Victoria Falls, Rogers, 5371.

**H. cymosa,** *De Wild. & Th. Dur.*
Victoria Falls, Engler.

**H. obtusifolia,** *Roxb.*
Fl. Trop. Afr. i. 369; Cat. Afr. Pl. Welw. i. 149.
Victoria Falls, Sep. Galpin, 7017; Sep. Gibbs, 139; Rogers, 5785; Sabi Riv. 1000 ft. Nov. Swyn. 1200; fr. Nov. Swyn. 1203.

FAMILY CLXII.—ICACINACEAE, *Miers.*

4686—**Apodytes dimidiata,** *E. Mey.*
Fl. Trop. Afr. i. 355; Fl. Cap. i. 235; Cat. Afr. Pl. Welw. i. 142; For. Fl. Port. E. Afr. 31; For. Fl. Cape, 135.
Chirinda, 3800 ft. Swyn. 184.

FAMILY CLXV.—SAPINDACEAE, *Juss.*

4724—**Paullinia pinnata,** *L.*
Fl. Trop. Afr. i. 419; For. Fl. Port. E. Afr. 31; Cat. Afr. Pl. Welw. i. 166.
Victoria Falls, Sep. Galpin, 7018; fl. & fr. Sep. Gibbs, 124; Engler; Rogers, 5101, 8674; Matopos, March, Flanagan, 2967.

4726—**Cardiospermum corindum,** *L.* (*C. canescens*, Wall.)
Fl. Trop. Afr. i. 418; Cat. Afr. Pl. Welw. i. 167.
Matopos, fl. & fr. Sep.–Oct. Gibbs, 78; Engler; Rogers, 5199.

**C. Halicacabum,** *L.*
Fl. Trop. Afr. i. 417; Cat. Afr. Pl. Welw. i. 167.
Bulawayo, Rogers.

4734—**Allophylus alnifolius** (*Baker*), *Radlk.* (*Schmidelia alnifolia*, Baker.)
Fl. Trop. Afr. i. 422.
Matopos, Engler.

**A. chirindensis,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 48.
Chirinda Forest, 3700–4000 ft. Swyn. 112.

**A. rubrifolius** (*Hochst.*), *Torre & Harms.* (*Schmidelia rubrifolia*, Hochst.)
Fl. Trop. Afr. i. 423.
Victoria Falls, Allen, 143; Rogers, 5538.

Genus No.
4784—**Pappea capensis,** *E. & Z.* (*Sapindus Pappea,* Sond.)
Fl. Cap. i. 241; For. Fl. Port. E. Afr. 33; For. Fl. Cape, 171.
Bulawayo, Galpin, 7064; Matabeleland, Davy.

**P. fulva,** *Conrad.*
Victoria, Monro, 947; Bulawayo, Chubb, 44; Salisbury, Rogers, 4077.

**P. spp.**
Victoria, Monro, 944, 988.

4831—**Dodonæa viscosa,** *L.*
Fl. Trop. Afr. i. 433; Fl. Cap. i. 242.
Victoria, Monro, 576; Melsetter and Nyahodi Riv. Swyn.; Odzani River Valley, Umtali, Teague, 86.

### Family CLXVII.—MELIANTHACEAE, *Endl.*

4853—**Bersama maschonensis,** *Gürke.*
Umtali, Sep. Engler, 3141.

**B. Swynnertoni,** *Baker f.*
Journ. Bot. 1907, 14.
Melsetter, 3800 ft. Swyn. 9; Chipete Forest, Dec. Swyn.

### Family CLXVIII.—BALSAMINACEAE, *Lindl.*

4856—**Impatiens Cecili,** *N. E. Br.*
Kew Bull. 1906, 101.
Manica Dist. Cecil, 169; Melsetter, 6000 ft. Sep. Swyn. 618.

**I. walleriana,** *Hook. f.*
Fl. Trop. Afr. i. 302.
Chirinda Forest, 3700 ft. April, Swyn. 344.

**I. zombensis,** *Baker*, forma.
Chirinda Forest, 3700–4000 ft. April, Swyn. 343

## Series RHAMNALES.

### Family CLXIX.—RHAMNACEAE, *Lindl.*

4861—**Zizyphus espinosus,** *Buettn.*
South Rhodesia, Rand, 301.

**Z. jujuba,** *Lam.*
Fl. Trop. Afr. i. 379; For. Fl. Port. E. Afr. 35.
Mazoe, 4300 ft. Sep. Eyles, 407; Victoria Falls, Rogers, 5726.

Genus No.

var. **nanus,** *Engl.*

Salisbury, Engler.

**Z. mucronata,** *Willd.*

Fl. Trop. Afr. i. 380; Fl. Cap. i. 475; Nat. Pl. 47; For. Fl. Port. E. Afr. 35; For. Fl. Cape, 177.

Bulawayo, Dec. Rand, 9; Chubb, 27; Rogers, 5505; Nov. Eyles, 1209; Govt. Herb. 915; Matopos, Davy; Govt. Herb. 905; Gwanda, Noble, 30; Umtali, Govt. Herb. 836; Victoria, Monro, 985; Gambadzia Riv. 3300 ft. fr. May, Swyn. 1385; Umvumvumvu Riv. 4000 ft. fr. April, Swyn. 2070; South Melsetter, Swyn.; Salisbury, Rogers, 5779; Matabeleland, Marloth.

**Z. spp.**

Bulawayo, Chubb, 396.

Victoria, Monro, 779.

South Rhodesia, Rand, 589.

4868—**Berchemia discolor,** *Hemsl.*

Fl. Trop. Afr. i. 381; For. Fl. Port. E. Afr. 35.

Sabi Riv. 1000 ft. Nov. Swyn. 1215; Hartley, Govt. Herb. 2095.

4875—**Rhamnus prinoides,** *L'Hérit.*

Fl. Trop. Afr. i. 382; Fl. Cap. i. 477; For. Fl. Cape, 179.

Chipete, 3800 ft. fr. May, Swyn. 428.

**R. sp.**

Bulawayo, 4500 ft. Dec. Eyles, 1005.

4886—**Phylica paniculata,** *Willd.*

Fl. Cap. i. 482; For. Fl. Cape, 180.

Chimanimani Mts. 7000 ft. fr. Sep. Swyn. 632*a*.

4888—**Lasiodiscus Holtzii,** *Engl.*

Chirinda Forest, 3700–4000 ft. fl. & fr. Oct. Swyn. 121; young fr. Dec. Swyn. 6227.

4902—**Gouania longispicata,** *Engl.*

Chirinda Forest, 3700–4000 ft. April, Swyn. 96.

4905—**Helinus mystacinus,** *Hemsl.*

Fl. Trop. Afr. i. 385.

South Rhodesia, Rand, 36.

**H. mystacinus,** *E. Mey.*

Chirinda, 3700–4000 ft. fl. & fr. May, Swyn. 217.

**H. ovatus,** *E. Mey.*

Fl. Trop. Afr. i. 384; Fl. Cap. i. 479; Nat. Pl. 44; Cat. Afr. Pl. Welw. i. 151.

Matopos, 4500 ft. Nov. Eyles, 1185; Rogers, 5646; Victoria, Monro, 1067; Victoria Falls, Rogers, 7146.

### Family CLXX.—VITACEAE, *Lindl.*

Genus No.

4909—**Vitis spp.**

Victoria, Monro, 1026.

Victoria Falls, Rogers, 5062, 5070.

4910—**Ampelocissus Grantii,** *Planch.*

Victoria Falls, Rogers, 5541.

**A. mossambicensis,** *Planch.*

South Melsetter, Swyn.

**A. obtusata,** *Planch.* (*Vitis obtusata,* Welw.)

Fl. Trop. Afr. i. 414 ; Cat. Afr. Pl. Welw. i. 156.

Salisbury, Rand, 1362.

4917—**Rhoicissus capensis,** *Planch.*

Chirinda, 3700–4000 ft. Nov. Swyn. 1370 ; Chikore Hills, 3700–4000 ft. bud Nov. Swyn. 1376.

**R. cunefolia,** *Planch.*

Chirinda, 3800 ft. bud Nov. Swyn. 221.

**R. erythrodes,** *Planch.* (*Vitis erythrodes,* Fresen.)

Fl. Trop. Afr. i. 401 ; Cat. Afr. Pl. Welw. i. 157.

Salisbury, July, Rand, 443.

var. **ferruginea** (*Baker*), *Planch.*

Mazoe, 4700 ft. Jan. Eyles, 507.

**R. rhomboidea,** *Planch.*

Mt. Pene Forest, 6500–7000 ft. Swyn. 1382 ; Chimanimani Mts. 7000 ft. Swyn. 1381; Chirinda Forest, 3700 ft. fr. Oct. Swyn. 92.

**R. sansibarensis,** *Gilg.*

Lusitu Riv. 3000 ft. fr. April, Swyn. 1380.

**R. spp.**

Victoria, Monro, 1060, cf. *R. sansibarensis,* Gilg. ; 1080, cf. *R. sericea,* E. & Z. ; and 577.

Umvumvumvu Riv. Swyn. 1379, cf. *R. sansibarensis,* Gilg.

4918—**Cissus Buchanani,** *Planch.*

Cat. Afr. Pl. Welw. i. 164.

Chipete, 3800 ft. fr. March, Swyn. 231.

**C. congesta,** *Planch.*

Salisbury, Rogers, 5775.

**C. crotalarioides,** *Planch.*

Salisbury, Rand, 1339, 1340.

**C. cymosa,** *Schum.* (*Vitis Thonningii,* Baker.)

Fl. Trop. Afr. i. 407.

Salisbury, Sep. Rand, 606.

Genus No.

**C. fragilis,** *E. Mey.*
Fl. Cap. i. 249.
Victoria Falls, Rogers, 5572, 5614.

**C. gracilis,** *Guill. & Perr.*
Victoria, Monro, 1043 ; Victoria Falls, Rogers, 5552.

**C. hypargyrea,** *Gilg.*
Salisbury, Rand, 1338.

**C. jatrophoides,** *Planch.* (*Vitis jatrophoides*, Welw.)
Fl. Trop. Afr. i. 400; Cat. Afr. Pl. Welw. i. 161.
Salisbury, Rand, 1337.

**C. Marlothii,** *Gilg.*
Matopos, Nov. Marloth, 3386.

**C. rhodesiae,** *Gilg.*
Salisbury, Engler.

**C. rotundifolia,** *Vahl.*
Sabi Riv. 1000 ft. bud Nov. Swyn. 2071.

**C. zombensis,** *Gilg. & Brandt,* forma.
Chirinda, 3500 ft. fr. Sep. Swyn. 194.

**C. spp.**
Bulawayo, 4500 ft. Feb. Eyles, 101, cf. *C. Sandersoni*, Harv.
Salisbury, Rand, 1336, 1363.
Victoria, Monro, 519.
Victoria Falls, Galpin, 7380.
Mazoe, 4400 ft. Jan. Eyles, 504; 4800 ft. Nov. Eyles, 459.

## Series MALVALES.

### Family CLXXIV.—TILIACEAE, *Juss.*

4953—**Corchorus asplenifolius,** *Burch.*
Fl. Cap. i. 229.
Bulawayo, Dec. Gardner, 97; Rogers, 5743, 5495; Wankie, Rogers, 6012.

**C. hirsutus,** *L.*
Fl. Trop. Afr. i. 264.
Matopos, Nov. Eyles, 1150 ; fl. and fr. Oct. Gibbs, 237 ; Engler ; March, Flanagan, 2978 ; Rogers, 5650 ; Victoria, Monro, 1066.

**C. Kirkii,** *N. E. Br.*
Matopos, Rogers, 5345, 5349.

**C. mucilagineus,** *Gibbs.*
Journ. Linn. Soc. Bot. xxxvii. 433.
Matopos, Sep. Gibbs, 8.

Genus No.

**C. muricatus,** *Hochst.*
Fl. Trop. Afr. i. 263.
Victoria Falls, Allen, 87.

**C. serræfolius,** *Burch.*
Fl. Cap. i. 229.
Bulawayo, Dec. Rand, 8.

**C. tridens,** *L.*
Fl. Trop. Afr. i. 264; Cat. Afr. Pl. Welw. i. 101.
Victoria Falls, July, Kolbe, 3174; Rogers, 5537; Ngomi, April, Flanagan, 3290.

**C. trilocularis,** *L.*
Fl. Trop. Afr. i. 262; Fl. Cap. i. 229; Cat. Afr. Pl. Welw. i. 100.
Bulawayo, 4500 ft. Dec. Eyles, 5; Victoria, Monro, 974; Chipete Forest, 3800 ft. fl. & fr. May, Swyn. 469; Upper Buzi, 3800 ft. fr. April, Swyn. 1480; Chipetzana Riv. 3000 ft. fr. April, Swyn. 1481.

**C. sp.**
Gwelo, Jan. Gardner, 40, cf. *C. trilocularis*, L.

4957—**Sparmannia palmata,** *E. Mey.*, **forma.**
Fl. Cap. i. 224.
Chipete Forest, 3800 ft. April, Swyn. 225; Melsetter, 6000 ft. fr. April, Swyn. 789; Chirinda, Swyn.

4966—**Grewia cana,** *Sond.*
Fl. Cap. i. 225.
Bulawayo, 4500 ft. Oct. Eyles, 1089; Monro, 55; Khami, Nov. Marloth, 3394.

**G. chirindae,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 31.
Chirinda, 3700–4000 ft. Nov. Swyn. 131; Chipete, Swyn.

**G. flava,** *DC.*
Fl. Trop. Afr. i. 250; Fl. Cap. i. 225; For. Fl. Cape, 148.
Matopos, Oct. Gibbs, 226; Engler; Victoria Falls, Rogers, 5144.

**G. flavescens,** *Juss.*
Victoria Falls, Rogers, 5597.

**G. guazumifolia,** *Juss.*
Fl. Trop. Afr. i. 245.
Victoria Falls, Rogers, 5590.

**G. monticola,** *Sond.*
Fl. Cap. i. 226.
Bulawayo, 4500 ft. Nov. Eyles, 1225; Chubb, 357; Rogers, 5498; Victoria, Monro, 667.

**G. obovata,** *K. Schum.*
Sabi Riv. 1000 ft. fr. Nov. Swyn. 1217.

Genus No.

**G. occidentalis,** *L.*

Fl. Trop. Afr. i. 246; Fl. Cap. i. 225; For. Fl. Cape, 147; Nat. Pl. 210.

Gwai Forest, 3800 ft. Allen, 236; Chirinda, 3800 ft. Dec. Swyn. 6628.

**G. pilosa,** *Lam.*

Fl. Trop. Afr. i. 250; Cat. Afr. Pl. Welw. i. 96.

Plumtree, fr. April, Flanagan, 3207 ?; Victoria Falls, Rogers, 5591.

**G. spp.**

Bulawayo, Dec. Gardner, 92, cf. *G. subspathulata,* N. E. Br.; Monro, 67, 81; Eyles, 1010.

Victoria Falls, Allen, 81, cf. *G. salvifolia,* Heyne; Allen, 67; Allen, 150, cf. *G. occidentalis,* L.; Rogers, 7265, cf. *G. cana,* Sond.

Mazoe, 4300 ft. Dec. Eyles, 208.

Victoria, Monro, 361, 740, 794, 919, 700.

South Rhodesia, Rand, 40, cf. *G. salvifolia,* Heyne; Rand, 11 and 294.

4975—**Triumfetta angolensis,** *Sprague & Hutchinson.*

Journ. Linn. Soc. Bot. xxxix. 256 (1909).

Odzani River Valley, Umtali, Teague, 204.

**T. annua,** *L.*

Fl. Trop. Afr. i. 256; Cat. Afr. Pl. Welw. i. 97.

Mazoe, 5000 ft. March, Eyles, 255; Victoria Falls, April, Flanagan, 3236; Chirinda, 3800 ft. fl. & fr. April, Swyn. 272; fl. May, Swyn. 473.

**T. annuletum,** *Sprague.*

Gwelo, Sr. Phil. 39; Umtali, 3900 ft. Engler, 3121*a*.

**T. dekindtiana,** *Engl.*

Umvumvumvu Riv. 4000 ft. fr. April, Swyn. 2062.

**T. diversifolia,** *E. Mey.*

Victoria, Monro, 886.

**T. effusa,** *E. Mey.*

Fl. Cap. i. 228; Nat. Pl. 318 (as *T. pilosa,* Roth.).

Victoria Falls, April, Flanagan, 3171; Chirinda, 3800 ft. fr. April, Swyn. 1156; Victoria, Monro, 902.

**T. Mastersii,** *Baker f.*

Salisbury, Aug. Rand, 440; fl. & young fr. Sep. Rand, 592; Bulawayo, Rogers, 5472 ?; Chipetzana Riv. 3000 ft. bud Oct. Swyn. 2061; Nyahodi Riv. 5000 ft. bud Sep. Swyn. 2060; Matabeleland, Oates (as *T. Welwitschii,* Mast.), South Rhodesia, Rand, 81.

Genus No.

**T. pilosa,** *Roth.*

Fl. Trop. Afr. i. 257 ; Fl. Cap. i. 227 ; Cat. Afr. Pl. Welw. i. 98.

Chirinda, 3500 ft. Feb. Swyn. 271; Melsetter, W. H. Johnson, 120.

**T. rhomboidea,** *Jacq.*

Fl. Trop. Afr. i. 257 ; Fl. Cap. i. 227 ; Cat. Afr. Pl. Welw. i. 98 ; Nat. Pl. 252 (as *T. effusa,* E. Mey.).

Matopos, March, Flanagan, 2988 ; Gwelo, Sr. Phil. 23 ; Chirinda, 3800 ft. Feb. Swyn. 270 ; fr. May, Swyn. 472 ; April, Swyn. 1157 ; Upper Buzi, 3000 ft. fr. April, Swyn. 2063.

**T. Sonderi,** *Fic. & Hiern.*

Victoria Falls, Rogers, 5707.

**T. trichocarpa,** *Sond.* (? See note Fl. Trop. Afr. i. 260.)

Fl. Cap. i. 228.

Victoria Falls, Rogers, 7030, 7021.[1]

**T. Welwitschii,** *Mast.*

Fl. Trop. Afr. i. 255 ; Cat. Afr. Pl. Welw. i. 97.

Matopos, fl. and fr. Oct. Gibbs, 261 ; Mazoe, 4300 ft. Sep. Eyles, 426 ; Matopos, Engler ; Salisbury, May, Flanagan, 3230 ; Rand, 1341 ; Odzani River Valley, Umtali, Teague, 266.

var. **laxiflora,** *Sprague & Hutch.* (*T. laxiflora,* Engl.)

Salisbury, 4800 ft. Engler, 3025.

var. **Rehmannii,** *Sprague & Hutch.*

Rusapi, 4200 ft. Engler, 3116.

**T. spp.**

Salisbury, May, Flanagan, 3197, cf. *T. semitriloba,* L.

Victoria, Monro, 502, 589.

Bulawayo, 4500 ft. Sep. Eyles, 1078.

## Family CLXXV.—MALVACEAE, *Juss.*

4983—**Abutilon angulatum,** *Mast.* (*A. intermedium,* Hochst.)

Fl. Trop. Afr. i. 183 ; Cat. Afr. Pl. Welw. i. 65.

Victoria Falls, Allen, 420 ; April, Flanagan, 3304 ; Rogers, 5114, 7122 ; Umvumvumvu Riv. Swyn. ; Bulawayo, Rogers.

**A. Cecili,** *N. E. Br.*

Kew Bull. 1906, 99.

Inyanga, etc. 5400–6300 ft. Cecil, 196.

**A. fruticosum,** *Guill. & Perr.*

Fl. Trop. Afr. i. 187 ; Cat. Afr. Pl. Welw. i. 67.

Bulawayo, Dec. Rand, 27.

[1] Rogers has this number named *T. pentandra,* Reich.

Genus No.

**A. hirsutissimum,** *Moench.* (*A. asiaticum*, Don.)
Cat. Afr. Pl. Welw. i. 66.
Bulawayo, Dec. Rand, 7.

**A. matopense,** *Gibbs.*
Journ. Linn. Soc. Bot. xxxvii. 431.
Matopos, Sep. Gibbs, 98.

**A. Sonneratianum,** *Sweet.*
Chirinda, 3800 ft. fl. & fr. May, Swyn. 504; Chipinga, Swyn.; Bulawayo, Rogers, 13603*.

**A. zanzibaricum,** *Bojer.*
Fl. Trop. Afr. i. 186; Cat. Afr. Pl. Welw. i. 66.
Mazoe, 4500 ft. April, Eyles, 354.

4985—**Wissadula hernandioides,** *Garcke.*
Victoria Falls, 3000 ft. May, Eyles, 142.

**W. rostrata,** *Planch.*
Fl. Trop. Afr. i. 182.
Victoria Falls, July, Kolbe, 3154; April, Flanagan, 3297; Rogers, 5011.

4995—**Malvastrum, spp.**
Khami Riv. 4500 ft. Oct. Eyles, 12.
Bulawayo, Rogers, 13602.
Victoria Falls, Rogers, 7170.

4998—**Sida acuta,** *Burm.* (*S. carpinifolia*, L.)
Fl. Trop. Afr. i. 180; Cat. Afr. Pl. Welw. i. 63.
Salisbury, Rogers, 4020.

**S. cordifolia,** *L.*
Fl. Trop. Afr. i. 181; Fl. Cap. i. 168; Cat. Afr. Pl. Welw. i. 64.
Victoria Falls, 3000 ft. May, Eyles, 145 (forma); Allen, 72; Rogers, 5709; Matopos, Nov. Marloth, 3358; Rogers, 5185, 7088; Gwelo, Sr. Phil. 32; Chipetzana & Chipinga, Swyn.; Bulawayo, Rogers, 5759.

**S. longipes,** *E. Mey.* (*S. capensis*, E. & Z.)
Fl. Cap. i. 167.
Bulawayo, 4500 ft. Jan. Eyles, 3; Dec. Rand, 30; fl. & fr. May, Rand, 292; Matopos, Sep. Gibbs, 79; Engler; Gwelo, Sr. Phil. 28; Victoria Falls, Rogers, 5627, 7168; Salisbury, Rogers, 5799; Matabeleland, Marloth.

var. **canescens,** *Szyszyl.*
Bulawayo, Rogers, 5735.

**S. rhombifolia,** *L.*
Fl. Trop. Afr. i. 181; Fl. Cap. i. 167; Cat. Afr. Pl. Welw. i. 64.
Bulawayo, Dec. Gardner, 91; Mazoe, 4500 ft. March, Eyles, 272 Victoria Falls, Rogers, 7073.

Genus No.

**S. spp.**

Bulawayo, Chubb, 304, 355.

Victoria Falls, Rogers, 5153.

Salisbury, Rogers, 5768, probably sp. n.

5006—**Urena lobata,** *L.*

Fl. Trop. Afr. i. 189; Cat. Afr. Pl. Welw. i. 67; For. Fl. Port. E. Afr. 17.

Victoria Falls, 3000 ft. May, Eyles, 146; April, Flanagan, 3278; Rogers, 5108, 6021.

5007—**Pavonia clathrata,** *Mast.*

Fl. Trop. Afr. i. 193.

North of Bulawayo, 3400 ft. Dec. Eyles, 1124; Bulawayo, Rogers, 13603*.

**P. columella,** *Cav.*

Chirinda, 3800 ft. April, Swyn. 299; May, Swyn. 525; Melsetter, 6000 ft. Swyn. 2049.

**P. macrophylla,** *E. Mey.*

Fl. Trop. Afr. i. 190; Fl. Cap. i. 169.

Mazoe, 4300 ft. Dec. Eyles, 205; Khami Riv. 4500 ft. Feb. Eyles, 1198; Victoria, Monro, 848; Salisbury, Rogers, 5794; Bulawayo, Rogers, 5761, 13603; South Rhodesia, Rand, 29.

**P. Meyheri,** *Mast.* (*P. galpiniana,* Schinz.)

Fl. Trop. Afr. i. 191.

Salisbury, March, Flanagan, 3021; Mazoe, 4500 ft. April, Eyles, 355; Odzani River Valley, Umtali, Teague, 98.

**P. schimperiana,** *Hochst.*

Fl. Trop. Afr. i. 192.

Chirinda, 3700–4000 ft. May, Swyn. 523.

**P. spp.**

Bulawayo, Chubb, 338; Rogers, 5762.

Matopos, Rogers, 5168.

Victoria Falls, Rogers, 5710, 7202.

South Rhodesia, Rand, 94.

5013—**Hibiscus æthiopicus,** *L.*

Fl. Cap. i. 174.

North Melsetter, 5000–6000 ft. Oct. Swyn. 6222; Bulawayo, Monro, 103 (var.).

**H. Allenii,** *Sprague & Hutch.*

Kew Bull. 1907, 45.

Victoria Falls, Allen, 103.

**H. articulatus,** *Hochst.*

Fl. Trop. Afr. i. 200.

Gwelo, Jan. Gardner, 32; Victoria Falls, Rogers, 7240*a*.

Genus No.
5013—**H. calycinus,** *Willd.* (*H. calyphyllus,* Cav.)
Fl. Trop. Afr. i. 202; Fl. Cap. i. 170; Cat. Afr. Pl. Welw. i. 72.
Bulawayo, Rogers, 5760.

**H. cannabinus,** *L.*
Fl. Trop. Afr. i. 204; Fl. Cap. i. 176; Cat. Afr. Pl. Welw. i. 72.
Bulawayo, fl. & fr. May, Rand, 293; Victoria Falls, Rogers, 7192, 7124, 7418; Chirinda, Swyn.; Odzani River Valley, Umtali, Teague, 130.

**H. diversifolius,** *Jacq.*
Fl. Trop. Afr. i. 198; Fl. Cap. i. 171.
Victoria Falls, Rogers, 5275.

**H. furcatus,** *Roxb.*
Fl. Cap. i. 176; Fl. Trop. Afr. i. 201.
Victoria Falls, Rogers, 7007*.

**H. gossypinus,** *Thunb.*
Fl. Trop. Afr. i. 205; Fl. Cap. i. 175.
Chirinda, 3500 ft. July, Swyn. 2053.

**H. Kirkii,** *Mast.*
Fl. Trop. Afr. i. 199.
Matopos, Rogers, 5367*.

**H. micranthus,** *L.* (*H. rhodanthus,* Gürke.)
Fl. Trop. Afr. i. 205; Cat. Afr. Pl. Welw. i. 74.
Matopos, fl. & fr. Oct. Gibbs, 255 (forma); Engler; Rogers, 5649; Salisbury, Darling, in Herb. Bolus, 10765 (var.); Hartley, Engler; Victoria, Monro.

forma **macranthus ?.**
Salisbury, Sep. Rand, 438, 591; Mazoe, 4300–4700 ft. Aug. Eyles, 183.

**H. mutatus,** *N. E. Br.*
Kew Bull. 1906, 99.
Matopos, Cecil, 108.

**H. panduriformis,** *Burm.*
Fl. Trop. Afr. i. 203; Cat. Afr. Pl. Welw. i. 72.
Mazoe, 4400–4800 ft. Jan. Eyles, 531; Salisbury, Rogers, 5771; Kolbe, 4189; South Rhodesia, Govt. Herb. 737.

**H. pentaphyllus,** *F. Muell.*
Fl. Trop. Afr. i. 199.
Victoria Falls, April, Flanagan, 3158; Rogers, 5584.

**H. physaloides,** *Guill. & Perr.* (*H. caesius,* Garcke.)
Fl. Trop. Afr. i. 199; Fl. Cap. i. 172; Nat. Pl. 319; Cat. Afr. Pl. Welw. i. 69.
Victoria Falls, Allen, 71; Rogers, 7209; Ngomi, April, Flanagan, 3292; Matopos, Flanagan, 3008; Rogers, 5645.

Genus No.
5013—**H. pusillus,** *Thunb.*
Fl. Cap. i. 175; Cat. Afr. Pl. Welw. i. 75.
Bulawayo, Jan. Rand, 25; Rogers, 5744; Matopos, March, Eyles, 110; Victoria Falls, Rogers.

**H. rhodesicus,** *Baker f.*
Journ. Bot. 1899, 424.
Bulawayo, fl. & fr. Dec. Rand, 28.

**H. Schinzii,** *Gürke.*
Victoria Falls, Rogers, 5016.

**H. shirensis,** *Sprague & Hutch.*
Chirinda, 3700–4000 ft. Swyn. 298.

**H. Solandra,** *L'Hér.*
Fl. Trop. Afr. i. 206; Cat. Afr. Pl. Welw. i. 74.
North of Bulawayo, May, Eyles, 81.

**H. surattensis,** *L.*
Fl. Trop. Afr. i. 201; Fl. Cap. i. 177; Nat. Pl. 358; Cat. Afr. Pl. Welw. i. 71
Victoria Falls, April, Flanagan, 3157; Chirinda, Swyn.

**H. Swynnertonii,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 28.
Sabi Riv. 1000 ft. Swyn.

**H. ternatus,** *Mast.*
Fl. Trop. Afr. i. 206.
Bulawayo, Jan. Rand, 69; Victoria Falls, Rogers, 7004.

**H. Trionum,** *L.*
Fl. Trop. Afr. i. 196; Fl. Cap. i. 176.
Bulawayo, Dec. Rand, 6; Rogers, 5745; Gwelo, Sr. Phil. 7.

**H. vitifolius,** *L.*
Fl. Trop. Afr. i. 197; Cat. Afr. Pl. Welw. i. 68.
Victoria Falls, Allen, 116; Rogers, 5050, 7095; Matopos, Rogers, 5658; South Rhodesia, Rand, 26.

**H. spp.**
Victoria Falls, April, Flanagan, 3232; Allen, 113, 133; Rogers, 5121.
Bulawayo, Monro, 22.
Mazoe, 4300 ft. Dec. Eyles, 225.
Victoria, Monro, 1098.
South Rhodesia, Rand, 74.

5015—**Kosteletzkya Büttneri,** *Gürke.*
Cat. Afr. Pl. Welw. i. 68.
Mazoe, 4300 ft. Dec. Eyles, 224.

Genus No.

**K. spp.**

Victoria Falls, April, Flanagan, 3281, cf. *K. flava,* Bak. f. Rogers, 5010, 5113.

5018—**Thespesia garckeana,** *F. Hoffm.*

Salisbury, Engler; Umtali, Engler; Govt. Herb. 834.

**T. spp.**

Victoria Falls, Allen, 277; Rogers, 5142, 5389.

Bulawayo, 4700 ft. Feb. Eyles, 1196.

South Rhodesia, Rand, 430.

5020—**Gossypium sp.**

Bulawayo, Monro, 30.

### Family CLXXVII.—BOMBACACEAE, *K. Schum.*

5023—**Adansonia digitata,** *L.*

Fl. Trop. Afr. i. 212; Cat. Afr. Pl. Welw. i. 79; For. Fl. Port. E. Afr. 16.

Victoria Falls, Davy; Gwanda, Noble, 39; Sabi Valley, Inyamadzi Riv. and Tanganda Riv. Swyn.

### Family CLXXVIII.—STERCULIACEAE, *Schott. & Endl.*

5047—**Melhania acuminata,** *Mast.*

Fl. Trop. Afr. i. 231.

Victoria Falls, Rogers, 7051*.

**M. ferruginea,** *A. Rich.*

Fl. Trop. Afr. i. 231; Cat. Afr. Pl. Welw. i. 88.

Victoria Falls, Rogers, 5611.

**M. Forbesii,** *Planch.*

Fl. Trop. Afr. i. 231; Cat. Afr. Pl. Welw. i. 88.

Victoria, Monro, 751.

**M. linearifolia,** *Sond.*

Fl. Cap. i. 222.

North of Bulawayo, 3400 ft. Dec. Eyles, 1127; Matabeleland, Marloth.

**M. obtusa,** *N. E. Br.*

Kew Bull. 1906, 99.

Bulawayo, Cecil, 94; Matopos, Oct. Gibbs, 283; March, Flanagan, 2979.

**M. prostrata,** *DC.*

Fl. Cap. i. 222.

Salisbury, Engler.

Genus No.

forma **latifolia ?.**

Bulawayo, Dec. Rand, 24.

**M. Randii,** *Baker f.*

Salisbury, fl. & fr. Aug. Rand, 439 ; Rogers, 4058, 4007 ; May, Flanagan.

**M. sp.**

Mazoe, 5000 ft. Sep. Eyles, 411.

5053—**Dombeya densiflora,** *Planch.*

Fl. Cap. ii. 589.

Matopos, Davy ; Odzani River Valley, Umtali, Teague, 248.

**D. reticulata,** *K. Schum.*

Chirinda, July, Swyn. 47.

**D. rosea,** *Baker f.*

Journ. Linn. Soc. Bot. xl. 29.

Chirinda, 3900 ft. April, Swyn. 196.

**D. rotundifolia,** *Harv.*

Fl. Cap. i. 221 ; Nat. Pl. 229.

Salisbury, July, Rand, 568 forma ; Matopos, Sep. Gibbs, 24 ; Engler ; Bulawayo, Engler ; Aug. Eyles, 1066 ; Chubb, 343 ; Victoria Falls, Allen, 419 ; Rogers, 5004 ; Mazoe, 4800 ft. July, Eyles, 377 ; Govt. Herb. 923 ; Gwanda, Noble, 70 ; Inyoka, Govt. Herb. 951.

5056—**Hermannia boraginiflora,** *Hook.*

Fl. Cap. i. 201.

Victoria Falls, July, Kolbe, 3179; Gwelo, Sr. Phil. 35; Bulawayo, Oct.–Dec. Chubb, 303.

**H. brachypetala,** *Harv.*

Fl. Cap. i. 202.

Matopos, Sep. Gibbs, 7 ; Galpin, 7004.

**H. depressa,** *N. E. Br.*

Salisbury, July, Rand, 569 ; Bulawayo, May, Rand, 332 ; Monro, 107 ; Mazoe, 4300–4800 ft. Sep. Eyles, 423.

**H. filipes,** *Harv.*

Fl. Trop. Afr. i. 232 ; Fl. Cap. i. 206.

Victoria Falls, Rogers, 5732.

**H. quartiniana,** *Rich.* (*Mahernia abyssinica,* Hochst.)

Fl. Trop. Afr. i. 234 ; Fl. Cap. i. 216.

Matopos, fl. & fr. Sep.–Oct. Gibbs, 77.

**H. viscosa,** *Hiern.*

Bulawayo, Monro, 59 ; Matopos, Sep. Gibbs, 5 ; Victoria Falls, April, Flanagan, 3228.

Genus No.

var. **Randii,** *Baker f.*

Journ. Bot. 1901, 128.

Bulawayo, May, Rand, 295.

**H. spp.**

Kesi, April, Flanagan, 3283.

Bulawayo, 4500 ft. Jan. Eyles, 2.

South Rhodesia, Rand, 18.

5057—**Melochia corchorifolia,** *L.*

Fl. Trop. Afr. i. 236; Cat. Afr. Pl. Welw. i. 90.

Victoria Falls, Allen, 397.

5059—**Waltheria americana,** *L.* (*W. indica,* L.)

Fl. Trop. Afr. i. 235; Fl. Cap. i. 180; Cat. Afr. Pl. Welw. i. 91.

Bulawayo, Dec. Rand, 53; Matopos, Galpin, 6957; between Plumtree and Bulawayo, April, Flanagan, 3180; Gwelo, Sr. Phil. 40; Victoria Falls, Rogers, 5001; 7159, 7201; Chimanimani Mts. 7000 ft. Sep. Swyn. 2057; Chipetzana, 3000 ft. April, Swyn. 2058; Odzani River Valley, Umtali, Teague, 205.

5083—**Sterculia diversicolor?.**

Matopos, Govt. Herb. 902.

**S. livingstoneana,** *Engl.*

Victoria Falls, Sep. Engler, 2936.

**S. spp.**

Between Malindi and Victoria Falls, Galpin, 7056*a*.

Victoria, Monro, 885.

## Series PARIETALES.

### Family CLXXXII.—OCHNACEAE, *DC.*

5112—**Ochna Antunesii,** *Engl. & Gilg.*

Victoria Falls, Sep. Gibbs, 305; Allen, 50; Rogers, 5301, 5302, 7450, 7459.

**O. chirindica,** *Baker f.*

Journ. Linn. Soc. Bot. xl. 37.

Chirinda Forest, 3700 ft. Oct. Swyn. 106, leaf in May.

**O. leptoclada,** *Oliv.*

Fl. Trop. Afr. i. 318.

Chikore Hills, 3500 ft. Nov. Swyn. 1356; Mt. Pene, 7000 ft. Oct. Swyn. 6172.

**O. pulchra,** *Hook f.*

Fl. Trop. Afr. i. 317; Fl. Cap. i. 449; Cat. Afr. Pl. Welw. i. 121.

Matopos, Davy; North of Bulawayo, Engler; Victoria Falls, Rogers, 7450.

Genus No.

**O. schweinfurthiana,** *F. Hoffm.*
Matopos, fl. & fr. Oct. Gibbs, 218.

**O. spp.**
Victoria Falls, Sep. Galpin, 7050; Allen, 172 cf. *O. Antunesii*, Engl. & Gilg.
Salisbury, Rand, 1351 cf. *O. humilis*, Engl.
Bulawayo, Eyles, 1184.
Chipete Forest, 3800 ft. Swyn. cf. *O. chirindica*, Bak. f.
Charter, Govt. Herb. 3021.
Mazoe, 4600 ft. Jan. Eyles, 506.

5114—**Brackenridgea zanguebarica,** *Oliv.* (*Pleuroridgea zanguebarica*, Van Tieghem.)
Chirinda, 3600 ft. fr. Dec. Swyn. 189; Chikore, Swyn.

## Family CLXXXVII.—GUTTIFERAE, *Juss.*

5168—**Hypericum æthiopicum,** *Thunb.*
Fl. Cap. i. 117.
Chirinda, 3800 ft. April, Swyn. 374; May, Swyn. 508; between Umtali and Imyanga Mts. Cecil.

**H. Lalandii,** *Choisy.*
Fl. Trop. Afr. i. 155; Fl. Cap. i. 118; Cat. Afr. Pl. Welw. i. 56.
Matopos, Gibbs; Rogers, 5175, 5364; Victoria, Monro, 1021; Mt. Pene, 6000 ft. Oct. Swyn. 6173.

**H. lanceolatum,** *Lam.*
Fl. Trop. Afr. i. 156; For. Fl. Port. E. Afr. 14.
Melsetter, 6000 ft. Sep. Swyn. 681, 681*a*; Mt. Pene, 7000 ft. Oct. Swyn. 6091; between Melsetter and Umvumvumvu Riv. Swyn.

5171—**Vismia corymbosa,** *A. Chev.*
Victoria Falls, Rogers, 7245.

5172—**Psorospermum febrifugum,** *Spach.*
Fl. Trop. Afr. i. 158; Cat. Afr. Pl. Welw. i. 57; For. Fl. Port. E. Afr. 14.
Victoria Falls, Rogers, 7259; Chirinda, 3800 ft. Oct. Swyn. 195.

**P. sp.**
Salisbury, Rand, 1367.

5173—**Haronga madagascariensis,** *Choisy.* (*Harungana paniculata*, Pers.)
Fl. Trop. Afr. i. 160; Cat. Afr. Pl. Welw. i. 58; For. Fl. Port. E. Afr. 14.
Chirinda, 3800 ft. fl. & fr. Feb. Swyn. 161.

Genus No.
5199—**Garcinia Livingstonei,** *T. And.*
Fl. Trop. Afr. i. 165; For. Fl. Port. E. Afr. 15.
Victoria Falls, Galpin, 7024; Davy; Sep. Gibbs, 114; Allen, 190; Rogers, 5316, 7463; Engler.

**G. sp.**
Chimanimani Mts. Swyn. 574.

### Family CLXXXVIII.—DIPTEROCARPACEAE, *Heim.*

5228—**Monotes africanus,** *A.DC.* var. **denudans,** *Hiern.* (*Vatica africana,* Welw. var. *laxa,* Oliv.)
Fl. Trop. Afr. i. 173; Cat. Afr. Pl. Welw. i. 61.
Mazoe, 4300 ft. Jan. Eyles, 242; Salisbury, Rand, 1398.

**M. glaber,** *Sprague.* (*Vatica africana,* Welw. var. *glabra,* Oliv.)
Kew Bull. 1909, 305; Fl. Trop. Afr. i. 173.
Hunyani Valley, Allen, 734; Salisbury, Rand, 557.

**M. hypoleucus,** *Gilg.* (*Vatica africana,* Welw. var. *hypoleuca,* Oliv.)
Fl. Trop. Afr. i. 173; Cat. Afr. Pl. Welw. i. 62.
Mazoe, 5000 ft. Dec. Eyles, 211; between Inyamadzi and Buzi, 3400 ft. Dec. Swyn. 157; Upper Buzi, 3000 ft. fr. Oct. Swyn. 1314; Chirinda, Swyn.

**M. sp.**
Victoria, Monro, 870, cf. *M. Engleri,* Gilg.

### Family CLXXXIX.—ELATINACEAE, *Lindl.*

5230—**Bergia decumbens,** *Planch.*
Fl. Trop. Afr. i. 153; Fl. Cap. i. 116.
Bulawayo, Rand, 333 and 337 p.p.; Oct. Eyles, 1092; Monro, 69, 236; Rogers, 5480; Matopos, Sep.–Oct. Gibbs, 30; Engler.

### Family CXCVIII.—VIOLACEAE, *DC.*

5262—**Rinorea convallarioides** (*Baker f.*), *Torre & Harms.* (*Alsodeia convallarioides,* Baker f.)
Journ. Linn. Soc. Bot. xl. 21.
Chirinda Forest, Sep. Swyn. 2119; fr. Oct. 2119*a*; also Swyn. 1110 fr. only taken from same shrub as flowers.

Genus No.

**R. gazensis** (*Baker f.*), *Torre & Harms.* (*Alsodeia gazensis*, Baker f.)
Journ. Linn. Soc. Bot. xl. 22.
Chirinda Forest, 3700–4000 ft. Oct. Swyn. 132; fr. Dec. Swyn. 6500.

5271—**Hybanthus enneaspermum** (*Vent.*), *Torre & Harms.* (*Ionidium enneaspermum*, Vent.)
Fl. Trop. Afr. i. 105.
Bulawayo, Rand, 58; Monro, 95.

**H. sp.**
Bulawayo, 4500 ft. Nov. Eyles, 1214.

5274—**Viola abyssinica,** *Steud.*
Fl. Trop. Afr. i. 105.
Mt. Pene, 7000 ft. Oct. Swyn. 6203.

## FAMILY CXCIX.—FLACOURTIACEAE, *Dumort.*

5275—**Rawsonia lucida,** *Harv. & Sond.*
Fl. Cap. i. 67; Nat. Pl. 575; For. Fl. Port. E. Afr. 12; For. Fl. Cape, 128.
Chirinda Forest, 3800 ft. Oct. Swyn. 658.

5284—**Oncoba spinosa,** *Forsk.*
Fl. Trop. Afr. i. 115; Fl. Cap. ii. 583: For. Fl. Port. E. Afr. 12; Cat. Afr. Pl. Welw. i. 38.
Victoria Falls, Sep. Gibbs, 304.

**O. sp.**
Victoria Falls, Allen, 110 cf. *O. spinosa*, Forsk.

5296—**Kiggelaria africana,** *L.*
Fl. Cap. i. 71; For. Fl. Cape, 128.
Chimanimani Mts. 7000 ft. Swyn. 2039; Mt. Pene Forest, 6500–7000 ft. bud Sep. Swyn. 2040.

5299—**Paropsia reticulata,** *Engl.*
Victoria Falls, Allen, 135; April, Flanagan, 3205; July, Kolbe, 3133; Rogers, 5629, 7460, 7161.

5326—**Neumannia theæformis** (*Benn.*), *Torre & Harms.* (*Aphloia theæformis*, Benn.)
Chimanimani Mts. 7000 ft. Sep. Swyn. 634; Mt. Pene, 6000–6500 ft. Sep. Swyn. 634*a*; fr. Oct. Swyn. 6168.

5327—**Flacourtia hirtiuscula,** *Oliv.*
Fl. Trop. Afr. i. 121.
Victoria, Monro, 638.

**F. Ramontchi,** *L'Hér.*
Fl. Trop. Afr. i. 120; For. Fl. Port. E. Afr. 13.
Matopos, Engler.

Genus No.

**F. spp.**

Victoria Falls, Allen, 192.
Victoria, Monro, 527.
Matopos, Rogers, 5895, 5696.
South Rhodesia, Rand, 605.

5328—**Doryalis (Dovyalis) caffra,** *Sim.* (*Aberia caffra,* Hook. f.)

Fl. Cap. ii. 584; For. Fl. Port. E. Afr. 13; For. Fl. Cape, 129; Harv. Gen. S. A. Pl. 16.

Gwanda, Noble, 45; Victoria, Monro, 472; Lomagundi, Govt. Herb. 977.

**D. macrocalyx,** *Warb.* (*Aberia ? macrocalyx,* Oliv.)

Fl. Trop. Afr. i. 122; Cat. Afr. Pl. Welw. i. 40.

Chirinda Forest, 3800–4000 ft. fr. Oct. Swyn. 68.

**D. Zeyheri** (*Sond.*), *Torre & Harms.* (*Aberia Zeyheri,* Sond.)

Fl. Cap. i. 70.

Victoria, Monro, 545, 763; Victoria Falls, Rogers, 13057*.

**D. sp.**

Victoria, Monro, 833.

## Family CCI.—TURNERACEAE, *H. B. & K.*

5355—**Wormskioldia lobata,** *Urb.*

Cat. Afr. Pl. Welw. i. 381.

Bulawayo, Dec. Rand, 13; Victoria, Monro, 686, 817, 897; Victoria Falls, Rogers, 5631* 7013*.

**W. longepedunculata,** *Mast.*

Fl. Trop. Afr. ii. 502.

Matabeleland, Oates; Bulawayo, Dec. Rand, 20 (forma); Nov. Eyles, 24; Salisbury, fl. and fr. Sep. Rand, 613; May, Flanagan, 3254; Matopos, Sep. Gibbs, 48; Victoria Falls, Gibbs; Allen, 95; North of Hartley, Engler; Rusapi, Engler; Mazoe, 4300–4800 ft. Nov. Eyles, 453; Victoria, Monro, 687; Gwelo, Sr. Phil. 24.

**W. petersiana ?.**

South Rhodesia, Rand.

**W. tanacetifolia,** *Klotzsch.* (? *W. heterophylla,* Schum.)

See note Fl. Trop. Afr. ii. 503.

Victoria, Monro, 1053.

**W. sp.**

Victoria Falls, Allen, 142.

5356—**Streptopetalum serratum,** *Hochst.*

Bulawayo, Jan. Rand, 68; Victoria Falls, Rogers, 7253.

FAMILY CCIII.—PASSIFLORACEAE, *Lindl.*

Genus No.
5369—**Tryphostemma apetalum,** *Baker f.* var. **serratum,** *Baker f.*
Journ. Bot. 1899, 437.
Salisbury, fl. and fr. Dec. Marshall; April, Flanagan, 3150; Rand, 1347; Rogers, 4022; Gwibi Flats, 5000 ft. Sep. Eyles, 412; Rusapi, Engler; Umtali, Engler; Mazoe, 4300 ft. Nov. Eyles, 461.

**T. Mastersii ?.**
South Rhodesia, Rand.

**T. parvifolium,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 73.
Between Lusitu and Melsetter, 6000 ft. Sep. Swyn. 1415.

**T. pedatum,** *Baker f.*
Journ. Bot. 1899, 436.
Shasi Riv. Jan. Rand, 67.

**T. spp.**
Salisbury, Rand, 470.
South Rhodesia, Flanagan, 3159.

5370—**Adenia senensis,** *Engl.*
Salisbury, Rand, 1345, 1346; Bulawayo, Monro, 68.

SERIES **OPUNTIALES.**

FAMILY CCX.—CACTACEAE, *Lindl.*

5416—**Rhipsalis Cassytha,** *Gaertn.* (*Hariota parasitica,* O. Kuntze.)
Fl. Trop. Afr. ii. 581; Fl. Cap. ii. 480; Cat. Afr. Pl. Welw. i. 407; Nat. Pl. 394.
Chirinda Forest, 3700–4000 ft. Nov. Swyn. 1086; Chipete, Swyn.

SERIES **MYRTIFLORAE.**

FAMILY CCXIII.—OLINIACEAE, *C. Presl.*

5428—**Olina vanguerioides,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 72.
Umswirizwi Riv. 3500 ft. Dec. Swyn. 158.

FAMILY CCXIV.—THYMELAEACEAE, *Reichb.*

5434—**Peddiea Dregei,** *Meisn.*
Chipete Forest, Jan. Swyn. 123; Mt. Pene, 6500 ft. Swyn. 123*a*; Chirinda Forest, Swyn.

Genus No.
5435—**Gnidia anthylloides ?.**
Bulawayo, Chubb, 57.
**G. Buchananii,** *Gilg.*
Fl. Trop. Afr. VI. i. 219.
Nyahodi Riv. 5000 ft. Sep.–Oct. Swyn. 1834, 6136.
**G. chrysantha,** *Gilg.* (*Arthrosolen chrysantha,* Solms-Laub.)
Fl. Trop. Afr. VI. i. 234.
Between Umtali and Salisbury, Cecil, 55.
**G. kraussiana,** *Meisn.* (*Lasiosiphon Kraussii,* Meisn.)
Fl. Trop. Afr. VI. i. 231; Nat. Pl. 256; For. Fl. Cape, 302.
Matopos, Oct. Gibbs, 229; Engler; Mazoe, 4300–4800 ft. Aug. Eyles, 396; Salisbury, Rogers, 4015, 4016; North of Hartley, Engler; Mt. Pene, 6500–7000 ft. Sept. Swyn. 1787; Bulawayo, Chubb, 307; Rogers, 5920.
**G. microcephala,** *Meisn.*
Fl. Trop. Afr. VI. i. 225.
North of Hartley, Engler; Salisbury, Rand, 1373; Victoria, Monro, 888.
**G. microphylla,** *Meisn.*
Matopos, 4800 ft. Nov. Eyles, 1186.
**G. phyllodinea,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 186.
Melsetter, 6000 ft. April, Swyn. 1833.
**G. roridus** (*S. Moore*), *Torre & Harms.* (*Lasiosiphon roridus,* S. Moore.)
Journ. Linn. Soc. Bot. xl. 187.
Melsetter, 6000 ft. Oct. Swyn. 6134.
**G. spp.**
Salisbury, Rand, 528, 529, 530; March, Flanagan, 3024; Darling, in Herb. Bolus 10787.
Bulawayo, Chubb, 385, 366.
South Rhodesia, Rand, 204, 205, 390, 643, 646.
5442—**Synaptolepis longiflora,** *Gilg.*
Fl. Trop. Afr. VI. i. 246.
Chirinda, 3500 ft. Oct. Swyn. 188.

### Family CCXVI.—LYTHRACEAE, *Lindl.*

5473—**Rotala cataractae** *Koehne.*
Victoria Falls, Sep. Engler, 2990.
**R. filiformis,** *Hiern.*
Fl. Trop. Afr. ii. 468; Cat. Afr. Pl. Welw. i. 372.
Victoria Falls, Kirk.

Genus No.

**R. heteropetala,** *Koehne*, var. **Engleri,** *Koehne.*
Victoria Falls, Sep. Engler, 2983.

**R. longistyla,** *Gibbs.*
Journ. Linn. Soc. Bot. xxxvii. 445.
Victoria Falls, Sep. Gibbs, 170.

**R. spp.**
Victoria Falls, 3000 ft. May, Eyles, 124 ; Rogers, 7416.
Victoria, Monro, 1072.

5474—**Ammannia baccifera,** *L.*
Fl. Trop. Afr. ii. 478 ; Cat. Afr. Pl. Welw. i. 374.
Ngomi, April, Flanagan, 3291 ; Victoria Falls, Rogers, 7096*.

**A. senegalensis,** *Lam.*
Fl. Trop. Afr. ii. 477 ; Cat. Afr. Pl. Welw. i. 373.
Bulawayo, May, Rand, 337, 574 ; Victoria, Monro, 1016, 1093.

**A. sp.**
Victoria, Monro, 1050.

5476—**Lythrum sagittifolium,** *Sond.*
Fl. Cap. ii. 516.
Bulawayo, 4500 ft. Oct. Eyles, 1070.

5486—**Nesæa erecta,** *G. & P.*
Fl. Trop. Afr. ii. 474.
Victoria Falls, Rogers, 7150*.

**N. floribunda,** *Sond.*
Fl. Trop. Afr. ii. 474 ; Fl. Cap. ii. 517 ; Cat. Afr. Pl. Welw. i. 376.
Victoria Falls, Galpin, 7032 ; Sep. Gibbs, 164 ; Kirk ; Allen, 38 ; Rogers, 5237 ; Matopos, Gibbs ; Umtali, Engler ; Gwelo, Sr. Phil. 29 ; Victoria, Monro, 815 & 348 ?

**N. heptamera,** *Hiern.*
Fl. Trop. Afr. ii. 472.
Marandellas, Rogers, 4039.

**N. mucronata,** *Koehne.*
Bulawayo, Chubb, 350, 324.

**N. passerinoides,** *Koehne.*
Cat. Afr. Pl. Welw. i. 377.
Salisbury, April, Flanagan, 3260.

**N. radicans,** *Guill. & Perr.*
Fl. Trop. Afr. ii. 474 ; Cat. Afr. Pl. Welw. i. 376.
Victoria Falls, 3000 ft. May, Eyles, 122 (forma) ; Engler ; Rogers, 5123.

**N. rigidula,** *Koehne.*
Khami Riv. 4500 ft. Oct. Eyles, 1084.

**N. sagittifolia,** *Sond.*
Bulawayo, May, Rand, 330.

Genus No.

**N. Stuhlmannii,** *Koehne.*
Marandellas, Engler.

**N. triflora,** *H. B. Kunth.*
Salisbury, Sep. Rand, 588.

**N. spp.**
Gwai, Jan. Allen, 246.
Victoria, Monro, 1049.
Bulawayo, Chubb, 365.
Salisbury, Rand, 1390 cf. *N. linifolia*, Hiern.

## Family CCXX.—RHIZOPHORACEAE, *Lindl.*

5528—**Weihea Gerrardi,** *Schinz.*
Mt. Pene Forest, 6500–7000 ft. Sep. Swyn. 1325.

## Family CCXXI.—COMBRETACEAE, *R. Br.*

5538—**Combretum abbreviatum,** *Engl.*
Chirinda Forest, Oct. Swyn. 95.

**C. apiculatum,** *Sond.*
Fl. Trop. Afr. ii. 429 ; Fl. Cap. ii. 510 ; For. Fl. Port. E. Afr. 63.
Bulawayo, Jan. Rand, 33 ; Nyamandhlovu, fr. April, Flanagan, 3195 ; Sabi Riv. 1000 ft. Nov. Swyn. 700 ; Victoria Falls, Rogers, 5569, 5525 ; Wankie, Rogers, 5992.

var. **parvifolium,** *Baker f.*
Journ. Bot. 1905, 46.
Bulawayo, 4500 ft. Oct. Eyles, 1094.

**C. arbuscula,** *Engl.*
Bulawayo, Monro, 6 & 84 ; Chirinda, 3700 ft. Oct. Swyn. 43 ; Inyamadzi Valley, fr. April, Swyn. 43*a*.

**C. atelanthum,** *Diels.*
Salisbury, Sep. Engler, 3098.

**C. Bragae,** *Engl.*
Umtali, Engler.

**C. cataractarum,** *Diels.*
Victoria Falls, Sep. Engler, 2925 ; Allen, 46 ; Sep. Gibbs, 127 ; Galpin, 7048 ; Rogers, 5289 ; Wankie, Rogers, 5994.

**C. cognatum,** *Diels.*
North of Bulawayo, Sep. Engler, 2885.

**C. erythrophyllum,** *Sond.*
Fl. Cap. ii. 509 ; For. Fl. Cape, 222.
Bulawayo, Monro, 89 ; Nyahodi Riv. 5500 ft. Sep. Swyn. 701.

Genus No.

5538—**C. glomeruliflorum,** *Sond.*

Fl. Cap. ii. 509.

Bulawayo, Rand, 585; Monro, 87, 88; Chubb, 50.

**C. Gueinzii,** *Sond.*

Fl. Cap. ii. 509.

Khami, Nov. Marloth, 3389; Matopos, Engler; Victoria Falls, Rogers, 5571.

**C. hereroense,** *Schinz.*

Bulawayo, Engler.

**C. holosericeum,** *Sond.*

Fl. Trop. Afr. ii. 430; Fl. Cap. ii. 510; Cat. Afr. Pl. Welw. i. 350; For. Fl. Port. E. Afr. 63.

Matabeleland, Oates; Marloth; Mashonaland, Mundy.

**C. imberbe,** *Wawra.*

South of Zambesi, Engler.

**C. Junodii,** *Dümmer.*

Victoria, Monro, 481, 508.

**C. Lindenbergianum,** *Engl. & Diels.*

Victoria, Monro, 499; Mashonaland, Mundy.

**C. microphyllum,** *Klotzsch.*

Fl. Trop. Afr. ii. 427; For. Fl. Port. E. Afr. 63.

Victoria, Monro, 467; Sabi Riv. 1000 ft. Nov. Swyn. 2083.

**C. mossambicense,** *Engl.*

Sabi Riv. 1000 ft. Nov. Swyn. 590, 591.

**C. oblongum,** *F. Hoffm.*

Victoria Falls, Rogers, 5792?

**C. patelliforme,** *Engl. & Diels.*

Victoria Falls, Rogers, 5589.

**C. platypetalum,** *Welw.* (*C. Oatesii*, Rolfe.)

Fl. Trop. Afr. ii. 433; Cat. Afr. Pl. Welw. i. 353.

Matabeleland, Oates; Bulawayo, Sep. Rand, 322; Nov. Eyles, 1109; Salisbury, Sep. Rand, 466; Rogers, 4060; Darling, in Herb. Bolus, 10775; Khami, Nov. Marloth, 3392; Matopos, Sep. Gibbs; Mazoe, 4300 ft. Sep. Eyles, 432; Gwibi Flats, 5000 ft. Oct. Eyles, 441; North of Hartley, Engler; Victoria, Monro, 451, 567, 504, 544; Marandellas, Rogers, 4037.

**C. primigenum,** *Marloth & Engl.*

Victoria Falls, April, Flanagan, 3227; Rogers, 5702, 5708; Victoria, Monro, 869, 646.

**C. rhodesicum,** *Baker f.*

Journ. Bot. 1899, 435.

Bulawayo, fl. & fr. Sep. Rand, 582, 583; Rogers, 5924, 5502; Matopos, fl. & fr. Oct. Gibbs, 267; Rogers, 5635; Zambesi

Genus No.

banks, Sep. Galpin, 7013; Umtali–Melsetter road, 2000–3000 ft. Oct. Swyn. 6600; Victoria Falls, Rogers, 5534, 5353.

**C. salicifolium.** *E. Mey.*

Fl. Cap. ii. 511; For. Fl. Port. E. Afr. 64; For. Fl. Cape, 222.

Bulawayo, Monro, 80; Victoria, Monro, 208; Gwanda, Noble, 50.

**C. tetraphyllum,** *Diels.*

South of Zambesi, Sep. Engler, 2906.

**C. ulugurense,** *Engl.*

Victoria, Monro, 466.

**C. Zeyheri,** *Sond.*

Fl. Cap. ii. 511; For. Fl. Port. E. Afr. 63; Cat. Afr. Pl. Welw. i. 352.

Matopos, Oct. Gibbs, 221; Mazoe, 4300 ft. Sep. Eyles, 434?; Umvumvumvu Riv. 2000 ft. April, Swyn. 2081; Victoria, Monro, 509, 564; Victoria Falls, Rogers, 5700; Bulawayo, Monro, 368, 346; Sebakwe, Rogers, 8591; Wankie, Rogers, 5990; between Bulawayo & Victoria Falls, Galpin; Queque, Rogers, 5451*.

**C. spp.**

Bulawayo, Chubb, 339, 372.

Salisbury, Rand, 467.

Victoria, Monro, 302, 475, 535, 650, 698, 699.

Victoria Falls, Gibbs, 127; Rogers, 5273, 5305, 5570.

Matopos, Rogers, 5344; Govt. Herb. 884.

Gockwe Hills, Govt. Herb. 952, 946.

Lomagundi, Govt. Herb. 963, 969.

Mazoe, Govt. Herb. 2084.

South Rhodesia, Rand, 32, 132, 323, 324, 426, 429, 579, 580, 584, 602.

5539—**Pteleopsis myrtifolia,** *Engl. & Diels.*

Upper Inyamadzi, Dec. Swyn. 48; Inyamadzi Valley, 3300 ft. fr. April, Swyn. 2084; Chirinda, Swyn.; Chikore, Swyn.

5541—**Quisqualis indica,** *L.*

Fl. Trop. Afr. ii. 435.

Chirinda, cultivated, Swyn.

5544—**Terminalia Brownii,** *Fresen.*

Fl. Trop. Afr. ii. 415; For. Fl. Port. E. Afr. 64.

Bulawayo, Monro, 48.

**T. prunioides,** *Laws.*

Fl. Trop. Afr. ii. 415; For. Fl. Port. E. Afr. 64.

Victoria Falls, Allen, 122.

Genus No.

**T. Randii,** *Baker f.*

Journ. Bot. 1899, 435.

Bulawayo, fl. & fr. May, Rand, 325; Chubb, 9*a*; Rogers, 5452; Nov. Eyles, 1210.

**T. sericea,** *Burch.*

Fl. Trop. Afr. ii. 416; Fl. Cap. ii. 508; Cat. Afr. Pl. Welw. i. 338; For. Fl. Port. E. Afr. 64; Harv. Gen. S.A. Pl. 110.

Bulawayo, 4500 ft. Eyles, 1221; Engler; Monro, 105; from Bulawayo to Victoria Falls, Galpin, 6955; Matopos, Davy; Engler; Victoria Falls, Davy; Allen, 425; Umtali, Engler; Gwanda, Noble, 35; Victoria, Monro, 668 var.; Fort Gibbs, Rand, 600, 601; Gwelo, Rand, 5; Chirinda, Swyn.; Chikore Hills, Swyn.; Nyahodi Riv. Swyn.

var. **angolensis,** *Hiern.*

Cat. Afr. Pl. Welw. i. 338.

Bulawayo, May, Rand, 416.

**T. silozensis,** *Gibbs.*

Journ. Linn. Soc. Bot. xxxvii. 444.

Matopos, Silozi Hill, fl. & fr. Oct. Gibbs, 277.

**T. spinosa,** *Engl.*

South of Zambesi, Engler.

**T. Stuhlmannii,** *Engl.*

Victoria Falls, Allen, 123; Rogers, 5526.

**T. torulosa,** *F. Hoffm.*

Victoria Falls, Rogers, 5568; Victoria, Monro, 880.

**T. trichopoda,** *Diels.*

Matopos, Sep. Engler, 2847; Umtali, Engler, 3142.

**T. velutina,** *Rolfe.*

Bulawayo, Chubb, 105.

**T. spp.**

Victoria Falls, Allen, 63 cf. *T. spinosa*, Engl.; Allen, 163.

Between Plumtree and Bulawayo, fr. April, Flanagan, 3209.

### Family CCXXII.—MYRTACEAE, *Pers.*

5578—**Eugenia angolensis,** *Engl.*

Chirinda, 3800 ft. Aug. Swyn. 242.

**E. chirindensis,** *Baker f.*

Journ. Linn. Soc. Bot. xl. 70.

Chirinda Forest, 3700–4000 ft. Dec. Swyn. 128; Oct. Swyn. 443; Chipete Forest, Oct. Swyn. 1343.

Genus No.

**E. cordata,** *Laws.* (*Syzygium cordatum,* Hochst.)

Fl. Trop. Afr. ii. 438; Fl. Cap. ii. 521; For. Fl. Port. E. Afr. 67; For. Fl. Cape, 226; Cat. Afr. Pl. Welw. i. 360.

Victoria Falls, Allen, 53; Galpin; Engler; Umtali, Engler; Mazoe, Govt. Herb. 925; North of Sengwe Riv. Govt. Herb. 954; Chirinda, 3800 ft. Oct. Swyn. 25; Haroni Riv. 3500 ft. Nov. Swyn. 1309; Melsetter Dist. Swyn.

**E. owariensis,** *P. Beauv.* (*Syzygium owariense,* Benth.; *Syzygium guineense,* DC.)

Fl. Trop. Afr. ii. 438; For. Fl. Port. E. Afr. 67; Cat. Afr. Pl. Welw. i. 359.

Salisbury, Aug. Rand, 468; Sep. Rand, 586 (forma); Engler; Mazoe, 4800 ft. Sep. Eyles, 403; Victoria Falls, Engler; Galpin, 7022; Allen, 69; Rogers, 6027; Umtali, Engler; Victoria, Monro, 480; Chirinda, 3500 ft. June, Swyn. 23; Chimanimani Mts. 7000 ft. Sep. Swyn. 642; Mt. Pene, 6500–7000 ft. Sep. Swyn. 638; Sabi Riv. 1000 ft. Nov. Swyn. 1311; Chipete Forest, Swyn.

forma **latifolia,** *Engl. & Gilg.*

Chirinda, 3500 ft. Oct. Swyn. 24; Chikore Hills, Nov. Swyn. 1304.

**E. spp.**

Victoria Falls, Allen, 56 cf. *E. cordata,* Laws.

Salisbury, Rand, 1366.

Victoria Monro, 547, 759, 764.

Mazoe, Govt. Herb. 926, 927.

5583—**Syzygium benguelense** (*Welw.*), *Engl.* (*Eugenia benguellensis,* Welw.)

Cat. Afr. Pl. Welw. i. 360.

North of Hartley, Engler.

**S. huillense** (*Hiern*), *Engl.* (*Eugenia guineensis,* var. *huillensis,* Hiern.)

Cat. Afr. Pl. Welw. i. 359.

North of Hartley, Engler; Salisbury, Engler; Marandellas, Engler.

**S. intermedium,** *Engl.*

Victoria Falls, Engler.

## Family CCXXIII.—MELASTOMATACEAE, *R. Br.*

5651—**Antherotoma Naudini,** *Hook. f.* (*Osbeckia antherotoma,* Naud.)

Fl. Trop. Afr. ii. 444; Cat. Afr. Pl. Welw. i. 363.

Chirinda, 3800 ft. fr. July, Swyn. 516.

Genus No.
5658—**Osbeckia Swynnertonii,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 71.
Chimanimani Mts. 7000 ft. Sep. Swyn. 2085.

5659—**Dissotis debilis,** *Triana.*
Cat. Afr. Pl. Welw. i. 366.
Matopos, 4500 ft. Jan. Eyles, 153.

**D. incana,** *Triana.*
Mazoe, 4300 ft. Jan. Eyles, 509; Salisbury, Rogers, 4070; Chirinda, 3800 ft. Dec. Swyn. 296; Odzani River Valley, Umtali, Teague, 101.

**D. phæotricha,** *Hook. f.* (*Osbeckia phæotricha*, Hochst.)
Fl. Trop. Afr. ii. 451; Fl. Cap. ii. 519.
Salisbury, Dec. Rand, 76; Matopos, 4500–5000 ft. March, Eyles, 1017; Victoria, Monro, 648, 815.

**D. princeps,** *Triana.*
Chirinda, 3800 ft. May, Swyn. 526; Odzani River Valley, Umtali, Teague, 227.

**D. segregata,** *Hook. f.*
Fl. Trop. Afr. ii. 448.
Victoria Falls, Allen, 111; Rogers, 5585, 7270.

**D. spp.**
Victoria Falls, April, Flanagan, 3165 cf. *D. segregata.*
Victoria, Monro, 348.

## Family CCXXIV.—OENOTHERACEAE, *Lindl.*

5791—**Jussieua repens,** *L.* (*J. diffusa*, Forsk.)
Fl. Trop. Afr. ii. 488; Cat. Afr. Pl. Welw. i. 379.
Victoria Falls, Allen, 73; April, Flanagan, 3282; North of Bulawayo, Engler.

**J. suffruticosa,** *L.* (*J. angustifolia*, Lam.; *J. villosa*, Lam.)
Fl. Trop. Afr. ii. 489; Fl. Cap. ii. 504; Cat. Afr. Pl. Welw. i. 380.
Victoria Falls, Allen, 32; May, Eyles, 120; Engler; April, Flanagan, 3233; Rogers, 5283; Matopos, Rogers, 5691; Victoria, Monro, 923.

**J. sp.**
Victoria, Monro, 872 cf. *J. linifolia*, Vahl.

5793—**Ludwigia jussiæoides,** *Harv.* (*non Lam.*).
Harv. Gen. S.A. Pl. 117.
Victoria Falls, 3000 ft. May, Eyles, 103.

**L. pulvinaris,** *Gilg.*
Victoria Falls, Rogers, 5286.

Genus No.

**L. sp.**

Victoria Falls, April, Flanagan, 3300 cf. *L. parviflora*, Benth.

5795—**Epilobium neriophyllum,** *Hausskn.*

Odzani River Valley, Umtali, Teague, 323.

**E. hirsutum,** *L.*

Fl. Trop. Afr. ii. 487 ; Fl. Cap. ii. 506.

Mazoe, 4500 ft. Feb. Eyles, 524.

**E. sp.**

Matopos, Rogers, 5257.

## Series UMBELLIFLORAE.

### Family CCXXVII.—ARALIACEAE, *Vent.*

5872—**Cussonia natalensis,** *Sond.*

Fl. Cap. ii. 568.

Matopos, fl. & fr. Sep. Gibbs, 107 ; Engler.

**C. spicata,** *Thunb.*

Fl. Trop. Afr. iii. 32 ; Fl. Cap. ii. 568 ; For. Fl. Port. E. Afr. 70 ; For. Fl. Cape, 229.

Umtali, Engler ; Chirinda, 3800 ft. Swyn. 159 ; Chimanimani Mts. 7000 ft. Swyn. 2092 ; Mazoe, Govt. Herb. 2087.

**C. umbellifera,** *Sond.*

Fl. Cap. ii. 570 ; For. Fl. Cape, 230.

Chimanimani Forest, fr. Sep. Swyn. 653*a*.

**C. sp.**

Victoria, Monro, 718.

### Family CCXXVIII.—UMBELLIFERAE, *Morison.*

5893—**Hydrocotyle asiatica,** *L.*

Fl. Trop. Afr. iii. 6 ; Fl. Cap. ii. 527 ; Cat. Afr. Pl. Welw. i. 423.

Victoria Falls, Engler.

**H. moschata,** *Forst.*

Fl. Trop. Afr. iii. 5.

Chirinda Forest, 3800 ft. fr. April, Swyn. 347.

**H. sp.**

Victoria Falls, Rogers, 5324 cf. *H. verticillata*, Thunb. & *H. Bonariensis*, Lam.

5918—**Sanicula europæa,** *L.*

Fl. Trop. Afr. iii. 8 ; Fl. Cap. ii. 533.

Chirinda Forest, 3700–4000 ft. April, Swyn. 346.

Genus No.
5922—**Alepidea propinqua,** *Dümmer.*
Trans. R. S. S. Afr. iii. 9; Fl. Trop. Afr. iii. 7, as *A. amatymbica*, E. & Z.
Chimanimani Mts. 4500 ft. Johnson, 184; Swyn. 6208; Chirinda, 3500 ft. Swyn. 233; Odzani River Valley, Umtali, Teague, 212.

**A. Swynnertonii,** *Dümmer.*
Trans. R. S. S. Afr. iii. 15.
Chimanimani Mts. 7000 ft. Swyn. 6208*a*.

5990—**Lichtensteinia sp.**
Bulawayo, 4500 ft. Sep. Eyles, 1251.

5992—**Heteromorpha arborescens,** *Cham. & Schlecht.*
Fl. Trop. Afr. iii. 10; Fl. Cap. ii. 542; For. Fl. Port. E. Afr. 69; For. Fl. Cape, 229; Harv. Gen. S.A. Pl. 140.
Mazoe, 4400 ft. March, Eyles, 279; Matopos, Rogers; Victoria, Monro, 778, 895; Chirinda, 4000 ft. fl. & fr. April, Swyn. 182; Lusitu Riv. 4000 ft. Swyn. 2091.

**H. spp.**
Victoria, Monro, 320.
South Rhodesia, Rand, 17, 329.

6020—**Carum copticum,** *Benth. & Hook.*
Fl. Trop. Afr. iii. 12.
Salisbury, Govt. Herb. 752.

6038—**Sium sp.**
Mazoe, 4300 ft. Dec. Eyles, 228.

6054—**Diplolophium zambesianum,** *Hiern.*
Fl. Trop. Afr. iii. 18.
Salisbury, Dec. Rand, 71; July, Rand, 473; May, Flanagan, 3247; Mazoe, 4300–4600 ft. March, Eyles, 269 ?; Bulawayo, Rogers, 13106*.

6055—**Physotrichia Swynnertonii,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 76.
Melsetter, 6000 ft. fl. and young fr. Sep. Swyn. 649.

6116—**Peucedanum araliaceum,** *Benth. & Hook.*
Fl. Trop. Afr. iii. 21.
South of Zambesi, Engler; Rusapi, Engler; Umtali, Engler.

**P. benguellensis** (*Welw.*), *Torre & Harms.* (*Lefeburia benguellensis*, Welw.)
Cat. Afr. Pl. Welw. i. 430 (*Lefeburia*).
Chirinda, 3800 ft. fr. May, Swyn, 395.

**P. fraxinifolium,** *Hiern.*
Fl. Trop. Afr. iii. 22; Cat. Afr. Pl. Welw. i. 427.
Matopos, fl. and old fr. Sep. Gibbs, 83; Victoria Falls, Gibbs; Allen, 407; Bulawayo, Oct.-Dec. Chubb, 318; Victoria, Monro, 307.

Genus No.

**P. spp.**

Mazoe, 4800 ft. March, Eyles, 268.

Salisbury, May, Flanagan, 3270. Same as Eyles 268, cf. *Lefeburia abyssinica*, Rich.

Victoria, Monro, 436, 524.

FAMILY CCXXIX.—CORNACEAE, *Link.*

6156—**Curtisia faginea,** *Ait.*

Fl. Cap. ii. 570.

Chimanimani Mts. 7000 ft. fl. & fr. Sep. Swyn. 637; Odzani River Valley, Umtali, Teague, 211.

## SUBCLASS **METACHLAMYDEAE.**

### SERIES **ERICALES.**

FAMILY CCXXXIII.—ERICACEAE, *DC.*

6237—**Erica lanceolifera,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 126.

Chimanimani Mts. 7000 ft. Sep. Swyn. 1288.

**E. pleiotricha,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 127.

Chimanimani Mts. 7000 ft. Sep. Swyn. 648*a*.

**E. Swynnertonii,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 128.

Melsetter, 6000 ft., between Lusitu and Nyahodi Rivs., 5000 ft., Chimanimani Mts. 6000 ft. fl. April, Sep. Swyn. 648, 1063, 1064, 1065.

**E. thryptomenoides,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 126.

Chimanimani Mts. 7000 ft. Sep. Swyn. 647.

6240—**Philippia hexandra,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 129.

Melsetter, 5000–6000 ft. Oct. Swyn. 1147; North Melsetter, Swyn. 6072.

**P. milanjiensis,** *Britt. & Rendle.*

Mazoe, 5200 ft. April, Eyles, 336; Hunyani Riv. Rand, 501.

Genus No.

**P. Simii,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 128.

Melsetter, 6000 ft. Oct. Swyn. 612.

## Series PRIMULALES.

### Family CCXXXVI.—MYRSINACEAE, *Lindl.*

6283—**Maesa lanceolata,** *Forsk.* (*M. rufescens*, A. DC.)

Fl. Trop. Afr. iii. 492; Fl. Cap. IV. i. 432; For. Fl. Cape, 249; Cat. Afr. Pl. Welw. i. 637.

Mazoe, 4300 ft. Jan. Eyles, 502; April, Eyles, 303; Salisbury, March, Flanagan, 3020; Chirinda, 3500 ft., North Melsetter, 5000–6000 ft. fl. & fr. April, Sep. Oct. Swyn. 142, 172, 6074; also Inyamadzi Riv., Chikore Hills and Lusitu Valley, etc. Swyn.

**M. sp.**

Chirinda, Swyn. 669.

6310—**Embelia nyassana,** *Gilg.*

Chirinda, 3700 ft. Swyn. 120.

**E. oleifolia,** *S. Moore.*

Journ. Bot. 1909, 297.

Bulawayo, Rand, 504; Monro, 31.

**E. spp.**

Salisbury, Rand, 558.

Victoria, Monro, 419.

6313—**Myrsine africana,** *L.*

Fl. Trop. Afr. iii. 493; Fl. Cap. IV. i. 434; Cat. Afr. Pl. Welw. i. 638; For. Fl. Cape, 250.

Melsetter, 6000 ft., Mt. Pene, 7000 ft., Chimanimani Mts. 7000 ft. Sep. Swyn. 633, 6153*a*, 6154*a*.

6314—**Rapanea umbratilis,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 130.

Melsetter, 6000 ft. Oct. Swyn. 6163.

### Family CCXXXVII.—PRIMULACEAE, *Vent.*

6338—**Anagallis Hanningtonii,** *Baker.*

Chipetzana Riv. 3000 ft. fl. & fr. Dec. Swyn. 357.

6340—**Samolus valerandi,** *L.*

Fl. Trop. Afr. iii. 490; Fl. Cap. IV. i. 430; Cat. Afr. Pl. Welw. i. 637.

Victoria Falls, Engler; Rogers, 5811.

### Family CCXXXVIII.—PLUMBAGINACEAE, *Lindl.*

Genus No.
6343—**Plumbago zeylanica,** *L.*

Fl. Trop. Afr. iii. 486; Fl. Cap. IV. i. 425; Cat. Afr. Pl. Welw. i. 634.

Matopos, Sep. Gibbs, 14; Rogers, 5065; Bulawayo, March, Monro; Rogers, 13610; Chubb, 209, 210; Victoria Falls, April, Flanagan, 3153; Salisbury, Rand, 505.

## Series EBENALES.

### Family CCXXXIX.—SAPOTACEAE, *Dumort.*

6368—**Sideroxylon cinereum** (*Pierre*), *Torre & Harms.* (*Pachystela cinerea*, Pierre.)

Inyamadzi Valley, 3000 ft. Swyn. 571*a*.

6377—**Chrysophyllum argyrophyllum,** *Hiern.*

Cat. Afr. Pl. Welw. i. 641.

Mazoe, 4300 ft. fl. Sep. fr. Nov. Eyles, 378; Chimanimani Mts. 7000 ft. Sep. Nov. Swyn. 22*b*; also at Mt. Pene Forest and Inyamadzi Riv. Swyn.

**C. fulvum,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 131.

Chirinda Forest, 3700–4000 ft. fl. & fr. Dec. Swyn. 19.

**C. natalense,** *Sond.*

Fl. Cap. IV. i. 437; Nat. Pl. 378; For. Fl. Port. E. Afr. 79; For. Fl. Cape, 252.

Chipete Forest, Dec. Swyn. 21.

6386—**Mimusops decorifolia,** *S. Moore.*

Journ. Bot. 1911, 154.

Victoria, Monro, 811.

**M. Kirkii,** *Baker.*

Fl. Trop. Afr. iii. 507; For. Fl. Port. E. Afr. 80.

Victoria Falls, Rogers, 5117, 5310, 5672.

**M. Mochisia,** *Baker.*

Fl. Trop. Afr. iii. 506; For. Fl. Port. E. Afr. 80.

Victoria Falls, Galpin, 7052; Allen, 185.

**M. Monroi,** *S. Moore.*

Journ. Bot. 1911, 154.

Victoria, Monro, 761, 690.

Genus No.

**M. Zeyheri,** *Sond.* var. **laurifolia**, *Engl.*

Fl. Cap. IV. i. 441 (type).

Victoria Falls, Galpin, 7044; Engler.

**M. sp.**

Mazoe, Govt. Herb. 2090.

## Family CCXL.—EBENACEAE, *Vent.*

6403—**Royena hirsuta,** *L.*

Fl. Cap. IV. i. 451; For. Fl. Cape, 258.

Salisbury, Engler.

**R. pallens,** *Thunb.* (*R. pubescens*, Willd.)

Fl. Trop. Afr. iii. 510; Fl. Cap. IV. i. 453; For. Fl. Cape, 258; Nat. Pl. 232; Cat. Afr. Pl. Welw. i. 647.

Victoria Falls, Sep. Gibbs, 112; Allen, 177; Engler; Matopos, Gibbs; Bulawayo, 4500 ft. Oct. Eyles, 1091; Monro, 39, 40; 113; Chubb, 378; Rogers, 5501, 13609; Chirinda, 3800 ft. Oct. Swyn. 62; Mt. Pene, 7000 ft. Swyn. 6070; South Rhodesia, Rand, 615.

**R. villosa,** *L.*

Fl. Cap. IV. i. 450; For. Fl. Cape, 257; Nat. Pl. 201.

Umtali, Engler.

6404—**Euclea divinorum,** *Hiern.*

Fl. Trop. Afr. iii. 513; Fl. Cap. IV. i. 469; For. Fl. Port. E. Afr. 81.

Victoria Falls, Kirk; Matopos, Sep. Gibbs, 34; Galpin, 7078; Gwelo, Sr. Phil. 50.

**E. Eylesii,** *Hiern.*

Journ. Bot. 1907, 47.

Sebakwe, 4000 ft. Dec. Eyles, 44; Victoria, Monro, 643*b*.

**E. Kellau,** *Hochst.*

Fl. Trop. Afr. iii. 514.

Bulawayo, 4500 ft. Nov. Eyles, 1252.

**E. lancea,** *Thunb.*

Fl. Cap. IV. i. 464; For. Fl. Cape, 260.

Matopos, Engler.

**E. lanceolata,** *E. Mey.*

Fl. Trop. Afr. iii. 512; Fl. Cap. IV. i. 467; Cat. Afr. Pl. Welw. i. 648; For. Fl. Cape, 261.

Bulawayo, Monro, 42, 43; Victoria, Monro, 517; Matopos, Galpin, 7005; Chirinda, 3500 ft. Swyn. 743; Chipete Forest, Swyn. 1298; Umvumvumvu Riv. 2000 ft. Swyn. 1305; in fl. April, Sep. Swyn.; South Rhodesia, Rand, 131, 361.

Genus No.

var. **angustifolia,** *Hiern.*

Mazoe, 5300 ft. ♀ Nov. Eyles, 470.

var. **confertiflora,** *Hiern.*

Mazoe, 4200 ft. ♂ Sep. Eyles, 410.

var. **parvifolia,** *Hiern.*

Mazoe, 5000 ft. ♂ Nov. Eyles, 457.

**E. macrophylla,** *E. Mey.*

Fl. Cap. IV. i. 472; For. Fl. Cape, 262.

Victoria Falls, Engler.

**E. multiflora,** *Hiern.*

Fl. Trop. Afr. iii. 513; Fl. Cap. IV i. 470; Cat. Afr. Pl. Welw. i 649; For. Fl. Cape, 262.

Matopos, ♂ Sep. Gibbs, 46; Victoria, Monro, 423, 419; Odzani River Valley, Umtali, Teague, 237 ♂.

**E. undulata,** *Thunb.*

Fl. Cap. IV. i. 474; For. Fl. Cape, 263.

Matopos, Davy; Lomagundi, Govt. Herb. 973.

**E. spp.**

Victoria Falls, Allen, 161.

Matopos, Sep. Galpin, 7070 cf. *E. natalensis*, A. DC.

Salisbury, Rand, 563.

Leopard Mine, Govt. Herb. 942.

6405—**Maba Mualala,** *Welw.*

Fl. Trop. Afr. iii. 515.

Chirinda Forest, 3700–4000 ft. Jan. Swyn. 3.

6406—**Diospyros mashuma ?.** (Note.—Swyn. gives native name of D. sabiensis, *Hiern*, as "Mashuma.")

Matopos, Govt. Herb. 886; Lomagundi, Govt. Herb. 980.

**D. mespiliformis,** *Hochst.*

Fl. Trop. Afr. iii. 518; Fl. Cap. IV. i. 477; Cat. Afr. Pl. Welw. i. 651; For. Fl. Port. E. Afr. 83.

Victoria Falls, Rogers, 5118; South Umtali, 2000–3000 ft. fr. Oct. Swyn. 6071; Umvumvumvu Riv. 4000 ft. Dec. Swyn. 6622; Victoria, Monro, 391, 713.

**D. sabiensis,** *Hiern.*

Journ. Linn. Soc. Bot. xl. 134.

Sabi Riv. 1000 ft. Nov. Swyn. 1209.

**D. spp.**

Gwanda, Noble, 6.

Victoria Falls, Sep. Allen, 395.

Victoria, Monro, 413.

## Series CONTORTAE.

### Family CCXLIII.—OLEACEAE, *Lindl.*

Genus No.
6422—**Schrebera mazoensis,** *S. Moore.*
Journ. Bot. 1907, 48.
Mazoe, 4300–5300 ft. Dec. Eyles, 202; Marandellas, Mundy.

**S. spp.**
Victoria Falls, Allen, 148 cf. *S. golungensis*, Welw.
Victoria, Monro, 675, 978.

6434—**Olea chrysophylla,** *Lam.*
Fl. Trop. Afr. IV. i. 18.
Victoria, Monro, 367, 744.

**O. laurifolia,** *Lam.*
Fl. Cap. IV. i. 487; For. Fl. Cape, 264.
Victoria, Monro, 404; Matopos, Govt. Herb. 892.

**O. verrucosa,** *Link.* (*O. woodiana*, Knobl.)
Fl. Cap. IV. i. 486; Nat. Pl. 237; For. Fl. Port. E. Afr. 83; For. Fl. Cape, 266.
Gwanda, Noble, 7; Matopos, Govt. Herb. 888, 889; Victoria Falls, Rogers, 5557; Chimanimani Mts. 7000 ft. bud Sep. Swyn. 1281.

**O. sp.**
Matopos, Govt. Herb. 893.

6435—**Dekindtia africana,** *Gilg.*
Fl. Trop. Afr. IV. i. 588.
Chirinda, 3800 ft. Oct. Swyn. 171.

6438—**Menodora heterophylla,** *Moric.*
Fl. Cap. IV. i. 484.
South Rhodesia, Rand, 595.

6440—**Jasminum mauritianum,** *Bojer.*
Fl. Trop. Afr. IV. i. 10; Fl. Cap. IV. i. 482; Cat. Afr. Pl. Welw. i. 655.
Victoria Falls, Sep. Galpin, 7020; fl. & fr. Sep. Gibbs, 111; Allen, 178; Rogers, 5155; Engler; Mazoe, 4200 ft. Jan. Eyles, 246; Sabi Riv. 1000 ft. Nov. Swyn. 2033.

**J. oleæcarpum,** *Baker.*
Fl. Trop. Afr. IV. i. 8.
Gwelo, Jan. Gardner, 21.

Genus No.

**J. stenolobum,** *Rolfe.*

Fl. Trop. Afr. IV. i. 4; Fl. Cap. IV. i. 481.

Matabeleland, Oates; Elliott; Matopos, Cecil, 113; Gwelo, Cecil, 132; Victoria Falls, Allen, 37; Rogers, 5493; Bulawayo, Dec. Gardner, 85; Monro, 4; Mazoe, 4400 ft. Nov. Eyles, 443; Victoria, Monro, 514, 515; Sabi Riv. 1000 ft. Nov. Swyn. 2034; South Rhodesia, Rand, 125.

**J. spp.**

Bulawayo, 4500 ft. Dec. Eyles, 55.

Victoria, Monro, 746, 836.

## Family CCXLV.—LOGANIACEAE, *Lindl.*

6449—**Mostuea Walleri,** *Baker.*

Fl. Trop. Afr. IV. i. 507.

Chirinda Forest, 3800 ft. Dec. Swyn. 6511.

6460—**Strychnos Burtoni,** *Baker.*

Fl. Trop. Afr. IV. i. 533.

Chirinda, Dec. Swyn. 1959; also Chipetzana and between Chirinda and Chipinga, Swyn.

**S. matopensis,** *S. Moore.*

Journ. Bot. 1905, 48.

Matopos, 4500 ft. Nov. Eyles, 1182.

**S. mellodora,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 147.

Chirinda Forest, 3700–4000 ft. Oct. Swyn. 101.

**S. micans,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 146.

Chirinda Forest, 3700–4000 ft. Dec. Swyn. 125.

**S. mitis,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 146.

Chirinda Forest, 3700–4000 ft. fl. Jan. fr. Oct. Swyn. 17, 17*a*.

**S. pungens,** *Solered.*

Fl. Trop. Afr. IV. i. 530; Fl. Cap. IV. i. 1051; Cat. Afr. Pl. Welw. i. 704.

Matopos, Davy; North of Bulawayo, Engler.

**S. spinosa,** *Lam.*

Fl. Trop. Afr. IV. i. 536; Fl. Cap. IV. i. 1055; Cat. Afr. Pl. Welw. i. 702; For. Fl. Port. E. Afr. 89; For. Fl. Cape, 274.

Chirinda, 3800 ft. Oct. Swyn. 55, 55*a*; throughout South Melsetter Dist.; South Rhodesia, Rand, 426; Victoria Falls, Rogers, 5976*, 7237*.

Genus No.

**S. tonga,** *Gilg.*

Salisbury, Engler.

**S. sp.**

Lomagundi, Govt. Herb. 983.

6466—**Anthocleista zambesiaca,** *Baker.*

Fl. Trop. Afr. IV. i. 540; Fl. Cap. IV. i. 1049.

Chirinda, Swyn.

6469—**Nuxia dentata,** *R. Br.*

Fl. Trop. Afr. IV. i. 513; Fl. Cap. IV. i. 1040; Cat. Afr. Pl. Welw. i. 700.

Odzani Riv. Cecil, 235; Lusitu Riv. 3000 ft. Nov. Swyn. 1294; Victoria, Monro, 497, 605, 748, 894.

**N. Holstii,** *Gilg.*

Fl. Trop. Afr. IV. i. 515.

Melsetter, April, Swyn. 1902.

**N. sambesina,** *Gilg.*

Fl. Trop. Afr. IV. i. 514.

Melsetter, 6000 ft. Sep. Swyn. 606.

**N. viscosa,** *Gibbs.*

Journ. Linn. Soc. Bot. xxxvii. 454.

Matopos, Oct. Gibbs, 246; Victoria, Monro, 435, 735.

6470—**Gomphostigma scoparioides,** *Turcz.*

Bulawayo, 4500 ft. Dec. Eyles, 14; Tengwe Riv. Baines.

6471—**Chilianthus arboreus,** *A. DC.* (*C. oleaceus*, Burch.)

Fl. Cap. IV. i. 1043; For. Fl. Cape, 276.

Bulawayo, 4500 ft. Dec. Eyles, 1138.

6473—**Buddleia salvifolia,** *Lam.*

Fl. Trop. Afr. IV. i. 516; Fl. Cap. IV. i. 1046; For. Fl. Cape, 277.

Bulawayo, Monro, 77; Melsetter, 6000 ft. Sep. Swyn. 609, 675; Mt. Pene, 6500–7000 ft. Oct. Swyn. 6090.

## Family CCXLVI.—GENTIANACEAE, *Dumort.*

6479—**Exacum quinquenervium,** *Griseb.*

Fl. Trop. Afr. IV. i. 546.

Victoria Falls, Rogers, 7101.

6481—**Sebæa barbeyiana,** *Schinz.*

Fl. Trop. Afr. IV. i. 549.

Victoria Falls, Kirk; Allen, 40.

**S. leiostyla,** *Gilg.*

Fl. Trop. Afr. IV. i. 548; Fl. Cap. IV. i. 1086.

Melsetter, 6000 ft. April, Swyn. 1898.

Genus No.

6483—**Exochænium,** in place of *Belmontia,* after A. W. Hill, in Kew Bull. 1908, pp. 317–341.

**Exochænium exiguum,** *A. W. Hill.* (*Chironia exigua,* Oliv.)

Kew Bull. 1909, 50.

Matopos, 4500 ft. March, Eyles, 1032.

**E. grande,** *Griseb.* (*Belmontia grandis,* E. Mey.; *Parasia grandis,* Hiern.)

Fl. Trop. Afr. IV. i. 553; Fl. Cap. IV. i. 1094; Cat. Afr. Pl. Welw. i. 707; Harv. Gen. S.A. Pl. 252.

Mazoe, 4400 ft. April, Eyles, 319; Chipetzana source, 4000 ft. April, Swyn. 2031.

6500—**Canscora diffusa** (*Vahl.*), *R. Br.*

Fl. Trop. Afr. IV. i. 558.

Victoria Falls, Engler.

**C. Kirkii,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 558.

Victoria Falls, Kirk; Rogers, 5043; fl. & fr. Sep. Gibbs, 152; Allen, 413; July, Kolbe, 3147; Matopos, Rogers.

6503—**Chironia gratissima,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 148.

Melsetter, 6000 ft. Sep. Swyn. 1892; North Melsetter, 5000–6000 ft. Oct. Swyn. 6162.

**C. humilis,** *Gilg.*

Fl. Cap. IV. i. 1107.

Matopos, Nov. Eyles, 1143?; Victoria, Monro, 756?

var. **Wilmsii,** *Prain.* (*C. humilis,* Bak. & Br.; *C. purpurascens,* Rolfe.)

Fl. Cap. IV. i. 1107; Fl. Trop. Afr. IV. i. 555; see Kew Bull. 1908, pp. 350, 373, 375.

South Rhodesia, Rand, 168; Matabeleland, Oates; Inyanga, 6000–7000 ft. Cecil, 190.

**C. transvaalensis,** *Gilg.* (*C. palustris,* Gilg.)

Fl. Trop. Afr. IV. i. 555; Fl. Cap. IV. i. 1105.

Umtali, Cecil, 162; Victoria Falls, Allen, 208; Gwelo, Jan. Gardner, 46; Mazoe, 4400 ft. Feb. Eyles, 527; Victoria, Monro, 662.

**C. spp.**

Bulawayo, Eyles, 90.

Gwai, 3000 ft. Jan. Allen, 228.

6512—**Sweertia stellarioides,** *Ficalho.* (*S. Welwitschii,* Engl.)

Fl. Trop. Afr. IV. i. 581; Fl. Cap. IV. i. 1119; Cat. Afr. Pl. Welw. i. 711.

Salisbury, March, Flanagan, 3019; Melsetter, 6000 ft. April, Swyn, 1919; Odzani River Valley, Umtali, Teague, 99.

Genus No.
6545—**Limnanthemum indicum,** *Dur. & De Wild.*
Fl. Trop. Afr. IV. i. 587.
South Rhodesia, Rand, 173.

**L. thunbergianum,** *Griseb.*
Fl. Trop. Afr. IV. i. 584; Fl. Cap. IV. i. 1120; Nat. Pl. 34.
Victoria Falls, Allen, 82; Upper Umswirizwi, 2600 ft. fl. & fr. Oct. Swyn. 393.

## Family CCXLVII.—APOCYNACEAE, *Lindl.*

6558—**Acocanthera venenata,** *G. Don.*
Fl. Trop. Afr. IV. i. 94; Fl. Cap. IV. i. 501; For. Fl. Cape, 270.
Bulawayo, Rand, 572; Matopos, Sep. Galpin, 7076.

6559—**Carissa Arduina,** *Lam.* (*C. acuminata*, DC.)
Fl. Trop. Afr. IV. i. 91; Fl. Cap. IV. i. 498; Nat. Pl. 203; For. Fl. Port. E. Afr. 86; For. Fl. Cape, 269.
Bulawayo, Rand, 285; Matopos, Davy; Chirinda Forest, 3700–4000 ft. Swyn.; Mt. Pene, 7000 ft. Swyn., fl. Sep. Dec. Swyn.

**C. edulis,** *Vahl.*
Fl. Trop. Afr. IV. i. 89; For. Fl. Port. E. Afr. 86.
Victoria Falls, Kirk; Davy.

var. **tomentosa,** *Stapf.* (*C. tomentosa*, A. Rich.)
Fl. Trop. Afr. IV. i. 90; Fl. Cap. IV. i. 497.
Matabeleland, Oates; Bulawayo, Rand, 176; Engler; Khami, Nov. Marloth, 3393; Matopos, Davy; Engler; Govt. Herb. 885; Victoria Falls, Davy; Bulawayo, 4500 ft. Sep. Eyles, 23; Chubb, 314; Rogers, 5509; Mrewa, Govt. Herb. 865; Chirinda, 3800 ft. Swyn. 70; South Umtali Dist. 2000–3000 ft. Swyn. 6621, 6623; fl. Oct. Dec. Swyn.; Victoria, Monro, 450.

6562—**Landolphia Buchananii,** *Stapf.*
Fl. Trop. Afr. IV. i. 35; For. Fl. Port. E. Afr. 85.
Umtali, Engler.

**L. Kirkii,** *Dyer.*
Fl. Trop. Afr. IV. i. 55; For. Fl. Port. E. Afr. 85.
Chirinda, 3800 ft. Oct. Dec. Swyn. 81*a*; South Melsetter, Govt. Herb. 716.

**L. (?) lucida,** *K. Schum.*
Fl. Trop. Afr. IV. i. 59.
Chirinda Forest, 3700 ft. Feb. Swyn. 83.

**L. Swynnertonii,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 136.
Chirinda Forest, 3700–4000 ft. Nov. Swyn. 82; Chipete, Swyn.

Genus No.

**L. sp.**

Victoria Falls, Engler.

6563—**Clitandra orientalis,** *K. Schum.*

Fl. Trop. Afr. IV. i. 594.

Victoria Falls, Rogers, 7234*, 7491*, 7505*.

6577—**Pleiocarpa Swynnertonii,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 138.

Chirinda Forest, fl. Sep. fr. Dec. Swyn. 14 & 6503.

6581—**Gonioma Kamassi,** *E. Mey.*

Fl. Cap. IV. i. 503; For. Fl. Cape, 272.

Gwanda, Noble, 16; Lomagundi, Govt. Herb. 995.

6582—**Holarrhena febrifuga,** *Klotzsch.*

Fl. Trop. Afr. IV. i. 162.

South Melsetter, Swyn.; Victoria, Monro, 809.

6589—**Diplorrhynchus mossambicensis,** *Benth.*

Fl. Trop. Afr. IV. i. 107; For. Fl. Port. E. Afr. 86.

Matopos, Oct. Gibbs, 273; Govt. Herb. 890; Engler; Chikore Hills, fr. April, Swyn.; Umswirizwi Riv. Swyn.; Victoria Falls, Rogers, 7221*.

6597—**Lochnera rosea,** *Reichb.* (*Vinca rosea,* L.)

Fl. Trop. Afr. IV. i. 118; Fl. Cap. IV. i. 504.

Salisbury, Darling.

6605—**Conopharyngia elegans,** *Stapf.*

Fl. Trop. Afr. IV. i. 149; Fl. Cap. IV. i. 506; For. Fl. Port. E. Afr. 87.

Chikore Hills, Swyn.

**C. stapfiana,** *Stapf.*

Fl. Trop. Afr. IV. i. 147.

Mt. Pene, 7000 ft., Oct. Swyn. 6148, 560.

**C. usambarensis,** *Stapf.*

Fl. Trop. Afr. IV. i. 148.

Chirinda Forest, 3700–4000 ft. fl. & young fr. Oct. Swyn. 37 & 37*a*.

6619—**Rauwolfia caffra,** *Sond.*

Fl. Trop. Afr. IV. i. 110; Fl. Cap. IV. i. 502.

Bulawayo, Govt. Herb. 1081; Mashonaland, Govt. Herb. 1000.

**R. inebrians,** *K. Schum.*

Fl. Trop. Afr. IV. i. 112.

Chirinda Forest, 3700–4000 ft.; Sep. Nov. Swyn. 6; Inyamadzi Valley, 3000 ft. Swyn. 602; Melsetter, 5000 ft. Swyn.; Mt. Pene Forest, Swyn.

**R. sp.**

Victoria Falls, Engler.

Genus No.

6632—**Thevetia nerifolia ?.**

Matopos, Govt. Herb. 898 (cultivated).

6680—**Adenium multiflorum,** *Klotzsch.*

Fl. Trop. Afr. IV. i. 229; Fl. Cap. IV. i. 514; For. Fl. Port. E. Afr. 89.

Sabi Riv. 1000 ft. fr. Nov. Swyn. 557.

6686—**Oncinotis chirindica,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 141.

Chirinda Forest, 3700–4000 fl. & fr. Oct. Swyn. 87; Chipete, Swyn.

## Family CCXLVIII.—ASCLEPIADACEAE, *Lindl.*

6688—**Strophantus sp.**

Wankie, Rogers, 58370 (near S. arnoldianus, Wildern & Dur.)

6729—**Chlorocodon Whytei,** *Hook. f.*

Fl. Trop. Afr. IV. i. 255; Fl. Cap. IV. i. 542; Cat. Afr. Pl. Welw. i. 680; Nat. Pl. 31.

Mazoe, 4300 ft. Dec. Eyles, 204; Victoria Falls, Allen, 259.

6730—**Tacazzea Kirkii,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 268; Fl. Cap. IV. i. 540.

Victoria Falls, Allen, 252, 283; Rogers, 5091, 5566, 7403; Victoria, Monro, 1099, 797.

6740—**Crytolepsis oblongifolia,** *Schlechter.* (*Ectadiopsis oblongifolia,* Benth.)

Fl. Trop. Afr. IV. i. 249; Fl. Cap. IV. i. 529; Nat. Pl. 513.

Mazoe, 5000–5300 ft. Nov. Eyles, 469; Bulawayo, Monro, 109; Victoria, Monro, 752; Chirinda, fl. & fr. Oct. Swyn. 243.

**C. producta,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 247.

Gwai Forest, 3600 ft. Allen, 239; Salisbury, Rand, 1368.

**C. transvaalensis,** *Schlechter.*

Fl. Cap. IV. i. 528.

Victoria, Monro, 812.

6747—**Raphiacme lanceolata,** *Schinz,* var. **latifolia,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 274 (*Raphionacme*).

Bulawayo, Rand, 284; Monro, 94.

**R. longifolia,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 274.

Mazoe, 5300 ft. Nov. Eyles, 468.

**R. procumbens,** *Schlechter.*

Fl. Cap. IV. i. 535.

Bulawayo, Monro, 111.

Genus No.

**R. spp.**

Gwelo, Jan. Gardner, 13.
Bulawayo, Monro, 100.

6777—**Xysmalobium bellum,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 311.
Mazoe, 4800 ft. Dec. Eyles, 492.

**X. Cecilae,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 310.
Salisbury, Cecil, 60; Rand, 1358; Victoria, Monro.

**X. dispar,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 307.
Mazoe, 4400 ft. Feb. Eyles, 529.

**X. gramineum,** *S. Moore.*

Fl. Trop. Afr. IV. i. 302.
Bulawayo, Rand, 193.

**X. recticulatum,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 303.
Mazoe, 4200 ft. Nov. Eyles, 467; between Umtali and Salisbury, Cecil, 51; between Enkeldoorn and Rocky Spruit, Cecil, 135; Malindi, Gwai Forest, Allen, 227; Chirinda, 3800 ft. Oct. Swyn. 247; Victoria, Monro, 628.

**X. sp.**

Bulawayo, Chubb, 7*a*, cf. *X. decipiens*, N. E. Br.

6778—**Schizoglossum aciculare,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 363; Fl. Cap. IV. i. 620.
Salisbury, Rand, 1359.

**S. biflorum,** *Schlechter.*

Fl. Cap. IV. i. 641.
Victoria, Monro, 657.

var. **gwelense,** *N. E. Br.* (*S. gwelense*, N. E. Br.)

Fl. Cap. IV. i. 642; Fl. Trop. Afr. IV. i. 360.
Gwelo, Cecil, 131; Salisbury, Rand, 190, 1354.

**S. Carsoni,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 366.
Between Umtali and Salisbury, Cecil, 48; Selukwe, Cecil, 48*a*; Salisbury, Darling; Rand, 1361; Mazoe, 4800 ft.
Dec. Eyles, 216.

**S. chirindense,** *S. Moore.*

Journ. Bot. 1908, 295.
Chirinda, 3800 ft. Swyn. 246, Mt. Pene, 7000 ft. in fl. Sep. Oct. Swyn. 246, 6095.

Genus No.

**S. Eylesii,** *S. Moore.*
Journ. Bot. 1914, 149.
Mazoe, 4800 ft. Jan. Eyles, 500.

**S. Pentheri,** *Schlechter.*
Eyles, 1116.

**S. strictissimum,** *S. Moore.*
Fl. Trop. Afr. IV. i. 358.
Bulawayo, Rand, 195; Victoria, Monro, 842.

6780—**Kanahia glaberrima,** *N. E. Br.*
Fl. Trop. Afr. IV. i. 297.
Shashi Riv. Baines.

**K. Monroi,** *Moore.*
Journ. Bot. 1911, 156.
Victoria, Monro, 1100.

6781—**Margaretta Holstii,** *K. Schum.*
Fl. Trop. Afr. IV. i. 374.
Victoria Falls, Allen, 194.

**M. Whytei,** *K. Schum.*
Fl. Trop. Afr. IV. i. 374.
Salisbury, Rand, 124, 547, 632; March, Flanagan, 2999; Darling in Herb. Bolus 11192; Rand, 1360; Rogers, 4008; Mazoe, 4300 ft. Sep. Eyles, 428; Chirinda, 3800 ft. Oct. Swyn. 1912.

6783—**Cordylogyne kassnerianum** (*Schlechter*), *Torre & Harms.* (*Periglossum kassnerianum,* Schlechter.)
Fl. Cap. IV. i. 584.
Victoria, Monro, 624.

**C. mossambicense** (*Schlechter*), *Torre & Harms.* (*Periglossum mossambicense,* Schlechter.)
Fl. Cap. IV. i. 583.
Salisbury, Rand, 1355.

6787—**Gomphocarpus concolor,** *Decne.* (*Pachycarpus concolor,* E. Mey.)
Fl. Trop. Afr. IV. i. 377; Fl. Cap. IV. i. 729.
Bulawayo, Rand, 187; Rogers, 5930; Salisbury, Rand, 1356.

6791—**Asclepias aurea,** *Schlechter.* (*Gomphocarpus aureus,* Schltr.)
Fl. Trop. Afr. IV. i. 345; Fl. Cap. IV. i. 685.
Salisbury, Rand, 638; Cecil, 144; Gwelo, Rand, 188; Matopos, 5000 ft. Nov. Eyles, 1152; Victoria, Monro, 313.

**A. densiflora,** *N. E. Br.*
Fl. Trop. Afr. IV. i. 320; Fl. Cap. IV. i. 705.
Between Salisbury and Bulawayo, Cecil, 78.

Genus No.
6791—**A. eminens,** *Schlechter.*
Fl. Trop. Afr. IV. i. 351; Fl. Cap. IV. i. 685.
Between Enkeldoorn and Rocky Spruit, Cecil, 134; Bulawayo, Rand, 183, 189; Gwelo, Jan. Gardner, 52; Mazoe, 4200 ft. Nov. Eyles, 460; Victoria, Monro, 618.

**A. Engleri,** *Schlechter.*
Umtali, Engler.

**A. fallax,** *Schlechter.*
Fl. Cap. IV. i. 706.
Salisbury, Rand, 1352; Bulawayo, Monro, 19.

**A. fruticosa,** *L.* (*Gomphocarpus fruticosus*, R. Br.)
Fl. Trop. Afr. IV. i. 330; Fl. Cap. IV. i. 691.
Shangani Riv. Rand, 191; Shashi Riv. Baines; Matopos, fl. & fr. Oct. Gibbs, 103; Victoria Falls, Allen, 275; Salisbury, Govt. Herb. 921; Victoria, Monro, 913.

**A. fulva,** *N. E. Br.*
Fl. Trop. Afr. IV. i. 321.
Chirinda, 3600 ft. Jan. Swyn. 1914.

**A. glaucophylla,** *Schlechter.* (*Gomphocarpus glaucophyllus*, Schlechter.)
Fl. Trop. Afr. IV. i. 321; Fl. Cap. IV. i. 696.
Salisbury, Cecil, 57; Rand, 185, 1357; Charter, Govt. Herb. 3023.

**A. lineolata,** *Schlechter.* (*Gomphocarpus lineolatus*, Decne.)
Fl. Trop. Afr. IV. i. 322.
Bulawayo, Rand, 184; Salisbury, Rand, 1353; Cecil, 66; Sebakwe, 4000 ft. Dec. Eyles, 166; Victoria Falls, Allen, 86; Upper Buzi, 3200 ft. Nov. Swyn. 245.

**A. palustris,** *Schlechter.*
Fl. Trop. Afr. IV. i. 349.
Mazoe, 4300–4800 ft. Nov. Eyles, 448.

**A. physocarpa,** *Schlechter.* (*Gomphocarpus physocarpus*, E. Mey.)
Fl. Trop. Afr. IV. i. 328; Fl. Cap. IV. i. 692; Nat. Pl. 217.
Eyles, 1129.

**A. Randii,** *S. Moore.*
Fl. Trop. Afr. IV. i. 351.
Salisbury, Rand, 194.

**A. reflexa,** *Britten & Rendle.*
North of Umtali, Cecil, 160; Sebakwe, 4000 ft. Dec.
Eyles, 169.

**A. scabrifolia,** *S. Moore.*
Journ. Bot. 1908, 297.
Chimanimani Mts. 7000 ft. Swyn. 1915; Mt. Pene, 7000 ft. Swyn. 6094, 6140, fl. Sep. Oct. Swyn.

Genus No.

**A. Swynnertonii,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 142.

Mt. Pene, 7000 ft. Oct. Swyn. 6092; Melsetter, 6000 ft. Swyn. 6093.

**A. tenuifolia,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 337.

Mangwe, Baines; Matopos, 5000 ft. March, Eyles, 1011; Sep. Gibbs, 100; March, Flanagan, 2989; Victoria, Monro, 422, 754, 1065; South Rhodesia, Rand, 192.

**A. spp.**

Salisbury, Darling in Herb. Bolus, 10796.

Matopos, Eyles, 1156.

6810—**Pentarrhinum insipidum,** *E. Mey.*

Fl. Trop. Afr. IV. i. 378; Fl. Cap. IV. i. 741; Nat. Pl. 517; Cat. Afr. Pl. Welw. i. 687.

Bulawayo, 4500 ft. Feb. Eyles, 106.

6834—**Cynanchum chirindense,** *S. Moore.*

Journ. Bot. 1908, 305.

Chirinda Forest, 3900 ft. Feb. Swyn. 137.

**C. præcox,** *Schlechter.*

Fl. Trop. Afr. IV. i. 399.

Mazoe, Rand, 512.

**C. sp.**

South Rhodesia, Rand, 362.

6849—**Sarcostemma viminale,** *R. Br.*

Fl. Trop. Afr. IV. i. 384; Fl. Cap. IV. i. 755; Cat. Afr. Pl. Welw. i. 689.

Matopos, Cecil, 106; Oct. Gibbs, 239; Engler; Nov. Eyles, 1155?; Bulawayo, Rand, 363; Chubb, 1*a*.

6860—**Secamone Alpini,** *Schult.*

Fl. Trop. Afr. IV. i. 279; Fl. Cap. IV. i. 544.

Chirinda, 3700–4000 ft. Dec. Swyn. 88; Bulawayo, Rogers, 13576*.

6862—**Oranthera jasminiflora,** *N. E. Br.*

Fl. Trop. Afr. IV. i. 434.

Victoria Falls, Rogers, 7468*.

6865—**Macropetalum Burchellii,** *Decne.*

Fl. Cap. IV. i. 798; Harv. Gen. S.A. Pl. 241.

Fig-tree, 4500 ft. Dec. Eyles, 155.

6870—**Brachystelma Barberiae,** *Harv.*

Fl. Cap. IV. i. 864; Nat. Pl. 587.

Bulawayo, March, Monro.

Genus No.

6874—**Ceropegia abyssinica,** *Decne.*
Fl. Trop. Afr. IV. i. 462.
Salisbury, Rand, 1400.

**C. hispidipes,** *S. Moore.*
Journ. Bot. 1908, 309.
Chirinda, 3800 ft. Feb. Swyn. 1137.

**C. mazoensis,** *S. Moore.*
Journ. Bot. 1908, 309.
Mazoe, 4700 ft. Jan. Eyles, 518.

**C. tentaculata,** *N. E. Br.*
Fl. Trop. Afr. IV. i. 443; Cat. Afr. Pl. Welw. i. 694.
Victoria, Monro, 834, 889.

**C. sp.**
Salisbury, Rand, 1399.

6875—**Riocreuxia profusa,** *N. E. Br.*
Fl. Trop. Afr. IV. i. 465.
Chikore Hills, 3500 ft. April, Swyn. 205.

6880—**Decabelone elegans,** *Decne.* (*Tavaresia angolensis,* Welw.)
Fl. Trop. Afr. IV. i. 493; Cat. Afr. Pl. Welw. i. 697.
South Rhodesia, Rand, 286.

6884—**Caralluma lateritia,** *N. E. Br.*
Fl. Trop. Afr. IV. i. 486.
Bulawayo, 4500 ft. Feb. Eyles, 22.

6885—**Stapelia gigantea,** *N. E. Br.*
Fl. Trop. Afr. IV. i. 501; Fl. Cap. IV. i. 948; Nat. Pl. 531.
Bulawayo, Monro.

**S. Marlothii,** *N. E. Br.*
Kew Bull. 1908, 436.
Matopos, Marloth, 3414.

6887—**Heurnia sp.**
Salisbury, Darling in Herb. Bolus 10767.

6891—**Gymnema sylvestre,** *R. Br.*
Fl. Trop. Afr. IV. i. 413; Fl. Cap. IV. i. 782.
Victoria Falls, Rogers, 5731.

6911—**Marsdenia zambesiaca,** *Schlechter.*
Fl. Trop. Afr. IV. i. 420.
Victoria Falls, Allen, 84.

6911*a*—**Swynnertonia cardinea,** *S. Moore.*
Journ. Bot. 1908, 308.
Chirinda Forest, 3700–4000 ft. Oct. Dec. Swyn. 1080, 6518.

6924—**Fockea Monroi,** *S. Moore.*
Journ. Bot. 1914, 149.
Victoria, Monro, 828, 837.

## Series TUBIFLORAE.

### Family CCXLIX.—CONVOLVULACEAE, *Vent.*

Genus No.
6968—**Cuscuta kilimanjari,** *Oliv.*
Fl. Trop. Afr. IV. ii. 205.
Chirinda, 3800 ft. May, Swyn. 453, on *Mellera lobulata,* S. Moore.

**C. obtusiflora,** var. **cordofana,** *Engelm.*
Fl. Trop. Afr. IV. ii. 204.
Mazoe, 4300 ft. April, Eyles, 352; Govt. Herb. 2081.

**C. planiflora,** *Ten.*
Fl. Trop. Afr. IV. ii. 203; Cat. Afr. Pl. Welw. i. 743.
Mazoe, 5000 ft. April, Eyles, 327.

6973—**Evolvulus alsinoides,** *L.*
Fl. Trop. Afr. IV. ii. 67; Fl. Cap. IV. ii. 79; Cat. Afr. Pl. Welw. i. 724.
Matabeleland, Oates; Elliott; Cecil, 116; Rand, 127; Victoria Falls, Allen, 124; April, Flanagan, 3156; Bulawayo, Dec. Gardner, 90; Rogers, 5758; Odzani River Valley, Teague, 262.

**E. spp.**
Bulawayo, 4500 ft. Jan. Eyles, 1.

6978—**Seddera capensis,** *Hallier f.* (*Breweria capensis,* Baker.)
Fl. Trop. Afr. IV. ii. 77; Fl. Cap. IV. ii. 80.
Salisbury, Rand, 126; Matabeleland, Gardner.

6991—**Jacquemontia capitata,** *G. Don.*
Fl. Trop. Afr. IV. ii. 85; Fl. Cap. IV. ii. 69; Nat. Pl. 13; Cat. Afr. Pl. Welw. i. 725.
Wankie, 2500 ft. May, Eyles, 129; Victoria Falls, Rogers, 7004.

6993—**Convolvulus Randii,** *Rendle.*
Fl. Trop. Afr. IV. ii. 94.
Gwelo, Rand, 274.

**C. sagittatus,** var. **abyssinica,** *Hallier f.*
Fl. Trop. Afr. IV. ii. 96.
Salisbury, Rand, 510; Cecil, 74; Chirinda, 3500 ft. June, Swyn. 1798.

**C. ulosepalus,** *Hallier f.*
Fl. Trop. Afr. IV. ii. 95; Fl. Cap. IV. ii. 73.
Salisbury, Engler.

**C. sp.**
Mazoe, 5000 ft. Nov. Eyles, 1106.

Genus No.

6995—**Hewittia bicolor,** *Wight.* (*Shutereia bicolor,* Choisy.)

Fl. Cap. IV. ii. 68 ; Cat. Afr. Pl. Welw. i. 727 ; Nat. Pl. 281.

Chirinda, 3700–4000 ft. June, Swyn. 1187.

6997—**Merremia angustifolia,** *Hallier f.* (*Ipomœa angustifolia,* Jacq.)

Fl. Trop. Afr. IV. ii. 111 ; Fl. Cap. IV. ii. 54 ; Cat. Afr. Pl. Welw. i. 729.

Matopos, Oct. Gibbs, 228 ; Victoria Falls, Allen, 285 ; April, Flanagan, 3170 ; Rogers, 5532 ; Bulawayo, Rand, 130.

**M. palmata,** *Hallier f.*

Fl. Trop. Afr. IV. ii. 108.

Bulawayo, Rand, 128, 129, 364 ; Rogers, 5753.

**M. pinnata,** *Hallier f.*

Fl. Trop. Afr. IV. ii. 113.

Mazoe, April, Eyles, 313 ; Victoria Falls, April, Flanagan, 3239.

**M. pterygocaulos,** *Hallier f.* (*Ipomœa pterygocaulos,* Choisy.)

Fl. Trop. Afr. IV. ii. 105 ; Cat. Afr. Pl. Welw. i. 727.

Victoria Falls, Allen, 39 ; Rogers, 5006* ; Engler ; July, Kolbe, 3185 ; Rogers, 5385.

7000—**Astrochlæna malvacea,** *Hallier f.*

Fl. Trop. Afr. IV. ii. 121 ; Fl. Cap. IV. ii. 69.

North of Hartley, Engler ; Salisbury, Engler ; Mazoe, 4300–4800 ft. Nov. Eyles, 454 ; Chirinda, 3800 ft. Sep. Swyn. 300 ; Victoria, Monro, 1014, 566*b*.

var. **epedunculata,** *Rendle.*

Fl. Trop. Afr. IV. ii. 122.

Salisbury, Rand, 511 ; Matopos, Oct. Gibbs, 84 ; South Umtali Dist. Melsetter Road, 2000–3000 ft. Oct. Swyn.

**A. Stuhlmanni,** *Hallier f.*

Fl. Trop. Afr. IV. ii. 122.

Umtali, Cecil, 35.

7003—**Ipomœa aquatica,** *Forsk.* (*I. reptans,* Poir.)

Fl. Trop. Afr. IV. ii. 170 ; Cat. Afr. Pl. Welw. i. 738.

Bulawayo, Jan. Gardner, 86.

**I. blepharophylla,** *Hallier f.*

Fl. Trop. Afr. IV. ii. 141 ; Cat. Afr. Pl. Welw. i. 732.

Victoria Falls, Allen, 1114 ; North of Hartley, Engler.

**I. bolusiana,** *Schinz.* (*I. angustisecta,* Engl.)

Fl. Trop. Afr. IV. ii. 175 ; Fl. Cap. IV. ii. 49.

Matabeland, Elliott.

**I. cardiosepala,** *Hochst.* (*I. calycina,* Benth.)

Fl. Trop. Afr. IV. ii. 147 ; Fl. Cap. IV. ii. 61 ; Cat. Afr. Pl. Welw. i. 733.

Bulawayo, Rand, 366 ; Rogers, 5752.

Genus No.
7003—**I. Cecilae,** *N. E. Br.*
Kew Bull. 1906, 166.
Umtali, Cecil, 36.

**I. coscinosperma,** *Hochst.* var. **hirta,** Rich.
Fl. Trop. Afr. IV. ii. 138 (type).
Bulawayo, Engler.

**I. crassipes,** *Hook.*
Fl. Cap. IV. ii. 56; Cat. Afr. Pl. Welw. i. 732.
Victoria, Monro, 566; Rogers, 5755 ?.

var. **cordifolia,** *Rendle.*
Journ. Bot. 1908, 180.
Bulawayo, 4500 ft. Oct. Eyles, 21.

var. **thunbergioides,** *Hallier f.*
Fl. Cap. IV. ii. 56.
Bulawayo, March, Monro.

**I. dammarana,** *Rendle.*
Fl. Trop. Afr. IV. ii. 183.
Bulawayo, Rand, 273.

**I. dissecta,** *Willd.*
Fl. Cap. IV. ii. 67; Fl. Trop. Afr. IV. ii. 176.
Victoria Falls, Rogers, 7097*, 7129*.

**I. eriocarpa,** *R. Br.*
Fl. Trop. Afr. IV. ii. 136; Cat. Afr. Pl. Welw. i. 732.
Victoria Falls, April, Flanagan, 3301; Rogers, 5031; Bulawayo, Monro, 83.

**I. fragilis,** *Choisy.*
Fl. Trop. Afr. IV. ii. 165.
Bulawayo, Monro, 60.

var. **pubescens,** *Hallier f.*
Fl. Trop. Afr. IV. ii. 165.
Bulawayo, Rand, 603; Chubb, 335; Salisbury, Cecil, 75; Matabeleland, Oates; Victoria Falls, Rogers, 7009*.

var. **Randii ?.**
Bulawayo, Monro, 58.

**I. Holubii,** *Baker.*
Fl. Trop. Afr. IV. ii. 188.
Matopos, Rogers, 5647.

**I. involucrata,** *Beauv.*
Fl. Trop. Afr. IV. ii. 150; Cat. Afr. Pl. Welw. i. 735.
Salisbury, Rand, 561.

**I. lapathifolia,** *Hallier f.*
Fl. Trop. Afr. IV. ii. 168.
Victoria Falls, Rogers, 5007.

Genus No.

7003—**I. lilacina,** *Blume.*

Fl. Trop. Afr. IV. ii. 187 ; Cat. Afr. Pl. Welw. i. 741.

Victoria Falls, 3000 ft. May, Eyles, 140 ; Rogers, 5145.

**I. Lugardi,** *N. E. Br.* var. **parviflora,** *Rendle.*

Fl. Trop. Afr. IV. ii. 163.

Matabeleland, Elliott.

**I. magnusiana,** *Schinz.*

Fl. Trop. Afr. IV. ii. 162 ; Fl. Cap. IV. ii. 65.

Bulawayo, Rogers, 5748 ; Victoria Falls, Rogers, 5668*.

**I. obscura,** *Ker.*

Fl. Trop. Afr. IV. ii. 164 ; Fl. Cap. IV. ii. 62.

Bulawayo, Rand, 604 ; Chubb, 91, 334 ; Matopos, Oct. Gibbs. 248 ; Odzani River Valley, Umtali, Teague, 110.

**I. Papilio,** *Hallier f.*

Fl. Trop. Afr. IV. ii. 167 ; Fl. Cap. IV. ii. 63.

Bulawayo, Rand, 365 ; Rogers, 5736 ; Matopos, 4500 ft. March, Eyles, 109 ; North of Hartley, Engler.

**I. Pes-tigridis,** *L.*

Fl. Trop. Afr. IV. ii. 158 ; Cat. Afr. Pl. Welw. i. 735.

Victoria Falls, Allen, 278.

**I. pileata,** *Roxb.*

Fl. Cap. IV. ii. 53 ; Fl. Trop. Afr. IV. ii. 151.

Victoria Falls, Rogers, 7086*.

**I. pubescens,** *Choisy,* var. **pubescens,** *Hallier f.*

North of Hartley, Engler.

**I. Randii,** *Rendle.*

Fl. Trop. Afr. IV. ii. 146.

Bulawayo, Rand, 271 ; Salisbury, Rand, 1423.

**I. rhodesiana,** *Rendle.*

Fl. Trop. Afr. IV. ii. 188.

Bulawayo, Rand, 141.

**I. shirambensis,** *Baker.*

Fl. Trop. Afr. IV. ii. 186.

Victoria Falls, Rogers, 5293 ; Wankie, Rogers, 5995.*

**I. shupangensis,** *Baker.*

Fl. Trop. Afr. IV. ii. 170.

South of Zambesi, Engler.

**I. simplex,** var. **obtusisepala,** *Rendle.*

Fl. Trop. Afr. IV. ii. 174.

Salisbury, Rand, 272, 1391 ; Bulawayo, Chubb, 397.

**I. stenosiphon,** *Hallier f.*

Fl. Trop. Afr. IV. ii. 192.

Matopos, 5000 ft. April, Eyles, 58 ; Victoria, Monro, 1037.

Genus No.

**I. verbascoidea,** *Choisy.* (*I. Elliottii*, Baker.)
Fl. Trop. Afr. IV. ii. 183 ; Cat. Afr. Pl. Welw. i. 741.
Matabeleland, Elliott ; Gwai Forest, 3600 ft. Allen, 233.

**I. Welwitschii,** *Vatke.*
Fl. Trop. Afr. IV. ii. 174 ; Cat. Afr. Pl. Welw. i. 739.
Chirinda, 3500 ft. Nov. Swyn. 301.

**I. Wightii,** *Choisy.*
Fl. Trop. Afr. IV. ii. 157 ; Fl. Cap. IV. ii. 63.
Bulawayo, Rand, 555 ; Salisbury, Rogers, 4019 ; Chirinda, 3800 ft. April, Swyn. 783 ; Melsetter, 6000 ft. June, Swyn. 1165 ; Odzani River Valley, Umtali, Teague, 108.

**I. spp.**
Victoria Falls, Sep. Galpin, 7012 ; April, Flanagan, 3293 ; Allen, 49 ; Rogers, 5232.
Salisbury, Darling in Herb. Bolus 10784.
Bulawayo, Monro, 16.
Gwai, 2400 ft. Allen, 244.
Matopos, Rogers, 5195.

## Family CCLII.—BORAGINACEAE, *Lindl.*

7038—**Cordia ovalis,** *R. Br.*
Fl. Trop. Afr. IV. ii. 15 ; Cat. Afr. Pl. Welw. i. 713.
Victoria, Monro, 726.

**C. spp.**
Matopos, Oct. Gibbs, 199.
Victoria, Monro, 767, 832, 1019.

7043—**Ehretia amœna,** *Klotzsch.* (*E. mossambicensis*, Klotzsch.)
Fl. Trop. Afr. IV. ii. 24 ; Fl. Cap. IV. ii. 5.
Enkeldoorn, Cecil, 89 ; Bulawayo, Monro, 5 ; Victoria, Monro, 730*a* ; South Rhodesia, Rand, 280.

**E. caffra,** *Sond.*
Matopos, Nov. Marloth, 3381.

**E. divaricata,** *Baker.*
Fl. Trop. Afr. IV. ii. 26.
Chirinda Forest, 3700–4000 ft. Sep. Swyn. 8.

**E. Fischeri,** *Gürke.*
Fl. Trop. Afr. IV. ii. 27.
Victoria, Monro, 939.

**E. hottentotica,** *Burch.*
Fl. Cap. IV. ii. 5 ; For. Fl. Port. E. Afr. 90 ; For. Fl. Cape, 279.
Bulawayo, 4500 ft. Oct. Eyles, 1069 ; Matopos, fl. & fr. Oct. Gibbs, 279 ; South Rhodesia, Rand, 279.

Genus No.

**E. sp.**

Bulawayo, Chubb, 344.

7051—**Tournefortia sp.**

Bulawayo, 4500 ft. Dec. Eyles, 20.

7052—**Heliotropium marifolium,** *Retz.*

Fl. Trop. Afr. IV. ii. 40.

Victoria Falls, Allen, 289.

**H. ovalifolium,** *Forsk.*

Fl. Trop. Afr. IV. ii. 34; Fl. Cap. IV. ii. 8; Cat. Afr. Pl. Welw. i. 718.

Gwai Forest, 3000 ft. Allen, 248; Victoria, Monro, 863.

**H. zeylanicum,** *Lam.*

Fl. Trop. Afr. IV. ii. 31; Cat. Afr. Pl. Welw. i. 720.

South Rhodesia, Rand, 106.

**H. sp.**

Bulawayo, Jan. Gardner, 19.

7056—**Trichodesma angustifolium,** *Harv.*

Fl. Cap. IV. ii. 11.

South Rhodesia, Rand, 636.

**T. physaloides,** *A. DC.* (*Borraginoides physaloides*, Hiern.)

Fl. Trop. Afr. IV. ii. 46; Fl. Cap. IV. ii. 11; Cat. Afr. Pl. Welw. i. 721.

Matabeleland, Oates; Elliott; Mashonaland, Bryce; Cecil; Bulawayo, 4500 ft. Sep. Eyles, 1081; Matopos, fl. Sep. fr. Oct. Gibbs, 74; Galpin, 6994; Engler; Salisbury, Engler; Darling in Herb. Bolus, 10785; Rand, 388, 571; Rogers, 4018; Marandellas, Engler; Victoria Falls, Rogers, 5003; Umvumvumvu Riv. Oct. Swyn. 2112; Nyahodi Valley, 4000 ft. Swyn. 6003; Victoria, Monro, 453, 482, 530, 1023; South Rhodesia, Rand, 633, 634, 635; Odzani River Valley, Umtali, Teague, 267.

**T. zeylanicum,** *R. Br.* (*Borraginoides zeylanica*, Hiern.)

Fl. Trop. Afr. IV. ii. 51; Cat. Afr. Pl. Welw. i. 720.

Victoria Falls, Rogers, 7216.

7064—**Cynoglossum lanceolatum,** *Forsk.* (*C. micranthum*, Desf.)

Fl. Trop. Afr. IV. ii. 54; Fl. Cap. IV. ii. 14; Cat. Afr. Pl. Welw. i. 721.

Mazoe, 4400–4800 ft. Dec. Eyles, 214; Odzani River Valley, Umtali, Teague, 114.

7109—**Lithospermum sp.**

South Rhodesia, Rand, 107.

## FAMILY CCLIII.—VERBENACEAE, *Juss.*

Genus No.

7138—**Verbena officinalis,** *L.*

Fl. Trop. Afr. v. 286; Fl. Cap. V. i. 209.

Mazoe, 4800 ft. March, Eyles, 297; Salisbury, April, Flanagan, 3261; South Rhodesia, Rand, 105.

7144—**Lantana salvifolia,** *Jacq.*

Fl. Trop. Afr. v. 276; Fl. Cap. V. i. 190; Cat. Afr. Pl. Welw. i. 827.

Bulawayo, 4500 ft. Eyles, 89; Chubb, 316, 367, 380; Dec. Gardner, 66; Rogers, 5914; Mazoe, 4400–4800 ft. Jan. Eyles, 505, 532; Matabeleland, Marloth; Elliott; Umtali, Engler; Odzani River Valley, Teague, 3; Victoria Falls, Rogers, 5795; Salisbury, Rogers, 5795, 4069; Melsetter, 6000 ft. April, Swyn.; Chirinda, 3700–4000 ft. Dec. Swyn. 259, 116, 2002; Victoria, Monro, 960; South Rhodesia, Rand, 114.

**L. sp.**

Salisbury, Rand, 513.

7145—**Lippia asperifolia,** *Rich.*

Fl. Trop. Afr. v. 280; Fl. Cap. V. i. 195.

Matabeleland, Oates; Elliott; Mazoe, 4400 ft. March, Eyles, 278; Matopos, July, Galpin, 6954; Victoria Falls, Rogers; Chirinda, 3800 ft. Melsetter, 6000 ft. April, May, Dec. Swyn. 260, 475, 475*a*, 1160, 2003; Victoria, Monro, 311; Odzani River Valley, Umtali, Teague, 229.

**L. Oatesii,** *Rolfe.*

Fl. Trop. Afr. v. 279.

Matabeleland, Oates; Nyamandhlovu, April, Flanagan, 3194 (forma); Bulawayo, Oct. Dec. Chubb, 382; Rogers, 5927; South Rhodesia, Rand, 103.

**L. Wilmsii,** *Pearson.*

Fl. Cap. V. i. 196.

Inyanga Mts. 6000–7000 ft. Cecil, 219; Gwelo, Jan. Gardner, 47; Chirinda, May, Dec. Swyn. 258, 474.

7148—**Bouchea hederacea,** *Sond.*

Fl. Cap. V. i. 200.

Victoria, Monro, 169, 671; Bulawayo, Rogers, 5750.

**B. pinnatifida,** *Schauer.*

Fl. Cap. V. i. 205.

Bulawayo, 4500 ft. Dec. Eyles, 1142; Oct. Dec. Chubb, 373 p.p. Rogers, 5919; between Plumtree and Bulawayo, April, Flanagan, 3210; South Rhodesia, Rand, 283.

Genus No.

**B. Wilmsii,** *Gürke.*

Fl. Cap. V. i. 200.

Bulawayo, Monro, 102.

7153—**Priva leptostachya,** *Juss.*

Fl. Trop. Afr. v. 285; Fl. Cap. V. i. 206.

Chirinda, 3800 ft. May, June, Swyn. 269, 517.

**P. sp.**

Bulawayo, Eyles, 16.

7162—**Duranta Plumieri,** *Jacq.*

Fl. Trop. Afr. v. 287; Fl. Cap. V. i. 210; Harv. Gen. S.A. Pl. 291.

Mazoe, 4200–4500 ft. Nov. Eyles, 193; Dec. Eyles, 213; Govt. Herb. 2083; Matopos, fl. & fr. Oct. Gibbs, 280; Victoria, Monro, 683, 793, 1033.

Note.—According to the Floras this is an introduction from Tropical America, but it is so common in kloofs and river-beds remote from European occupation, that this seems doubtful.

7186—**Vitex Cienkowskii,** *Kot. & Peyr.*

Fl. Trop. Afr. v. 328; Cat. Afr. Pl. Welw. i. 836.

Lusitu Riv. Swyn.

V. Eylesii, *S. Moore.*

Journ. Bot. 1907, 154.

Bulawayo, 4500 ft. Dec. Eyles, 1201; Chirinda, 3500 ft., Chikore Hills, 3500 ft. throughout S. Melsetter Dist. fl. April, Nov. Dec. fr. May, June, Swyn. 34, 34*b*, 1059.

**V. flavescens,** *Rolfe,* var. **parviflora,** *Gibbs.*

Journ. Linn. Soc. Bot. xxxvii. 463; Fl. Trop. Afr. v. 321 (type).

Victoria Falls, Sep. Gibbs, 135.

**V. gürkeana,** *Engl.*

Umtali, Engler.

**V. isotjensis,** *Gibbs.*

Journ. Linn. Soc. Bot. xxxvii. 463.

Matopos, Isotje Hill, Oct. Gibbs, 236; Victoria, Monro, 803.

**V. Kirkii,** *Baker.*

Fl. Trop. Afr. v. 321; For. Fl. Port. E. Afr. 94.

Victoria Falls, Allen, 60; Rogers, 5377.

**V. sp.**

Salisbury, Rand, 553.

7191—**Clerodendron amplifolium,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 167.

Chirinda Forest, 3700–4000 ft. April, Swyn. 335.

Genus No.
7191—**C. glabrum,** *E. Mey.* (*C. ovale,* Klotzsch.) (*Siphonanthus glabra,* Hiern.)

Fl. Trop. Afr. v. 297 & *C. ovale,* p. 298 partly; Fl. Cap. V. i. 219; Cat. Afr. Pl. Welw. i. 842; For. Fl. Port. E. Afr. 91 & 92; For. Fl. Cape, 286; Nat. Pl. 45.

Bulawayo, Monro, 115; Matopos, Engler; Victoria Falls, Rogers, 5561; Allen, 257 (var.).

**C. hirsutum,** *Pearson.*

Fl. Cap. V. i. 221.

Chimanimani Mts. 7000 ft. Sep. Swyn. 2004; Mt. Pene, 7000 ft. Oct. Swyn. 6086.

**C. lanceolatum,** *Gürke.*

Fl. Trop. Afr. v. 312; For. Fl. Port. E. Afr. 93.

Victoria Falls, Allen, 99; Mazoe, 4400–4800 ft. Nov. Eyles, 447; Bulawayo, Rogers, 5914, 5378, 5530.

**C. myricoides,** *R. Br.* (*Siphonanthus myricoides,* Hiern.)

Fl. Trop. Afr. v. 310 & 519; Fl. Cap. V. i. 223; For. Fl. Port. E. Afr. 93; Cat. Afr. Pl. Welw. i. 844; Nat. Pl. 282.

Matopos, Oct. Gibbs, 282; Bulawayo, Oct. Dec. Chubb, 383, 393, 394, 395; Chirinda, 3500 ft. Sep. Dec. Swyn. 173; Mt. Pene, 7000 ft. Swyn. 1296; Haroni Riv. 5000 ft. Swyn. 1297; Victoria, Monro, 734.

var. **cuneatum,** *Pearson.*

Fl. Cap. V. i. 223.

Bulawayo, Monro, 114.

var. **discolor,** *Baker.*

Fl. Trop. Afr. v. 310.

Victoria Falls, Allen, 102; Mazoe, 4800 ft. Nov. Eyles, 458.

**C. reflexum,** *Pearson.*

Trans. S.A. Phil. Soc. xv. 182.

Bulawayo, 4500 ft. Dec. Eyles, 1006; Victoria Falls, Rogers, 5634.

**C. spinescens,** *Gürke.*

Fl. Trop. Afr. v. 313; Fl. Cap. V. i. 221.

Victoria Falls, Allen, 402; Rogers, 5329.

**C. Swynnertonii,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 166.

Chirinda Forest, 3700–4000 ft. fl. & fr. May, Swyn. 85.

**C. sp.**

Victoria Falls, Rogers, 5378.

FAMILY CCLIV.—LABIATAE, *B. Juss.*

Genus No.
7213—**Tinnea rhodesiana,** *S. Moore.*
Journ. Bot. 1905, 51.
Matopos, 4500 ft. Jan. Eyles, 159.

**T. zambesiaca,** *Baker.*
Fl. Trop. Afr. v. 499.
Bulawayo, 4500 ft. March, Eyles, 1063; Victoria, Monro, 747 or 947.

7234—**Scutellaria Livingstonei,** *Baker.*
Fl. Trop. Afr. v. 462.
Mashonaland, Bryce; Salisbury, Sep. Rand, 520; Darling in Herb. Bolus 11198; North of Hartley, Engler; Mazoe, 4300–4800 ft. Sep. Eyles, 427, 433; Victoria, Monro.

36—**Acrotome sp.**
Redbank, April, Flanagan, 3188.

7264—**Leonotis Melleri,** *Baker.*
Fl. Trop. Afr. v. 491.
Odzani River Valley, Umtali, Teague, 268.

**L. mollissima,** *Gürke.*
Fl. Trop. Afr. v. 493.
Chirinda, 3700–4000 ft. June, Swyn. 235; plentiful throughout Melsetter Dist.

**L. nepetifolia,** *R. Br.*
Fl. Trop. Afr. v. 491; Cat. Afr. Pl. Welw. i. 879.
Mazoe, 5000 ft. Nov. Eyles, 462; Victoria, Monro, 1063.

**L. randii,** *S. Moore.*
Journ. Bot. 1900, 465.
Bulawayo, Dec. Rand, 165.

**L. spectabilis,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 180.
Chimanimani Mts. Sep. Swyn. 2013.

7268—**Leucas capensis,** *Engl.* (*Lasiocorys capensis*, Benth.)
Fl. Cap. V. i. 373.
Bulawayo, Dec. Rand, 162.

**L. martinicensis,** *R. Br.*
Fl. Trop. Afr. v. 479; Fl. Cap. V. i. 371; Cat. Afr. Pl. Welw. i. 876.
Bulawayo, May, Rand, 385; Mazoe, 4800 ft. March, Eyles, 294; Marandellas, Rogers, 4042.

Genus No.

**L. milanjiana**, *Gürke.*
Fl. Trop. Afr. v. 478.
Mazoe, 4300–4800 ft. Sep. Eyles, 429; Gwelo, Jan. Gardner, 22; Umtali, Engler, Odzani River Valley, Teague, 185; Chirinda, 3800 ft. April, Swyn. 385.

**L. neuflizeana,** *Courb.*
Fl. Trop. Afr. v. 480; Fl. Cap. V. i. 372.
Matopos, March, Flanagan, 2960.

**L. nyassae,** *Gürke.*
Fl. Trop. Afr. v. 485.
Salisbury, May, Flanagan, 3250; Bulawayo, Rogers, 5817*.

**L. Randii,** *S. Moore.*
Journ. Bot. 1900, 464.
Salisbury, July, Rand, 522.

**L. stricta,** *Baker.*
Fl. Trop. Afr. v. 484.
Victoria Falls, April, Flanagan, 3152.

**L. spp.**
South Rhodesia, Rand, 376; Flanagan, 3151.

7281—**Stachys æthiopica,** *L.*
Fl. Trop. Afr. v. 467; Fl. Cap. V. i. 348.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1972.

7283—**Achyrospermum Carvalhi,** *Gürke.*
Fl. Trop. Afr. v. 464.
Chirinda Forest, 3700–4000 ft. May, Swyn. 78.

7290—**Salvia runcinata,** *L. f.*
Fl. Cap. V. i. 327.
Bulawayo, Jan. Rand, 134.

**S. stenophylla,** *Burch.*
Fl. Cap. V. i. 326.
Bulawayo, 4500 ft. Dec. Eyles, 1003.

**S. sp.**
South Rhodesia, Rand, 142.

7305—**Satureia biflora,** *Briq.* (*Micromeria biflora*, Benth.)
Fl. Trop. Afr. v. 452; Fl. Cap. V. i. 306.
Melsetter, 6000 ft. Sep. Swyn. 1971; Odzani River Valley, Umtali, Teague, 78.

**S. masukensis** (*S. Moore*), *Torre & Harms.* (*Calamintha masukensis*, S. Moore.) (*Leucas masukensis*, Baker.)
Fl. Trop. Afr. v. 476.
Melsetter, 6000 ft. April, Swyn. 1990, 1991.

Genus No.
7328—**Mentha longifolia,** *Huds.* (*M. sylvestris*, L.)
Fl. Trop. Afr. v. 451; Fl. Cap. V. i. 303.
Salisbury, Dec. Rand, 145; Gwelo, Jan. Gardner, 1; Sr. Phil. 33; Mazoe, 4400 ft. Feb. Eyles, 528.

7342—**Hyptis pectinata,** *Poit.* (*Mesosphærum pectinatum*, O. Kuntze.)
Fl. Trop. Afr. v. 448; Fl. Cap. V. i. 297; Cat. Afr. Pl. Welw. i. 873.
Victoria Falls, April, Flanagan, 3277; Rogers, 5025; Victoria, Monro, 1054; Odzani River Valley, Umtali, Teague, 270.

7345—**Æolanthus crenatus,** *S. Moore.*
Journ. Bot. 1907, 94.
Matopos, 5000 ft. March, Eyles, 1013; Victoria, Monro, 749.

**Æ. Rehmannii,** *Gürke.*
Odzani River Valley, Umtali, Teague, 202.

**Æ. sericeus,** *Gürke.*
Matopos, 4800 ft. April, Eyles, 42.

**Æ. sp.**
Matopos, March, Flanagan, 2973.

7337—**Pycnostachys remotifolia,** *Baker.*
Fl. Trop. Afr. v. 381.
Mazoe, 4300 ft. April, Eyles, 325; Salisbury, May, Flanagan, 3273.

**P. reticulata,** *Benth.*
Fl. Trop. Afr. v. 382; Fl. Cap. V. i. 291.
Upper Buzi, 3500 ft. May, Swyn. 1954.

**P. urticifolia,** *Hook.*
Fl. Trop. Afr. v. 386; Fl. Cap. V. i. 291.
Salisbury, July, Rand, 525; May, Flanagan, 3274; Darling, in Herb. Bolus, 10786; Chirinda, 3800 ft. May, Swyn. 521; Victoria, Monro, 354, 1052.

7350—**Plectranthus caudatus,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 176.
Chimanimani Mts. 7000 ft. Sep. Swyn. 2010.

**P. chimanimanensis,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 174.
Chimanimani Mts. 7000 ft. Sep. Swyn. 2019.

**P. esculentus,** *N. E. Br.*
Fl. Cap. V. i. 285.
Melsetter, Govt. Herb. 753 (cultivated).

**P. floribundus,** *N. E. Br.*
Fl. Cap. V. i. 273.
Salisbury, Aug. Rand, 524; Matopos, Sep. Gibbs, 9; Umtali, Engler.

Genus No.

var. **longipes,** *N. E. Br.*

Fl. Trop. Afr. v. 403.

Umzingwane Riv. Baines; Mazoe, 4800 ft. Aug. Eyles, 196; Chirinda, 3800 ft. Sep. Swyn. 237.

**P. grandidentatus,** *Gürke.*

Fl. Cap. V. i. 278.

Odzani River Valley, Umtali, Teague, 148.

**P. hoslundioides,** *Baker.*

Fl. Trop. Afr. v. 418.

Chirinda, April, Swyn. 445; Chipetzana Riv. 3000 ft. May, Swyn. 1989.

**P. laxiflorus,** *Benth.*

Fl. Cap. V. i. 276.

Chirinda Forest, April, May, Swyn. 341, 467; Odzani River Valley, Umtali, Teague, 89.

**P. marrubioides,** *Hochst.*

Fl. Trop. Afr. v. 414.

Odzani River Valley, Umtali, Teague, 127.

**P. matabelensis,** *Baker.*

Fl. Trop. Afr. v. 417.

Shashi Riv. Holub, 1403–1406.

**P. petrensis,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 175.

Chimanimani Mts. 7000 ft. Sep. Swyn. 2018.

**P. selukwensis,** *N. E. Br.*

Kew Bull. 1906, 167.

Selukwe, Cecil, 123; Mazoe, 5200 ft. Dec. Eyles, 200; 5000 ft. March, Eyles, 251.

**P. Swynnertonii,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 176.

Chirinda Forest, 3700–4000 ft. fl. & fr. Feb. Swyn. 337.

**P. spp.**

Victoria Falls, April, Flanagan, 3237, cf. *P. Whytei*, Baker.

Mazoe, March, Flanagan, 3011.

Selukwe, Jan. Gardner, 53.

Matopos, Rogers, 5254, cf. *P. myrianthus*, Briq.

7353—**Englerastrum Schweinfurthii,** *Briq.*

Fl. Trop. Afr. v. 445; Cat. Afr. Pl. Welw. i. 860.

Victoria Falls, 3000 ft. May, Eyles, 111; Allen, 410; Matopos, Rogers, 5160 (var).

7355—**Coleus gazensis,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 178.

Melsetter, 6000 ft. April, Swyn. 1998.

Genus No.

**C. latifolius,** *Hochst.*
Fl. Trop. Afr. v. 437.
Mazoe, 4700 ft. March, Eyles, 267.

**C. matopensis,** *S. Moore.*
Journ. Bot. 1907, 96.
Matopos, 5000 ft. March, Eyles, 1024.

**C. palliolatus,** *S. Moore.*
Journ. Bot. 1900, 464.
Bulawayo, Jan. Rand, 144.

**C. Pentheri,** *Gürke.*
Fl. Cap. V. i. 289.
Bulawayo, Rogers, 5933.

**C. polyanthus,** *S. Moore.*
Journ. Bot. 1907, 96.
Matopos, 5000 ft. March, Eyles, 1012; Mazoe, 5300 ft. April, Eyles, 335.

**C. shirensis,** *Gürke.*
Fl. Trop. Afr. v. 443.
Umtali, Engler.

**C. Swynnertonii,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 177.
Chirinda, 3700–4000 ft. May, Swyn. 349.

**C. umbrosus,** *Vatke.*
Fl. Trop. Afr. v. 434.
Matopos, 4800 ft. April, Eyles, 54.

7357—**Hoslundia decumbens,** *Benth.* (*H. opposita,* Vahl, var. *decumbens,* Baker.)
Fl. Trop. Afr. v. 377; Fl. Cap. V. i. 298.
Victoria Falls, Rogers, 5420, 5577.

**H. verticillata,** *Vahl.*
Cat. Afr. Pl. Welw. i. 860.
Bulawayo, Dec. Rand, 163; Umtali, Engler; Chirinda, Nov. Swyn. 386.

7362—**Acrocephalus callianthus,** *Briq.*
Fl. Trop. Afr. v. 360.
Lusitu Riv. 5000 ft. April, Swyn. 1955.

**A. chirindensis,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 181.
Chirindia, April, Swyn. 313.

**A. picturatus,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 171.
Chirinda, Swyn. 257.

Genus No.

**A. sericeus,** *Briq.*

Fl. Trop. Afr. v. 362 ; Cat. Afr. Pl. Welw. i. 887.

Bulawayo, Jan. Rand, 146 ; Matopos, 4600 ft. April, Eyles, 46 ; Victoria, Monro, 357.

**A. spp.**

Mazoe, 4300 ft. April, Eyles, 324, cf. *A. sericeus*, Briq.

Between Plumtree and Bulawayo, April, Flanagan, 3179.

Salisbury, April, Flanagan, 3264.

7363—**Geniosporum angolense,** *Briq.*

Fl. Trop. Afr. v. 351; Fl. Cap. V. i. 293; Cat. Afr. Pl. Welw. i. 852.

Salisbury, March, Flanagan, 3014 ; April, Flanagan, 3263.

7364—**Moschosma multiflorum,** *Benth.*

Fl. Trop. Afr. v. 354.

Salisbury, May, Flanagan, 3259 ? ; Odzani River Valley, Umtali, Teague, 143.

**M. riparium,** *Hochst.* (*Iboza riparia*, N. E. Br. ; *Basilicum myriostachyum*, O. Kuntze.)

Fl. Trop. Afr. v. 354 & 523 ; Fl. Cap. V. i. 300 ; Nat. Pl. 1 & 2 : Cat. Afr. Pl. Welw. i. 858 ; Harv. Gen. S.A. Pl. 303.

Matopos, ♂ ♀ Sep. Gibbs, 3 (forma) ; Salisbury, July, Rand, 526 ; Mazoe, 4300 ft. ♀ March, Eyles, 290 ; Bulawayo, 4600 ft. Aug. Eyles, 1234.

**M. sp.**

Victoria Falls, Rogers, 5133.

7365—**Hemizygia flabellifolia,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 173.

Chimanimani Mts. 7000 ft. Sep. Swyn. 1414.

**H. ornata,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 172.

Mt. Pene, 6500–7000 ft. Sep. Oct. Swyn. 1999, 6078.

7366—**Ocimum americanum,** *L.* (*O. canum*, Sims.)

Fl. Trop. Afr. v. 337 & 521 ; Fl. Cap. V. i. 235 ; Cat. Afr. Pl. Welw. i. 848.

Bulawayo, 4500 ft. Nov. Eyles, 1219 ; Jan. Rand, 164 ; June, Rand, 516.

**O. angustifolium,** *Benth.* (*Becium angustifolium*, N. E. Br.)

Fl. Cap. V. i. 231.

Bulawayo, Rogers, 5481*.

**O. Buchananii,** *Baker.*

Fl. Trop. Afr. v. 348.

Salisbury, Rogers, 4010.

Genus No.

**O. filamentosum,** *Forsk.*

Fl. Trop. Afr. v. 343.

North of Hartley, Engler.

**O. knyanum,** *Vatke.*

Fl. Trop. Afr. v. 346; Cat. Afr. Pl. Welw. i. 850.

Bulawayo, Oct.–Dec. Chubb, 305; Chirinda, Feb. May, Nov. Swyn. 277, 468, 1988.

**O. obovatum,** *E. Mey.* (*Becium obovatum,* N. E. Br.)

Nat. Pl. 257; Fl. Cap. V. i. 230.

Matopos, Oct. Gibbs, 102; Salisbury, Sep. Rand, 621; Darling, in Herb. Bolus; Rogers, 4009; Odzani River Valley, Umtali, Teague, 137.

**O. odontosepalum,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 170.

Melsetter, 6000 ft. Oct. Swyn. 6087, 6088.

**O. Randii,** *S. Moore.*

Journ. Bot. 1900, 463.

Salisbury, Sep. Rand, 618.

**O. scoparium,** *Gürke.*

Fl. Trop. Afr. v. 339.

Salisbury, May, Flanagan, 3267.

**O. suave,** *Willd.*

Fl. Trop. Afr. v. 338; Fl. Cap. V. i. 234; Cat. Afr. Pl. Welw. i. 849; Nat. Pl. 325.

Chirinda, 3700–4000 ft. Aug. Swyn. 384, 466.

**O. sp.**

Allen, Victoria Falls, 195.

7367—**Orthosiphon bracteosus,** *Baker.* (*Ocimum bracteosum,* Benth.; *Hemizygia bracteosa,* Briq.)

Fl. Trop. Afr. v. 375; Fl. Cap. V. i. 248.

Mazoe, 4400 ft. Dec. Eyles, 489; Gwai, April, Flanagan, 3295; Umtali, Engler; Odzani River Valley, Teague, 21; Salisbury, Dec. Rand, 166; Rogers, 4071; Victoria, Monro, 973; Chikore Hills, 3500 ft. March, Swyn. 268; Umvumvumvu Riv. 4000 ft. April, Swyn. 1956; Victoria Falls, Rogers, 5608; Bulawayo, Rogers, 5482.

**O. Elliottii,** *Baker.*

Fl. Trop. Afr. v. 376; Fl. Cap. V. i. 249.

Bulawayo, Dec. Rand, 167; Dec. Gardner 96; Matabeleland, Elliott.

**O. Kirkii,** *Baker.*

Fl. Trop. Afr. v. 376.

Bulawayo, May, Rand, 384; Deka, 2400 ft. May, Eyles, 134.

Genus No.

**O. linearis,** *Benth.*
Fl. Trop. Afr. v. 374.
Matabeleland, Oates; Bulawayo, May, Rand, 386.

**O. rhodesianus,** *S. Moore.*
Journ. Bot. 1905, 50.
Deka, 2400 ft. May, Eyles, 132.

**O. shirensis,** *Baker.*
Fl. Trop. Afr. v. 368.
Bulawayo, Jan. Rand, 143; Jan. Gardner, 65; Sebawke, 4000 ft. Dec. Eyles, 71.

**O. teucriifolius,** *N. E. Br.* (*Hemizygia teucriifolia,* Briq.)
Fl. Cap. V. i. 254.
Mt. Pene, 7000 ft. Oct. Swyn. 6075.

**O. Woodii,** *Gürke.*
Mt. Pene, 6500–7000 ft. Sep. Swyn. 1974.

## Family CCLVI.—SOLANACEAE, *Hall.*

7377—**Nicandra physaloides,** *Gærtn.* (*Pentagonia physalodes,* Hiern.)
Fl. Cap. IV. ii. 109; Cat. Afr. Pl. Welw. i. 752; Harv. Gen. S.A. Pl. 257.
Salisbury, Darling, in Herb. Bolus 10795; Odzani River Valley, Umtali, Teague, 104.

7379—**Lycium tetrandrum,** *Thunb.* (*L. horridum,* Thunb.)
Fl. Cap. IV. ii. 114.
Salisbury, Rand, 514; South Rhodesia, Rand, 382.

**L. persicum,** *Miers.* (*L. arabicum,* Schweinf.)
Fl. Trop. Afr. IV. ii. 254.
Bulawayo, 4500 ft. Oct. Eyles, 1073; Monro, 10; Salisbury, Rand, 515; South Rhodesia, Rand, 147.

7400—**Withania somifera,** *Dunal.* (*Physaloides somnifera,* Moench.)
Fl. Trop. Afr. IV. ii. 249; Fl. Cap. IV. ii. 107; Cat. Afr. Pl. Welw. i. 752; Harv. Gen. S.A. Pl. 258.
Bulawayo, 4500 ft. Dec. Eyles, 15; Tati Riv. Holub; Mazoe, 4300 ft. Jan. Eyles, 239; Rusapi, Engler; Matabeleland, Marloth.

7401—**Physalis minima,** *L.*
Fl. Trop. Afr. IV. ii. 247; Fl. Cap. IV. ii. 106; Cat. Afr. Pl. Welw. i. 750.
Victoria Falls, April, Flanagan, 3305.

Genus No.

**P. peruviana,** *L.*

Fl. Trop. Afr. IV. ii. 248 ; Fl. Cap. IV. ii. 106 ; Harv. Gen. S.A. Pl. 257.

Mazoe, 4800 ft. Jan. Eyles, 236 ; Odzani River Valley, Umtali, Teague, 129.

7407—**Solanum acanthocalyx,** *Klotzsch.*

Fl. Trop. Afr. IV. ii. 234.

Chirinda Forest, 3700–4000 ft. Nov. Swyn. 93.

**S. aculeastrum,** *Dun.*

Fl. Trop. Afr. IV. ii. 243 ; Fl. Cap. IV. ii. 95 ; For. Fl. Cape, 278.

Chirinda, cultivated for hedges, Swyn.

**S. bifurcum,** *Hochst.*

Fl. Trop. Afr. IV. ii. 213 ; Fl. Cap. IV. ii. 94 ; Cat. Afr. Pl. Welw. i. 746.

Chirinda Forest, 3700–4000 ft. Oct. Swyn. 86.

**S. incanum,** *L.*

Fl. Trop. Afr. IV. ii. 238 ; Fl. Cap. IV. ii. 101.

Salisbury, Rogers, 5802.

**S. indicum,** *L.*

Fl. Trop. Afr. IV. ii. 232 ; Fl. Cap. IV. ii. 101 ; Cat. Afr. Pl. Welw. i. 750.

Chirinda, 3800 ft. fl. Oct. fr. May, Swyn. 388, 482, on cultivated ground.

**S. nigrum,** *L.*

Fl. Trop. Afr. IV. ii. 218 ; Fl. Cap. IV. ii. 89 ; Cat. Afr. Pl. Welw. i. 745.

Bulawayo, 4500 ft. Jan. Eyles, 1009 ; Rogers, 6202 ; Victoria Falls, Rogers, 5131 ; Victoria, Monro, 1024 ; South Rhodesia, Rand, 171 ; Odzani River Valley, Umtali, Teague, 74.

**S. nodiflorum,** *Jacq.*

Fl. Trop. Afr. IV. ii. 218 ; Cat. Afr. Pl. Welw. i. 745.

Melsetter, 6000 ft. fl. & fr. April, May, Swyn. 342 ; Chirinda Forest, 3800 ft. Swyn. 481 ; Chirinda, on cultivated ground, Swyn. 1794.

**S. panduræforme,** *E. Mey.* (*S. delagoense*, Dun.)

Fl. Trop. Afr. IV. ii. 214 ; Fl. Cap. IV. ii. 99 ; Cat. Afr. Pl. Welw. i. 747 ; Nat. Pl. 596.

Matabeleland, Oates ; Elliott ; Sebakwe, 4000 ft. Dec. Eyles, 123 ; Plumtree, April, Flanagan, 3177 ; Bulawayo, Chubb, 390 ; Rogers, 5504 ; Chirinda, 3800 ft. Nov. Swyn. 1793 ; Salisbury, Rogers, 5772 ; Matopos, May, Rogers ; Victoria Falls, April, Rogers ; South Rhodesia, Rand, 170.

Genus No.

**S. sodomeum,** var. **Hermanni,** *Dun.*
Fl. Cap. IV. ii. 96.
Bembesi, Jan. Gardner, 49.

7415—**Datura Stramonium,** *L.*
Fl. Trop. Afr. IV. ii. 257; Fl. Cap. IV. ii. 118; Cat. Afr. Pl. Welw. i. 753; Harv. Gen. S.A. Pl. 258.
Mazoe, 4400 ft. March, Eyles, 280; Bulawayo, Chubb, 349; South Rhodesia, Rand, 169.

7436—**Petunia violacea,** *Lindl.*
Umgusa Riv. 4400 ft. Nov. Eyles, 1189.

## Family CCLVII.—SCROPHULARIACEAE, *Lindl.*

7467—**Apostimum decumbens,** *Schinz.*
Fl. Trop. Afr. IV. ii. 272; Cat. Afr. Pl. Welw. i. 755.
Victoria Falls, Allen, 105; April, Flanagan, 3202; Rogers, 7212.

**A. elongatum,** *Engl.*
Fl. Trop. Afr. IV. ii. 273.
Mashonaland, Bryce; South Rhodesia, Rand, 641.

**A. lineare,** *Marl. & Engl.* (*A. Randii*, S. Moore.)
Fl. Trop. Afr. IV. ii. 269; Fl. Cap. IV. ii. 129; Cat. Afr. Pl. Welw. i. 755.
Bulawayo, 4500 ft. Nov. Eyles, 87; Cecil, 115; Rand, 180; Rogers, 5925; Jan. Gardner, 63; Chubb, 327; Matopos, Sep. Gibbs, 13; Gwelo, Sr. Phil. 57; Matabeleland, Elliott; Marloth.

7476—**Nemesia affinis,** *Benth.*
Fl. Trop. Afr. IV. ii. 286; Fl. Cap. IV. ii. 182.
Matopos, Sep. Gibbs, 49.

**N. dentata,** *G. Don.*
Fl. Trop. Afr. IV. ii. 286.
Matabeleland, Herb. Desfontaines.

**N. divergens,** *Benth.*
Fl. Cap. IV. ii. 193.
Bulawayo, 4600 ft. Aug. Eyles, 1229.

**N. fœtens,** Vent. Fl. Cap. IV. ii. 193.
Bulawayo, 4500 ft. Dec. Eyles, 31; Matopos, Sep. Gibbs, 312.

7477—**Diclis petiolaris,** *Benth.*
Fl. Trop. Afr. IV. ii. 287; Fl. Cap. IV. ii. 201.
Bulawayo, May, Rand, 372; Matopos, Sep. Gibbs, 76; March, Flanagan, 2955; Victoria Falls, Allen, 409.

Genus No.
7493—**Halleria lucida,** *L.*

Fl. Trop. Afr. IV. ii. 295 ; Fl. Cap. IV. ii. 207 ; Nat. Pl. 545.

Chirinda Forest, 3700–4000 ft. Sep. Swyn. 124 ; Melsetter, 6000 ft., Dec. Swyn. 1138.

7494—**Teedia lucida,** *Rud.*

Fl. Cap. IV. ii. 210.

Chimanimani Mts. 7000 ft. Sep. Swyn. 785.

7497—**Freylinia tropica,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 152.

Melsetter, 6000 ft. Sep. Swyn. 608.

7517—**Manulea rhodesiana,** *S. Moore.*

Journ. Bot. 1911, 156.

Victoria, Monro, 924.

7519—**Sutera atropurpurea,** *Hiern.* (*Lyperia atropurpurea,* Benth.)

Fl. Trop. Afr. IV. ii. 309 ; Fl. Cap. IV. ii. 306.

Bulawayo, May, Rand, 370 ; June, Eyles, 148.

**S. Bolusii,** *Hiern.*

Fl. Cap. IV. ii. 300.

Bulawayo, Chubb, 6*a*.

**S. brunnea,** *Hiern.*

Fl. Cap. IV. ii. 305.

Bulawayo, Rogers, 5749.

**S. burkeana,** *Hiern.* (*Lyperia burkeana,* Benth.)

Fl. Trop. Afr. IV. ii. 308 ; Fl. Cap. IV. ii. 299; Cat. Afr. Pl. Welw. i. 757.

Matabeleland, Baines ; Oates ; Bulawayo, May, Rand, 371 ; Chubb, 317, 331 ; Matopos, fl. & fr. Sep. Oct. Gibbs, 15 ; March, Flanagan, 2994 ; Gwelo, Sr. Phil. 5 ; Odzani River Valley, Umtali, Teague, 18.

**S. Carvalhoi,** *Skan.*

Fl. Trop. Afr. IV. ii. 307.

Inyanga, Cecil, 198 ; Melsetter, 6000 ft. Sep. Swyn. 1980 ; North Melsetter, 5000–6000 ft. Oct. Swyn. 6228.

**S. floribunda,** *O. Kuntze.*

Fl. Cap. IV. ii. 277.

Melsetter, 6000 ft. Sep. Swyn. 1996 ; North Melsetter, 5000–6000 ft. Oct. Swyn. 6149.

**S. micrantha,** *Hiern.* (*S. fissifolia,* S. Moore ; *Chaenostoma micranthum,* Engl.)

Fl. Trop. Afr. IV. ii. 303 ; Fl. Cap. IV. ii. 263 ; Journ. Bot. 1900, 467.

Bulawayo, Jan. Rand, 155 ; Oct. Eyles, 1077 ; Gwelo, Gardner, 16 ; Matengwe Riv. Holub, 1312, 1313 ; Matopos, Sep. Gibbs, 36; Bulawayo, 4500 ft. Aug. Eyles, 1243.

Genus No.

**S. spp.**

Bulawayo, Rogers, 13612 and 5681.

7523—**Zaluzianskya capensis,** *Walp.*

Fl. Cap. IV. ii. 338.

Melsetter, 6000 ft. Sep. Swyn. 1981.

7524—**Mimulus gracilis,** *R. Br.* (*M. angustifolius*, Hochst.; *M. strictus*, Benth.)

Fl. Trop. Afr. IV. ii. 310; Fl. Cap. IV. ii. 354; Cat. Afr. Pl. Welw. i. 758.

Bulawayo, Dec. and May, Rand, 156, 368, 506; Dec. Eyles, 57; Aug. Eyles, 1230; Gardner, 70; Rogers, 13604.

7532—**Limnophila ceratophylloides,** *Skan.* (*Stemodiacra ceratophylloides*, Hiern.)

Fl. Trop. Afr. IV. ii. 317; Cat. Afr. Pl. Welw. i. 759.

Salisbury, Rand, 539.

**L. gratioloides,** *R. Br.*

Fl. Trop. Afr. IV. ii. 319.

Salisbury, July, Rand, 518.

**L. sessiflora,** *Blume.*

Fl. Trop. Afr. IV. ii. 318.

Matopos, Oct. Gibbs, 212.

**L. sp.**

Mazoe, 4300 ft. Jan. Eyles, 511.

7535—**Stemodiopsis Eylesii,** *S. Moore.*

Journ. Bot. 1908, 71.

Mazoe, 5000 ft. March, Eyles, 252.

**S. humilis,** *Skan.*

Fl. Trop. Afr. IV. ii. 316.

Matopos, 5000 ft. Feb. Eyles, 1166.

7558—**Limosella aquatica,** *L.* var. **tenuifolia,** *Hook. f.*

Fl. Trop. Afr. IV. ii. 352; Fl. Cap. IV. ii. 357.

Mazoe, 4200 ft. Sep. Eyles, 408, 409.

7560—**Craterostigma nanum,** *Oliv.*

Fl. Trop. Afr. IV. ii. 331; Fl. Cap. IV. ii. 360.

Inyanga, 6000–7000 ft. Cecil, 208.

**C. plantagineum,** *Hochst.*

Fl. Trop. Afr. IV. ii. 329; Fl. Cap. IV. ii. 361; Cat. Afr. Pl. Welw. i. 761.

Matabeleland, Oates; Bulawayo, Dec. Rand, 157; Chubb, 401; Iron Mine Hill, Cecil, 93; Victoria, Monro, 838; Matopos, Nov. Marloth, 3405.

**C. sp.**

Victoria, Monro, 788.

Genus No.
7564—**Ilysanthes conferta,** *Hiern.* (*I. Plantaginella*, S. Moore.)
Fl. Trop. Afr. IV. ii. 347; Fl. Cap. IV. ii. 365; Journ. Bot. 1905, 49.
Matopos, 4500 ft. April, Eyles, 47; March, Flanagan, 2987.

**I. micrantha,** *S. Moore.*
Journ. Bot. 1911, 158.
Victoria, Monro, 1031.

**I. Muddii,** *Hiern.*
Fl. Cap. IV. ii. 366.
Matopos, 4500 ft. March, Eyles, 1033.

7566—**Hebenstreitia dentata,** *L. f.*
Fl. Cap. V. i. 101; Cat. Afr. Pl. Welw. i. 825.
Nyahodi Riv. 5000 ft. April, Swyn. 1888.

**H. elongata,** *Bolus.*
Fl. Cap. V. i. 99.
Mt. Pene, 6500–7000 ft. Sep. Swyn. 1887.

**H. Holubii,** *Rolfe.*
Victoria Falls, fl. & fr. Sep. Gibbs, 116; Engler; Odzani River Valley, Umtali, Teague, 230.

7568—**Selago Cecilae** (*Rolfe*), *Torre & Harms.* (*Walafrida Cecilae*, Rolfe.)
Kew Bull. 1906, 167.
Bulawayo, Cecil.

**S. chongweensis** (*Rolfe*), *T. & H.* (*Walafrida chongweensis*, Rolfe.)
Journ. Linn. Soc. Bot. xxxvii. 462.
Victoria Falls, Allen, 120; Sep. Gibbs, 117.

**S. Hoepfneri,** *Rolfe.*
Sicumy Vlei, 3200 ft. Allen, 231.

**S. Swynnertonii** (*S. Moore*), *T. & H.* (*Walafrida Swynnertonii*, S. Moore.)
Journ. Linn. Soc. Bot. xl. 165.
Nyahodi Riv. 5000 ft. fl. & fr. April, Swyn. 2135.

**S. spp.**
Matopos, Engler, cf. *S. micrantha*, Choisy.
Bulawayo, Rand, 551.

7597—**Melasma communis** (*Hemsl.*), *Torre & Harms.* (*Alectra communis*, Hemsl.)
Fl. Trop. Afr. IV. ii. 372.
Chirinda, 3700–4000 ft. June, Swyn. 1975.

**M. orobanchoides,** *Engl.* (*Alectra pumila*, Benth.; *Alectra kilimandjarica*, Hemsl.)
Fl. Trop. Afr. IV. ii. 365, *where see note that this name probably includes several distinct species.*
Fl. Cap. IV. ii. 376; Cat. Afr. Pl. Welw. i. 768.
Mazoe, 5000 ft. April, Eyles, 332; March, Eyles, 289; Matopos, 5000 ft. March, Eyles, 1016.

Genus No.

**M. sessiliflorum,** *Hiern.* (*Alectra melampyroides,* Benth.)

Fl. Trop. Afr. IV. ii. 371; Fl. Cap. IV. ii. 375; Cat. Afr. Pl. Welw. i. 767; Nat. Pl. 397.

Victoria Falls, Sep. Gibbs, 293; Rogers, 5780.

**M. sp.**

Victoria Falls, April, Flanagan, 3163, cf. *M. indicum,* Hiern.

7614—**Graderia scabra,** *Benth.* (*Bopusia scabra,* Presl.)

Fl. Cap. IV. ii. 389; Cat. Afr. Pl. Welw. i. 772.

Mt. Pene, 6500–7000 ft. Sep. Swyn. 1977, 1978; Haroni Riv. 5500 ft. Oct. Swyn. 6077.

7616—**Sopubia cana,** *Harv.*

Fl. Cap. IV. ii. 386; Cat. Afr. Pl. Welw. i. 774.

Mazoe, 4300 ft. April, Eyles, 322.

**S. leprosa,** *S. Moore.*

Fl. Trop. Afr. IV. ii. 453; Journ. Bot. 1900, 468.

Salisbury, Dec. Rand, 158.

**S. ramosa,** *Hochst.*

Fl. Trop. Afr. IV. ii. 449; Cat. Afr. Pl. Welw. i. 773.

Salisbury, May, Flanagan, 3272; Chirinda, 3800 ft. fl. & fr. April, June, Swyn. 389; Chipetzana Riv. 3000 ft. Swyn. 2125; Upper Buzi Riv. 3000 ft. Swyn. 2126; Odzani River Valley, Umtali, Teague, 224; Victoria Falls, Rogers, 13310*; Matopos, Rogers, 7919*.

**S. simplex,** *Hochst.*

**S. dregeana,** *Benth.*

*In* Fl. Cap. IV. ii. 386, 1904, *these two species are treated as synonymous, but in* Fl. Trop. Afr. IV. ii. 450, 451, 1906, *they are again separated. As I am unable to allocate all the records of various collectors, I give them here, distinguishing the species where known:—*

See also Cat. Afr. Pl. Welw. i. 773 & Nat. Pl. 364.

*S. simplex,* Matabeleland, Bryce; Matopos, Oct. Gibbs, 99; Mazoe, 4300 ft. Dec. Eyles, 481; Mt. Pene, 6500–7000 ft. Sep. Oct. Swyn. 1976, 6209.

*S. dregeana,* Umtali, Cecil, 234.

*Doubtful,* Matopos, 4800 ft. Nov. Eyles, 1102; Salisbury, Dec. Rand, 159; Victoria, Monro, 582, 799, 948, 1028.

7622—**Buchnera ciliolata,** *Engl.*

Fl. Trop. Afr. IV. ii. 379; Cat. Afr. Pl. Welw. i. 775.

Victoria, Monro, 1029.

**B. dura,** *Benth.*

Fl. Cap. IV. ii. 391.

Matopos, 5000 ft. March, Eyles, 1014.

Genus No.

**B. Eylesii,** *S. Moore.*
Journ. Bot. 1908, 72.
Mazoe, 5000 ft. April, Eyles, 334.

**B. Henriquesii,** *Engl.* (*B. rhodesiana*, S. Moore.)
Fl. Trop. Afr. IV. ii. 396; Journ. Bot. 1900, 468; Cat. Afr. Pl. Welw. i. 775.
Salisbury, Dec. Rand, 154; Engler; Matabeleland, Elliott; Mashonaland, Bryce; Charter Flats, Cecil, 83; Bulawayo, 4500 ft. Nov. Eyles, 1111; Chirinda, 3800 ft. May–Nov. Swyn. 303*a*; Melsetter, 6000 ft. Swyn. 1982; Upper Buzi, 3500 ft. Swyn. 6106; Mt. Pene, 7000 ft. Swyn. 6109; Victoria Falls, Rogers, 7295.

**B. hispida,** *Buch.-Ham.*
Fl. Trop. Afr. IV. ii. 397.
Victoria Falls, Rogers, 7071*, 7093*.

**B. Lastii,** *Engl.*
Fl. Trop. Afr. IV. ii. 392.
Mt. Pene, 7000 ft. Oct. Nov. Swyn. 6105, 6150.

**B. leptostachya,** *Benth.*
Fl. Trop. Afr. IV. ii. 394.
Selukwe, Rogers, 4093 ?.

**B. pusilliflora,** *S. Moore.*
Journ. Bot. 1908, 310.
Mazoe, 4300 ft. April, Eyles, 367.

**B. Randii,** *S. Moore.*
Fl. Trop. Afr. IV. ii. 387; Journ. Bot. 1900, 467.
Salisbury, July, Rand, 573.

**B. sp.**
Matopos, March, Flanagan, 2985, 2971.

7622*a*—**Eylesia buchneroides,** *S. Moore.*
Journ. Bot. 1908, 311.
Mazoe, 4300 ft. April, Eyles, 366.

7623—**Cycnium adonense,** *E. Mey.*
Fl. Trop. Afr. IV. ii. 431; Fl. Cap. IV. ii. 395; Cat. Afr. Pl. Welw. i. 777; Nat. Pl. 273.
Bulawayo, 4500 ft. Dec. Eyles, 18; Dec. Rand, 161; Salisbury, Darling; Chipete Forest, 3800 ft. April, Swyn. 234; Melsetter, 6000 ft. Oct. Swyn. 6076; also Chirinda, Lusitu Valley, etc. Odzani River Valley, Umtali, Teague, 121.

**C. palustre ?.**
Victoria Falls, Davy.

Genus No.
7624—**Rhamphicarpa fistulosa,** *Benth.*

Fl. Trop. Afr. IV. ii. 419; Fl. Cap. IV. ii. 398; Cat. Afr. Pl. Welw. i. 778.

Bulawayo, May, Rand, 387; Matopos, March, Flanagan, 2963*a*.

**B. montana,** *N. E. Br.*

Fl. Trop. Afr. IV. ii. 427; Kew Bull. 1901, 129; Fl. Cap. IV ii. 400.

Matabeleland, Elliott; Bulawayo, Rand, 160; between Charter and Bulawayo, Cecil, 90; Bulawayo, 4500 ft. Nov. Eyles, 1112; Rogers, 5511; Chubb, 399; Victoria, Monro, 611, 792.

**R. tubulosa,** *Benth.* (*Cycnium tubulosum*, Engl.)

Fl. Trop. Afr. IV. ii. 428; Fl. Cap. IV. ii. 399; Harv. Gen. S.A. Pl. 271.

Victoria Falls, Sep. Galpin; Allen, 34; fl. & fr. Sep. Gibbs, 131, 101; Engler; April, Flanagan, 3164; Rogers, 5277; Mashonaland, Bryce; Victoria, Monro, 921, 948*a*.

**R. sp.**

Matopos, March, Flanagan, 2963?, n. sp.

7625—**Striga elegans,** *Benth.*

Fl. Trop. Afr. IV. ii. 408; Fl. Cap. IV. ii. 382; Cat. Afr. Pl. Welw. i. 779.

Mashonaland, Cecil, 259; Mazoe, 4400 ft. April, Eyles, 368; Victoria, Monro, 975.

**S. Forbesii,** *Benth.*

Fl. Trop. Afr. IV. ii. 410; Fl. Cap. IV. ii. 384; Cat. Afr. Pl. Welw. i. 780.

Victoria Falls, April, Flanagan, 3155.

**S. lutea,** *Lour.* (*S. coccinea*, Benth.)

Fl. Trop. Afr. IV. ii. 409; Fl. Cap. IV. ii. 382; Cat. Afr. Pl. Welw. i. 780.

Gwelo, Jan. Gardner, 42; Matabeleland, Cecil, 128; Matopos, March, Flanagan, 2992; Upper Buzi, 3000 ft. April, Swyn. 1985; Odzani River Valley, Umtali, Teague, 84.

**S. orobanchoides,** *Benth.*

Fl. Trop. Afr. IV. ii. 402; Fl. Cap. IV. ii. 380; Cat. Afr. Pl. Welw. i. 778.

Matopos, March, Flanagan, 2993; Mazoe, 4600 ft. Jan. Eyles, 508; Victoria Falls, April, Flanagan, 3202; Rogers, 7023.

**S. Thunbergii,** *Benth.*

Fl. Trop. Afr. IV. ii. 404; Fl. Cap. IV. ii. 380; Cat. Afr. Pl. Welw. i. 779; Nat. Pl. 370.

Salisbury, July, Rand, 521; Engler; Manica, Cecil, 159; Gwelo, Jan. Gardner, 54; Matabeleland, Elliott; Victoria, Monro, 976.

FAMILY CCLVIII.—BIGNONIACEAE, *Pers.*

Genus No.

7716*a*—**Podranea Brycei,** *Sprague.* (*Tecoma Brycei,* N. E. Br.)

Fl. Trop. Afr. IV. ii. 515; Kew Bull. 1901, 130.

Mashonaland, Bryce; Bulawayo, Franklin White; Mazoe, 4300 ft. June, Eyles, 373; Victoria, Monro, 1087; Chipete Forest, 3800 ft. May, Swyn. 429; Melsetter Dist. 3000–5000 ft. Swyn.; Selukwe, Rogers, 4099.

7722—**Rhigozum brevispinosum,** *O. Kuntze.*

Fl. Trop. Afr. IV. ii. 531.

Shashi Riv. Baines.

7744—**Markhamia acuminata,** *Sprague.*

Fl. Trop. Afr. IV. ii. 524.

Sebakwe, 4000 ft. Dec. Eyles, 171; Victoria Falls, Allen, 149.

**M. lanata,** *K. Schum.*

Fl. Trop. Afr. IV. ii. 527.

Upper Buzi, 3000 ft. Dec. Swyn. 33; also western slopes of Mpengo Mt., Chirinda, Chikore Hills and Umswirizwi.

7761—**Kigelia pinnata,** *DC.* var. **tomentella,** *Sprague.*

Fl. Trop. Afr. IV. ii. 537; & for type Fl. Cap. IV. ii. 454; Nat. Pl. 386, 387; Cat. Afr. Pl. Welw. i. 793; For. Fl. Port. E. Afr. 91; Harv. Gen. S.A. Pl. 276.

Victoria Falls, Sep. Galpin, 7025; Davy; Cartwright; Allen, 30; Salisbury, Darling; Gwanda, Noble, 38; Mazoe, Govt. Herb. 929; Victoria, Monro, 495.

FAMILY CCLIX.—PEDALIACEAE, *Lindl.*

7769—**Pterodiscus Elliottii,** *Baker.*

Fl. Trop. Afr. IV. ii. 542.

Matabeleland, Elliott.

**P. speciosus,** *Hook.*

Fl. Trop. Afr. IV. ii. 542; Fl. Cap. IV. ii. 456.

Shashi Riv. Rand, 197; Victoria, Monro, 659, 825.

**P. sp.**

Gwai Forest, Jan. Allen, 272.

7771—**Harpagophytum procumbens,** *DC.*

Fl. Trop. Afr. IV. ii. 548; Fl. Cap. IV. ii. 458.

Victoria Falls, Allen, 74; April, Flanagan, 3240; Bulawayo, Rogers, 5602.

var. **sublobatum,** *Engl.*

Fl. Trop. Afr. IV. ii. 548.

Matabeleland, Elliott; Shashi Riv. Rand, 200; Victoria Falls, Rogers, 5384.

Genus No.

7776—**Rogeria adenophylla,** *J. Gay.*

Fl. Trop. Afr. IV. ii. 549; Cat. Afr. Pl. Welw. i. 796.

South Rhodesia, Rand, 199.

7777—**Sesamum alatum,** *Thonn.*

Fl. Trop. Afr. IV. ii. 559.

South Rhodesia, Rand, 378.

**S. angustifolium,** *Engl.*

Fl. Trop. Afr. IV. ii. 554.

Mazoe, 4800 ft. Jan. Eyles, 234; Victoria Falls, Allen, 132; Rogers, 5140, 5601, 7242, 7144; July, Kolbe, 3134; April, Flanagan, 3161.

**S. Baumii,** *Stapf.*

Fl. Trop. Afr. IV. ii. 554.

Victoria Falls, Sep. Gibbs, 115.

**S. calycinum,** *Welw.*

Fl. Trop. Afr. IV. ii. 555; Cat. Afr. Pl. Welw. i. 797.

Salisbury, Cecil, 142; Rand.

**S. capense,** *Burm. f.* (*Sesamopteris pentaphylla,* DC.)

Fl. Trop. Afr. IV. ii. 560; Fl. Cap. IV. ii. 461; Cat. Afr. Pl. Welw. i. 800; Harv. Gen. S.A. Pl. 278.

Bulawayo, Jan. Gardner, 60; Eyles; Matabeleland, Marloth; South Rhodesia, Rand, 196.

**S. indicum,** *L.*

Fl. Trop. Afr. IV. ii. 558; Fl. Cap. IV. ii. 460; Cat. Afr. Pl. Welw. i. 797.

Chirinda, 3800 ft. cultivated ground, April, Swyn. 251; Upper Buzi, 3000 ft. May, Swyn. 2000.

7778—**Ceratotheca kraussiana,** *Kunth.*

Victoria, Monro, 993.

**C. sesamoides,** *Endl.*

Fl. Trop. Afr. IV. ii. 563.

Deka, 2400 ft. May, Eyles, 133; Victoria Falls, April, Flanagan, 3204; Rogers, 5621.

**C. triloba,** *E. Mey.*

Fl. Trop. Afr. IV. ii. 564; Fl. Cap. IV. ii. 462; Nat. Pl. 367.

Shashi Riv. Holub; Matengwe Riv. Holub, 1283; Bulawayo, Rand, 379; Matabeleland, Elliott; Rogers, 5112; between Umtali and Salisbury, Cecil, 52; Odzani River Valley, Umtali, Teague, 11; Manica, Bryce; Matopos, 4500 ft. March, Eyles, 107; Oct. Gibbs, 258; Rogers, 5365, 5408, 1112; Salisbury, May, Flanagan, 3258; North Melsetter, 5000–6000 ft. Oct. Swyn. 6221; Victoria, Monro, 1093*a*.

Genus No.
7780—**Pretrea zanguebarica,** *J. Gay.* (*P. eriocarpa*, Decne.)
Fl. Trop. Afr. IV. ii. 565; Fl. Cap. IV. ii. 463; Cat. Afr. Pl. Welw. i. 801; Harv. Gen. S.A. Pl. 277.
Bulawayo, 4500 ft. Nov. Eyles, 80; Monro, 3 & 17; Salisbury, Cecil, 73; Matopos, Oct. Gibbs, 264; Engler; March, Flanagan, 2995; Victoria Falls, Allen, 157; Umtali, Engler; Odzani River Valley, Teague, 94; Matabeleland, Marloth; South Rhodesia, Rand, 198, 377.

## Family CCLXI.—OROBANCHACEAE, *Lindl.*

7791—**Orobanche minor,** *Sutton.*
Fl. Trop. Afr. IV. ii. 467.
Mazoe, 5000 ft. April, Eyles, 331.

## Family CCLXII.—GESNERIACEAE, *Nees.*

7823—**Streptocarpus spp.**
Matopos, 5000 ft. March, leaf only, Eyles, 1041; Nov. fl. Eyles, 1097; Selukwe, Rogers.

## Family CCLXIV.—LENTIBULARIACEAE, *Lindl.*

7899—**Genlisea africana,** *Oliv.*
Fl. Trop. Afr. IV. ii. 497; Cat. Afr. Pl. Welw. i. 789.
Matopos, fl. & fr. Oct. Gibbs, 219; Victoria Falls, Engler.

7901—**Utricularia exoleta,** *R. Br.*
Fl. Trop. Afr. IV. ii. 495; Fl. Cap. IV. ii. 435; Cat. Afr. Pl. Welw. i. 786.
Victoria Falls and Matopos, Oct. Gibbs, 174; Victoria Falls, Engler; July, Kolbe, 3151; Rogers, 5291.

**U. firmula,** *Welw.*
Fl. Trop. Afr. IV. ii. 479; Cat. Afr. Pl. Welw. i. 788.
Victoria Falls, Kirk; Victoria Falls and Matopos, Sep. Gibbs, 172, 173.

**U. Gibbsiae,** *Stapf.*
Fl. Trop. Afr. IV. ii. 574.
Victoria Falls, Sep. Gibbs, 177; Rogers, 5024; Galpin, 7038; Engler.

Genus No.

**U. Kirkii,** *Stapf.*

Fl. Trop. Afr. IV. ii. 476; Fl. Cap. IV. ii. 428.

Victoria Falls, Sep. Gibbs, 176; Sep. Galpin, 7039; Engler; Rogers, 5027.

**U. transrugosa,** *Stapf.*

Fl. Trop. Afr. IV. ii. 473 & 574; Fl. Cap. IV. ii. 428.

Salisbury, Rand, 517; Matopos, Sep. Gibbs, 50; 4500 ft. Nov. Eyles, 1099 partly.

**U. Welwitschii,** *Oliv.*

Fl. Trop. Afr. IV. ii. 478; Cat. Afr. Pl. Welw. i. 788.

Matopos, Oct. Gibbs, 230, 214.

**U. sp.**

Mazoe, 4300 ft. Jan. Eyles, 510.

## Family CCLXVI.—ACANTHACEAE, *Juss.*

7909—**Nelsonia campestris,** *R. Br.*

Fl. Trop. Afr. v. 28; Cat. Afr. Pl. Welw. i. 805.

Victoria Falls, Sep. Galpin, 7026.

**N. tomentosa,** *Willd.*

Victoria Falls, Sep. Gibbs, 122.

7914—**Thunbergia affinis,** *S. Moore.*

Fl. Trop. Afr. v. 11; Cat. Afr. Pl. Welw. i. 801.

Mazoe, 4200–4600 ft. Dec. Eyles, 191, 199.

**T. alata,** *Boj.*

Fl. Trop. Afr. v. 16; Fl. Cap. V. i. 10; Nat. Pl. 300; Cat. Afr. Pl. Welw. i. 803.

Khami, March, Eyles, 10; Chirinda, 3700–4000 ft. Jan. Swyn. 353; Chipete Forest, 3000 ft. May, Swyn. 452.

**T. Bachmanni,** *Lindau.*

Fl. Cap. V. i. 8.

Victoria, Monro, 652, 653*a*.

**T. glaberrima,** *Lindau.*

North of Hartley, Engler.

**T. lancifolia,** *T. Anders.*

Fl. Trop. Afr. v. 25; Cat. Afr. Pl. Welw. i. 804.

Salisbury, Sep. Rand, 631, 1383; Darling, in Herb. Bolus, 11194; Inyati Riv. Bryce; Mazoe, 4300–4800 ft. Oct. Nov. Eyles, 190; Nyahodi Riv. 5000 ft. Sep. Swyn. 1925.

**T. Monroi,** *S. Moore.*

Journ. Bot. 1913, 209.

Victoria, Monro, 652*a*, 653.

Genus No.

**T. oblongifolia,** *Oliv.* var. **Berringtonii,** *Burkill.*
Fl. Trop. Afr. v. 24 & 508.
Mashonaland, Berrington.

**T. Randii,** *S. Moore.*
Fl. Trop. Afr. v. 508; Journ. Bot. 1900, 201.
Bulawayo, Dec. Rand, 275, 276; Mazoe, 4400–4600 ft. Dec. Eyles, 479; Salisbury, Rand, 1381; Gwelo, Sr. Phil. 49; Umvumvumvu Riv. 4000 ft. Oct. Swyn. 6098; Mt. Pene, 7000 ft. Swyn. 6216.

**T. Swynnertonii,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 157.
Chirinda Forest, 3700–4000 ft. May, Swyn. 339.

7915—**Pseudocalyx africanus,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 156.
Chirinda Forest, 3800 ft. May, Swyn. 97.

7924—**Synnema Acinos,** *S. Moore.*
Journ. Bot. 1908, 73.
Bulawayo, 4500, Aug. Eyles, 1242; Victoria, Monro, 414*a*, 590.

7925—**Brillantaisia grandidentata,** *S. Moore.*
Journ. Bot. 1907, 331.
Mt. Pene, 6500–7000 ft. Sep. Swyn. 336, 1145.

7926—**Hygrophila cataractae,** *S. Moore.*
Journ. Linn. Soc. Bot. xxxvii. 459.
Victoria Falls, Sep. Gibbs, 159; Sep. Galpin, 7035.

**H. rhodesiana,** *S. Moore.*
Journ. Bot. 1900, 201; Fl. Trop. Afr. v. 509.
Salisbury, July, Rand, 519; Gwibi Flats, Sep. Eyles 413.

7929—**Mellera lobulata,** *S. Moore.*
Fl. Trop. Afr. v. 50.
Chirinda, 3700–4000 ft. June, Swyn. 1141.

7932—**Phaylopsis** (*Phaulopsis*) **longfolia,** *T. Thoms.*
Fl. Trop. Afr. v. 84; Fl. Cap. V. i. 21.
Victoria Falls, Sep. Gibbs, 160; Melsetter, 6000 ft. June, Swyn. 1929; Chirinda, 3700–4000 ft. Sep. Swyn. 1930.

**P. parviflora,** *Willd.*
Fl. Trop. Afr. v. 83; Fl. Cap. V. i. 20; Nat. Pl. 255.
Victoria Falls, Engler; Rogers, 5021; Odzani River Valley, Umtali, Teague, 147.

7934—**Petalidium sp.?.**
Matopos, Rogers, 5177.

7939—**Dyschoriste alba,** *S. Moore.*
Journ. Bot. 1907, 89.
Mazoe, 4300–4800 ft. Jan. Eyles, 237.

Genus No.

**D. depressa,** *Nees.*
Fl. Cap. V. i. 16; Fl. Trop. Afr. v. 72.
Victoria Falls, Rogers, 7408*.

**D. Fischeri,** *Lindau.*
Fl. Trop. Afr. v. 77; Fl. Cap. V. i. 17.
Bulawayo, Dec. Jan. May, Rand, 181, 182, 383; Nov. Eyles, 1160; Monro, 93; Rogers, 5733.

**D. matopensis,** *N. E. Br.*
Kew Bull. 1906, 166.
Matopos, Cecil, 114.

**D. Monroi,** *S. Moore.*
Journ. Bot. 1910, 251.
Victoria, Monro, 950; Bulawayo, Gardner, 98.

**D. Perrottetii,** *O. Kuntze.*
Fl. Trop. Afr. v. 72.
Victoria Falls, Sep. Gibbs, 296; Sep. Galpin, 7036; Engler; Rogers, 7138*a*.

**D. radicans** (*T. And.*), *O. Kuntze.*
North of Hartley, Engler.

**D. sp.**
Matopos, March, Flanagan, 2991.

7940—**Disperma densiflorum,** *C. B. Cl.*
Fl. Trop. Afr. v. 82.
Mazoe, March, Flanagan, 3028.

**D. quadrisepalum,** *C. B. Cl.* var. **grandifolium,** *S. Moore.*
Journ. Bot. 1908, 73; Flor. Trop. Afr. v. 80 (type).
Mazoe, 4500 ft. Jan. Eyles, 513.

**D. viscidissium,** *S. Moore.*
Journ. Linn. Soc. Bot. xxxvii. 460.
Victoria Falls, Sep. Gibbs, 123.

7941—**Chætacanthus Persoonii,** *Nees.*
Fl. Cap. V. i. 18.
Matopos, 5000 ft. Nov. Eyles, 1104; Chirinda, 3800 ft. April, Swyn. 377.

7945—**Hemigraphis myostiflora,** *Stapf.*
Victoria Falls, Allen, 180, 412.

**H. prunelloides,** *S. Moore.*
Journ. Linn. Soc. Bot. xxxvii. 459.
Victoria Falls, Sep. Gibbs, 161; Engler; Rogers, 5279, 5292, 5224; July, Kolbe, 3146; Sep. Galpin, 7037.

7953—**Strobilanthopsis hircina,** *S. Moore.*
Fl. Trop. Afr. v. 511; Journ. Bot. 1900, 202.
Fort Gibbs, Sep. Rand, 640.

Genus No.
7965—**Ruellia ovata,** *Thunb.*
Fl. Cap. V. i. 14.
Chirinda, 3500 ft. Nov. Swyn. 1931; Victoria, Monro, 623; Bulawayo, Rogers, 13592*.

**R. patula,** *Jacq.*
Fl. Trop. Afr. v. 45; Fl. Cap. V. i. 12; Cat. Afr. Pl. Welw. i. 808.
Bulawayo, Jan. Rand, 177, 178; Monro, 21; Oct. Eyles, 1071; Jan. Gardner, 31, 41; Matabeleland, Elliott; Salisbury, Rand, 1369, 1382; Victoria, Monro, 652, 849.

**R. praetermissa,** *Lindau.*
Fl. Trop. Afr. v. 45.
Victoria Falls, Allen, 62.

7966—**Eranthemum subviscosum,** *C. B. Cl.*
Fl. Trop. Afr. v. 173.
Chirinda Forest, 3700–4000 ft. Oct. Swyn. 130.

7971—**Lepidagathis scariosa,** *Nees.*
Fl. Trop. Afr. v. 122.
Victoria Falls, Rogers, 7217*.

7972—**Crabbea nana,** *Nees.* (*C. crisioides*, Nees.)
Fl. Trop. Afr. v. 118; Fl. Cap. V. i. 38.
Bulawayo, May, Rand, 428; Victoria Falls, April, Flanagan, 3176; Chirinda, 3800 ft. April, Swyn. 304; Salisbury, Rogers, 5800; Selukwe, Rogers, 4091.

**C. velutina,** *S. Moore.*
Fl. Trop. Afr. v. 119.
Victoria Falls, Rogers, 5399, 5763.

7973—**Barleria albostellata,** *C. B. Cl.*
Fl. Trop. Afr. v. 162.
Shashi Riv. Holub, 1397; Matopos, Rogers, 5637*, 7908*.

**B. Boehmii,** *Lindau.*
Fl. Trop. Afr. v. 167.
Victoria Falls, Allen, 75.

**B. Eylesii,** *S. Moore.*
Journ. Bot. 1905, 50.
Matopos, 4500 ft. Feb. Eyles, 160; Davy; Victoria, Monro, 805.

**B. Mackenii,** *Hook. f.*
Matabeleland, Elliott; Bulawayo, Dec. Rand, 117; Victoria, Monro, 955.

**B. matopensis,** *S. Moore.*
Journ. Bot. 1907, 91.
Matopos, 5000 ft. Feb. Eyles, 1165; Victoria Falls, Rogers, 5527, 5680.

Genus No.

**B. meyeriana,** *Nees.*
Fl. Cap. V. i. 53.
Victoria Falls, Allen, 109.

**B. Randi,** *S. Moore.*
Fl. Trop. Afr. v. 512; Journ. Bot. 1900, 203.
Bulawayo, Dec. Rand, 115; Nov. Eyles, 88; Rogers, 5663.

**B. spinulosa,** *Klotzsch.*
Fl. Trop. Afr. v. 152.
Bulawayo, 4500 ft. Feb. Eyles, 1199; Victoria, Monro, 954.

**B. spp.**
Victoria Falls, Allen, 398, cf. *B. spinulosa*, Klotzsch.
Victoria Falls, Allen, 406.
Matopos, Rogers, 5264, 5412.

7978—**Sclerochiton harveyanus,** *Nees.*
Fl. Cap. V. i. 36.
Chirinda Forest, 3700–4000 ft. & Mt. Pene, fl. May, Oct. Dec. Swyn. 424, 455, 6119, 6638.

7980—**Blepharis Bainesii,** *S. Moore.*
Fl. Trop. Afr. v. 98.
Bulawayo, May, Rand, 381.

**B. boerhaaviæfolia,** *Pers.*
Fl. Trop. Afr. v. 96; Fl. Cap. V. i. 24; Cat. Afr. Pl. Welw. i. 811.
Victoria Falls, April, Flanagan, 3168; Victoria, Monro, 938.

**B. diversispina,** *C. B. Cl.*
Fl. Trop. Afr. v. 104; Fl. Cap. V. i. 31; Cat. Afr. Pl. Welw. i. 813.
Shashi Riv. Jan. and Bulawayo, May, Rand, 116, 380; Victoria, Monro, 398, 977.

**B. innocua,** *C. B. Cl.*
Fl. Cap. V. i. 25.
Bulawayo, Jan. Rand, 281.

**B. molluginifolia,** *Pers.*
Fl. Cap. V. i. 24; Fl. Trop. Afr. v. 98.
Bulawayo, Rogers, 13634*.

**B. spp.**
Victoria Falls, April, Flanagan, 3285, 3245.
Victoria Falls, Rogers, 5110, cf. *B. pungens*, Klotzsch.
Salisbury, March, Flanagan, 3026.
Matopos, 4800 ft. Feb. Eyles, 1164 ?.
Gwelo, Sr. Phil. 46 ? sp. n.

Genus No.

8007—**Asystasia coromandeliana,** *Nees.*

Fl. Trop. Afr. v. 131; Fl. Cap. V. i. 42; Cat. Afr. Pl. Welw. i. 817.

Victoria Falls, 3000 ft. May, Eyles, 141; April, Flanagan, 3235; Sep. Gibbs, 119.

8026—**Peristrophe usta,** *C. B. Cl.*

Fl. Trop. Afr. v. 244.

Salisbury, Sep. Rand, 507; Mazoe, 4300 ft. Aug. Eyles, 189; North of Hartley, Engler.

**P. sp.**

Matopos, 4600 ft. March, Eyles, 1025. cf. *P. caulopsila*, Presl.

8030—**Macrorungia pubinervia,** *C. B. Cl.*

Fl. Trop. Afr. v. 255.

Chirinda Forest, 3700–4000 ft. May, Oct Swyn. 77, 77*a*.

8031—**Dicliptera cephalantha,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 162.

Chirinda, on cultivated ground, 3800 ft. May, Swyn. 514.

**D. Melleri,** *Rolfe.* (*Diapedium Melleri*, S. Moore.)

Fl. Trop. Afr. v. 261 & 515.

Matabeleland, Oates, Salisbury, Sep. Rand, 507*b*; Mazoe, 4300 ft. Aug. Eyles, 188; Matopos, Oct. Gibbs, 80; Victoria, Monro, 474.

**D. Monroi,** *S. Moore.*

Journ. Bot. 1911, 189.

Victoria, Monro, 1039.

**D. nobilis,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 164.

Chirinda, 3500 ft. June, Swyn. 1935; Melsetter, 6000 ft. Sep. Swyn. 1936.

**D. Swynnertonii,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 163.

Chirinda Forest, 3700–4000 ft. May, June, July, Swyn. 528, 528*a*, 528*b*.

**D. tanganyikensis,** *C. B. Cl.*

North of Hartley, Engler.

8032—**Hypoëstes aristata,** *R. Br.*

Fl. Trop. Afr. v. 245; Fl. Cap. V. i. 86.

Umtali, Engler; Chirinda, 3800 ft. May, Swyn. 105.

**H. verticillaris,** *R. Br.*

Fl. Trop. Afr. v. 250; Fl. Cap. V. i. 88.

Bulawayo, May, Rand, 373; Mazoe, 4300 ft. April, Eyles, 304; Sep. Eyles, 430; March, Flanagan, 3013; Salisbury, Darling; Gwelo, Sr. Phil. 27; Upper Buzi, 3000 ft. April, Swyn. 1932.

Genus No.

8049—**Siphonoglossa tubulosa,** *Lindau.* (*Justicia prostrata,* Nees.)
Fl. Cap. V. i. 74.
Victoria, Monro, 822 ; Salisbury, Engler ?.

8054—**Rhinacanthus communis,** *Nees.*
Fl. Trop. Afr. v. 224; Fl. Cap. V. i. 78 ; Cat. Afr. Pl. Welw. i. 823.
Matengwe Riv. Holub, 1285, 1286 ; Victoria Falls ?, Rogers, 5104.

8079—**Isoglossa mossambicensis,** *Lindau.*
Fl. Trop. Afr. v. 231.
Chirinda Forest, 3700–4000 ft. May, Swyn. 248*a*, 1146.

8094—**Justicia Bagshawei** (*S. Moore*), *Torre & Harms.* (*Adhatoda Bagshawei,* S. Moore.)
Journ. Bot. 1907, 333.
Chirinda Forest, 3700–4000 ft. fl. & fr. Oct. Swyn. 127, 127*a*.

**J. Betonica,** *L.*
Fl. Trop. Afr. v. 184 ; Fl. Cap. V. i. 57.
Bulawayo, May, Rand, 375 ; Chirinda, Chimanimani Mts. 7000 ft. Mt. Pene, 7000 ft. fl. June, July, Sep. Oct. Swyn. 136, 1121, 1987, 6120.

**J. betonicoides,** *C. B. Cl.*
Fl. Trop. Afr. v. 184 ; Fl. Cap. V. i. 58.
Mazoe, 5000 ft. March, Eyles, 254 ; Plumtree, April, Flanagan, 3178 ; Gwelo, Sr. Phil. 25.

**J. debillis,** *Vahl.* (*Monechma bracteatum,* Hochst.)
Fl. Trop. Afr. v. 214 ; Fl. Cap. V. i. 68.
South Rhodesia, Rand, 374 ; Redbank, April, Flanagan, 3189 ; Gwai, April, Flanagan, 3296 ; Gwelo, Sr. Phil. 9 ; Bulawayo, Rogers, 5751 ; Victoria Falls, Rogers, 7024*, 7199*.

**J. elegantula,** *S. Moore.*
Fl. Trop. Afr. v. 513 : Journ. Bot. 1900, 204 ; includes also vars. *elatior* & *repens,* S. Moore, see Journ. Linn. Soc. Bot. xxxvii. 461, 462.
Salisbury, Sep. Rand, 508, 509, 642 ; Rogers, 4023 ; Bulawayo, Dec. Rand, 179 ; Matopos, 4800 ft. Nov. Eyles, 1101 ; Sep. Oct. Gibbs, 32 ; Somabula, May, Flanagan, 3266 ; Victoria, Monro, 399, 430, 959.

**J. exigua,** *S. Moore.*
Fl. Trop. Afr. v. 514 ; Fl. Cap. V. i. 66 ; Journ. Bot. 1900, 204.
Bulawayo, May, Rand, 389.

**J. Eylesii** (*S. Moore*), *Torre & Harms.* (*Adhatoda Eylesii,* S. Moore.)
Journ. Bot. 1910, 253.
Mazoe, 4500–4800 ft. Jan. Eyles, 560.

Genus No.

**J. filifolia,** *Lindau.*
Fl. Trop. Afr. v. 198.
Victoria, Monro, 896.

**J. flava,** *Vahl.*
Fl. Trop. Afr. v. 190; Fl. Cap. V. i. 58; Cat. Afr. Pl. Welw. i. 820.
Bulawayo, Dec. Rand, 101; Victoria Falls, April, Flanagan, 3241, forma.

**J. glabra,** *Roxb.*
Fl. Trop. Afr. v. 208.
South Rhodesia, Victoria Falls, Rogers, 5066.

**J. matammensis,** *Oliv.*
Fl. Trop. Afr. v. 209; Fl. Cap. V. i. 66.
Matabeleland, Elliott; Bulawayo, Jan. Gardner, 15; Matopos, March, Flanagan, 2954; Victoria Falls, Rogers, 5374; Odzani River Valley, Umtali, Teague, 145.

**J. Melampyrum,** *S. Moore.*
Fl. Trop. Afr. v. 199.
Chirinda, 3700–4000 ft. May, Swyn. 505, 506.

**J. pulegioides,** *E. Mey.* (*J. protracta,* T. And.)
Fl. Cap. V. i. 62; Nat. Pl. 216; Journ. Bot. 1911, 243.
Salisbury, Rand, 1380.

**J. rhodesiana,** *S. Moore.*
Journ. Bot. 1913, 188.
Bulawayo, Rogers, 5740.

**J. uncinulata,** *Oliv.*
Fl. Trop. Afr. v. 210.
Victoria, Monro, 853.

**J. spp.**
Salisbury, Darling, in Herb. Bolus, 11195, 11196.
Bulawayo, Feb. Eyles, 1197.

## Series RUBIALES.

### Family CCLXX.—RUBIACEAE, *B. Juss.*

8136—**Oldenlandia angolensis,** *K. Schum.*
Cat. Afr. Pl. Welw. i. 449.
South Rhodesia, Rand, 119.

Genus No.
8136— **O. Bojeri,** *Hiern.*

Fl. Trop. Afr. iii. 53 ; Cat. Afr. Pl. Welw. i. 440.

Matopos, Galpin, 6953 ; March, Flanagan, 2980 ; Salisbury, Rand, 474 ; Victoria, Monro, 845 ; Gwelo, Sr. Phil. 37 ; Chirinda, fl. & fr. May, Swyn. 500 ; South Rhodesia, Rand, 118 ; Odzani River Valley, Umtali, Teague, 197.

**O. caffra,** *E. & Z.*

Fl. Trop. Afr. iii. 58 ; Fl. Cap. iii. 10 ; Cat. Afr. Pl. Welw. i. 444.

Bulawayo, 4500 ft. Nov. Eyles, 1220 ; Salisbury, May, Flanagan, 3255 ; Victoria, Monro, 851 ; Victoria Falls, Rogers, 5531.

**O. capensis,** *Linn. f.* (*Hedyotis capensis*, Lam.)

Fl. Trop. Afr. iii. 62 ; Fl. Cap. iii. 9 ; Cat. Afr. Pl. Welw. i. 446.

South Rhodesia, Rand, 336.

**O. cuspidata,** *K. Schum.*

Cat. Afr. Pl. Welw. i. 443.

Gwai Forest, 3200 ft. Allen, 241.

**O. cynanchica,** *K. Schum.*

Melsetter, 6000 ft. Oct. Swyn. 6107.

**O. decumbens,** *Hiern.* (*Hedyotis decumbens*, Hochst.)

Fl. Trop. Afr. iii. 54 ; Fl. Cap. iii. 11 ; Cat. Afr. Pl. Welw. i. 442.

Victoria Falls, April, Flanagan, 3166.

**O. Heynei,** *Oliv.* (*Hedyotis Heynei*, R. Br.)

Fl. Trop. Afr. iii. 59 ; Fl. Cap. iii. 10.

Mazoe, 4600 ft. March, Eyles, 264 ; Bulawayo, Jan. Gardner, 73 ; Matopos, March, Flanagan, 2969 ; Victoria Falls, Rogers, 6026*a* ; South Rhodesia, Rand, 335 ; Odzani River Valley, Umtali, Teague, 271.

**O. hirtula,** *O. Kuntze.* (*Hedyotis hirtula*, Harv.)

Fl. Cap. iii. 12.

Mazoe, 5100 ft. April, Eyles, 346 ; Chimanimani Mts. 7000 ft. Sep. Swyn. 2152.

**O. lasiocarpa,** *Hiern.*

Fl. Trop. Afr. iii. 55.

Victoria Falls, April, Flanagan, 3243 ; Gwai, April, Flanagan, 3288.

**O. natalensis,** *O. Kuntze.* (*Hedyotis natalensis*, Hochst.)

Fl. Cap. iii. 12.

Chirinda, 3800 ft. fl. & fr. July, Swyn. 303.

**O. obtusiloba,** *Hiern.*

Fl. Trop. Afr. iii. 56.

Mazoe, 4400 ft. April, Eyles, 315.

Genus No.

**O. papillosa,** *K. Schum.*
Cat. Afr. Pl. Welw. i. 443.
Salisbury, Rand, 120.

**O. rhodesiana,** *S. Moore.*
Salisbury, Rand, 122.

**O. thymifolia,** *Prantl.* (*Hedyotis thymifolia,* Presl.)
Fl. Cap. iii. 11.
Bulawayo, Monro, 56; Rand, 121, 369; Odzani River Valley, Umtali, Teague, 260.

**O. trinervia,** *Retz.*
Fl. Trop. Afr. iii. 63; Cat. Afr. Pl. Welw. i. 449.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1534.

**O. Welwitschii,** *Hiern.*
Cat. Afr. Pl. Welw. i. 442.
Gwelo, Jan. Gardner, 14.

**O. sp.**
Matopos, March, Flanagan, 2981.

8154—**Pentas carnea,** *Benth.* (*Neurocarpæa lanceolata,* R. Br.)
Fl. Trop. Afr. iii. 46; Cat. Afr. Pl. Welw. i. 438.
Salisbury, March, Flanagan, 3018; Rogers, 4072; Odzani River Valley, Umtali, Teague, 174.

**P. nobilis,** *S. Moore.*
Journ. Bot. 1908, 37.
Mazoe, 5000 ft. March, Eyles, 248; Dec. Eyles, 496.

**P. purpurea,** *Oliv.*
Fl. Trop. Afr. iii. 46.
Chirinda, 3800 ft. fl. Feb., April, June, Swyn. 274, 1152, 2143.

**P. Woodii,** *Scott-Elliott.*
Mazoe, 4500 ft. March, Eyles, 275; Salisbury, Rand, 1394; Victoria, Monro, 816, 1040; Gwelo, Sr. Phil. 30.

8156—**Otomeria dilatata,** *Hiern.*
Fl. Trop. Afr. iii. 50; Cat. Afr. Pl. Welw. i. 440.
Upper Buzi, 3000 ft. fl. & fr. Nov. Dec. Swyn. 355, 2144; also Umswirizwi Riv., Chipinga, etc. Swyn.

8160—**Dirichletia pubescens,** *Klotzsch.*
Fl. Trop. Afr. iii. 51.
Victoria Falls, Allen, 106; Matopos, Rogers, 5414, 5533.

8212—**Crossopteryx kotschyana,** *Fenzl.*
Fl. Trop. Afr. iii. 44; Cat. Afr. Pl. Welw. i. 437.
Bulawayo, Rand, 415; Govt. Herb. 1076; Victoria Falls, Rogers, 5529.

Genus No.
8226—**Adina microcephala,** *Hiern.*
Fl. Trop. Afr. iii. 40: Cat. Afr. Pl. Welw. i. 434; For. Fl. Port. E. Afr. 70.
Upper Inyamadzi, 3300 ft. Dec. Swyn. 26; also Nyahodi, Lusitu, Upper Umswirizwi and between Umtali and Melsetter, Swyn.

8230—**Cephalanthus natalensis,** *Oliv.*
Lusitu Riv. 4000 ft. Sep. Swyn. 645; also Mt. Pene and Chimanimani Mts. Swyn.

8238—**Mussaenda arcuata,** *Poir.*
Fl. Trop. Afr. iii. 68; Cat. Afr. Pl. Welw. i. 453.
Chirinda Forest, 3800 ft. fl. & young fr. March, Swyn. 6636.

8255—**Urophyllum symplocoides,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 79.
Mt. Pene Forest, 6500 ft. Sep. Swyn. 1278.

8274—**Leptactinia lanceolata,** *K. Schum.*
Mazoe, 5200 ft. Jan. Eyles, 519; Salisbury, Rand; Victoria, Monro, 421.

8283—**Randia vestita,** *S. Moore.*
Journ. Bot. 1911, 150.
Salisbury, Rand, 1395; Victoria, Monro.

8285—**Gardenia asperula,** *Stapf & Hutch.*
Melsetter, 3500 ft. Oct. Swyn. 56; Chikore Hills, Nov. Swyn. 56*a*; Victoria, Monro, 384.

**G. Neuberia,** *E. & Z.*
Fl. Cap. III. 6; For. Fl. Cape, 234.
Umvumvumvu Riv. 4000 ft. April, Swyn. 1401.

**G. Norae** *Swynnerton.*
Journ. Linn. Soc. Bot. xl. 80.
Chirinda Forest, 3700–4000 ft. Jan. Swyn. 11.

**G. posoquerioides,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 81.
Chirinda Forest, 3700–4000 ft. Nov. Jan. Swyn. 71, 6504.

**G. resiniflua,** *Hiern.*
Fl. Trop. Afr. iii. 102; For. Fl. Port. E. Afr. 73.
Victoria Falls, Allen, 59.

**G. rothmannia,** *Linn. f.*
Victoria, Monro, 733, 1051.

**G. spatulifolia,** *Stapf & Hutch.*
Sabi Riv. 1000 ft. Nov. Swyn. 715.

Genus No.

**G. thunbergia,** *Linn. f.*

Fl. Trop. Afr. iii. 100; Fl. Cap. iii. 6; For. Fl. Port. E. Afr. 72; For. Fl. Cape, 234; Nat. Pl. 40.

Sebakwe, 4000 ft. Sep. Eyles, 175; Umtali, Engler.

**G. tigrina,** *Welw.*

Cat. Afr. Pl. Welw. i. 462.

Chirinda Forest, 3700–4000 ft. Oct. Swyn. 10.

**G. spp.**

Salisbury, Rand, 570.

Shangani, Govt. Herb. 958.

Lomagundi, Govt. Herb. 986.

8293—**Oxyanthus Gerrardi,** *Sond.* ?.

Fl. Cap. iii. 3; For. Fl. Cape, 235.

Chirinda Forest, 3700–4000 ft. fl. & fr. Jan. Feb. Swyn. 116.

**O. Swynnertonii,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 82.

Chirinda Forest, 3700–4000 ft. fl. Oct.–Dec. fr. Dec. Swyn. 76.

var. **breviflorus,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 83.

Chirinda Forest, Nov. Swyn. 76*a*.

8299—**Feretia æruginescens,** *Stapf.*

Kew Bull. 1906, 79.

Victoria Falls, Allen, 57.

8303—**Empogona Allenii,** *Stapf.*

Kew Bull. 1906, 79.

Victoria Falls, Oct. Nov. Allen, 55.

8308—**Tricalysia ligustrina,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 84.

Upper Buzi, 3000 ft. Sep. Oct. Swyn. 685, 1284.

**T. myrtifolia,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 83.

Upper Inyamadzi Valley, 3000 ft. Sep. Swyn. 1133; Upper Buzi Riv. 3500 ft. Oct. Swyn. 1283.

**T. pachystigma,** *K. Schum.* (*T. jasminiflora,* Hook.; *Coffea Engleri,* K. Krause.)

Fl. Trop. Afr. iii. 124; Journ. Bot. 1907, 199.

Bulawayo, Rand, 637; Matopos, Sep. Oct. Gibbs, 67; Galpin, 7085; Engler; Chimanimani Mts. 6500 ft. Sep. Swyn. 641, 1134; Mt. Pene, 6500–7000 ft. Oct. Swyn. 6068.

8326—**Heinsia jasminiflora,** *DC.*

Fl. Trop. Afr. iii. 81; For. Fl. Port. E. Afr. 71.

Chirinda Forest, 3700 ft. Nov. Dec. Swyn. 1258.

Genus No.

8337—**Heinsenia sylvestris,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 85.
Chirinda Forest, 3700–4000 ft. Oct. Swyn. 576, 689.

8338—**Cremaspora africana,** *Benth.*
Fl. Trop. Afr. iii. 126; Cat. Afr. Pl. Welw. i. 471.
Chirinda Forest, 3700–4000 ft. Dec. Swyn. 1285; also Chipete Forest, Swyn.

8348—**Pentanisia rhodesiana,** *S. Moore.*
Salisbury, Rand, 575, 1396.

**P. Schweinfurthii,** *Hiern.*
Fl. Trop. Afr. iii. 131.
Melsetter, 6000 ft., Mt. Pene, 7000 ft., North Melsetter, 5000–6000 ft. in. fl. April, Oct. Swyn. 2146, 6103, 6104, 6213.

**P. sericocarpa,** *S. Moore.* (*P. crassifolia,* K. Krause.)
See Journ. Bot. 1907, 198.
South Rhodesia, Rand, 619; North of Hartley, Engler; Salisbury, Sep. Engler, 3022.

**P. variabilis,** *Harv.*
Fl. Cap. iii. 24; Harv. Gen. S.A. Pl. 154; Nat. Pl. 251 (var.).
Salisbury, Darling; Odzani River Valley, Umtali, Teague, 83.

var. **intermedia,** *Sond.*
Fl. Cap. iii. 24.
Chirinda, 3800 ft. Swyn. 425.

8351—**Vangueria apiculata,** *K. Schum.*
Chirinda Forest, Dec. Swyn. 64; also along eastern border of South Melsetter, Swyn.

**V. esculenta,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 91.
Chirinda Forest, 3700–4000 ft. Sep. Oct. Swyn. 65.

var. **glabra,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 91.
Chirinda Forest, Dec. Swyn. 1307.

**V. infausta,** *Burch.*
Fl. Trop. Afr. iii. 147; Fl. Cap. iii. 13; Cat. Afr. Pl. Welw. i. 480; Nat. Pl. 369; For. Fl. Port. E. Afr. 75; For. Fl. Cape, 243.
Victoria Falls, Rogers, 5615, 5471; Chirinda, Swyn. 63; Chikore Hills, Swyn. 1290; fl. Oct. Dec. Swyn.

var. **virescens,** *Sond.* (*V. edulis,* Vahl, var. *Bainesii,* Hiern.)
Fl. Cap. iii. 14; see note Fl. Trop. Afr. iii. 148.
Mangwe Riv. Baines; Victoria Falls, Rogers, 5388; Bulawayo, Chubb 3*a*.

Genus No.

**V. munjiro,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 92.
Victoria, Monro, 605*a*.

**V. Randii,** *S. Moore.*
Journ. Bot. 1902, 252.
Bulawayo, Rand, 123; Monro, 97; Victoria, Monro, 692; Matabeleland, Eyles, 1191.

**V. rhodesiana,** *S. Moore.*
Journ. Bot. 1909, 130.
Salisbury, Rand, 1349.

**V. velutina** *Hiern.*
Fl. Trop. Afr. iii. 151; For. Fl. Port. E. Afr. 75.
Mazoe, 5300 ft. Dec. Eyles, 201; Victoria Falls, Allen, 415; Victoria, Monro, 639.

**V. spp.**
Victoria Falls, Allen, 184, cf. *V. parvifolia*, Sond.
Victoria, Monro, 548, 753*a*, 768.

8352—**Plectronia abbreviata,** *K. Schum.* (*Canthium abbreviatum*, S. Moore.)
Matopos, Oct. Gibbs, 278.

**P. ciliata,** *Sond.*
Fl. Cap. iii. 18; For. Fl. Cape, 241.
Victoria Falls, Rogers, 5587 (var.).

**P. Gueinzii,** *Sim.* (*Canthium Gueinzii*, Sond.)
Fl. Cap. ii. 16; For. Fl. Cape, 241.
Chipete Forest, April, Swyn. 170; Mt. Pene, 7000 ft. fr. Oct. Swyn. 6101; also at Chikore and near Chirinda, Swyn.

**P. lanciflora** (*Hiern*), *Torre & Harms.* (*Canthium lanciflorum*, Hiern.)
Fl. Trop. Afr. iii. 146.
Victoria Falls, Kirk; Salisbury, Rand, 552.

**P. livida** (*Hiern*), *Torre & Harms.* (*Canthium lividum*, Hiern.)
Fl. Trop. Afr. iii. 144.
Victoria, Monro, 796.

**P. Oatesii** (*Rolfe*), *Torre & Harms.* (*Canthium Oatesii*, Rolfe.)
Matabeleland, Oates.

**P. Randii** (*S. Moore*), *Torre & Harms.* (*Canthium Randii*, S. Moore.)
Journ. Bot. 1911, 152.
Salisbury, Rand, 1393; Victoria, Monro, 691.

**P. Swynnertonii** (*S. Moore*), *Torre & Harms.* (*Canthium Swynnertonii*, S. Moore.)
Journ. Linn. Soc. Bot. xl. 88.
Chirinda Forest, 3700–4000 ft. Nov. Swyn. 546.

Genus No.

**P. ventosa,** *L.* (*Canthium ventosum*, S. Moore.)
Fl. Cap. iii. 17; Cat. Afr. Pl. Welw. i. 369; For. Fl. Cape, 240.
Mt. Pene, 6500 ft. Sep. Swyn. 547.

**P. sp.**
Gwai Forest, 3000 ft. Allen, 250.

8354—**Craterispermum laurinum,** *Benth.*
Fl. Trop. Afr. iii. 160; Cat. Afr. Pl. Welw. i. 485.
Chirinda, Oct. Swyn. 183.

8359—**Pachystigma Cienkowskii** (*Schweinf.*), *Torre & Harms.* (*Fadogia Cienkowskii*, Schweinf.)
Fl. Trop. Afr. iii. 154; Cat. Afr. Pl. Welw. i. 481.
Chirinda Forest, Swyn. 241; Mt. Pene, Swyn. 6122, 6502; in fl. Sep.–Dec. Swyn.

**P. lateritica** (*K. Krause*), *Torre & Harms.* (*Fadogia lateritica*, K. Krause.)
North of Hartley, Engler.

**P. obovata** (*N. E. Br.*), *Torre & Harms.* (*Fodogia obovata*, N. E. Br.)
Kew Bull. 1906, 105.
Salisbury, Cecil, 141; Rand, 1348; Mazoe, 4300 ft. Dec. Eyles, 209.

**P. stenophylla** (*Welw.*), *Torre & Harms.* (*Fadogia stenophylla*, Welw.)
Fl. Trop. Afr. iii. 155; Cat. Afr. Pl. Welw. i. 483.
Salisbury, Rand, 629, 1370.

**P. tetraquetra** (*K. Krause*), *Torre & Harms.* (*Fadogia tetraquetra*, K. Krause.)
Umtali, Sep. Engler, 3139.

**P. Zeyheri,** *Sond.* (*Fadogia Zeyheri*, Sond.; *Vangueria Zeyheri*, Sond.)
Fl. Trop. Afr. iii. 153; Fl. Cap. iii. 15.
Between Bulawayo and Victoria Falls, Davy; Lomagundi, Govt. Herb. 990.

8360—**Ancylanthus Bainesii,** *Hiern.*
Fl. Trop. Afr. iii. 160.
Victoria Falls, Allen, 97.

8381—**Coffea ligustroides,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 94.
Chipete Forest, 3800 ft. fl. Dec. ripe fr. July, Swyn. 67.

**C. Swynnertonii,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 95.
Chirinda, 3000 ft. in cultivation, fl. Oct. fr. Dec. Swyn. 578.

8383—**Pavetta angolensis,** *Hiern.*
Cat. Afr. Pl. Welw. i. 485.
Victoria, Monro, 666; Matopos, Rogers, 5260.

Genus No.

**P. assimilis,** *Sond.*
Fl. Cap. iii. 20.
Sebakwe, 4000 ft. Dec. Eyles, 168; Bulawayo, Monro, 49; Victoria, Monro, 806.

**P. Cecilae,** *N. E. Br.*
Kew Bull. 1906, 106.
Selukwe, Cecil, 124; Mazoe, 5300 ft. Dec. Eyles, 203.

**P. comostyla,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 98.
Chiranda Forest, 3700–4000 ft. Jan. Swyn. 75.

**P. Eylesii,** *S. Moore.*
Journ. Bot. 1905, 47.
Matopos, 4500–5000 f. Nov. Eyles, 1159.

**P. gardeniæfolia,** *Hochst.*
Fl. Trop. Afr. iii. 177.
South Rhodesia, Rand, 421.

**P. luteola,** *Stapf.*
Kew Bull. 1906, 80.
Victoria Falls, Oct. Allen, 54.

**P. neurophylla,** *S. Moore.*
Journ. Bot. 1905, 47.
Bulawayo, 4500 ft. Dec. Eyles, 1140; Monro, 52.

**P. obovata,** *E. Mey.*
Fl. Cap. iii. 20; Nat. Pl. 313; For. Fl. Cape, 237.
Bulawayo, Monro, 54.

**P. schumanniana,** *K. Hoffm.*
Cat. Afr. Pl. Welw. i. 488.
Bulawayo, Monro, 104; Victoria Falls, Rogers, 7244; Chikore Hills, 3500 ft. Nov. Swyn. 1212.

**P. stipulopallium,** *K. Schum.*
Salisbury, Rand, 1350; Victoria, Monro, 666, 1056*a*; Nyahodi Riv. 5000 ft. April, Swyn. 2147.

**P. Swynnertonii,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 99.
Chirinda Forest, 3700–4000 ft. Jan. Swyn. 117.

**P. spp.**
Victoria Falls, Allen, 94, ? n. sp.; Rogers, 5049.
Victoria Falls, Rogers, 5553, cf. *P. gracilis*, Klotzsch.
Bulawayo, Monro, 53.

8399—**Psychotria hirtella,** *Oliv.*
Victoria Falls, Rogers, 5382.

**P. sp.**
Victoria, Monro, 802.

Genus No.

8402—**Grumilea punicea,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 101.
Chimanimani Mts. 7000 ft. fl. & unripe fr. Sep. Swyn. 563.

8410—**Geophila uniflora,** *Hiern.*
Fl. Trop. Afr. iii. 221; Cat. Afr. Pl. Welw. i. 498.
Chirinda Forest, 3700–4000 ft. March, Swyn. 350.

8435—**Galopina circæoides,** *Thunb.*
Fl. Cap. iii. 26.
Chirinda, fl. & fr. April, Swyn. 317.

8438—**Anthospermum ammanioides,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 102.
Melsetter, 6000 ft. April, Swyn. 2156.

**A. ciliare,** *L.*
Fl. Cap. iii. 28.
Matopos, Oct. Gibbs, 186.

**A. hispidulum,** *E. Mey.*
Fl. Cap. iii. 29.
Mazoe, 5100 ft. April, Eyles, 343.

**A. lanceolatum,** *Thunb.*
Fl. Cap. iii. 30.
Matopos, Sep. Gibbs, 93; Odzani River Valley, Umtali, Teague, 181.

**A. Randii,** *S. Moore.*
Salisbury, Rand, 475; Victoria, Monro, 326.

**A. rigidum,** *E. & Z.*
Fl. Cap. iii. 31.
Victoria, Monro, 884; South Rhodesia, Rand, 338; Bulawayo, Rogers, 13537*.

**A. vallicolum,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 103.
Chimanimani Mts. 7000 ft. Sep. Swyn. 2155.

**A. sp.**
Salisbury, May, Flanagan, 3196.

8450—**Otiophora inyangana,** *N. E. Br.*
Kew Bull. 1906, 107.
Inyanga, Cecil, 203; Mt. Pene, 7000 ft. Sep. Oct. Swyn. 2007, 6146.

**O. scabra,** *Zucc.*
Cat. Afr. Pl. Welw i. 499; Journ. Bot. 1908, 76.
Mazoe, 5200 ft. Jan. Eyles, 522.

Genus No.
8464—**Richardsonia brasiliensis,** *Hayne.*
Chirinda, 3700 ft. fl. & fr. Nov. Swyn. 2134.

**R. scabra,** *St. Hil.* (*Richardia scabra,* L.)
Fl. Trop. Afr. iii. 242.
Salisbury, Rand, 1397.

8473—**Borreria arvensis,** *K. Schum.* (*Tardavel arvensis,* Hiern.)
Cat. Afr. Pl. Welw. i. 504.
Victoria, Monro, 981, 1020.

**D. dibrachiata,** *K. Schum.* (*Spermacoce dibrachiata,* Oliv.; *Tardavel dibrachiata,* Hiern.)
Fl. Trop. Afr. iii. 239; Cat. Afr. Pl. Welw. i. 507.
Umtali, Engler, Odzani River Valley, Teague, 12, 119; Matopos, March, Flanagan, 2946; Mazoe, 4300–4800 ft. Jan. Eyles, 243; Salisbury, Rogers, 5797, Kolbe.

**B. natalensis,** *K. Schum.* (*Spermacoce natalensis,* Hochst.)
Fl. Cap. iii. 24.
Chirinda, May, Swyn. 376, 518.

B. Ruelliae, *K. Schum.* (*Spermacoce Ruelliae,* DC.; *Tardavel scabra,* Hiern.)
Fl. Trop. Afr. iii. 238; Cat. Afr. Pl. Welw. i. 504.
Mazoe, 4400–4600 ft. March, Eyles, 271; Bulawayo, Monro, 941; Victoria Falls, Rogers, 5081*a**.

**B. stricta,** *K. Schum.* (*Spermacoce stricta,* Linn. f.; *Tardavel stricta,* Hiern.)
Fl. Trop. Afr. iii. 236; Cat. Afr. Pl. Welw. i. 503.
Mazoe, 4600 ft. March, Eyles, 260.

**B. subvulgata,** *K. Schum.*
Odzani River Valley, Umtali, Teague, 225; Victoria Falls, Rogers, 7032*.

**B. spp.**
Gwai, April, Flanagan, 3193.
Salisbury, May, Flanagan, 3198.

8486—**Galium stenophyllum,** *Baker.*
Chipete, 3800 ft. fl. & fr. July, Swyn. 2141.

8489—**Rubia cordifolia,** *L.*
Fl. Trop. Afr. iii. 244; Fl. Cap. iii. 35.
Chirinda, 3800 ft. April, Swyn. 216; Odzani River Valley, Umtali, Teague, 215.

**R. petiolaris,** *DC.*
Fl. Cap. iii. 35.
Bulawayo, Jan. Gardner, 8; Rogers, 5684.

### FAMILY CCLXXIV.—DIPSACACEAE, *Lindl.*

Genus No.
8546—**Scabiosa columbaria,** *L.*

Fl. Trop. Afr. iii. 252 ; Fl. Cap. iii. 43 ; Cat. Afr. Pl. Welw. i. 512.

Bulawayo, 4500 ft. Jan. Eyles, 61 (var.) ; Salisbury, Engler ; Darling ; Mazoe, 4300–4800 ft. Nov. Eyles, 452 ; Victoria, Monro, 949 ; Chirinda, April, Swyn. 278 ; Mt. Pene, Sep. Swyn. 1143 ; South Rhodesia, Rand, 98 ; Odzani River Valley, Umtali, Teague, 75.

## SERIES CAMPANULATAE.

### FAMILY CCLXXV.—CUCURBITACEAE, *Hall.*

8562—**Melothria longepedunculata,** *Cogn.*

Chirinda Forest, 3700–4000 ft. Jan. Swyn. 232 (forma).

8591—**Momordica Balsamina,** *L.*

Fl. Trop. Afr. ii. 537 ; Fl. Cap ii. 491 ; Cat. Afr. Pl. Welw. i. 394.

Victoria Falls, fl. & fr. Sep. Gibbs, 299 ; Allen, 179 ; Engler ; July, Kolbe, 3135 ; Rogers, 5604, 5111.

**M. clematidea,** *Sond.*

Fl. Cap. ii. 491.

Wankie, Rogers, 13244* ; Victoria Falls, Rogers, 13164*.

**M. fœtida,** *Schum. & Thonn.*

Chirinda Forest, 3700–4000 ft. Dec. Swyn. 94.

**M. involucrata,** *E. Mey.*

Fl. Cap. ii. 491 ; Nat. Pl. 516.

Bulawayo, May, Rand, 327.

**M. Morkorra,** *A. Rich.* (*M. cordifolia,* Sond.)

Fl. Trop. Afr. ii. 538 ; Fl. Cap. ii. 492.

Mazoe, 4500 ft. Nov. Eyles, 473 ; Odzani River Valley, Umtali, Teague, 91.

**M. spp.**

Victoria Falls, Dec. Allen, 224.

South Rhodesia, Rand, 93.

8598—**Citrullus vulgaris,** *Schrad.* (*Colocynthis amarissima,* Schrad.)

Fl. Trop. Afr. ii. 549 ; Fl. Cap. ii. 494 ; Cat. Afr. Pl. Welw. i. 397.

Matopos, Rogers, 5659.

Genus No.

8599—**Cucumis Cecili,** *N. E. Br.*
Kew Bull. 1906, 104.
Inyanga, Cecil, 225.

**C. Figarei,** *Delile.* (*C. chrysocomus*, Schum. & Thonn.)
Fl. Trop. Afr. ii. 543; Cat. Afr. Pl. Welw. i. 396.
Victoria Falls, April, Flanagan, 3306; Matopos, Rogers, 5659*a* ?.

**C. hirsutus,** *Sond.*
Fl. Trop. Afr. ii. 546; Fl. Cap. ii. 497.
Bulawayo, Jan. Rand, 90 & 91.

**C. naudinianus,** *Sond.*
Fl. Cap. ii. 496 in part; Fl. Trop. Afr. ii. 549.
Bulawayo, Rogers, 5739.

**C. Zeyheri,** *Sond.*
Fl. Cap. ii. 496.
Chirinda, 3800 ft. May, Swyn. 496.

**C. spp.**
Bulawayo, Dec. Eyles, 50; Chubb, 322, 328.

8608—**Trochomeria macrocarpa,** *Hook. f.* (*Zehneria macrocarpa*, Sond.)
Fl. Trop. Afr. ii. 524; Fl. Cap. ii. 488; Harv. Gen. S.A. Pl. 125.
Mazoe, 4600 ft. Sep. Eyles, 424; Bulawayo, Monro, 70.

8612—**Peponium** (*Peponia*) **chirindensis,** *Baker f.*
Journ. Linn. Soc. Bot. xl. 74.
Chirinda, 3700–4000 ft. Nov. Swyn. 2102.

8628—**Coccinia palmata,** *Cogn.* (*Cephalandra palmata*, Sond.)
Fl. Cap. ii. 493; Nat Pl. 283.
Bulawayo, Jan. Rand, 87 & 89.

**C. pubescens,** *Sond.* (*Cephalandra pubescens*, Sond.)
Fl. Trop. Afr. ii. 551; Fl. Cap. ii. 493.
Bulawayo, Rogers, 5660.

**C. sp.**
Bulawayo, Rogers, 5708.

## Family CCLXXVI.—CAMPANULACEAE, *Juss.*

8663—**Prismatocarpus spp.**
Victoria Falls, Allen, 118; Rogers, 5617; April, Flanagan, 3162

8668—**Wahlenbergia arenaria,** *A. DC.*
Fl. Cap. iii. 581.
Between Salisbury and Macheke, Rogers, 4025.

**W. banksiana,** *A. DC.*
Fl. Cap. iii. 574.
Matabeleland, Oates.

Genus No.

**W. Caledonica,** *Sond.*

Fl. Cap. iii. 579.

Matopos, 5000 ft. March, Eyles, 1065 ; March, Flanagan, 2964 ; Oct. Gibbs, 220 ; Mazoe, 4400 ft. April, Eyles, 306 ; Bulawayo, Monro, 12 ; Rand, 476 ; Victoria, Monro, 876 ; Inyanga, Cecil ; South Rhodesia, Rand, 358, 616.

**W. mashonica,** *N. E. Br.*

Kew Bull. 1906, 165.

Between Salisbury and Headlands, Cecil, 157.

**W. Oatesii,** *Rolfe.*

Matabeleland, Oates.

**W. rhodesiana,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 125.

Melsetter, 5000–6000 ft. fl. & fr. Oct. Swyn. 6225.

**W. rivularis,** *Diels ?.*

Victoria, Monro, 928.

**W. saginoides,** *S. Moore.*

Journ. Bot. 1911, 153.

Victoria, Monro, 649.

**W. undulata,** *A. DC.*

Fl. Cap. iii. 579 ; Nat. Pl. 37.

Gwelo, Jan. Gardner, 18 ; Bulawayo, Jan. Gardner, 71.

**W. virgata,** *Engl.*

Melsetter, April, Swyn. 2020 ; Mt. Pene, 6500–7000 ft. Sep. Swyn. 2021.

**W. Zeyheri,** *E. & Z.*

Fl. Cap. iii. 580.

Matabeleland, Jan. Eyles, 1056 ; North of Hartley, Engler ; Marandellas, Engler ; Umtali, Engler ; Victoria, Monro, 753, 909.

**W. spp.**

Salisbury, May, Flanagan, 3268, cf. *W. paniculata*, A. DC.

Salisbury, May, Flanagan, 3253.

Matopos, March, Flanagan, 2974 ; Eyles, 1028, 1147 ; Rogers, 5685.

Victoria Falls, Feb. Allen, 288.

Gwai Forest, Jan. Allen, 242.

8670—**Lightfootia abyssinica,** *Hochst.*

Fl. Trop. Afr. iii. 474.

Mazoe, 4300–4800 ft. Sep. Eyles, 421 ; March, Flanagan, 3012 ; Salisbury, Rand, 478, 479 ; Chirinda, 3800 ft. May, Swyn. 515 ; Odzani River Valley, Umtali, Teague, 259.

Genus No.

**L. denticulata,** *Sond.* (*L. capillaris,* Buek.)
Fl. Cap. iii. 559.
Matopos, 4800 ft. March, Eyles, 1038; March, Flanagan, 2961; Rogers, 5685; Gwelo, Sr. Phil. 47.

**L. glomerata,** *Engl.*
Mazoe, 5100 ft. March, Eyles, 285; Flanagan, May, 3257.

**L. juncea,** *Sond.*
Fl. Cap. iii. 563.
Salisbury, Engler.

**L. tenuifolia,** *A. DC.*
Fl. Trop. Afr. iii. 475; Cat. Afr. Pl. Welw. i. 629.
Matopos, Sep. Gibbs, 35; Engler; Salisbury, Rand, 477; South Rhodesia, Rand, 359, 360.

**L. sp.**
Salisbury, May, Flanagan, 3229.

8681—**Cyphia alba,** *N. E. Br.*
Kew Bull. 1906, 165.
North of Umtali, Cecil, 163.

**C. mazoensis,** *S. Moore.*
Journ. Bot. 1907, 46.
Mazoe, 4700–4900 ft. Jan. Eyles, 231.

8694—**Lobelia Boivini,** *Sond.*
Fl. Cap. iii. 546.
Matopos, 5000 ft. March, Eyles, 1040.

**L. cobaltica,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 124.
Chimanimani Mts. 7000 ft. Sep. Swyn. 2036.

**L. decipiens,** *Sond.*
Fl. Cap. iii. 540.
Matabeleland, Oates; Matopos, Sep. Oct. Gibbs, 87; Marandellas, Engler; Rogers, 4041; Mt. Pene, 6000 ft. Oct. Swyn. 6081; Victoria, Monro, 583.

**L. Erinus,** *L.*
Fl. Cap. iii. 544.
Victoria Falls, Rogers, 5290.

**L. fervens,** *Thunb.*
Fl. Trop. Afr. iii. 468; Fl. Cap. iii. 548; Cat. Afr. Pl. Welw. i. 627.
Chirinda, 3800 ft. May, Swyn. 513.

**L. fonticola,** *Engl. & Gilg.*
Matopos, Sep. Gibbs, 96.

**L. jugosa,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 125.
Between Lusitu and Nyahodi Rivs. 5000 ft. Sep. Swyn. 2037; Mt. Pene, Swyn. 6080?, 6085?, Victoria, Monro, 309.

Genus No.

**L. microdon,** *A. DC.* (*L. Erinus*, L. var. *microdon*, Sond.)
Fl. Cap. iii. 545.
Matopos, Sep. Oct. Gibbs, 37.

**L. minutidentata,** *Engl. & Gilg.*
Matopos, Oct. Gibbs, 272.

**L. natalensis,** *A. DC.*
Fl. Trop. Afr. iii. 469 ; Fl. Cap. iii. 545.
Plumtree, April, Flanagan, 3184 ; Mazoe, 5200 ft. April, Eyles, 348; Victoria, Monro, 327 ; South Rhodesia, Rand, 172 ; Odzani River Valley, Umtali, Teague, 222.

**L. thermalis,** *Thunb.* (*Parastranthus thermalis*, Sond.)
Fl. Cap. iii. 537 ; Cat. Afr. Pl. Welw. i. 625.
Bulawayo, 4500 ft. Oct. Eyles, 1076 ; Monro, 71 ; Gwelo, Jan. Gardner, 10 & 26 ; Matopos, Sep. Oct. Gibbs, 31.

**L. trullifolia,** *Hemsl.*
Fl. Trop. Afr. iii. 466.
Matopos, Oct. Gibbs, 271.

**L. spp.**
Salisbury, March, Flanagan, 3025.
Victoria Falls, Allen, 19, cf. *L. Erinus*, L. ; Rogers, 5134.
Matopos, Nov. Eyles, 1105.

## Family CCLXXX.—COMPOSITÆ, *Vaill.*

8734—**Ethulia conyzoides,** *L.*
Fl. Trop. Afr. iii. 262 ; Fl. Cap. iii. 47.
Victoria Falls, Allen, 83 ; April, Flanagan, 3035 ; Rogers, 5082.

8740—**Erlangea Eylesii,** *S. Moore.*
Journ. Bot. 1908, 38.
Mazoe, 4400 ft. April, Eyles, 309.

**E. laxa,** *S. Moore.*
Matopos, 4800 ft. April, Eyles, 43 ; Mazoe, 4800 ft. March, Eyles, 293.

**E. longipes,** *S. Moore.*
Chirinda, Swyn. 391 ; Melsetter, Swyn. 1809.

**E. Schinzii,** *O. Hoffm.*
Victoria Falls, Sep. Gibbs, 298.

**E. spp.**
Gwai, April, Flanagan, 3070.
Victoria Falls, April, Flanagan, 3063 ; Rogers, 6156.

8746—**Bothriocline inyangana,** *N. E. Br.*
Kew Bull. 1906, 107.
Inyanga, Cecil, 227*a*.

Genus No.
8751—**Vernonia acuminatissima,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 104.
Upper Buzi, 3500 ft. May, Swyn. 1906.

**V. Bainesii,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 272.
Salisbury, April, Flanagan, 3046; Chipetzana Riv. 4000 ft. April, Swyn. 1903; between Lusitu and Nyahodi Rivs. 5000 ft. Swyn. 1903*a*; Victoria, Monro, 1272; Odzani River Valley, Umtali, Teague, 176.

**V. cinerea,** *Less.*
Fl. Trop. Afr. iii. 275; Cat. Afr. Pl. Welw. i. 521.
Victoria Falls, Rogers, 5042.

**V. cistifolia,** *O. Hoffm.* var. **rosea,** *O. Hoffm.*
Chirinda, 3800 ft. May, Swyn. 496.

**V. fastigiata,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 282.
Bulawayo, May, June, Rand, 277 & 352; Chubb, 379; Gwelo, Sr. Phil. 42; Nyamandhlovu, April, Flanagan, 3066.

**V. gerberæformis,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 285.
Salisbury, Sep. Rand, 626; Melsetter, 6000 ft. Sep. Oct. Swyn. 1900; Mt. Pene, 6500–7000 ft. Swyn. 6112.

**V. glabra,** *Vatke.*
Fl. Trop. Afr. iii. 286.
Bulawayo, May, Rand, 353; Mazoe, 4300 ft. April, Eyles, 317; April, Flanagan, 3058; Victoria Falls, April, Flanagan, 3064; Chirinda, 3500 ft. April, Swyn. 1814; Chipetzana Riv. 3000 ft. Aug. Swyn. 1831; Salisbury, Sep. Rand, 622 (var.); Odzani River Valley, Umtali, Teague, 106.

**V. gracilipes,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 105.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1830, 1830*a*; Mt. Pene, 6000 ft. Oct. Swyn. 6126, 6127.

var. **minor,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 106.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1909.

**V. hirsuta,** *Sch. Bip.*
Fl. Cap. iii. 51; Nat. Pl. 335.
North Melsetter, 5000–6000 ft. Oct. Swyn. 6116, 6138.

**V. Holstii,** *O. Hoffm.*
Chirinda, 3700–4000 ft. June, Swyn. 523*a*.

**V. humilis,** *C. H. Wright.*
Salisbury, Dec. Rand, 153; May, Rand, 492.

Genus No.
8751—**V. integra,** *S. Moore.*
Journ. Bot. 1908, 39.
Mazoe, 4300–4800 ft. March, Eyles, 277 ; Gwelo, Sr. Phil. 3 ; Umtali, Rogers, 4079*.

**V. Kraussii,** *Sch. Bip.*
Fl. Trop. Afr. iii. 276 ; Fl. Cap. iii. 51 ; Nat. Pl. 334.
Bulawayo, Dec. Rand, 150 ; Salisbury, May, Rand, 624 ; Darling ; Rogers, 4080 ; Matopos, Engler ; Oct. Gibbs, 342 ; North of Hartley, Engler ; Umtali, Engler ; Mt. Pene, 6000–7000 ft. Sep., Umvumvumvu Riv. 4000 ft. Oct. Swyn. 1827, 6002, 6141, 6142.

**V. lancibracteata,** *S. Moore.*
Journ. Bot. 1908, 293.
Mazoe, 4500–5000 ft. March, Eyles, 291.

**V. livingstoniana,** *Hiern.*
Fl. Trop. Afr. iii. 295.
Chirinda, Swyn.

**V. mashonica,** *N. E. Br.*
Kew Bull. 1906, 108.
Salisbury and Umtali, Cecil, 70, 229.

**V. Melleri,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 282.
Salisbury, Aug. Rand, 494 ; April, Flanagan, 3047 ; Mazoe, 4500–4800 ft. Aug. Eyles, 185 ; Odzani River Valley, Umtali, Teague, 97.

**V. monocephala,** *Harv.*
Fl. Cap. iii. 53 ; Nat. Pl. 331.
Melsetter, 6000 ft. Sep. Swyn. 1829 ; Chimanimani Mts. 7000 ft. Oct. Swyn. 6144.

**V. natalensis,** *Sch. Bip.*
Fl. Trop. Afr. iii. 277 ; Fl. Cap. iii. 51 ; Nat. Pl. 333 ; Cat. Afr. Pl. Welw. i. 522.
Salisbury, Engler ; Chirinda, 3800 ft. Oct. Swyn. 275 ; Mt. Pene, 7000 ft. Swyn. 6145.

**V. pauciflora,** *Less.*
Fl. Trop. Afr. iii. 283.
Matopos, Rogers, 5360 ?.

**V. Petersii,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 273 ; Cat. Afr. Pl. Welw. i. 519.
Deka, 2400 ft. May, Eyles, 135.

Genus No.
8751—**V. podocoma,** *Sch. Bip.*

Fl. Trop. Afr. iii. 296 ; Cat. Afr. Pl. Welw. i. 539.

Victoria Falls, Sep. Galpin, 7029 ; Matopos, fl. & fr. Sep. Gibbs, 66 ; Mazoe, 4700 ft. Aug. Eyles, 386 ; Chirinda, Sep. Swyn. 113 ; Odzani River Valley, Umtali, Teague, 258.

**V. porphyrolepis,** *S. Moore.*

Journ. Bot. 1908, 39.

Mazoe, 4800–5000 ft. May, Eyles, 371 : Odzani River Valley, Umtali, Teague, 71.

**V. Poskeana,** *Vatke & Hildebr.* var. **chlorolepis,** *Steetz.* (*V. steetziana,* Oliv. & Hiern.)

Fl. Trop. Afr. iii. 273, 274 ; Cat. Afr. Pl. Welw. i. 520.

Bulawayo, May, Rand, 344 ; Victoria Falls, 3000 ft. May, Eyles, 137 ; Chipetzana Riv. 3000 ft. Dec. Swyn. 1828*a* ; Mazoe, 4400 ft. April, Eyles, 311 ; Plumtree, April, Flanagan, 2067 ; Odzani River Valley, Umtali, Teague, 96.

**V. purpurea,** *Sch. Bip.*

Fl. Trop. Afr. iii. 281.

Salisbury, April, Flanagan, 3042.

**V. Randii,** *S. Moore.*

Journ. Bot. 1899, 369.

Salisbury, July, Rand, 495, 1371 ; Mazoe, 4300–4800 ft. July, Aug. Eyles, 380, 387 ; Victoria, Monro, 338*b*, 358, 692 ; Matopos, Rogers, 5162 ; Victoria Falls, Rogers, 5295 ; Odzani River Valley, Umtali, Teague, 250.

**V. senegalensis,** *Less.*

Fl. Trop. Afr. iii. 283 ; Fl. Cap. iii. 50 ; Cat. Afr. Pl. Welw. i. 528 ; For. Fl. Port. E. Afr. 77.

Victoria Falls, Allen, 33 ; Engler ; Rogers, 5054 ; Mazoe, April, Flanagan, 3052 ; Victoria, Monro, 338 ; Umvukwe, Govt. Herb. 1091.

**V. tenoreana,** *Oliv.*

Fl. Trop. Afr. iii. 290.

Salisbury, July, Rand, 497.

**V. Wollastonii,** *S. Moore.*

Victoria, Monro, 1550, 1990.

**V. Woodii,** *O. Hoffm.*

Salisbury, May, Flanagan, 3038 ; Victoria Falls, April, Flanagan, 3065 ; Victoria, Monro, 346 ; Melsetter, 6000 ft. April, Swyn. 1824 ; Upper Buzi, 3000 ft. May, Swyn. 1824*a* ; also Chirinda, Swyn.

Genus No.

7851—**V. spp.**

Mazoe, April, Flanagan, 3078, cf. *V. turbinata*, Oliv. & Hiern.

Victoria Falls, April, Flanagan, 3074 ; Allen, 131; Rogers, 5156, 5295*a*, 7015, cf. *V. demulans*, Vatke.

Bulawayo, Dec. Gardner, 84.

Matopos, March, Eyles, 1045; Rogers, 5171 & 5360, cf. *V. pauciflora*, Less.

8775—**Elephantopus scaber,** *L.*

Fl. Trop. Afr. iii. 299 ; Cat. Afr. Pl. Welw. i. 540.

Mazoe, 4500–4800 ft. March, Eyles, 256.

8785—**Adenostemma viscosum,** *Forst.* (*A. caffrum*, DC. ; *A. Dregei*, DC.)

Fl. Trop. Afr. iii. 299; Fl. Cap. iii. 58; Cat. Afr. Pl. Welw, i. 542; Nat. Pl. 346.

Matopos, 5000 ft. Feb. Eyles, 1168; Rogers, 5693; Mazoe, 4300 ft. Dec. Eyles, 226; Salisbury, May, Flanagan, 3050; between Salisbury and Umtali, Rogers, 4072; Victoria Falls, April, Flanagan, 3049.

8816—**Eupatorium africanum,** *Oliv. & Hiern.*

Fl. Trop. Afr. iii. 301: Cat. Afr. Pl. Welw. i. 542.

Gwelo, Jan. Gardner, 43; North of Hartley, Engler; Umtali, Engler; Mazoe, 4300–4800 ft. Sep. Eyles, 431; Salisbury, Darling in Herb. Bolus, 10779 ; Rogers, 4012 ; South Rhodesia, Rand, 153.

8818—**Mikania scandens,** *Willd.* (*M. capensis*, DC.; *Willugbaeya scandens*, O. Kuntze.)

Fl. Trop. Afr. iii. 301; Fl. Cap. iii. 59; Cat. Afr. Pl. Welw. i. 543.

Mazoe, 4400 ft. April, Eyles, 362; Umtali, Engler; Victoria Falls, Sep. Galpin, 6962; Rogers, 5124, 7218; Victoria, Monro, 823.

8865—**Grangea maderaspatana,** *Poir.*

Fl. Trop. Afr. iii. 304; Cat. Afr. Pl. Welw. i. 545.

Victoria Falls, Allen, 100.

8901—**Erigeron canadense,** *L.*

Fl. Cap. iii. 86; Harv. Gen. S.A. Pl. 173.

Salisbury, Aug. Rand, 481; Bulawayo, 4600 ft. Aug. Eyles, 1232; Macheke, Engler; Odzani River Valley, Umtali, Teague, 136.

8919—**Felicia angustifolia,** *Nees.*

Fl. Cap. iii. 73.

Bulawayo, Rogers, 13619*, 13668*.

**F. fascicularis,** *DC.* (*Aster muricatus*, Less. var. *fascicularis*, E. Mey.)

Fl. Cap. iii. 72.

South Rhodesia, Rand, 347.

Genus No.

**F. hyssopifolia,** *Nees.*
Bulawayo, Jan. Gardner, 79.

**F. lutea,** *N. E. Br.*
Kew Bull. 1901, 123.
Bulawayo, 4500 ft. Nov. Eyles, 1216; Sebakwe, 4000 ft. Dec. Eyles, 161; Victoria, Monro, 1076; Gwelo, Sr. Phil. 34; Odzani River Valley, Umtali, Teague, 118.

**F. simulans?** (*Detris simulans* ?)
Salisbury, Aug. Rand. 491.

**F. tenella,** *DC.* (*Aster tenellus,* L.)
Fl. Cap. iii. 71.
South Rhodesia, Jan. Rand, 135.

**F. sp.**
Bulawayo, Chubb, 364, cf. *F. rigidula,* DC.

8923—**Psiadia arabica,** *Jaub. & Spach.*
Fl. Trop. Afr. iii. 319; Cat. Afr. Pl. Welw. i. 553.
Bulawayo, Jan. Rand, 138.

8925—**Nidorella auriculata,** *DC.*
Fl. Cap. iii. 88.
Matabeleland, Oates; Matopos, Rogers, 5359; Odzani River Valley, Umtali, Teague, 4.

**N. depauperata,** *Harv.*
Fl. Cap. iii. 90.
Victoria Falls, July, Kolbe, 3144; Swartz.

**N. hirta,** *DC.*
Fl. Cap. iii. 88.
Rusapi, Engler.

**N. microcephala,** *Steetz.*
Fl. Trop. Afr. iii. 310.
Umtali, Engler; Bulawayo, Chubb, 402; Chirinda, 3700–4000 ft. May, Swyn. 287.

**N. namaquensis ?.**
Matabeleland, Marloth.

**N. resedifolia,** *DC.*
Fl. Cap. iii. 88; Cat. Afr. Pl. Welw. i. 550.
Bulawayo, Dec. Rand, 137; Chubb, 320 p.p., 398; Nov. Eyles, 1110: Dec. Gardner, 99; Victoria Falls, Allen, 121.

**N. sp.**
Matopos, Rogers, 5186.

8926—**Conyza ægyptiaca,** *Ait.* (*Marsea ægyptiaca,* Hiern.)
Fl. Trop. Afr. iii. 314; Cat. Afr. Pl. Welw. i. 550.
Victoria Falls, Rogers, 5014.

Genus No.

**C. costata,** *Harv.*

Fl. Cap. iii. 114.

Odzani River Valley, Umtali, Teague, 217.

**C. paucifolia,** *Oliv. & Hiern.*

Victoria Falls, Rogers, 5015.

**C. persicæfolia,** *Oliv. & Hiern.* (*Marsea persicæfolia,* Hiern.)

Fl. Trop. Afr. iii. 312 ; Cat. Afr. Pl. Welw. i. 550.

Victoria Falls, Swartz; Chirinda, 3700–4000 ft. June, Swyn. 2066, 2065*a* ; Odzani River Valley, Umtali, Teague, 144.

**C. pinnatifida,** *Less.*

Fl. Cap. iii. 113.

Odzani River Valley, Umtali, Teague, 249.

**C. variegata,** *Sch. Bip.*

Fl. Trop. Afr. iii. 315.

Bulawayo, May, Rand, 357 ; Melsetter, 6000 ft. Oct. Swyn. 6128.

**C. sp.**

Victoria Falls, Rogers, 5325.[1]

8929—**Nolletia.**

Victoria Falls, Rogers, 5109, cf. *N. rariflora,* Steetz.

8936—**Brachylæna discolor,** *DC.*

Fl. Cap. iii. 117 ; Nat. Pl. 23 & 24 ; For. Fl. Port. E. Afr. 77 ; Flor. Fl. Cape, 247.

Victoria, Monro, 573.

**B. rhodesiana,** *S. Moore.*

Journ. Linn. Soc. Bot. xxxvii. 448.

Matopos, Sep. Gibbs, 72 ; Galpin, 7069 ; Bulawayo, Chubb, 25 ; Inyamadzi Valley, 3000 ft. Swyn. 1856 ; Chipetzana Riv. 3000 ft. Swyn. 1857 ; also Chikore and Lusitu, Swyn.

**B. rotundata,** *S. Moore.*

Victoria, Monro, 516.

**B. spp.**

Victoria, Monro, 478, 965.

8937—**Tarchonanthus camphoratus,** *L.*

Fl. Cap. iii. 118 ; For. Fl. Port. E. Afr. 77 ; For. Fl. Cape, 245.

South of Bulawayo, Galpin, 7008 ; Bulawayo, Engler ; April, Eyles, 64 ; Matopos, Sep. Gibbs, 315 ; Engler ; Gwelo, Sr. Phil. 52.

**T. sp.**

South Rhodesia, Rand, 342.

[1] Rogers has this named *Microglossa volubilis,* DC.

Genus No.

8939—**Blumea Gariepina,** *DC.* (*Placus gariepinus*, O. Kuntze.)

Fl. Cap. iii. 120; Cat. Afr. Pl. Welw. i. 556.

Bulawayo, Dec. Rand, 278; Oct. Eyles, 1075; Chubb, 312; Mazoe, 4800 ft. Jan. Eyles, 235; Matopos, Sep. Gibbs; Victoria Falls, Allen, 408; Galpin, 7007; Gwelo, Sr. Phil. 51 & 55; South Rhodesia, Rand, 341.

**B. lacera,** *DC.* (*Placus lacerus*, O. Kuntze.)

Fl. Trop. Afr. iii. 322; Fl. Cap. iii. 119; Cat. Afr. Pl. Welw. i. 555.

Matopos, Sep. Gibbs, 269; Victoria Falls, Engler; Sep. Galpin, 7031; Bulawayo, Chubb, 302.

**B. sp.**

Victoria Falls, Rogers, 7421.

8940—**Laggera alata,** *Sch. Bip.*

Fl. Trop. Afr. iii. 326; Nat. Pl. 324; Cat. Afr. Pl. Welw. i. 556.

Matopos, Galpin, 6956; Rogers, 5179; Salisbury, April, Flanagan, 3053; Chirinda, 3800 ft. May, Swyn. 498; Odzani River Valley, Umtali, Teague, 133.

**L. brevipes,** *Oliv. & Hiern.*

Fl. Trop. Afr. iii. 327; Cat. Afr. Pl. Welw. i. 557.

Chirinda, 3500 ft. July, Swyn. 2066.

**L. pterodonta,** *Sch. Bip.* (*L. purpurascens*, Sch. Bip.)

Fl. Trop. Afr. iii. 324.

Salisbury, July, Aug. Rand, 480, 500; Mazoe, 4800 ft. June, Eyles, 376; Matopos, Rogers, 5385.

8941—**Pluchea Dioscoridis,** *DC.*

Fl. Trop. Afr. iii. 329.

Victoria Falls, Rogers, 7134*.

8949—**Denekia capensis,** *Thunb.*

Fl. Trop. Afr. iii. 331; Fl. Cap. iii. 119; Nat. Pl. 365.

Crocodile Riv. Oates; Matopos, Galpin, 6961; Nov. Eyles, 1118; Gibbs, 39; Victoria Falls, May, Eyles, 138; Gibbs, 156; Allen, 405; Rogers, 5278, 5039; Victoria, Monro, 335; Gwelo, Jan. Gardner, 45; Marandellas, Engler; Mazoe, 4200 ft. Sep. Eyles, 406.

8951—**Nicolasia nitens,** *S. Moore.*

Victoria Falls, Rogers, 7099*.

8953—**Epaltes gariepina,** *Steetz.*

Fl. Trop. Afr. iii. 332; Cat. Afr. Pl. Welw. i. 558.

Bulawayo, May, Rand, 354; Chubb, 360; Khami Riv. Oct. Eyles, 1085; Matopos, Oct. Gibbs, 195; Engler; Chipete Forest, 3800 ft. April, Swyn. 198; North Melsetter, Swyn. 1819.

Genus No.

8954—**Porphyrostemma alata ?.**

Umtali, Rogers, 4036.

8955—**Sphæranthus peduncularis,** *DC.*

Fl. Cap. iii. 115.

Bulawayo, May, Rand, 355 ; Aug. Eyles, 1231.

**S. Randii,** *S. Moore.*

Journ. Bot. 1908, 40.

Salisbury, Rand, 527 ; Mazoe, 4200 ft. Sep. Eyles, 405.

**S. Steetzii,** *Oliv. & Hiern.*

Fl. Trop. Afr. iii. 334.

Victoria Falls, Sep. Galpin, 7030.

8972—**Amphidoxa sp.**

Gwelo, Jan. Gardner, 51.

8990—**Achyrocline batocana,** *Oliv. & Hiern.*

Fl. Trop. Afr. iii. 339.

Matopos, Rogers, 5190 ; Macheke, Rogers, 4046.

8992—**Gnaphalium luteo-album,** *L.*

Fl. Trop. Afr. iii. 313 ; Fl. Cap. iii. 262.

Bulawayo, Dec. Rand, 136 ; Salisbury, Rand, 151 ; Bulawayo, 4600 ft. Aug. Eyles, 1236 ; Matopos, Sep. Gibbs, 40 ; Rogers, 5248 ; Gwelo, Jan. Gardner, 12.

9006—**Helichrysum acervatum,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 109.

Chimanimani Mts. 7000 ft. Sep. Swyn. 1845.

**H. adenocarpum,** *DC.*

Fl. Trop. Afr. iii. 350 ; Fl. Cap. iii. 229.

Chirinda, Chipetzana Riv., Nyahodi Riv. fl. April, May, Swyn. 1842, 1843, 1843*a*, 1843*b*.

**H. appendiculatum,** *Less.*

Fl. Cap. iii. 242.

Chirinda, 3700 ft. May, Swyn. 1851 ; Upper Buzi, 3500 ft. Nov. Swyn. 1851*a*.

**H. argyrosphærum,** *DC.*

Fl. Trop. Afr. iii. 351 ; Fl. Cap. iii. 222 ; Cat. Afr. Pl. Welw. i. 562.

Bulawayo, Galpin, 7063 ; April, Flanagan, 3056 ; Matopos, Sep. Gibbs, 27 ; Engler ; Chirinda, 3700 ft. Aug. Swyn. 1806.

**H. auriculatum,** *Less.*

Fl. Trop. Afr. iii. 347 ; Fl. Cap. iii. 253 ; Cat. Afr. Pl. Welw. i. 562.

Chirinda, 3700 ft. June, Swyn. 1838.

**H. brunioides,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 111.

Chimanimani Mts. 7000 ft. Sep. Swyn. 1847.

Genus No.
9006—**H. Buchanani,** *Engl.*
Melsetter, 6000 ft. Sep. Swyn. 1905.

**H. cæspititium,** Sond.
Fl. Cap. iii. 217.
Bulawayo, Jan. Rand, 100.

**H. callicomum,** *Harv.*
Fl. Cap. iii. 247.
Salisbury, May, Flanagan, 3048.

**H. cymosum,** *Less.*
Fl. Trop. Afr. iii. 353; Fl. Cap. iii. 245.
Matopos, 4500 ft. Feb. Eyles, 1169; Rogers, 5188; Umtali, Engler.

**H. declinatum,** *Less.*
Fl. Cap. iii. 218.
Salisbury, Dec. Rand, 152; Bulawayo, May, Rand, 351; Victoria Falls, Rogers, 5470.

**H. ericæfolium,** *Less.*
Fl. Cap. iii. 217.
Matopos, Sep. Gibbs, 10.

**H. fulgidum,** *Willd.*
Fl. Cap. iii. 232.
Matopos, Rogers, 5653.

**H. gazense,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 110.
Melsetter, 6000 ft. Sep. Swyn. 1853.

**H. Kraussii,** *Sch. Bip.*
Fl. Cap. iii. 249; Nat. Pl. 269.
Salisbury, July, Rand, 531; Matopos, Engler; Melsetter, May, Swyn. 1835; Upper Buzi, 3600 ft. Sep. Swyn. 1835*a*.

**H. latifolium,** *Less.*
Fl. Cap. iii. 237.
Umtali, Rogers, 4030; Chirinda, May, Swyn. 510.

**H. leiopodium,** *DC.*
Fl. Cap. iii. 239; Cat. Afr. Pl. Welw. i. 565.
Victoria, Monro, 859; Chirinda, 3800 ft. April, Swyn. 307; Lusitu Riv. 4000 ft. May, Swyn. 502; Mt. Pene, 6500–7000 ft. Sep. Swyn. 1837, 1852.

**H. leptolepis,** *DC.*
Fl. Cap. iii. 222.
Bulawayo, May, Rand, 348; Matopos, Sep. Gibbs, 11; Mazoe, April, Flanagan, 3055; Victoria, Monro, 452; Bulawayo, Aug. Eyles, 1246.

Genus No.

**H. nitens,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 350.
Chirinda, Chimanimani Mts., Mt. Pene, Melsetter, in fl. Aug.–Oct. Swyn. 280, 1836, 1839, 1840, 6111.

**H. quinquenerve,** *Less.*
Fl. Cap. iii. 240.
Victoria Falls, Rogers, 5688*.

**H. Saweri,** *S. Moore.*
Journ. Bot. 1905, 170.
Penhalonga, 6000 ft. E. R. Sawer.

**H. setosum,** *Harv.*
Fl. Cap. iii. 231.
Salisbury, July, Rand, 499; Bulawayo, 4500 ft. Feb. Eyles, 1170; Matabeleland, Marloth; Mazoe, 4300 ft. April, Eyles, 350; Matopos, Rogers, 5653?; Chirinda, Swyn. 279, 279*a*; Melsetter, 6000 ft. April, Swyn. 281.

**H. stenopterum,** *DC.*
Fl. Cap. iii. 244.
Salisbury, April, Flanagan, 3044.

var. **citrinum,** *S. Moore.*
Journ. Bot. 1908, 41.
Mazoe, 4400 ft. April, Eyles, 363; Melsetter, June, Swyn. 1841; Chirinda Sep. Swyn. 1841*a*.

**H. Swynnertonii,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 109.
Melsetter, 6000 ft. Oct. Swyn. 6110.

**H. spp.**
Sicumy Vlei, 3200 ft. Allen, 230, cf. *H. setosum*, Harv.
Bulawayo, 4500 ft. June, Eyles, 152.
Matopos, Rogers, 5182, 5192.

9019—**Humea africana,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 112.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1849.

9055—**Athrixia elata,** *Sond.*
Fl. Cap. iii. 292.
Mazoe, Sep. Rand, 484; July, Eyles, 383; Odzani River Valley, Umtali, Teague, 196.

**A. foliosa,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 113.
Melsetter, 6000 ft. July, Swyn. 1820.

**A. oblonga,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 112.
Chirinda, 3800 ft. Oct. Swyn. 276.

Genus No.

**B. rosmarinifolia,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 355.
North Melsetter, 5000–6000 ft. Umvumvumvu, 4000 ft. Oct. Swyn. 6135, 6137, 6137*a*, 6219.

9061—**Inula acervata,** *S. Moore.*
Chirinda, 3800 ft. May, Swyn. 460.

**I. glomerata,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 359 ; Cat. Afr. Pl. Welw. i. 566.
Umtali, Engler, Odzani River Valley, Teague, 155.

9069—**Calostephane divaricata,** *Benth.*
Fl. Trop. Afr. iii. 363 ; Cat. Afr. Pl. Welw. i. 569.
North of Bulawayo, 3400 ft. May, Eyles, 82 ; between Salisbury and Bulawayo, April, Flanagan, 3069 (var.).

**C. sp.**
Salisbury, April, Flanagan, 3062.

9073—**Pegolettia senegalensis,** *Cass.*
Fl. Trop. Afr. iii. 361 ; Cat. Afr. Pl. Welw. i. 568.
Deka, 2400 ft. May, Eyles, 131 ; Victoria Falls, April, Flanagan, 3071 ; Rogers, 5063, 7052.

9078—**Pulicaria capensis,** *DC.*
Fl. Cap. iii. 121.
Bulawayo, May, Rand, 356 ; Matopos, Rogers, 5243.

**P. longifolia,** *Boiss.*
Gwelo, Jan. Gardner, 48.

9083—**Philgrophyllum Schinzii,** *O. Hoffm.*
Matopos, Rogers, 7928* ; Wankie, Rogers*.

9087—**Sphacophyllum flexuosum,** *Hutch.*
Kew Bull. 1906, 249.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1866.

**S. sparsum,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 114.
Lusitu Riv. 3000 ft. April, Swyn. 1867.

9090—**Geigeria passerinoides,** *Harv.*
Fl. Cap. iii. 125.
Matopos, 4600 ft. March, Eyles, 1035.

**G. protensa,** *Harv.* var. **pubigera,** *S. Moore.*
Journ. Bot. 1899, 375 ; Fl. Cap. iii. 125 (type).
Bulawayo, Dec. Rand, 104.

**G. pubescens,** *S. Moore.*
Journ. Bot. 1899, 374.
Bulawayo, May, Rand, 345.

Genus No.

**G. Randii,** *S. Moore.*
Journ. Bot. 1899, 374.
Bulawayo, May, Rand, 346.

**G. rhodesiana,** *S. Moore.*
Journ. Bot. 1908, 41.
Mazoe, 4300 ft. April, Eyles, 318; Flanagan, 3061; Victoria, Monro, 968; Chirinda, 3800 ft. 490, Nyahodi Riv. 5000 ft., Chipetzana Riv. 3000 ft. fl. April, May, Swyn. 490, 1817, 1823.

**G. Zeyheri,** *Harv.*
Fl. Cap. iii. 126.
Crocodile Riv. Oates; Matopos, April, Flanagan, 3059.

**G. spp.**
Matopos, April, Flanagan, 3060, cf. *G. africana*, Gr.
Matopos, Eyles, 1059.
Bulawayo, Chubb, 323.

9148—**Xanthium spinosum,** *L.*
Bulawayo, 4500 ft. Eyles, 99?; Salisbury, Govt. Herb. 797.

9160—**Siegesbeckia abyssinica,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 372.
Victoria Falls, Rogers, 5032.

9169—**Sclerocarpus africanus,** *Jacq.*
Fl. Trop. Afr. iii. 374; Cat. Afr. Pl. Welw. i. 575.
Salisbury, April, Flanagan, 3037.

9192—**Wedelia abyssinica,** *Vatke.*
Fl. Trop. Afr. iii. 377.
Umtali, Rogers, 4063*; Bulawayo, 13559*.

**W. africana,** *P. Beauv.*
Fl. Trop. Afr. iii. 376; Cat. Afr. Pl. Welw. i. 576.
Salisbury, April, Flanagan, 3037*a*.

**W. diversipapposa,** *S. Moore.*
Journ. Bot. 1899, 401.
Bulawayo, Jan. Rand, 111.

**W. menotriche,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 377.
Bulawayo, Rogers, 5910*; Salisbury, Rogers, 13089*.

**W. spp.**
Victoria Falls, Allen, 10, apparently undescribed.
Victoria Falls, Allen, 21, cf. *W. Menotriche,* Oliv. & Hiern.
Bulawayo, Chubb, 333.

9195—**Aspilia brachyphylla,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 115.
Chirinda, May, Swyn. 292, 495; Salisbury, Rogers, 13092*.

Genus No.

9411—**A. Eylesii,** *S. Moore.*
Journ. Bot. 1907, 45.
Sebakwe, 4000 ft. Dec. Eyles, 164.

**A. vulgaris,** *N. E. Br.*
Kew Bull. 1906, 164.
Between Salisbury and Umtali, Cecil, 43.

**A. zombensis,** *Baker.*
Victoria Falls, Allen, 199.

**A. sp.**
Victoria Falls, Allen, 254, cf. *A. Kotschyi*, Bth. & Hook.

9204—**Melanthera Brownei,** *Sch. Bip.*
Fl. Trop. Afr. iii. 382; Cat. Afr. Pl. Welw. i. 579.
Victoria Falls, Rogers, 5012, 5581; Chirinda, 3500 ft. Oct. Swyn. 293, 294.

9222—**Guizotia abyssinica,** *Cass.*
Fl. Trop. Afr. iii. 384.
Salisbury, April, Flanagan, 3039.

**G. Eylesii,** *S. Moore.*
Journ. Bot. 1908, 43.
Mazoe, 4300 ft. April, Eyles, 349; Chirinda, 3800 ft. May, Swyn. 295; Odzani River Valley, Umtali, Teague, 175.

9227—**Coreopsis insecta,** *S. Moore.*
Journ. Bot. 1908, 42.
Mazoe, 4700 ft. March, Eyles, 266.

**C. Steppia,** *Steetz.*
Fl. Trop. Afr. iii. 388; Cat. Afr. Pl. Welw. i. 584.
Mazoe, 4400 ft. April, Eyles, 307.

**C. sp.**
Between Wankie and Victoria Falls, Rogers, 6001.

9232—**Chrysanthellum procumbens,** *Pers.*
Fl. Trop. Afr. iii. 395; Cat. Afr. Pl. Welw. i. 588.
Bulawayo, Jan. Rand, 148; Jan. Gardner, 81; Rogers, 5926; Victoria Falls, Rogers, 6026*.

9237—**Bidens pilosa,** *L.*
Fl. Trop. Afr. iii. 392; Fl. Cap. iii. 133; Cat. Afr. Pl. Welw. i. 587.
Bulawayo, May, Rand, 340; Mazoe, 4300–4800 ft. March, Eyles, 296; Victoria Falls, Rogers; Odzani River Valley, Umtali, Teague, 149.

**B. prolixus,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 116.
Melsetter, fl. & fr. April, Swyn. 1884.

Genus No.

**B. Schimperi,** *Sch. Bip.*
Fl. Trop. Afr. iii. 393.
Victoria Falls, April, Flanagan, 3036, 3041; Gwelo, Kolbe.

9262—**Jaumea compositarum,** *Benth. & Hook.*
Fl. Trop. Afr. iii. 395.
Salisbury, April, Flanagan, 3077; Gwelo, Sr. Phil. 36.

**J. elata** (*N. E. Br.*), *Torre & Harms.* (*Hypericophyllum elatum,* N. E. Br.)
Chipetzana Riv. 3000 ft. April, Swyn. 1816.

9291—**Schkuhria bonariensis,** *L.*
Bulawayo, Rogers, 5911, a weed of cultivation.

9311—**Tagetes glandulifera,** *Schrank.*
Bulawayo, Monro, 79; Chubb, 341.

**T. minuta,** *L.*
Salisbury, March, Flanagan, 3015; Gwelo, Sr. Phil. 54; Bulawayo, Chubb, 10*a*.

9351—**Cotula anthemoides,** *L.*
Fl. Trop. Afr. iii. 397; Fl. Cap. iii. 182; Cat. Afr. Pl. Welw. i. 590.
Bulawayo, 4600 ft. Aug. Eyles, 1238; Monro, 36; Matopos, Rogers, 5245.

9356—**Schistostephium artemisiifolium,** *Baker.*
Umtali, Engler.

**S. heptalobum,** *Benth. & Hook.*
Fl. Trop. Afr. iii. 399.
Salisbury, April, Flanagan, 3041; Chirinda, 3500 ft. May, Swyn. 491; Melsetter, 6000 ft. Sep. Swyn. 1808.

**S. oxylobum,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 117.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1871; Mt. Pene, 7000 ft. Oct. Swyn. 6132.

9358—**Artemisia afra,** *Jacq.*
Fl. Cap. iii. 170; Cat. Afr. Pl. Welw. i. 590; Harv. Gen. S.A. Pl. 185.
Crocodile Riv. Oates; Salisbury, July, Rand, 496; April, Flanagan, 3045; Mazoe, 4300 ft. April, Eyles, 351; Chirinda 3700 ft. July, Swyn. 446; Melsetter, 6000 ft. Swyn. 646; Lusitu Riv. Swyn. 646*a*, 646*b*; Nyahodi Riv. Swyn. 1822; Odzani River Valley, Umtali, Teague, 92.

9374—**Congrothamus sp.**
Victoria, Monro 1018.

Genus No.
9401—**Lopholæna brickellioides,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 118.
Chimanimani Mts. 7000 ft. Sep. Swyn. 1802; Mt. Pene, 7000 ft. Oct. Swyn. 6033.

**L. Randii,** *S. Moore.*
Gwelo, Sr. Phil. 4.

9405—**Gynura cernua,** *Benth.* (*Crassocephalum cernuum,* Moench.)
Fl. Trop. Afr. iii. 402; Cat. Afr. Pl. Welw. i. 593.
Salisbury, Aug. Rand, 493.

**G. crepidoides,** *Benth.* (*Crassocephalum diversifolium,* Hiern, var. *crepidioides,* Hiern.)
Fl. Trop. Afr. iii. 403; Cat. Afr. Pl. Welw. i. 594.
Salisbury, April, Flanagan, 3072.

**G. sarcobasis,** *DC.*
Matopos, 4800 ft. April, Eyles, 40.

**G. vitellina,** *Benth.*
Fl. Trop. Afr. iii. 402.
Mazoe, 4300 ft. Dec. Eyles, 227.

9406—**Cineraria lobata,** *L'Herit.*
Fl. Cap. iii. 311.
Melsetter, 6000 ft. Sep. Swyn. 1875.

**C. mazoensis,** *S. Moore.*
Journ. Bot. 1908, 43.
Mazoe, 5000–5200 ft. April, Eyles, 345.

9411—**Senecio acervatus,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 121.
Chirinda Forest, 3700–4000 ft. Oct. Swyn. 665.

**S. barbertonicus,** *Klatt,* var. **microcephala,** *S. Moore.*
Journ. Linn. Soc. Bot. xxxvii. 451.
Matopos, Oct. Gibbs, 250; Bulawayo, 4500 ft. Aug. Eyles, 1239.

**S. bupleuroides,** *DC.*
Fl. Trop. Afr. iii. 414; Fl. Cap. iii. 378.
Salisbury, Darling; May, Flanagan, 3079.

**S. deltoideus,** *Less.*
Fl. Trop. Afr. iii. 420; Fl. Cap. iii. 403; Nat. Pl. 382.
Chirinda, 3700–4000 ft. Feb. Swyn. 288; Chipete Forest, 3800 ft. June, Swyn. 288*a*; Mt. Pene, Oct. Swyn. 6131.

**S. discifolius,** *Oliv.*
Fl. Trop. Afr. iii. 410.
Gwelo, Jan. Gardner, 35.

Genus No.
9411—**S. erubescens,** *Ait.*

Fl. Cap. iii. 363; Cat. Afr. Pl. Welw. i. 597.

Matopos, Oct. Gibbs, 241; Chirinda, 3700–4000 ft. Nov. Swyn. 1812; Macheke, Rogers, 4045*; Bulawayo, Rogers, 5519*.

**S. gazensis,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 121.

Melsetter, 6000 ft. Oct. Swyn. 6143.

**S. homoplasticus,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 120.

Chirinda, 3500 ft. Oct. Swyn. 288.

var. **tomentellus,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 121.

Chirinda, 3500 ft. Swyn. 288*a*.

**S. lasiorhizus,** *DC.* (*S. coronatus*, Harv.)

Fl. Trop. Afr. iii. 415; Fl. Cap. iii. 369; Cat. Afr. Pl. Welw. i. 598.

Bulawayo, Dec. Rand, 139; Nov. Eyles, 1222; Salisbury, Sep. Rand, 628 (var.); Engler; Darling; Matopos, Sep. Gibbs, 189; Salisbury, Rogers, 4026.

**S. latifolius,** *DC.*

Fl. Cap. iii. 377; Cat. Afr. Pl. Welw. i. 598.

Bulawayo, Dec. Rand, 140; Salisbury, Engler; Chirinda, Nov. Swyn. 1876, 1944; also Melsetter Dist. Swyn.

**S. longiflorus,** *Oliv. & Hiern.* (*Kleinia longiflora*, DC.)

Bulawayo, 4500 ft. fl. Sep. fr. Oct. Eyles, 1083; Engler.

**S. othonnæflorus,** *DC.*

Fl. Cap. iii. 373.

Bulawayo, 4500 ft. Nov. Eyles, 1223.

**S. oxyriæfolius,** *DC.*

Fl. Cap. iii. 376.

Chimanimani Mts. 7000 ft. Sep. Swyn. 1946; Bulawayo, Rogers, 13563*.

**S. picridifolius,** *DC.*

Fl. Trop. Afr. iii. 413; Fl. Cap. iii. 379; Cat. Afr. Pl. Welw. i. 597.

Salisbury, April, Flanagan, 3076; Umtali, Rogers, 4052.

**S. propior,** *S. Moore.*

Journ. Linn. Soc. Bot. xl. 118.

Chimanimani Mts. 7000 ft. Sep. Swyn. 1879.

**S. protracta** (*S. Moore*), *Torre & Harms.* (*Emilia protracta*, S. Moore.)

Journ. Bot. 1905, 48.

Victoria Falls, 3000 ft. May, Eyles, 119; April, Flanagan, 3234; Rogers, 5023.

Genus No.

**S. purpureus,** *L.*
Fl. Cap. iii. 363.
Macheke, Rogers, 4048.

**S. Randii,** *S. Moore.*
Journ. Bot. 1899, 402.
Salisbury, Sep. Rand, 625.

**S. rosmarinifolius,** *L. f.*
Fl. Cap. iii. 100.
Matopos, Oct. Gibbs, 43; April, Flanagan, 3081; Gwelo, Sr. Phil. 31.

**S. sagittata** (*DC.*), *Torre & Harms.* (*Emilia sagittata,* DC.; *Emilia flammea,* Cass.)
Fl. Trop. Afr. iii. 405; Cat. Afr. Pl. Welw. i. 595.
Mazoe, 5000 ft. March, Eyles, 288; April, Flanagan, **2057**; Odzani River Valley, Umtali, Teague, 16.

**S. sarmentosus,** *O. Hoffm.*
Mazoe, 4300 ft. July, Eyles, 379.

**S. Serra,** *Sond.*
Fl. Cap. iii. 389.
Matopos, May, Flanagan, 3080.

**S. tamoides,** *DC.*
Fl. Cap. iii. 404; Nat. Pl. 95.
Chipete Forest, 3800 ft. Swyn. 1877.

**S. tenellulus,** *S. Moore.*
Journ. Linn. Soc. Bot. xxxvii. 449.
Matopos, Oct. Gibbs, 203.

**S. spp.**
Salisbury, April, Flanagan, 3073, cf. *S. myriocephalus,* Sch. Bip.
Salisbury, Darling, in Herb. Bolus, 10780.
Matopos, Rogers, 5183.
Victoria Falls, Allen, 15, cf. *S. sagittata* (DC.)

9417—**Euryops osteospermum,** *S. Moore.*
Journ. Bot. 1899, 403.
Salisbury, July, Rand, 498.

var. **parvifolia,** *S. Moore.*
Journ. Bot. 1899, 403.
Salisbury, Dec. Rand, 109.

9420—**Othonna ambifaria,** *S. Moore.*
Journ. Bot. 1899, 403.
Shashi Riv. Jan. Rand, 110.

9427—**Osteospermum herbaceum,** *Linn. f.*
Fl. Cap. iii. 435.
Salisbury, Aug. Rand, 489.

Genus No.

**O. moniliferum,** *Linn.*

Fl. Cap. iii. 436 ; Nat. Pl. 55.

Salisbury, Aug. Rand, 487 (var.) ; Melsetter, 6000 ft. Swyn. 497 ; Chirinda, 3500 ft. Swyn, 1858 ; Mt. Pene, Swyn. 1858*a* ; Haroni Riv. 5000 ft. Swyn. 6130 ; in fl. May, Sep. Oct. Swyn.

**O. muricatum,** *E. Mey.*

Fl. Trop. Afr. iii. 425 ; Fl. Cap. iii. 441 ; Cat. Afr. Pl. Welw. i. 607.

Salisbury, Aug. Rand, 339 ; Matopos, fl. & fr. Sep. Gibbs, 22 ; Galpin, 6990 ; Bulawayo, Chubb, 351, 371 ; Rogers, 5932.

9428—**Tripteris amplexicaulis,** *Less.*

Fl. Cap. iii. 427 ; Cat. Afr. Pl. Welw. i. 607.

Salisbury, Sep. Rand, 485 ; Mazoe, 4300–4800 ft. Oct. Eyles, 437 ; Victoria, Monro, 727 ; Mt. Pene, 6500–7000 ft. Sep. Swyn. 1859.

**T. monocephala,** *Oliv. & Hiern.*

Fl. Trop. Afr. iii. 424.

Salisbury, Rogers, 4001 ; Mt. Pene, 7000 ft. Oct. Swyn. 6161.

**T. sp.**

Salisbury, Darling, in Herb. Bolus, 10777, cf. *T. monocephala, Oliv. & Hiern.*

9432—**Arctotis scaposa** (*Harv.*) *Torre & Harms.* (*Haplocarpha scaposa,* Harv.)

Fl. Trop. Afr. iii. 427 ; Fl. Cap. iii. 465.

Bulawayo, Dec. Rand, 99 ; Gwelo, Jan. Gardner, 80 ; Plumtree, April, Flanagan, 3032.

9434—**Gazania krebsiana,** *Less.*

Fl. Cap. iii. 475.

Salisbury, Rand, 490.

var. **hispidula,** *Harv.*

Fl. Cap. iii. 476.

Mazoe, 4300 ft. Aug. Eyles, 184 ; Matopos, fl. & fr. Sep. Gibbs, 75 ; Victoria, Monro, 444 ; Mt. Pene, Oct. Swyn. 6115.

9436—**Berkheyopsis integrifolia,** *Volk.*

Bulawayo, Dec. Rand, 133.

**B. bechuanensis,** *S. Moore.*

Bulawayo, Rogers, 5496*, 13554*.

**B. spp.**

Plumtree, April, Flanagan, 3033.

9438—**Berkheya Adlami,** *Hook. f.*

Sebakwe, 4000 ft. Dec. Eyles, 118 ; Victoria, Monro, 964 ; Bulawayo, Rand, 149.

Genus No.

**B. gorterioides,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 429.
Bulawayo, Rogers, 13555*.

**B. setifera,** *DC.* var. **tropica,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 123; Fl. Cap. iii. 509 (type).
Lusitu Riv. 5000 ft. Sep. Swyn. 1869.

**B. subulata,** *Harv.*
Fl. Cap. iii. 507; Nat. Pl. 225.
Mazoe, 4500 ft. Aug. Eyles, 178; Salisbury, Darling; Odzani River Valley, Umtali, Teague, 9.

**B. Zeyheri,** *Sond. & Harv.*
Fl. Trop. Afr. iii. 429.
Gwelo, Jan. Gardner, 6; Bulawayo, Jan. Rand, 113; Haroni Riv. 5600 ft. Sep. Swyn. 1868; Melsetter, 6000 ft. Oct. Swyn. 6114.

**B. spp.**
Salisbury, Rogers, 4065.
Victoria Falls, Flanagan, 3031, 3034.

9476—**Centaurea rhizocephala,** *Oliv. & Hiern.* var. **australis?.**
Fl. Trop. Afr. iii. 438 (type).
Salisbury, Aug. Rand, 482; Mazoe, 4400–4800 ft. Aug. Eyles, 397.

**C. sp.**
Salisbury, Darling in Herb. Bolus, 10776.

9499—**Pleiotaxis Antunessii,** *O. Hoffm.*
Cat. Afr. Pl. Welw. i. 611.
Mazoe, 4500–5000 ft. March, Eyles, 287; April, Flanagan, 3054.

**P. spp.**
Gwelo, Sr. Phil. 2; Salisbury, Rogers, 4079.

9501—**Dicoma anomala,** *Sond.*
Fl. Trop. Afr. iii. 443; Fl. Cap. iii. 517; Cat. Afr. Pl. Welw. i. 614.
Bulawayo, June, Rand, 486; Salisbury, Darling; Matopos, Rogers, 5358; Victoria Falls, Rogers, 7151; North Melsetter, April, Swyn. 1818; Odzani River Valley, Umtali, Teague, 153.

var. **microcephala,** *Harv.*
Fl. Trop. Afr. iii. 443; Fl. Cap. iii. 517.
Matopos, 4500 ft. Feb. Eyles, 1176; Victoria, Monro, 883.

var. **Sonderi,** *Harv.*
Fl. Trop. Afr. iii. 443; Fl. Cap. iii. 517.
Plumtree, April, Flanagan, 3029.

**D. Kirkii,** *Harv.*
Fl. Trop. Afr. iii. 444; Fl. Cap. iii. 518.
Salisbury, May, Flanagan, 3051; Gwelo, Sr. Phil. 41; Odzani River Valley, Umtali, Teague, 154.

Genus No.

var. **angustifolia,** *S. Moore.*
Journ. Linn. Soc. Bot. xl. 123.
Chirinda, 3800 ft. May, Swyn. 444 ; Victoria, Monro, 413, 1100*c.*

**D. Schinzii,** *O. Hoffm.*
Victoria Falls, Rogers, 5300 (var.).

**D. sessiflora,** *Harv.*
Fl. Trop. Afr. iii. 444 ; Fl. Cap. iii. 518.
Mazoe, 4800 ft. Aug. Eyles, 186 (var. ?).

**D. tomentosa,** *Cass.*
Fl. Trop. Afr. iii. 443 ; Cat. Afr. Pl. Welw. i. 613.
Deka, 2400 ft. May, Eyles, 136.

9504—**Erythrocephalum zambesianum,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 441.
Chirinda, Oct. Swyn. 236.

9528—**Gerbera abyssinica,** *Sch. Bip.* (*Perdicium abyssinicum,* Hiern.)
Fl. Trop. Afr. iii. 445 ; Cat. Afr. Pl. Welw. i. 615.
Salisbury, Sep. Rand, 623 ; Gwelo, Jan. Gardner, 36 ; Mt. Pene, 6500 ft. Sep. Oct. Swyn. 1821, 6113.

**G. ambigua,** *Sch. Bip.*
Fl. Cap. iii. 522.
Umtali, Rogers, 4033.

**G. discolor,** *Sond.*
Fl. Cap. iii. 522.
Salisbury, April, Flanagan, 3043.

**G. piloselloides,** *Cass.* (*Perdicium piloselloides,* Hiern.)
Fl. Trop. Afr. iii. 445 ; Fl. Cap. iii. 522 ; Cat. Afr. Pl. Welw. i. 615.
Salisbury, Dec. Rand, 112 ; Matopos, fl. & fr. Oct. Gibbs, 257 ; Chirinda, 4500 ft. Nov. Swyn. 1870.

**G. plantaginea,** *Harv.*
Fl. Cap. iii. 522.
Mazoe, 4800 ft. Aug. Eyles, 400 ?

**G. viridifolia,** *Sch. Bip.* (*G. natalensis,* Sch. Bip.)
Fl. Cap. iii. 523 ; Nat. Pl. 546.
Crocodile Riv. Oates ; Salisbury, Darling ; Rogers, 4006, 4005.

**G. sp.**
Salisbury, Rogers, 4076.

9561—**Tolpis sp.** (*Swertia* sp.)
Victoria, Monro, 580.

9595—**Sonchus Bipontini,** *Aschers.* var. **pinnatifidus,** *Oliv. & Hiern.*
Fl. Trop. Afr. iii. 458.
Chirinda, 3800 ft. May, Swyn. 1886.

Genus No.

**S. elliotanus,** *Hiern.*
Cat. Afr. Pl. Welw. i. 623.
Salisbury, Sep. Rand, 483; Bulawayo, Chubb, 348.

**S. macer,** *S. Moore.*
Journ. Bot. 1899, 404.
Salisbury, Sep. Rand, 627.

**S. oleraceus,** *L.*
Fl. Trop. Afr. iii. 457; Fl. Cap. iii. 528; Cat. Afr. Pl. Welw. i. 622.
Gwelo, Sr. Phil. 45; a common weed, Rogers.

**S. violaceus,** *O. Hoffm.*
Salisbury, Rogers, 4062*.

9596—**Lactuca capensis,** *Thunb.*
Fl. Trop. Afr. iii. 452; Fl. Cap. iii. 526; Cat. Afr. Pl. Welw. i. 621.
Bulawayo, May, Rand, 349; Jan. Eyles, 67; Chubb, 374, 376, 381; Salisbury, July, Rand, 488; Darling; Matopos, Nov. Eyles, 1149; fl. & fr. Sep. Gibbs, 52; Gwelo, Jan. Gardner, 39; North of Hartley, Engler; Mazoe, 4300–4800 ft. Oct. Eyles, 438; Victoria, Monro, 446, 446*a*; Odzani River Valley, Umtali, Teague, 76, 122, 123.

**L. virosa,** *Thunb.* (*L. dregeana*, DC.)
Fl. Cap. iii. 526.
Matopos, Engler.

# ALPHABETICAL LIST.

Names of FAMILIES are given in capitals.
Names of Genera are printed close to margin and not repeated.
Names of Species are slightly inset.
Names of Synonyms are printed in *italics*.

# TRANSACTIONS

OF THE

# South African Philosophical Society.

The following volumes have been published:—

| VOL. | | PUB. | s. | d. |
|---|---|---|---|---|
| I.— | Part 1 | 1878 | | |
| | Part 2 | 1879 | 2 | 6 |
| | Part 3 | 1880 | 2 | 6 |
| II.— | Part 1 | 1881 | 5 | 0 |
| | Part 2 | 1881 | 2 | 6 |
| | Part 3 | 1882 | 2 | 6 |
| III.— | Part 1 | 1884 | 2 | 6 |
| | Part 2 | 1885 | 10 | 0 |
| IV.— | Part 1 | 1887 | 2 | 6 |
| | Part 2 | 1888 | | |
| V.— | Part 1 | 1888 | | |
| | Part 2 | 1893 | 2 | 6 |
| VI.— | Part 1 | 1890 | 2 | 6 |
| | Part 2 | 1892 | 2 | 6 |
| VII.— | Part 1 | 1893 | 10 | 0 |
| | Part 2 | 1896 | 20 | 0 |
| VIII.— | Part 1 | 1893 | 2 | 6 |
| | Part 2 | 1896 | 5 | 0 |
| IX.— | Part 1 | 1897 | 5 | 0 |
| | Part 2 | 1898 | 7 | 6 |
| X.— | Part 1 | 1897 | 15 | 0 |
| | Part 2 | 1898 | 7 | 6 |
| | Part 3 | 1899 | 7 | 6 |
| XI.— | Part 1 | 1900 | 12 | 6 |
| | Part 2 | 1900 | 12 | 6 |
| | Part 3 | 1901 | 7 | 6 |
| | Part 4 | 1902 | 12 | 6 |
| XII.— | (Pp. 1–560) | 1901 | 25 | 0 |
| | (Pp. 561–896) | 1902 | 14 | 0 |
| | (Pp. 897–920) | 1903 | 2 | 0 |
| XIII.— | (Pp. 1–293) | 1904 | 12 | 6 |
| | (Pp. 289–546) | 1907 | 8 | 6 |
| | (Pp. 547–752) | 1908 | 10 | 0 |
| XIV.— | Part 1 | 1903 | 5 | 6 |
| | Part 2 | 1903 | 8 | 6 |
| | Part 3 | 1903 | 11 | 0 |
| | Part 4 | 1903 | 5 | 0 |
| | Part 5 | 1904 | 3 | 0 |
| XV.— | Part 1 | 1904 | 3 | 6 |
| | Part 2 | 1904 | 3 | 6 |
| | Part 3 | 1904 | 17 | 0 |
| | Part 4 | 1905 | 7 | 6 |
| | Part 5 | 1905 | 12 | 6 |
| XVI.— | Part 1 | 1905 | 10 | 0 |
| | Part 2 | 1905 | 10 | 0 |
| | Part 3 | 1906 | 5 | 0 |
| | Part 4 | 1906 | 15 | 0 |
| | Part 5 | 1907 | 8 | 6 |
| XVII.— | Part 1 | 1907 | | |
| | Part 2 | 1908 | | |
| XVIII.— | Part 1 | 1907 | 9 | 0 |
| | Part 2 | 1908 | 12 | 0 |
| | Part 3 | 1907 | 4 | 6 |
| | Part 4 | 1909 | 7 | 0 |

Copies may be obtained from the Honorary Secretary of the Royal Society of South Africa; or from Messrs. Wm. Wesley & Son, 28, Essex Street, Strand, London.

*Members of the Society may obtain the publications, from the Secretary only, at half of the above prices.*

Part 1. of vol. I., Part 2 of vol. IV., Part 1 of vol. V., and vol. XVII., Parts 1 and 2 are out of print.

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH AFRI[illegible]

| | | | | |
|---|---|---|---|---|
| Vol. I. Part 1 | 1909 | Price | 1 | [illegible] |
| ,, I. Part 2 | 1910 | Price | 0 | [illegible] |
| ,, II. Part 1 | 1910 | Price | 0 | [illegible] |
| ,, II. Part 2 | 1911 | Price | 0 | [illegible] |
| ,, II. Part 3 | 1912 | Price | 0 | [illegible] |
| ,, II. Part 4 | 1912 | Price | 0 | [illegible] |
| ,, II. Part 5 | 1912 | Price | 0 | [illegible] |
| ,, III. Part 1 | 1913 | Price | 0 | [illegible] |
| ,, III. Part 2 | 1913 | Price | 0 | [illegible] |
| ,, III. Part 3 | 1913 | Price | 0 | [illegible] |
| ,, IV. Part 1 | 1914 | Price | 0 | [illegible] |
| ,, IV. Part 2 | 1914 | Price | 0 | [illegible] |
| ,, IV. Part 3 | 1915 | Price | 0 | [illegible] |
| ,, V. Part 1 | 1915 | Price | 0 | [illegible] |
| ,, V. Part 2 | 1915 | Price | 0 | [illegible] |
| ,, V. Part 3 | 1915 | Price | 0 | [illegible] |
| ,, V. Part 4 | 1916 | Price | 0 | [illegible] |

Copies may be obtained from the Honorary Secretary, [illegible]

Messrs. Wm Wesley & Son, 28, Essex Street, Strand, Lo[illegible]

*Members of the Society may obtain the publications [illegible] Secretary only, at half of the above prices.*

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH AFRICA.



VOLUME V.—PART 5.
1916.

CAPE TOWN:
PUBLISHED BY THE SOCIETY.

1916.

[illegible] 1916. [Price £1 7s. 6d.

# CONTENTS

# THE EQUIVALENT MASS OF A SPRING VIBRATING LONGITUDINALLY.

By Alexander Brown.

(From the Applied Mathematics Laboratory, South African College.)

(Received April 16, 1915.)

§ 1. When a mass M is oscillating under gravity at the end of a spiral spring, it is usual to make allowance for the mass $m$ of the spring itself by adding a quantity $\frac{1}{3}m$ to M and treating the spring as if it were light. This result is correct only if $m$ is small compared to M; and in this case it is possible to give an elementary solution by supposing the displacement of any point on the spring to be proportional to its distance from the fixed end. In ordinary laboratory practice M is comparable with $m$ in magnitude, and the above approximation no longer holds; for small values of M it is found that $\frac{2}{5}m$ is a better value for the equivalent mass of the spring than $\frac{1}{3}m$. It seems worth while to determine how this quantity changes as M changes. Rayleigh, in his book on Sound, vol. i, §§ 155–6, works out certain results in the longitudinal vibrations of bars which can be applied to this problem. The effect of a very small mass and of a very large mass added to a bar vibrating longitudinally are there shown; and from them the results $\frac{4}{\pi^2}m$ and $\frac{1}{3}m$ can be deduced for the equivalent mass of $m$ when M is very small and very large respectively. For moderate values of M the equivalent mass varies between the extremes mentioned, and for any actual $m$ it is important to know the effect of the mass of the spring more closely.

§ 2. We assume that the spring behaves like a uniform thin elastic cord. Let E be its elastic coefficient, $\rho$ its line density, and $l$ its length; M is the mass attached to the free end.

Let $\xi$ be the distance of a particular element of the spring from the fixed end at any time; $x$ the distance when the spring is unstretched;

$\xi_0$ the distance when the spring hangs in equilibrium under its own weight and that of M.

T is the tension of the spring in the neighbourhood of the element.

The element originally of length $\Delta x$ is stretched to $\Delta\xi$ under tension T.

$$\therefore \frac{\Delta\xi-\Delta x}{\Delta x}=\frac{T}{E} \text{ or } \frac{d\xi}{dx}=1+\frac{T}{E}$$

The equation of motion of the element is

$$\rho \cdot \Delta x \cdot \ddot{\xi}=\rho g \cdot \Delta x+\left(T+\frac{\partial T}{\partial x} \cdot \Delta x\right)-T$$

$$i.e. \quad \rho\ddot{\xi}=\rho g+\frac{\partial T}{\partial x}=\rho g+E\frac{\partial^2 \xi}{\partial x^2}$$

Since $\xi_0$ marks an equilibrium position

$$0=\rho g+E\frac{\partial^2\xi_0}{\partial x^2}$$

$\therefore$ if $z$ be the displacement of the element from its equilibrium position $z=\xi-\xi_0$, and we have

$$\rho\ddot{z}=E\frac{\partial^2 z}{\partial x^2}$$

Try a solution of the type $z=X \begin{smallmatrix}\cos\\ \sin\end{smallmatrix} pt$ where X is a function of $x$ only.

$$\therefore \quad -\rho p^2X=E\frac{X}{\partial x^2} \quad \therefore\ X=A \cos xp\sqrt{\frac{\rho}{E}}+B \sin xp\sqrt{\frac{\rho}{E}}$$

The condition $z=0$ when $x=0$ for all time cuts out the cosine terms in $x$.

If the system is started from rest (as happens in the ordinary experiment), $\dot{z}=0$ when $t=0$ for all values of $x$; this cuts out the cosine term in $t$.

We are left with

$$A \sin pt \sin px \sqrt{\frac{\rho}{E}}$$

The value of $p$ is now got by considering the conditions at the free end.

The element $\Delta x$ is stretched to length $\Delta\xi_0$ under the tension $\rho g(l-x)+Mg$.

$$\therefore \quad \frac{\Delta\xi_0-\Delta x}{\Delta x}=\frac{\rho g(l-x)+Mg}{E}$$

$$\therefore \quad \xi_0=x+\frac{g\rho lx}{E}-\frac{1}{2}\cdot\frac{g\rho x^2}{E}+\frac{Mgx}{E}$$

Then

$$T=E\left(\frac{\partial\xi}{\partial x}-1\right)=E\left(\frac{\partial z}{\partial x}+\frac{\partial\xi_0}{\partial x}-1\right)$$

$$=E\left(\frac{\partial z}{\partial x}+1+\frac{g\rho l}{E}-\frac{g\rho x}{E}+\frac{Mg-1}{E}\right)$$

$\therefore$ the end value of T is

$$E\left(\frac{\partial z}{\partial x}\right) + Mg$$

The acceleration of M is

$$-Ap^2 \sin pt \,.\, \sin pl \sqrt{\frac{\rho}{E}}$$

$$\therefore \quad -MAp^2 \sin pt \,.\, \sin pl \sqrt{\frac{\rho}{E}} = Mg - T_e = -E \,.\, \left(\frac{\partial z}{\partial x}\right)_l$$

$$= -EAp \sqrt{\frac{\rho}{E}} \cdot \sin pt \,.\, \cos pl \sqrt{\frac{\rho}{E}}$$

$$i.e. \quad Mp \tan pl \sqrt{\frac{\rho}{E}} = \sqrt{\rho E}$$

Let $m$ be the whole mass of the spring, and K the force necessary to produce unit extension of it, then

$$\rho = \frac{m}{l} \text{ and } E = Kl$$

$$\therefore \quad Mp \tan pl \sqrt{\frac{m}{K}} = \sqrt{mK}$$

To deal with this equation write $p = \theta\sqrt{\frac{K}{m}}$ ; the equation becomes

$$\frac{M}{m} = \frac{\cot\theta}{\theta}$$

Let $m'$ be the equivalent mass of $m$ for the oscillation; $m'$ is defined by

$$\text{period} = 2\pi\sqrt{\frac{M+m'}{K}} = \frac{2\pi}{p}$$

$$\therefore \quad M + m' = \frac{K}{p^2} = \frac{m}{\theta^2}$$

$$\therefore \quad m' = \frac{m}{\theta^2} - M = m\left[\frac{1}{\theta^2} - \frac{\cot\theta}{\theta}\right]$$

§ 3. For particular values of M and $m$ the equation for $\theta$ can be solved to any stated degree of accuracy and the corresponding value of $m'$ found.

The two extreme cases may be noted:

($a$) M small—

Approximately $\theta = \frac{\pi}{2}$ $\therefore$ $m' = m \,.\, \frac{4}{\pi^2}$

This is very nearly $\frac{2}{5}\,m$.

($b$) M great—

Here $\theta = 0$ $\quad m' = m\left[\frac{1}{\theta^2} - \frac{1-\frac{\theta^2}{2}}{\theta\left(\theta - \frac{\theta^3}{6}\right)}\right] = \frac{m}{3}$

This is the result generally used.

It is interesting to observe that the addition of a mass M to the end of the spring does not increase the equivalent mass of the apparatus by M. To show this we obtain a further approximation to the equivalent mass when $\frac{M}{m}$ is small—equal to $e$, say.

$$e=\frac{\cot\theta}{\theta} \text{ gives } \theta=\frac{\pi}{2}-\lambda \text{ where } \lambda \text{ is small.}$$

$$i.e. \quad e=\frac{\tan\lambda}{\frac{\pi}{2}-\lambda}=\frac{\lambda}{\frac{\pi}{2}} \text{ approx. whence } \lambda=\frac{\pi e}{2} \text{ and } \theta=\frac{\pi}{2}-\frac{\pi e}{2}$$

$$\therefore \quad m'=m\left[\frac{1}{\frac{\pi^2}{4}(1-e)^2}-\frac{\tan\frac{\pi e}{2}}{\frac{\pi}{2}}\right]=m\left[\frac{4}{\pi^2}-e\left(1-\frac{8}{\pi^2}\right)\right]$$

$$=\frac{4m}{\pi^2}-\frac{M}{5} \text{ roughly.}$$

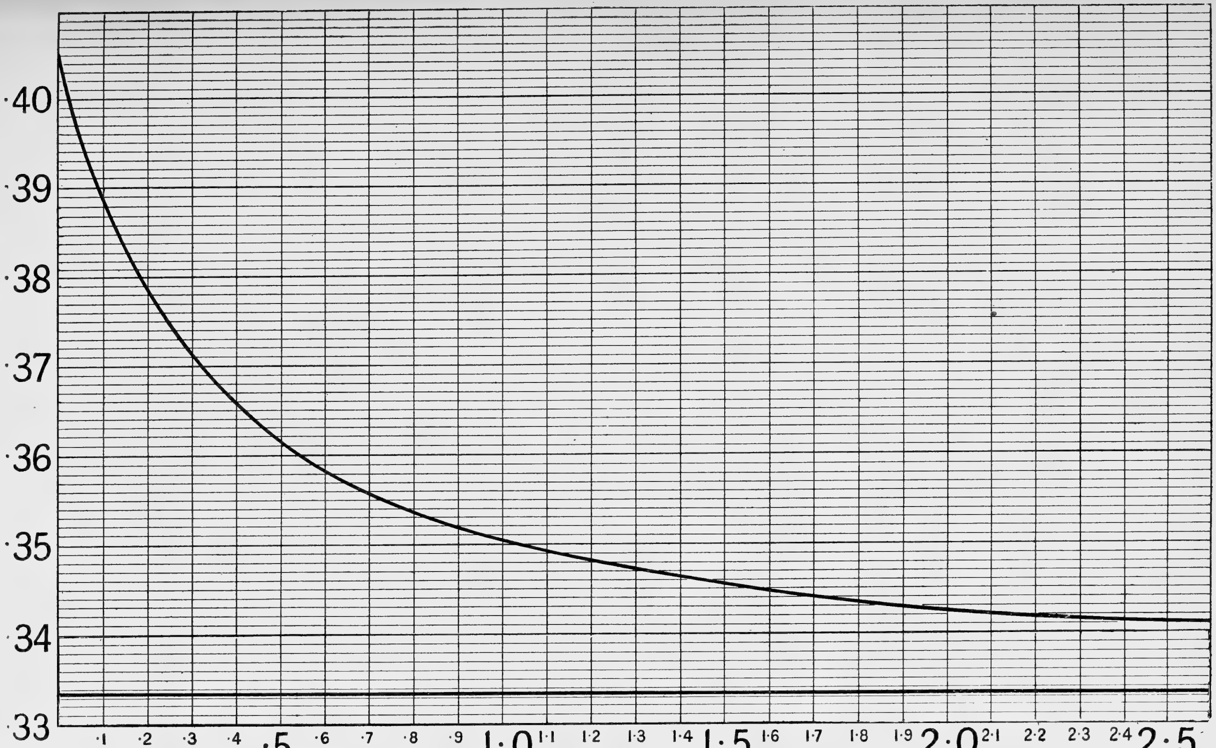
Thus for small additions the equivalent mass of the spring diminishes by about one-fifth of the mass added.

§ 4. To show how $m'$ varies between its extreme values a graph has been drawn with $\frac{M}{m}$ as abscissa and $\frac{m'}{m}$ as ordinate; the method of construction of the graph was to tabulate values of $\frac{\cot\theta}{\theta}$ and of $\frac{1}{\theta^2}-\frac{\cot\theta}{\theta}$ for values of $\theta$ from 0° to 90° at intervals of 5°. The line showing the value $\frac{m'}{m}=\frac{1}{3}$ has also been drawn in the same figure to show the deviation of the approximate result for M large from the true result as M varies.

For reference the tabulated values are given here.

| $\theta$ | $\frac{\cot\theta}{\theta}$ | $\frac{1}{\theta^2}-\frac{\cot\theta}{\theta}$ | $\theta$ | $\frac{\cot\theta}{\theta}$ | $\frac{1}{\theta^2}-\frac{\cot\theta}{\theta}$ |
|---|---|---|---|---|---|
| 0° | ∞ | ·3333 | 50° | ·9616 | ·3515 |
| 5 | 130·9788 | ·3335 | 55 | ·7295 | ·3555 |
| 10 | 32·4940 | ·3340 | 60 | ·5516 | ·3604 |
| 15 | 14·2553 | ·3349 | 65 | 4111 | ·3659 |
| 20 | 7·8710 | ·3363 | 70 | ·2980 | ·3722 |
| 25 | 4·9149 | ·3375 | 75 | ·2047 | ·3793 |
| 30 | 3·308 | ·3396 | 80 | ·1263 | ·3866 |
| 35 | 2·3378 | ·3418 | 85 | ·0590 | ·3954 |
| 40 | 1·7071 | ·3448 | 90 | 0 | ·4054 |
| 45 | 1·2732 | ·3479 | | | |

§ 5. To test the theory experiments were carried out on a spiral spring of mass 164 grammes, length 38 cms., and diameter 4 cms., made of steel wire of circular section 1·35 mm. diameter. The statical value of K (force necessary to produce unit extension) was found to be 16·96 grammes'




The curve shows the variation of the equivalent mass of the spring as the added mass changes (see §4). Abscissae are ratios of added mass (M) to actual mass of spring ($m$). Ordinates are ratios of equivalent mass of spring ($m'$) to actual mass of spring.

weight for a range of weights from 50 to 400 grammes. The period of oscillation of the spring with various weights attached was determined, and the equivalent mass of spring and added weight calculated from the formula

$$t = 2\pi \sqrt{\frac{M'}{K}}$$

Subtraction of the added weight from M′ now gives the equivalent mass of the spring alone.

The last column gives the equivalent mass of the spring as derived from the above theory.

TABLE OF RESULTS.

$m$=164 grammes. K= 16·96 × 979·7 dynes.

| M. | T. | M′. | $m'$ (obs.). | $m'$ (theor.). |
|---|---|---|---|---|
| 0 | ·3991 | 67·1 | 67·1 | 65·5 |
| 10 | ·4223 | 75·1 | 65·1 | 64·8 |
| 20 | ·4469 | 84·1 | 64·1 | 63·5 |
| 50 | ·5139 | 111·2 | 61·2 | 61·0 |
| 100 | ·6138 | 158·6 | 58·6 | 58·8 |
| 200·1 | ·7817 | 257·3 | 57·3 | 57·1 |
| 250·3 | ·8537 | 306·8 | 56·5 | 56·7 |
| 400·1 | 1·0390 | 454·2 | 54·1 | 55·7 |

What difference there is between the observed and the theoretical value may be put down to the change in the value of K for different loads; the value increases with the load, but more elaborate experiments will be necessary in order to assign definite values of K for different loads.

The experiments show that (1) the assumption of uniformity of the spring introduces no error, (2) the rough approximation usually given for the equivalent mass is inadequate, (3) no difference appears between the static and the dynamic value of K.

# ON THE "LINES" WITHIN RÖNTGEN INTERFERENCE PHOTOGRAMS.

By J. Steph. van der Lingen.

(Read May 19, 1915.)

(Plates XXXVII, XXXVIII.)

The object of this communication is to show that "lines" or "ghosts" which appear within the reflected spectra of Röntgen rays may be due to ruptured lattices of crystals.

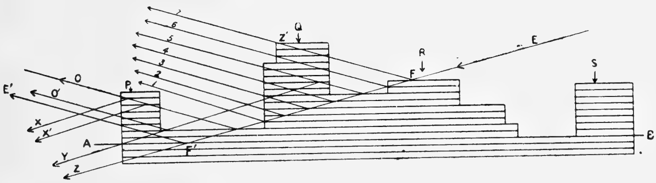


Fig. 1.

It seems probable that some pieces of crystal are chipped out, and some partially rotated, during the process of cutting.

In Fig. 1 AB represents the first *ideal* plane surface of the cut crystal; P, Q, R, and S projecting columns which were left when the neighbouring pieces were chipped out.

Consider the ray EF.

Under ideal circumstances it would have given the first reflection at F′ in the plane AB, but under the assumed condition of the crystal it gives nine reflected rays before it reaches F′. A ray parallel to FE and incident at Z′ will give a reflected ray, whereas it would not have given any reflection if Q were removed. On account of these projecting columns the ideal F′E′ is weakened.

If Q is rotated slightly towards R, then the rays O, O′ will diverge, and Y will approach the rays X and X′. The opposite holds true if Q is rotated towards P.

Q thus causes a distribution of the intensity of the reflected rays as well as of the transmitted rays.

In order to obtain such a surface a biprism was cut out of a crystal of NaCl.

The top-, bottom-, and back-surfaces are planes of natural cleavage, and the angle 179 degrees (Fig. 2*a*).

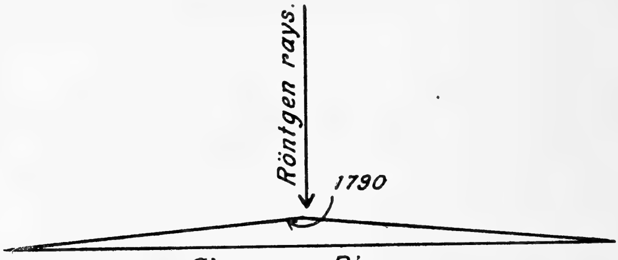



Fig. 2*a*.

A second prism, equilateral triangular, was also obtained from Göttingen.

It seems probable that these prisms will represent the required—even if irregular—ultramicroscopic echelon gratings (Fig. 2*b*).

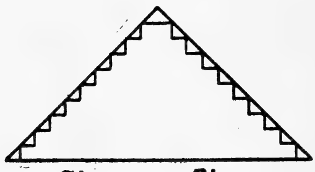



Fig. 2*b*.

## Experiments with NaCl Prisms.

The prism (*a*) was set optically so that the Röntgen rays passed normally through the back-surface.

A pair of films were placed 15 cm. behind the prism, so that the "spots" may be fairly large.

The photogram (Fig. 3*a*) shows that there are positions of zero intensity within the spots as well as of definite points of maximum intensity.

The central spot, which is circular in the case of crystalline plates, is now elliptic.

This indicates that the *small increased* thickness of the central part plays a prominent part in the shape of the spots.

On rotating the prism through a small angle and then obtaining a photogram the effect is enlarged, because those points which move away from the central spot become drawn-out elliptical spots.

These spots show the (probable) effect of the irregular echelon grating clearly (Fig. 3*b*).

Similar results were obtained with the second prism (Fig. 4).

### Quartz Plates.

An experiment on a plate of quartz cut perpendicular to the optic axis showed a series of parallel lines in all the spots (Fig. 5).

### $Mg(OH)_2$.

A plate of $Mg(OH)_2$ was examined microscopically, and it showed small leaflets of partially removed planes adhering to the surface.

This substance, which does not cleave so cleanly as mica, showed irregular interference spots.

The border of the spots are chiefly influenced.

The "spots" are as irregular as those of silicon (Fig. 6).

### Silicon.

The photogram of silicon seems to indicate that this substance is built up of microcrystalline units, the whole forming the crystal of silicon.

The radial line indicates the presence of a two-dimensional grating as well as the usual three-dimensional grating.

The spots are not as large as expected, nor are they circular.

The spots B are almost lines; D and F spots seem to come from the same planes, whereas E seems to be D and a reflected image of D; C seems to be B projected at a different angle.

Unlike the diamond, D′ is almost invisible, whereas D is a maximum point.

This "regular" microcrystalline structure may account for its inability to produce spots at an obtuse angle.*

* M. v. Lane and the Author, "Die Naturwissenschaften," 13, 328, 1914.

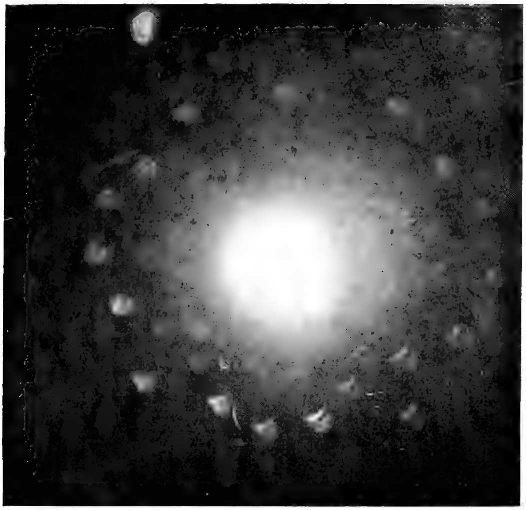


Fig. 3a.

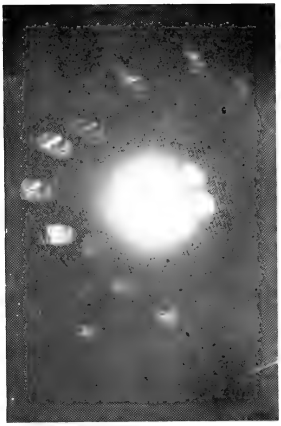


Fig. 3b.

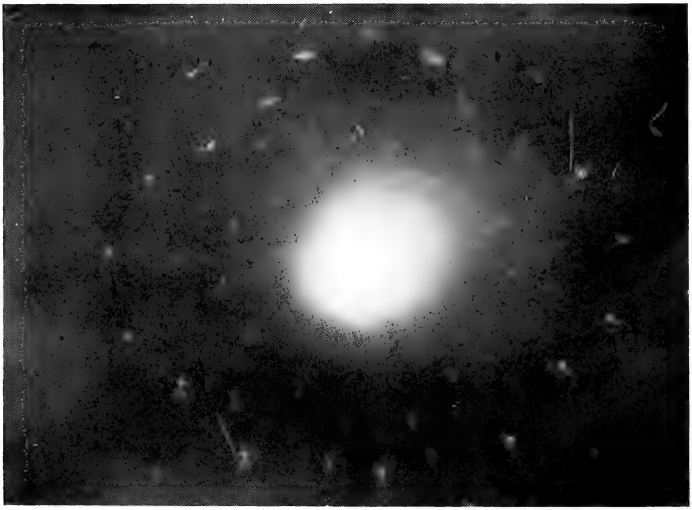


Fig. 4.

Adlard & West Newman.

Fig. 5.

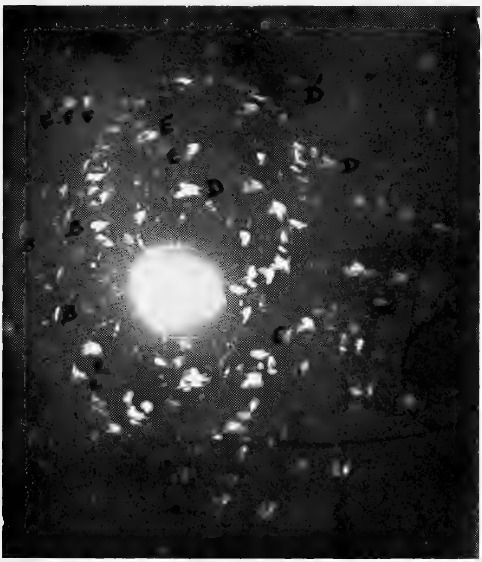


Fig. 6.

*Adlard & West Newman.*

# OSTEOLOGY OF PALAEORNIS, WITH OTHER NOTES ON THE GENUS.

By R. W. Shufeldt.

(Communicated by L. Péringuey.)

(Read June 16, 1915.)

(Plates XXXIX–XLI.)

One of the most abundant parrots of India is *Palaeornis torquatus*, or the Ring-parrot, so named for the reason that in the adult a ring or collar forms a part of the plumage of the neck. It is a species long known to many in the Indian Empire, where it is represented as the vahana or "vehicle" of Kama, one of the gods of the Hindus. Kama corresponds to our Cupid, or rather the classic Eros, symbolising Love. These birds—for there are several species of them—were supposed to be known to the Greeks and Romans; but they were not considered as a sub-family of parrots until so founded by Vigors in 1825, who named the *Palaeornithinae* to contain them.

Linnaeus described one species, naming it *Palaeornis alexandri*, believing it to be the bird that was referred to by Onesicritus, one of the historians of Alexander the Great.

They are generally gregarious in habit, and *Palaeornis torquatus*, the species mentioned above, is often found in flocks numbering several thousands.

There are about twenty-five species of these parrots, and they occur principally in the Orient, though others inhabit Africa. They are noisy birds, with harsh notes given with great vehemence. Many like them as pets, and occasionally one may be taught to say a few words, while as a rule they are gentle and tractable. *Palaeornis exul*, A. Newton, is supposed to be extinct; it formerly inhabited the Island of Rodriguez. The African species is *Palaeornis docilis*, and it is found in Sudan, Equatorial Africa, and in Abyssinia.

Garrod, the British ornithotomist, examined a number of species of the *Palaeornithidae*, and found that in them the *ambiens muscle* was absent, and that there were two carotids, except in the genus *Cacatua*.

Garrod worked out the main stem of the *Psittaci*, and stated that "Each of the two secondary branches persists as the *Palaeornithinae* and the

*Pyrrhurinae* respectively, they both branching dichotomously in an exactly similar manner, the former giving rise to the *Stringopinae* and the specially modified *Cacatua cristata* and *C. sulphurea*, the other to the similarly modified *Platycercinae* and *Chrysotinae*." * In another place Garrod stated that "the presence of a gall-bladder in the *Cacatuinae* will have to be included among the characteristic peculiarities of this sub-family. At the same time its persistence in them is in favour of the view that the *Palaeornithinae*, as restricted by me, are but little different from the ancestral parrots, and the *Cacatuinae* still less so. The primitive parrots must have possessed a gall-bladder, because we know that this organ is present in the *Cacatuinae*, and consequently was not absent in the primitive species, as the probability that it should have been independently developed a second time is infinitely little." †

Late in the autumn of 1914 Mr. Edward S. Schmid, of Washington, D.C., presented me with a specimen of a parrot that had died in captivity, the history of which was not known to him. Before removing the skin of this bird, I made, by the aid of my camera and tints, the figure here reproduced in Plate XXXIX, which is exactly half natural size. No notes were made upon the soft parts, while upon the other hand I obtained a perfect skeleton for description.

Not being sure of the species, I took the skin to Mr. J. H. Riley, of the Division of Birds of the U.S. National Museum, for examination, and from him I received, in a day or so, the following letter, for which he has my sincere thanks. It is dated at the Smithsonian Institution, November 5, 1914, and the essential part of it reads as follows: "The parrot left by you to be identified is either *Palaeornis torquata* or *Palaeornis docilis*. These two species are practically identical in plumage, and only differ in size, *P. docilis* being slightly smaller. As the skin left by you lacks the bill and the wing bones have been taken out, it is hard to tell with any certainty to which species to assign it, but am inclined to place it with *P. docilis*. *P. torquata* is Indian and Malayan, while *P. docilis* is typical African in distribution." ‡ I may say that the superior mandible in the specimen was

* Garrod, A. H.: "On Some Points in the Anatomy of the Parrots which bear on the Classification of the Suborder." P.Z.S., 1874, pp. 586–598, Plates LXX and LXXI. The part quoted occurs on p. 595.

† Garrod, A. H.: "Note on the Absence or Presence of a Gall-Bladder in the Family of the Parrots." P.Z.S., 1877, p. 793.

‡ Newton, in the article "Parrot" in the Ninth Edition of the "Encyclopaedia Britannica" (vol. xviii, p. 322), says, in a footnote, that "It is right to state, however, that the African examples of this bird are said to be distinguishable from the Asiatic by their somewhat shorter wings and weaker bill, and hence they are considered by some authorities to form a distinct species or subspecies, *P. docilis*; but in thus regarding them the difference of locality seems to have influenced opinion, and without that difference they would scarcely have been separated, for in many other groups of birds distinctions so slight are regarded as barely evidence of local races."

of a brilliant vermilion red, with the apex tipped with black; the lower mandible was entirely black. Irides very pale straw yellow; feet pale flesh colour. The character and colour of the plumage is well shown in the plates.

## THE SKELETON.

(Plates XL and XLI, figs. 1–8.)

*Introduction.*—Up to the present time the osteology of the Parrots or *Psittaci* has, as compared with that of other birds, been touched upon but very lightly. Neither Garrod nor Forbes gave the subject any very serious attention. The first-named ornithotomist, as we know, devoted himself principally to certain peculiarities of the muscles and arterial system in those birds, as he did in the case of other representatives of the class *Aves*. He gave some attention, however, to the *furcula* as well as to the oil-gland. That this was the case was much deplored by the late Alfred Newton, F.R.S., who said in regard to it, in his article "Parrot" in the Ninth Edition of the *Encyclopaedia Britannica*, when referring to what little Garrod had done even with the *furcula*: "But except as regards the last character he unfortunately almost wholly neglected the rest of the skeleton, looking upon such osteological features as the formation of an orbital ring and peculiarities of the atlas as 'of minor importance,' an estimate to which nearly every anatomist will demur; for, though undoubtedly the characters afforded by blood-vessels and muscles are useful in default of osteological characters, it is obvious that these last, drawn from the very framework of any vertebrate's structure, cannot be inferior in value to the former." *

Huxley, in his time-honoured and admirable paper "On the Classification of Birds" (*P.Z.S.*, 1867, pp. 465, 466), gives some of the salient characters on the skeleton of the *Psittacomorphae*, which are very useful for the purposes of classification, but not sufficiently extensive for all other purposes. They are excellent for group definition, while not exact enough for taxo-

* "Indeed," continues Professor Newton in the same place, "the investigations of Professor A. Milne-Edwards (Ann. Sc. Nat. Geologie, ser. 5, vi, pp. 91–111; viii, pp. 145–156) on the bones of the head in various Psittacine forms make it clear that these alone present features of much significance, and if his investigations had not been carried on for a special object, but had been extended to other parts of the skeleton, there is little doubt that they would have removed some of the greatest difficulties. The one osteological character to which Garrod trusted—namely, the condition of the furcula—cannot be said to contribute much towards a safe basis of classification. That it is wholly absent in some genera of parrots had long been known, but its imperfect ossification, it appears, is not attended in some cases by any diminution of volant powers, which tends to show that it is an unimportant character, an inference confirmed by the fact that it is found wanting in genera placed geographically so far apart that the loss must have had in some of them an independent origin" (*loc. cit.*, p. 323).

nomical use in the case of families and genera. Moreover, when Professor Huxley says that "the lachrymal and the post-orbital bend towards one another, and frequently unite below the orbit" (p. 465), he makes a statement, as will be shown further on in the present paper, that does not hold true for all parrots.

Many years ago, I published an account of the skeleton of our now nearly extinct Carolina parrot, and later, a somewhat more extensive contribution on the osteology of a number of species of the family, with an account of the skeleton of the famous Owl Parrot included in the same article.* Shortly after these appeared, the late Professor St. George Mivart kindly sent me reprints of some of his own work on the osteology of this group, and these papers are now at hand.†

Then we have for consultation the classical works on the osteology of these birds by E. Blanchard, Sir Richard Owen, Max Fürbringer, and a few others.

*The Skull.*—As in all of the *Psittaci* thus far examined by me, the skull, when viewed from above (Plate XL, fig. 2), is smooth and hemiglobular with respect to the vault or cranial region, while it is markedly very broad and flat between the sharp superior margins of the orbits. Between this area and the base of the broadly rounded and much decurved superior mandible, there is found the long, transverse "cranio-facial hinge," here represented by a fine, slit-like groove, perpendicular to the long axis of the cranium. Beyond this line a short distance are the rather large, subcircular *narial apertures*, either one facing forwards, upwards and outwards. Their margins are sharp, and projecting from within one of these openings there is a free little process of bone. This is also seen to be present in *Ara chloroptera* and other *Psittaci*, and in adult birds it is somewhat difficult to say from which bone of the face it is developed. In *Palaeornis*, however, it would appear to be a *free*, shell-like ossification, held in place by the surrounding membrane in the upper region of the rhinal chamber. In no parrot is it connected with the anterior part of the mesethmoid, while in the big macaws it seems to fuse almost indistinguishably in the adult with

* Shufeldt, R. W.: "Osteology of the *Conurus carolinensis*." Journ. of Anat. and Phys., London, April, 1886, vol. xx, Plates X and XI, pp. 407–425. "Osteology of the *Psittaci*." Annals of the Carnegie Museum, Pittsburg, Pa., 1902, vol. i, Plates XXI-XXIV, pp. 399-421.

† Mivart, St. George, F.R.S.: "On the Hyoid Bone of Certain Parrots." P.Z.S. Lond., March 5, 1895, pp. 162-174, figs. 1-6. This is an excellent paper with instructive illustrations. In it Professor Mivart said: "That the Parrots should have a tongue-bone of exceptional form is, of course, only what was to be expected from the exceptional form of their tongue as a whole" (p. 163). "The Skeleton of *Lorius flavopalliatus* compared with that of *Psittacus erithacus*" (Part I). P.Z.S., Lond., April 2, 1895, pp. 312-337, figs. 1-22. "On the Hyoid Bones of *Nestor meridionalis* and *Nanodes discolor*." P.Z.S., Lond., February 4, 1896, pp. 236-340, figs. 1 and 2.

the mesial aspect of the nasal and the maxillo-palatine of the same side. This is a large, fused, osseous mass in the skull of a macaw, while in *Palaeornis* these ossifications appear to be quite free and scroll-like. They appear to take the place of *turbinals,* and apparently have a similar function of increasing the osseous surface for the nasal mucous membrane.

The sharp apex of the superior mandible, as in all parrots I believe, points directly downward, and is trihedral in form. In the macaws (*Ara*) the external narial apertures are extremely small for the size of the skull, they not having the diameter of those openings as seen in the skull of a specimen of *Amazona leucocephala* in my collection, the skull of which latter is not one-third the size of that of the former species. Then, too, in the macaws they are far apart as in *Ara severa,* a skeleton of which I have in my own collection, as well as in other species of that genus.

At the base of the cranium the *foramen magnum* is seen to be circular in outline as it is in most parrots. In *Ara* it may occasionally approach the cordate form, but in a specimen in my collection it is quite circular. The temporal wings of the exoccipitals in *Palaeornis* are only fairly well developed, not as much so as in *Amazona,* and very much less than in *Ara chloroptera,* where they are very conspicuous, thin, projecting plates of bone standing out far behind the cranial base. They are not quite so prominent in some of the smaller species of macaws. These latter birds also have the presphenoid strongly compressed transversely, with its lower border sharp and thin. It is also sharp in *Palaeornis,* but it at once becomes broader above; and in all *Psittaci* thus far examined by me, the *interorbital septum* is thick and never perforated by a central or other vacuity.

Either *pterygoid* is a long, straight, delicate bar, and, as in other parrots, these bones meet each other anteriorly, while the articulation with either quadrate is on a small, subcircular facet, situated at the infero-distal end of the single, convex, transversely flattened facet for the mandible. I may say here that the *orbital* process of a quadrate is, as usual in these birds, a pointed and much aborted spine.

As usual, the *palatines* are broad, plate-like bones, with their extensive mesial surfaces nearly parallel to each other. Their form has been previously described by me in my above-cited papers for *Conurus* and other species, and they agree in this African species in their main characters. It is to be noted, however, in *Palaeornis* that anteriorly the *mesethmoid* projects much further beyond the interpalatine articulation than it does in *Ara* and other species.

With respect to the morphology and arrangement of the *ethmoid, maxillo-palatines,* and other bones forming the walls and enclosures of the rhinal chamber, *Palaeornis docilis* agrees essentially with other *Psittaci,* apart from a few generic departures that pertain especially to it as a species. It lacks the peculiar, wing-like extensions of the maxillo-palatines seen in the big macaws, as well as the plate-like median partition found in those and other representatives of the group, which partition fulfils in part the place of a true nasal septum. Possibly this septum may partially be derived from either nasal, and this is a point I cannot settle with exactitude without seeing the skull of an immature specimen.

All parrots have the osseous roof of the mouth entire, with its posterior boundary a sharp, transverse margin or edge. This area is invariably concaved, the outer borders (*tomia*) being sharp. In *Palaeornis* this edge, on either side, presents a distinct notch, as shown in Plate XL, fig. 1. This notch is also found in this locality in the skulls of the birds in the genus *Amazona* and many others; but it is usually absent in macaws—indeed, entirely so in *Ara chloroptera*. On the other hand, in *Cacatua* the posterior two-thirds of the osseous tomial margin of the superior mandible is horizontal (parallel to the plane of the superficies of the frontal region of the skull), while the anterior third is perpendicular to this, the two edges forming a right angle between them.

Turning to the lateral view, we are to note that *Palaeornis* forms no exception to the general rule for the *Psittaci* in possessing a nearly straight, long, and rather stout *quadrato-jugal bar*. Posteriorly, it articulates in a little pit on a special elevation *on the side* of the curiously formed quadrate in these birds, while anteriorly, it abruptly merges into the infero-posterior angle of the upper osseous mandible, in the locality of the maxillo-palatine mass. Immediately before doing this, this rod exhibits a very slight disposition to enlarge somewhat, evidenced in a compression from above downwards.

Interest, however, centres on this lateral view of the skull of *Palaeornis*, as in the case of other *Psittaci*, in the form of the orbit, and the arrangement of the bones constituting its limiting periphery. Parrots, almost without exception, have the boundary of an orbit wonderfully circular in outline, while its margins are, for the most part, thin and sharp.

As is usually the rule throughout the group, the orbit is entirely surrounded by bone. This is effected in *Palaeornis docilis* by the slender, narrow, and transversely compressed, infero-posteriorly extending process of the lacrymal bone uniformly curving backwards to touch, but not to fuse with, the anterior apex of the squamosal process on the lateral aspect of the cranium (Plate XL, fig. 1). This is interesting from the fact that this lower boundary of the orbit in this species of parrot is formed almost entirely by the backward extension of the lacrymal bone; that it is the *squamosal* process and not the post-frontal that it seeks in order to complete the ring; and that that process is in no way especially elongated to meet it.

In the skull of the different species of *Ara*, in so far as I have examined them, the bounding orbital ring is very complete, its lower half being of uniform width, with sharp edges above and below, while posteriorly it completely fuses with the *post-frontal process*, and in such a manner, in a skull of *Ara chloroptera* at hand, that no line of sutural union is visible, while the anterior portion of the process has conformed itself entirely to the *form* of the encircling bone. I am inclined to believe, however, that, as in *Palaeornis*, the *lacrymal bone* here, too, extended backward to meet the post-frontal apophysis, rather than the latter extended forward to meet the lacrymal. Now, in *Amazona leucocephala* the lacrymal bone again completes the circlet, meeting and fusing with the anterior end of the *post-frontal process;* but as it passes the apex of the squamosal process below, it develops a slight elevation on its lower edge, which is directed toward the apex of the squamosal process as though it were making an effort to reach it.

In the cockatoos (*Cacatua leadbeateri*) this union is not only accomplished, but it is so extensive that a bony plate is formed in this locality, stretching between and fusing with the *two* lateral processes of the side of the cranium—that is, the post-frontal and squamosal apophyses—to such an extent that a large foramen exists between them, into which leads the *crotaphyte fossa* of the same side of the skull. As the *crotaphyte fossa* harbours the temporal muscle, the tendon of which is inserted into the mandible,* this plate forms a very effective osseous protection to that muscle, for which there seems to be no sufficient reason apparent.

Thus we see that the encirclature of the orbit in parrots differs considerably in the different genera; but this in no way explains why these birds should require that their orbits be entirely surrounded by bone and as extensively so as in the big macaws. That there is some reason for it there can be no doubt, or else the lacrymal bone would not take upon itself such a supreme effort to form that osseous surrounding ring through reaching to the apex of one of the lateral processes of the cranium in one series of forms, and to the apex of the other process in all other parrots, apart from *Palaeornis*, in so far as I know, including the Owl Parrot (*Stringops*).

The *mandible* of *Palaeornis docilis* (Plate XL, figs. 4 and 5) has the usual broad U-shaped form found in the case of this bone among parrots generally, and, as is always the case, it is highly pneumatic. Beyond the articular extremities its upper, free margin is thin and sharp all the way round. Relatively speaking, its symphysis is not as deep as it is in the macaws (*Ara*) or in many other parrots. Viewed directly from the front, its free dentary margin forms in outline another U, the open part being above. The lower ramal border is slightly thickened, while the articular ends are truncated above in the downward direction from before backwards. Here each shows the peculiar, shallow, antero-posterior facet for articulation with the *quadrate* of either side. On the upper aspect, posterior to either one of these, is a large, *pneumatic foramen*, and occasionally a smaller opening of the kind exists in front of it. In *Ara chloroptera* the mesial

* Shufeldt, R. W.: "Myology of the Raven," London, 1901, p. 28, fig. 7, and other figures.

aspect of either ramus of the mandible is pierced in numerous places by these air-holes, and there may occur other small ones on the outer surface.

The *sclerotal platelets* of an eyeball are comparatively rather small, and they differ from each other but very little in size; otherwise they do not present anything beyond their usual ornithic characters.

Upon comparing the *hyoid arches* with the descriptions and figures of those given in Mivart's paper, cited above, I find that this skeletal portion of the tongue in *Palaeornis* comes nearer to the corresponding parts of those structures in *Nanodes discolor* than to those of any other species there described. Especially is this observable in the short *entoglossum* in these two species; but then there may be other parrots with the osseous parts of the tongue still more like those bones in *Palaeornis;* and doubtless there are, for *Nanodes discolor* may not be particularly near our present subject in other respects, in so far as I am aware, though it may be.

The *glosso-hyal* (*entoglossum*) is notably short in *Palaeornis* in the antero-posterior direction, while it is composed of two separate pieces, as I believe it is in all *Psittaci.* Either one of these is pointed posteriorly, and supports an oblique enlargement distally. They only meet mesially at a minute point in the middle line somewhat posterior to their middles. The *basihyal* is anteriorly elongated, and supports, upon either side, the peculiar forward-projecting, spiculiform processes seen on this element of the skeleton of the hyoid in so many birds of this group. *Urohyal,* which is not very long, is co-ossified with the basihyal.

The *ceratobranchials* are long compared with the other elements (hypobranchials of Mivart), while the *epibranchials* (ceratobranchials of Mivart) are very short and thick, terminating posteriorly in fine, short, hair-like cartilaginous terminations. As taken together, the *thyrohyals* are straightish, not especially elongated, and present scarcely any upward curvature.

I made no careful study of the ossifications of the *larynx,* the *trachea,* or the other parts of the air-passages; but they do not seem to present any very striking differences, in so far as they are concerned, when contrasted with what we find in other ordinary parrots; but when I say this I do not desire to have it understood that it would be a profitless task to study and compare these parts, for it would most assuredly be both important and interesting, and would have been undertaken here had I had the proper material for comparison.

*Of the Axial Skeleton.—Palaeornis docilis* agrees with *Psittacus erithacus* and *Lorius flavopalliatus,* and doubtless with other parrots, in having nineteen free vertebrae between the skull and the pelvis. This number, however, is not found in this cervico-dorsal region of the column in all *Psittaci,* for in *Conurus carolinensis* there are eighteen, and but seventeen in the representatives of the genus *Ara.*

Mivart has so minutely described the several vertebrae in this section of the spine for *Psittacus erithacus* and *Lorius flavopalliatus* that it would be quite superfluous to give a detailed description of these bones here for our present subject. Taking these bones, vertebra by vertebra, the differences are not so very great, though there are, doubtless, specific, as well as perhaps generic, differences to be found in them. In my own published papers on the osteology of the *Psittaci*, cited above, still further descriptions will be found of the vertebrae, as they are found to be in still other forms, as the cockatoos, *Conurus*, and the macaws.

In *Palaeornis* the *atlas* has the articular cup entire, and there is a conspicuous process extending backward from the centrum, On the *axis* the *odontoid process* is extremely minute, while the haemal spine, as is likewise the case in the *third cervical vertebra*, is prominently developed. The "carotid canal" is seen to be open, and is only to be observed on the sixth, seventh, eighth, and ninth cervicals; these, including the tenth cervical, are all without neural spines, while their spine-like pleurapophyses are not very long.

*Thirteenth* and *fourteenth cervical* vertebrae support well-developed ribs of good length, the first being half as long as the second, while neither bear unciform appendages.

The *five dorsal vertebrae* are all separate bones, their neural spines being low, and they interlock with each other at their upper anterior and posterior angles. Only the fifteenth and sixteenth possess haemal spines, while the broad transverse processes on their dorsal aspects develop spine-like metapophyses that reach across from one vertebra to another.

The *ribs*, which are well shown in Plates XL and XLI, are rather delicately formed, and all possess epipleural or unciform appendages, those on the last pair being small. Each pair articulates with a pair of costal ribs reaching to the sternum. This is not the case with the costal ribs or haemapophyses of the first long, thin pair of pelvic ribs, which latter entirely lack epipleural processes. Posterior to this pair of ribs there is another pair, which last are aborted, short, spiculiform affairs, thoroughly anchylosed to the ventral surface of the ilium on either side.

In *Amazona leucocephala* the dorsal ribs are stouter than in *Palaeornis;* the last pair bears no unciform processes, and the long, slender haemapophyses of the only pair of pelvic ribs reach the costal border of the sternum to articulate on the facets there for them.

*Ara chloroptera* has very broad ribs in the dorsal region, and their flat and broad epipleural appendages develop in mid-series a descending process from the postero-inferior angles. In this macaw the first pair of cervical ribs are short, and the elongate second pair have small unciform processes upon them.

Thus it will be observed that important differences exist with respect to the cervical and dorsal ribs in the various genera of parrots, and these should be more carefully and extensively studied by ornithotomists. The few notes I have given here upon them should be compared with descriptions of mine in former papers for other species of the *Psittaci*, and more especially with Mivart's figures and descriptions for *Psittacus erithacus* and *Lorius flavopalliatus.*

When we come to compare the *pelves* of different parrots, we soon observe that there is considerable uniformity in the matter of their morphology, with respect to the various species mentioned in this paper. To this statement *Palaeornis* forms no exception: *Conurus carolinensis* is not far off, and this is probably true for a good many other species of parrots (see Plate XLI, fig. 7.)

Viewed from above, the *pelvis* of *Palaeornis docilis* shows the anterior rounded and emarginated borders of the ilia, and the rather elongate, concaved surfaces of these bones between these borders and the cotyloid cavity upon either side. These bones do not meet in the middle line in this region, while they do meet and form an osseous union with the crest of the sacrum. Posteriorly, the ilio-neural canals are entirely sealed over, and but few foramina are found to exist between the diapophyses of the *uro-sacral vertebrae.* All this formation gives a very smooth and unbroken appearance to the dorsal aspect of the pelvis of this and other parrots, which is quite characteristic of this bone in the case of other members of the group.

On lateral view, it is seen that the *obturator foramen* is, as a vacuity, almost continuous with the *obturator space;* the *ischiadic foramen* is rather large and subelliptical in outline. Another feature of note is the pointedness and elongation of the ischium in the posterior direction, the distal apex of this bone of the pelvis coming in contact with the upper margin of the long, slender pubic element behind. As a " notch," the ilio-ischiadic one is hardly worthy of the name; in other words, scarcely any mark of differentiation on the posterior pelvic border exists at all to define the meeting of the ilium and the ischium. We know this " notch " is very pronounced in the pelves of some birds.

There are *six* free *caudal vertebrae,* the transverse processes of which, all to those of the ultimate one, are rather spreading, and not very markedly bent ventrad. To these is to be added a triangular *pygostyle* of corresponding proportions with a blunt-pointed apex.

*Amazona leucocephala* possesses but *five* free caudal vertebrae, and the pygostyle differs in form entirely from that bone in *Palaeornis,* for it is of a quadrilateral outline in the former bird, with a thickened posterior border, and, moreover, it is pierced from side to side at its antero-inferior angle by a round foramen. In the specimen before me, there is also a deep little pit in the lower part of the posterior margin.

Curiously enough, *Ara severa* has but *four* free caudal vertebrae, and the rather large pygostyle is inclined to be somewhat pointed superiorly. *Ara* *chloroptera*—the Red and Blue Macaw—is entirely at variance with this again, for it has *five* very large caudal vertebrae, and, for a parrot, an unusually large pygostyle, which is drawn out superiorly into a point, while it exhibits the thickened hinder border, the foramen, and the pit found in the pygostyle of *Palaeornis docilis* as described above. In this macaw, too, the last two *uro-sacral vertebrae,* thoroughly anchylosed with the others, are found beyond the iliac bones of the pelvis. In this big parrot also we find the ilio-ischiadic notches on the posterior pelvic borders to be quite prominently defined, which, as I have said, is not usually the case in this bone among the *Psittaci.*

Passing to the bones of the *shoulder-girdle* we are to note that, although the *os furcula* is completely developed, it is nevertheless by no means a strong bone. It has the U pattern in outline and lacks a hypocleidium, while it is greatly compressed throughout its extent. This compression is in the antero-posterior direction below, and transversely for the clavicular limbs above, including the superior heads of the bone, each one of which latter exhibits considerable expansion whereby a thin, flat surface is produced—a surface which, when the *os furcula* is duly articulated, is pressed snugly against the coracoid of the same side, touching the scapula posteriorly, thus ensuring the formation of a completed *foramen triosseum.*

Cockatoos, macaws, and representatives of the genus *Amazona* and numerous others, possess a clavicular arch more or less like what is found in *Palaeornis,* while, in some other parrots, the bone is more or less imperfect below or else very rudimentary, as in *Calyptorhynchus ;* in *Ara chloroptera* the *os furculum* is, while much flattened, strong and complete.

*Palaeornis* possesses a neat pair of *scapulae,* each bone being rather short and small when compared with the size of the bird. One of these scapulae closely resembles in form the blade of a scimitar, being thin, sharply pointed posteriorly, curved, and lacking in any angle on its mesial edge, where it is seen to occur in the scapula of many other species of birds. Its head forms about one-third of the articular surface of the glenoid cavity for the head of the humerus.

The *coracoids,* when articulated as in life, are in contact with each other in the coracoidal grooves of the sternum. In *Ara* the contact is quite extensive. At its sternal extremity the *coracoid* of *Palaeornis* is considerably expanded, and there is developed at its infero-external angle, or rather just above it, the process—here quite conspicuous—which is found in the same locality in representatives of other groups of birds widely removed from the *Psittaci.* The coracoidal shaft is straight, stout, and smooth, while the enlarged upper end of the bone is peculiarly excavated on its mesial aspect just below the summit. In *Ara chloroptera* this excavation is very extensive, forming a striking feature of the bulky head of the coracoid of that bird. At its base occur numerous pneumatic foramina. I may say, in passing, that the *scapula* of this macaw is remarkably short and considerably expanded at its distal extremity, and the upper parts of the clavicular heads are pneumatic, with the foramina in plain view at either posterior apex of the bone. Indeed, in these large parrots all the bones of the pectoral arch or shoulder-girdle are more or less pneumatic, as is nearly all the rest of the skeleton.

Although it does not show as much as I should like, still a fair idea of the form of the *sternum* in *Palaeornis* may be gained from Figs. 6 and 8 on Plates XL and XLI of this paper. It presents all the average characters of this bone in the parrots generally, and I have compared it with that bone as it occurs in quite a number of species and genera. Considerable depth and marked thinness are two of the principal features seen in the carina or keel of the bone, which is so extensive that it not only springs from the entire length of the body of the sternum beneath, but projects anteriorly to a large extent, and it is here that its greatest depth is seen. On either side there is a raised welt descending directly downward from the coracoidal groove to the raised pectoral muscular line, which, as usual, runs forwards and backwards on the side of the keel. The *carinal angle* is broadly rounded off, constituting a striking feature in the sterni of all parrots. A conspicuous *manubrial process* projects almost directly upwards ; it has a flat, triangular surface in front, and is fashioned posteriorly to form a part of the articular area for the coracoids. The groove for the accommodation of these bones is deep and narrow, the articular surface in them being continuous.

As in most *Psittaci*, the *coracoidal processes* are greatly reduced, being mere low, triangular elevations of no great proportions. Back of them, on either side, we find the six transverse facets for the costal ribs. The body of the sternum of this parrot is shortish as compared with its width, and notably more so as compared with the shape of the body of the bone in the macaws (*Ara*). Superiorly, it is deeply concave and correspondingly convex on its ventral aspect. Its xiphoidal or posterior margin is the widest part of the bone, being very slightly convex outwardly ; thin, notwithstanding that it is defined by a perceptible thickened edge on its ventral side, and withal entire—that is, never presenting any "notching" whatever.

On either side of the carina, and well within this posterior border, there is to be found a subcircular foramen of some considerable size. Along the anterior three-fourths of the line of the keel or median line, on the dorsal aspect of the sternum, are to be noted numerous pneumatic foramina, and similar air-sac apertures of no great size pass from the anterior termination of this median row, along the side of the bone, as far back as points opposite the last articulations of the ultimate pair of costal ribs.

All the big macaws (*Ara*) have the xiphoidal foramina comparatively much larger than we find them in *Palaeornis*, and the pneumatic foramina on the dorsal aspect of the bone, while practically found in the same localities, are far more numerous and more abundant. These foramina are almost entirely absent in the sternum of my specimen of *Ara severa*, and on the right-hand side of the same bone the elliptical xiphoidal foramen, although completely closed in posteriorly, the postero-mesial angle of the outer portion is merely in contact with the postero-external angle of the mid-xiphoidal portion. On the left-hand side the hinder margin of the foramen is entire, with a width of a little more than a millimetre.

Sometimes the xiphoidal foramina are entirely closed in, and this is the case in the sternum of a skeleton of *Cacatua leadbeateri* in my collection. On the dorsal aspect of this sternum, anteriorly, there is formed, mesially, a stout bridge of bone, extending backward from the middle point of the anterior border to a point in the middle line some five or six millimetres posterior to it. Beneath this are found pneumatic foramina, and nowhere else in the bone, apparently. A bridge corresponding to this, only rather shorter, is also found in a sternum of *Amazona leucocephala*, with a circular pneumatic foramen on either side of it. This parrot, too, may have either one or both of the large xiphoidal foramina closed in posteriorly in the same manner as I have just described for a case as found in *Ara severa;* while in addition to this I find here, on either side, a small, circular foramen, situated between the big elliptical one and the keel close to the hinder border of the bone. This bone, however, is often subject to decided variation in species belonging to the same genus; and I find in a sternum of a specimen of *Amazona oratrix* in my collection the aforesaid bridge entirely absent, only one pair of small, irregularly outlined xiphoidal foramina present, while on the dorsal aspect there is a line of minute pneumatic foramina occurring down half the middle line anteriorly, with a few scattered ones behind the anterior border, chiefly near the thickened central portion.

Mivart found, in a specimen of *Lorius flavopalliatus*, the sternum having two—one large and one small—xiphoidal foramina on the right side and none on the left. So it goes; and I believe, when such variations as these are present, there is no hard and fast rule for the presence or absence of these vacuities in the sternums of the *Psittaci*, even in the same species.

*The Pectoral Limb.*—Considerable variation is found here with respect to the pneumaticity of the bones of this part of the skeleton. In *Palaeornis docilis* only the *humerus* appears to enjoy this condition, and this is likewise the case in *Amazona oratrix* and *Amazona leucocephala*, in *Ara severa*, and such cockatoos as I have examined, while in *Ara chloroptera* the entire skeleton of this limb appears to be more or less pneumatic.

Returning to *Palaeornis docilis*, it is to be observed that the *humerus* has a straight, comparatively short shaft, which exhibits some transverse flattening. The *radial crest* is conspicuous though short, and bluntly pointed, while it is bent downward and outward towards the palmar aspect of the head of the bone. *Incisura capitis* is deeply sculpt as in most parrots, and this renders the tuberculum internum rather prominent. The excavation or fossa in which the pneumatic foramina are found is circumscribed, the crista inferior being short and projecting.

At the distal end the oblique or radial tubercle is particularly well developed as in other parrots, as is the ulnar trochlea on the other aspect of this end of the shaft of the bone.

In the *antibrachium* or forearm the radius is a wonderfully straight bone, while, on the other hand, the *ulna* is considerably bowed, and shows but very faintly down its shaft the papillae for the insertions of the quill-butts of the secondary feathers of the wing. *Carpus* has the two bones found in the wrist of all birds—namely, the *radiale* and the *ulnare;* they require no special description, though doubtless they exhibit some morphological differences in the various species of the *Psittaci* of the world's avifauna.

*Radius* has a length of 4 cms. and the *carpo-metacarpus* of 2·3 cms., the humerus striking an average with a length of 3·5 cms. The main shaft of the carpo-metacarpus is straight and comparatively stout, while that of medius digit is slender and slightly bowed at its proximal third.

For the rest, the skeleton of manus presents nothing exceptionally peculiar, or what I have not elsewhere invited attention to in my previous writings.

In some parrots (*Amazona*, etc.) and macaws (*Ara*), at the distal end of the carpo-metacarpus, on the palmar side, one of the muscular grooves is bridged across transversely with a small bridge of bone, and a knowledge of the presence of this character may, in some instances, help out in making references of fossil psittacine carpo-metacarpi.

*Ara* has the expanded part of the proximal phalanx of medius digit perforated by two foramina, and the vacuities, as a rule, do not occur in ordinary parrots.

Claws do not appear on any of the digits of manus.

*The Pelvic Limb.*—There are some good distinctive characters in the skeleton of this limb among parrots, and, as a rule, these are present in the majority of the representatives of the group.

With respect to pneumaticity, it seems to be restricted to the *femur* in *Palaeornis docilis*, while in the big macaws (*Ara chloroptera*) the bones of the entire pelvic limb appear to enjoy that condition, all to the pedal phalanges. None of the bones of this limb are pneumatic in *Cacatua leadbeateri*, and this may be true of other cockatoos not examined by me.

Returning to the femur of *Palaeornis docilis*, it is to be noted that its subcylindrical shaft is quite straight, smooth, long, and slender. Proximally, the usual characters there seen are but feebly developed, as I find the *caput femoris* small and sessile, and the trochanter major much reduced at the summit as well as on the anterior aspect. It rises not at all above the smooth summit of the shaft, while there is no evidence of a trochanter minor being present. Distally, the condyles are small, with a very shallow popliteal excavation between them posteriorly, and a not much deeper channel, or rotular channel, as Sir Richard Owen called it, between them on the anterior aspect. As usual, the external condyle is grooved to receive the head of the fibula when the leg bones are duly articulated.

All parrots and macaws possess a *patella* of fair size; and, in so far as I have examined it, I may say that it seems invariably to possess a flat area proximally, with a continuous sharp edge for the sides and below, and an elevated surface posteriorly, the anterior surface being moderately convex. Occasionally we may find exceptions to this; for in *Amazona leucocephala* the patella is very small, and its superior surface exhibits more of a concavity. This species has a femur which, while somewhat larger, nevertheless closely resembles that bone in *Palaeornis.*

In our subject, the *tibio-tarsus* is as straight as its femur, and its shaft is, comparatively speaking, equally slender.

The *cnemial processes* are both greatly reduced, and proximally they may be said to be about on the level with the summit of the shaft.

Distally, the condyles are but moderately developed, and, as in all parrots and macaws, the *outer condyle* is notably smaller than the inner one. At the lower third of the bone in front, the tendinal groove is short and shallow, and as in *Psittaci* generally, it is twice spanned by tendinous bridges to hold the tendons in the aforesaid groove, the upper one being obliquely attached, with its outer extremity the lower. In *Amazona oratrix* the tibio-tarsus is considerably compressed from before backwards, giving it the appearance of some fossil specimens of this bone.

The "fibular ridge" occupies its usual site, the *fibula* itself being a feebly developed bone, and when articulated extends only a short distance below this ridge as a fine, hair-like prolongation. Macaws, in which the fibula is comparatively much stouter, have the bone even shorter than in *Palaeornis,* for it does not extend below the fibular ridge at all. This is likewise the case in *Amazona oratrix,* and in probably other *Psittaci,* while in the entire assemblage it is a short bone, though one sometimes well developed for what there is of it.

Coming to the *tarso-metatarsus* there is first to be noted its extreme shortness when compared with the other bones of the thigh and leg. For example, in *Palaeornis docilis,* where the femur has a length of 3·1 cms., the tibio-tarsus 4·3 cms., the tarso-metatarsus possesses a length of but 1·6 cms. Other *Psittaci* exhibit similar proportions upon measuring these several bones. Its distal extremity in *Palaeornis docilis,* and in other parrots, cockatoos, and macaws is much compressed from before backwards, and much spread out transversely. This is due to the conformation of the trochlear prolongations, which are fashioned to adapt themselves to the zygodactyle arrangement of the toes in this and other *Psittaci*. The *hypotarsus* at the postero-proximal extremity is extremely narrow from above downwards. In macaws this is even more markedly the case, and in these birds it has but one large, central perforation for the passage of tendons, while in *Palaeornis docilis* there are two very distinct small ones.

In *Amazona oratrix* this perforation is also single, as it is likewise in Leadbeater's Cockatoo (*Cacatua leadbeateri*).

*First metatarsal* or "accessory metatarsal" for *hallux digit* in *Palaeornis* small, and, as a matter of fact, is not especially large in the big macaws. As to the *phalanges of pes*, they offer nothing of unusual character beyond what I have already described for the *Psittaci* generally in previous papers of mine, cited above. That these birds all possess zygodactyle feet, through the reversion of the fourth digit, is a fact long known both to systematic ornithologists and to avian anatomists.

## Conclusions.

In so far as the osteology of *Palaeornis* goes, it would seem that it tends to support the views of those taxonomers who claim that the birds of this genus, together with other genera, constitute a subfamily—*Palaeornithinae*. This subfamily Garrod placed in a family *Palaeornithidae*, while R. Bowdler Sharpe relegated the same subfamily to the family *Psittacidae*, which is probably nearer the case than what the first-named classifier seemed to believe to be their position in the system.

This entire group of birds stands much in need of researches upon its morphology, and particularly its osteology; and until this is far more exhaustively done than it has been up to the present time (January, 1915), we shall not be able to appreciate the natural affinities of many of these birds which are now classified upon a few external characters, and, in only a limited number, only too few internal structural ones.

## EXPLANATION OF PLATES.

(All the figures in the three Plates are the work of the author, made direct from the specimens shown.)

---

### PLATE XXXIX.

PALAEORNIS DOCILIS; half natural size.

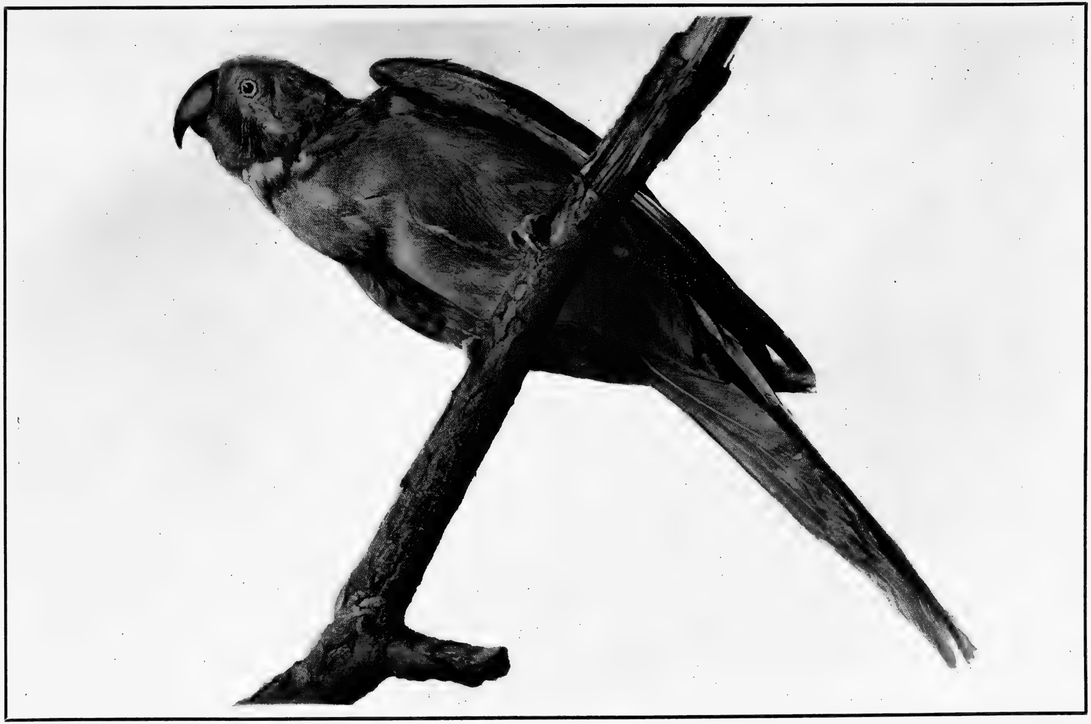
### PLATE XL.

(All the figures in this Plate, as well as those in Plate XLI, are of natural size, and all illustrate the skeleton of the specimen shown in Plate I.)

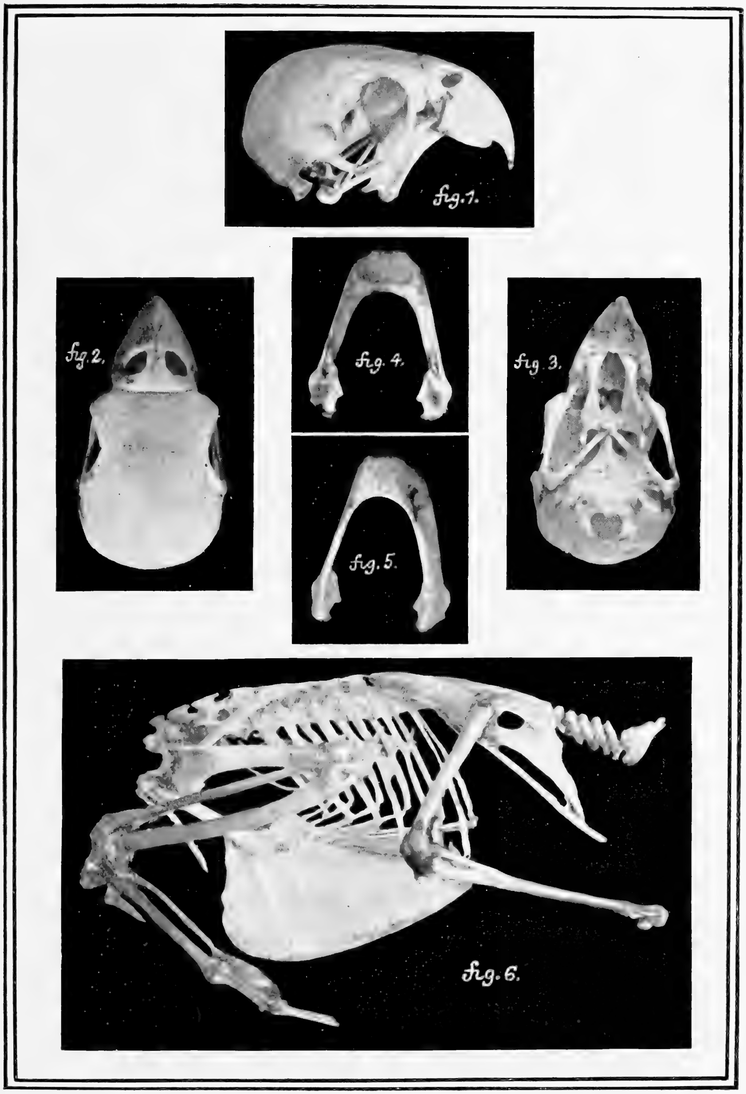
FIG.
1. Right lateral view of the skull; mandible removed.
2. Skull from above; mandible removed.
3. Skull from below; mandible removed.
4. Direct view of mandible from above.
5. Semi-oblique view of the mandible from below.
6. Left lateral view of the trunk skeleton; the left pectoral limb *in situ*; and the skeleton of the left thigh and leg.

### PLATE XLI.

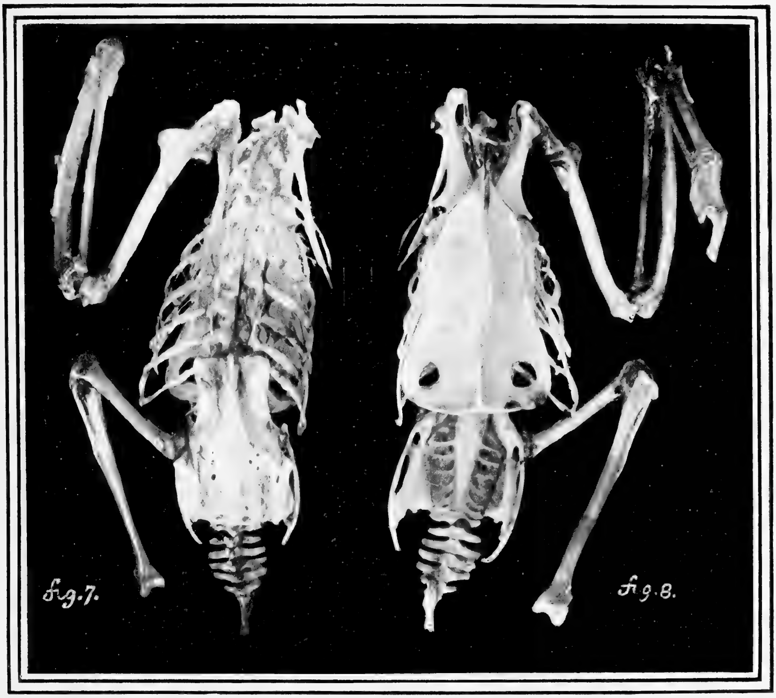
7. Same as in Fig. 6 of Plate XL, seen from above.
8. Same as in Fig. 6 of Plate XL and Fig. 7 of this Plate, seen upon ventral aspect.



Adlard & West Newman.




*Adlard & West Newman.*




*Adlard & West Newman.*

# NOTE ON APPARENT APOGAMY IN *PTERYGODIUM NEWDIGATAE*.

By A. V. Duthie.

(Read June 16, 1915.)

(Plates XLII, XLIII.)

*Pterygodium Newdigatae* is represented by the normal open-flowered species and a cleistogamous variety, which differs greatly from the type in perianth and column. The forms which were regarded by Dr. Bolus as constituting the normal species are represented by three individuals now in the Bolus Herbarium and one in the Government Herbarium, Cape Town. These were collected by Miss Newdigate near Forest Hill, in the Knysna district, in 1894. The cleistogamous form occurs in some abundance, growing among grass and bush in sandy and stony localities in the districts of George, Knysna, Humansdorp, and Albany ; but, so far as I am aware, no further specimens of the open-flowered form have been found of late years in spite of careful search.

Instances of cleistogamy, though rare, are not wanting among Orchids, but the occurrence of strikingly distinct chasmogamous and cleistogamous forms seems unknown in the case of any other Orchid species.

Dr. Bolus, in his monograph on *Orchids of South Africa*, concludes his description of the cleistogamous form as follows : " No open or punctured flower has, as yet, been observed ; no pollen has in any case been found upon the stigma ; yet the ovaries have swollen, producing abundance of seed, and Dr. Schoenland, who examined them, found the seeds to contain a perfect embryo. The question remains, How is the fertilisation effected ? This, with some other points in respect of this remarkable species, must await for its elucidation a supply of fresh material, which Dr. Schoenland, who has kindly assisted me in this matter, hopes to obtain during the ensuing season."

Rolfe, in his account of the species in *Flora Capensis* observes : "The column is very variable in the normal cleistogamic form, three conditions being figured by Bolus. Schlechter makes it a species, under the name of *Pterygodium cleistogamum*, but it is clearly only a peloriate, self-fertilising form of *Pterygodium Newdigatae*."

As much interest attaches to the method of reproduction and mode of fertilisation in this Orchid, I undertook an investigation into these processes.

Although this investigation is still far from complete, it seemed advisable to publish a preliminary account of certain of the facts observed.

Material, of the cleistogamous form only, was collected in the Knysna district on several different occasions. The spikes have usually from three to seven flowers, but single-flowered spikes are infrequently found. The largest specimen examined was nine-flowered. In colour the perianths vary from pale green to yellow flushed with orange. Young specimens are readily confused with buds of *Pterygodium catholicum*, often found growing in the same situations. As the buds swell, the difference between the two species becomes more apparent, but even in the early stages the powerful almond scent of *Pterygodium Newdigatae* is very distinctive.

I have examined some hundreds of flowers and noted considerable variation in the inner perianth lobes. A large percentage of specimens received from Knysna on November 9, 1914, had one or occasionally both side petals well developed, and of a deeper yellow colour and more delicate texture than other floral parts (Figs. 2–5). A thickening at the base of the labellum was of fairly frequent occurrence (Figs. 7–9). The closest approach to the perianth of the chasmogamous form was observed in a single-flowered specimen received on November 20 (Figs. 6, 10, 11). The parts, which were at first united, sprang apart during the handling of the specimen, disclosing a column of abnormal form (Figs. 12, 13).

The column in the cleistogamous variety is exceedingly variable. Dr. Bolus figured three distinct forms; I have examined some 500 flowers and noted the following varieties:

(*a*) Rostellum arms 2, undivided; column occasionally symmetrical (Fig. 14), but more frequently showing a difference in length, breadth, or curvature of the arms (307 examples).

(*b*) Rostellum arms 2, variously lobed or divided. The lobing may affect the sterile tissue only, or the fertile tips, or both (Figs. 15, 16) (75 examples).

(*c*) Rostellum arms 4, undivided. As a rule the two pairs of arms are somewhat widely separated (Figs. 17–20) (48 examples).

(*d*) Rostellum arms 4, variously lobed or divided (Fig. 21) (17 examples).

(*e*) Rostellum arms 3, contorted or slightly lobed (Fig. 22) (12 examples).

(*f*) Extreme abnormalities (Figs. 23–25) (22 examples).

The drawings give some idea of the enormous variation of the column met with in this Orchid, which is in striking contrast with the conservative character of the essential organs in allied species and throughout the entire order.

The two-armed form is by far the commonest, but does not seem to have been represented in the material examined by Dr. Bolus. Further development and branching of this form may have given rise to the variations noted above.

Although a single type of column is usually constant for any one spike, yet individuals were observed in which the number and shape of the rostellum arms of the different flowers showed considerable variation.

The strong perfume of the cleistogamous flower is possibly a relic of the time when insect pollination was essential for seed production. The zygomorphy of the normal flower is more or less completely lost in the cleistogamous form, but resupination of the ovary occurs as usual.

The small gland-like pollen masses (?) remain permanently embedded in the tips of the rostellary arms (Fig. 26). The supposition that the pollen grains germinate *in situ* proved to be incorrect. Freehand sections through the base of the column of flowers of various ages showed no trace of pollen tubes, though these are readily demonstrated in the case of other Orchid flowers.

Material, collected at different times, was fixed in chromacetic acid and microtomed. The youngest buds available had ovaries from 3–4 mm. in length. The tips of the rostellary arms contained compact sporogenous tissue (?), composed of somewhat elongated cells with dense protoplasm and well-defined nuclei (Fig. 27). No indication of nuclear division was observed. The tissue appeared to be in the mother-cell stage. Ovules of the same flower showed no trace of integuments. The single hypodermal cell enlarges and functions directly as the megaspore-mother-cell (Fig. 28).

Somewhat older flowers exhibited no further development of sporogenous tissue (?) in the rostellary arms (Fig. 29). The megaspore-mother-cells, however, appeared for the most part in synapsis (Fig. 30). This condition evidently lasts for some time, as not only was it present in material collected on several different occasions, but was also found to occur in inverted ovules with fairly well developed integuments (Figs. 31–33). In no case was there any trace of pollen tubes in the ovary, in the tissues of the column, or in the rostellum arms. The statement is often made that Orchid ovules do not develop far unless pollination has occurred. It is worthy of note that in the species under discussion ovular development is apparently completed in the absence of fertile pollen.

Unfortunately several gaps occur in my material, the most serious being from October 19 to November 8; thus, further stages in the development of the megaspore-mother-cell and embryo sac are missing. Ovules of flowers received on November 8 contained young embryos, while much of the material received two weeks later had the embryos fully formed. Microtome sections through the rostellum arms of flowers with conspicuously swollen ovaries showed no appreciable change in the archesporial (?) tissue. Fig. 34 is a drawing of isolated cells from the disorganising sporogenous (?) tissue of a flower, the seeds of which had already been shed.

Sterility of the anthers has been shown in certain genera to be associated with apogamous development of the embryo. It seems reasonable to conclude that we are here also dealing with a case of apogamy.

Various stages in the development of the rudimentary embryos were observed (Figs. 35–39). While the seeds are immature, the intermediate layers of the ovarian wall, the cells of the placenta, and the suspensors are packed with starch. This disappears, and the supensors begin to disorganise before the seeds are shed. Suspensors are often seen reaching almost to the apex of the integument, but they do not project from the micropyle and penetrate the placental tissue as has been described in many Orchid species.

Polyembryony is of very common occurrence in *Pterygodium Newdigatae.* The two embryos are often of approximately equal size, though one may be markedly smaller than the other (Figs 40–42). In order to get some idea of the frequency of polyembryony in this species, ripe seeds were removed from various parts of mature ovaries and placed in alcohol to allow them to separate. The average of a number of counts showed that as many as 12 per cent. of the seeds of an ovary may exhibit polyembryony. Three embryos may occur within one seed coat, but this condition is not frequent (Fig. 43). It is possible that cases of two mother-cells in a single ovule, as figured in 44, may account for some of the additional embryos. Again, instances were noted of an apparent segmentation of the embryonal mass, but the detailed explanation of the origin of polyembryony in this Orchid must await the examination of more suitable material.

The dehiscence of the clavate fruit is unlike any of those mentioned by Pfitzer in his discussion of this order in *Die naturlichen Pflanzenfamilien,* Part II, sect. vi. The capsule splits by three longitudinal fissures into three broad and one narrow valve, which remain connected at base and apex. The narrow valve consists of the midrib of the carpel below the odd sepal; the two broad valves lying on either side are each composed of two united half carpels together with a carpellary midrib (Figs. 45, 46).

An attempt is being made to grow this Orchid from seed, in the hope that some light may be thrown upon the relationship existing between the open and closed flowered forms. Seeds dusted over the outer surface of unglazed porcelain cylinders kept constantly moist, were found to be appreciably swollen less than three weeks later. The seed coats were split, and delicate unicellular hairs had emerged from certain of the superficial cells of the embryos (Fig. 47). In older seedlings these hairs had increased considerably in length, some being three times as long as the testa. Where two embryos occurred within a single integument, both, as a rule, showed signs of germination (Fig. 48). The seeds were collected in November, 1914, but seed which had been kept dry for considerably over a year failed to germinate. Several distinct species of fungi occur in profusion among the germinating seeds (Fig. 49). Whether the seedlings will complete their development, thus indicating the presence of the necessary mycorrhizal fungus, remains to be seen.

It seems probable that there is some relationship between the extraordinary polymorphism of this species and its apparent apogamy.

The exact nature of the nuclear changes in the female elements will be investigated after a complete series of the various stages has been obtained.

The above investigation was commenced with the assumption that the gland-like bodies at the tips of the rostellum arms are reduced anther cells. An examination of the closely allied species, *Pterygodium catholicum*, has suggested the possibility that the masses of tissue in question may represent the rostellary glands. On dissecting away the anther from young flowers of *Pt. catholicum*, the appearance presented by the rostellary arms is strikingly like that of the two-armed form of *Pt. Newdigatae*. A microscopic examination of the gland-like tissues in each case reveals a further similarity. If this supposition should prove to be correct, then we have in the cleistogamous form of *Pt. Newdigatae* complete suppression of the fertile anther together with the lip appendage, which is considered by some as representing the posterior stamen of the inner whorl.

## EXPLANATION OF PLATES XLII, XLIII.

FIG.

1. Petal of peloriate cleistogamous flower.
2. Odd sepal coherent with side petals, one of which is somewhat petaloid.

3–5. Side petals showing various stages of development.

6. Side petal of single-flowered spike showing striking similarity with petal of chasmogamous species.
7. Lip with tooth-like appendage on one margin.

8, 9. Lip with basal thickening.

10. Well developed lip of single-flowered spike.
11. Flower with well-developed petals. Details of floral parts figured in 6, 10, 12 and 13.

12, 13. Back and front view of column of the flower figured in 11.

14. Rostellum arms 2, undivided.
15. Rostellum arms 2, one arm lobed.
16. Rostellum arms 2, both lobed.
17. Rostellum arms 4, approximating.
18. Rostellum arms 4, the two pairs widely separated. One arm shows two masses of sporogenous (?) tissue at its tip.

19, 20. Rostellum arms 4, the two lowest sterile.

21. Rostellum arms 4, the two lowest divided.
22. Rostellum arms 3, in one of which the sporogenous (?) tissue is lobed.

23–25. Extreme abnormalities of column.

26. Enlarged tip of rostellum arm showing embedded mass of sporogenous (?) tissue,
27. Section through sporogenous (?) tissue of very young flower.
28. Ovule from the youngest ovary examined, showing hypodermal megaspore-mother-cell.
29. Section through sporogenous (?) tissue of older flower.
30. Young ovule: nucleus of mother-cell in synapsis.

31–33. Older ovules with mother-cell still in synapsis.

34. Isolated cells of sporogenous (?) tissue from flower with dehisced ovary.

35, 36. Stages in development of embryo.

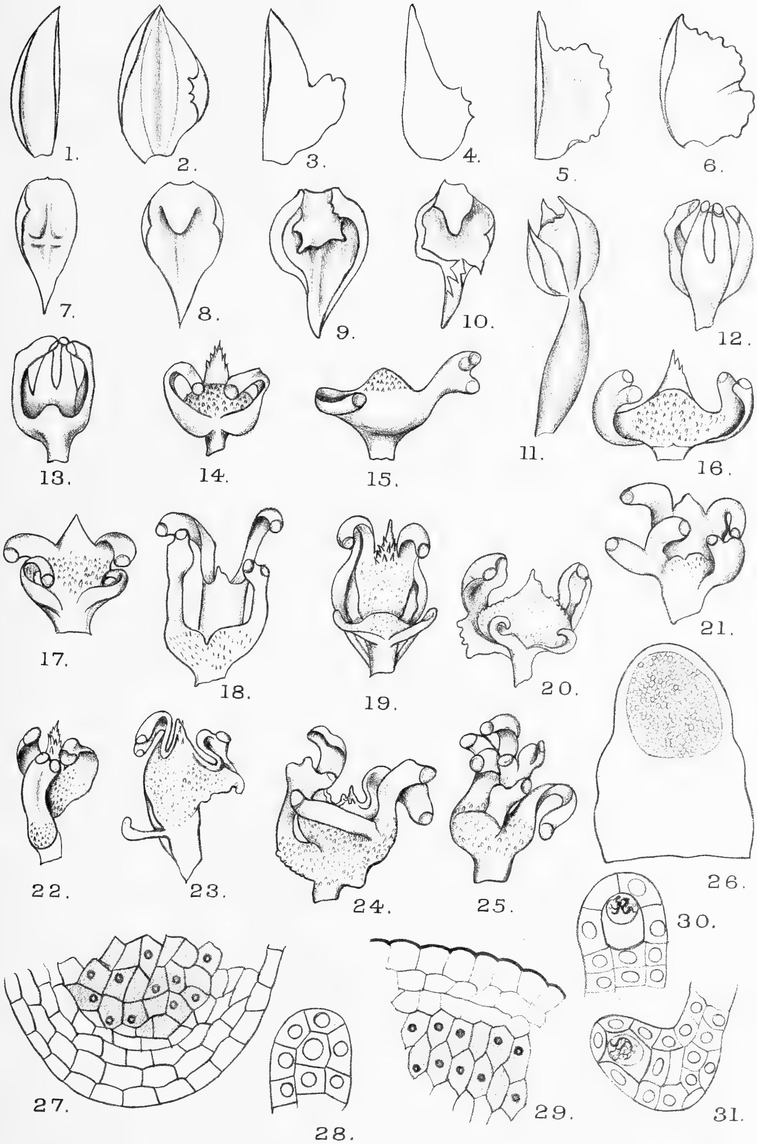
37, 38. Ovules with suspensors almost reaching micropyle.

39. Embryo in transverse section.

40–43. Polyembryony.

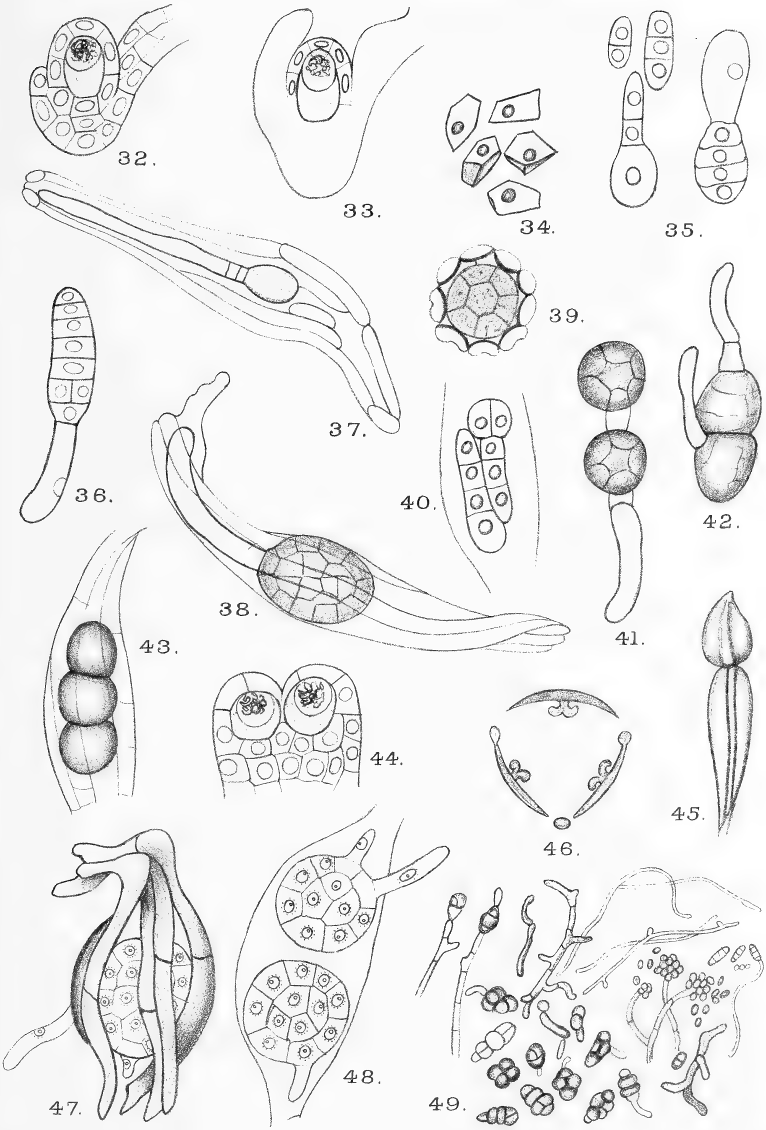
44 Ovule with two mother-cells.

45. Dehiscent capsule showing narrow valve below odd sepal.
46. Diagram to show method of capsular dehiscence.
47. Early stage in germination of seed.
48. Two embryos germinating within one seed coat.
49. Fungi present among germinating seeds.




A.V.D. del.

Adlard & West Newman.




A.V.D. del. Adlard & West Newman.

# SIMPLE APPARATUS FOR USE IN APPLIED MATHEMATICS.

By J. Steph. van der Lingen.

(From the Applied Mathematics Laboratory, South African College.)

(Received April 9, 1915.)

## I.—Apparatus for Finding "g."

Teachers of applied mathematics generally find some difficulty in satisfying the queries of students who desire to have some definite idea about the acceleration of a freely falling body.

The following is a brief description of a simple piece of apparatus which does not involve assumptions of dynamical quantities which the beginner cannot determine for himself (see Fig. 1).

The axis, A, of a rigid pendulum is firmly screwed on to a board on a wall.

Vertically above A a clamp, F, is screwed on a fixed board so that the rod, S, may be clamped at various heights above or below A.

The rod, S, carries an electro-magnet, M, which is connected electrically to T T by means of flexible wire.

Below B, the movable bob of the pendulum, a light platform, P, is clamped by screws on to the rod.

At H, the centre of P, an hole is cut so that a steel ball may fall freely through it.

When the rod of the pendulum is hooked by the catch, C, an electric current passes through R, the variable resistance, and M.

R is varied until the steel ball is just held up by M.

On releasing the pendulum at C the ball begins to fall.

The height (h) of M above H is increased or decreased according as the ball falls to the left or right of H until the ball just falls through H.

A piece of paper with a central line on it is now placed over H, and the ball at M slightly inked at its lowest point.

The height of M is now set so that the ball falls on the central line.

The height "h" is now measured, and also the diameter of the ball.

The time of vibration is now found by observing the time that the pendulum takes to make a hundred vibrations.

The beginner immediately sees that the ball fell through a height "h" in the same time that the pendulum takes to make one-half of an oscillation, hence he is enabled to find "g."

The time of vibration is then varied by moving B along the length of the pendulum and a second set of observations recorded.

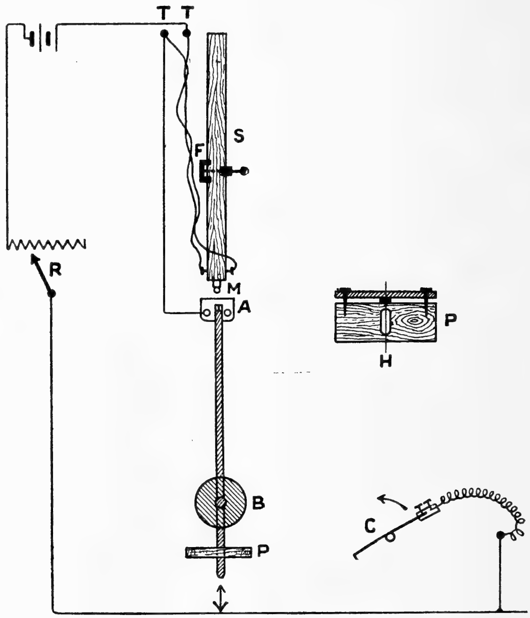



Fig. 1.

*Record of Results obtained by Elementary Students.*

| | | | |
|---|---|---|---|
| Cand. | I. | g = | 984, 981, 1003. |
| " | II. | " | 977, 991. |
| " | III. | " | 994, 986, 1030. |
| " | IV. | " | 993, 1035. |
| " | V. | " | 991, 966. |
| " | VI. | " | 976, 981, 981. |
| " | VII. | " | 971, 987, 980. |
| " | VIII. | " | 964, 979. |

The best results are naturally obtained when the time of vibration is short and when the ball is not magnetised. After each observation the ball is demagnetised.

This apparatus does not involve any dynamical knowledge of quantities which the beginner cannot determine for himself.

## II.—Standardizing a Given Vibrator.

Another difficulty which presents itself to the beginner is that he must assume the time of vibration of some vibrator when he is asked to determine velocities and accelerations of trolleys, etc.

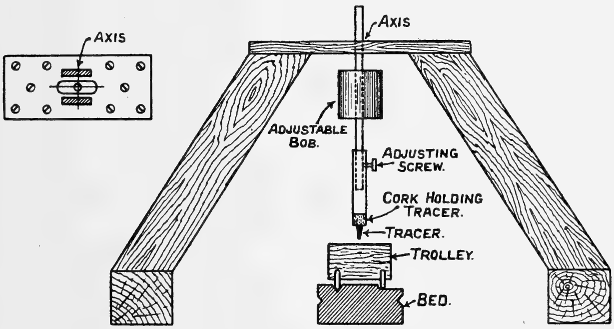



Fig. 2.

The piece of apparatus figured enables the student to determine the period of vibration of the vibrator (Fig. 2).

The pendulum vibrates perpendicularly to the direction of motion of the trolley, and thus crosses the trace of the vibrator after definite intervals of time.

The trolley is given a light tap so that it moves with practically uniform velocity under the pendulum and vibrator.

When the velocity is small a large number of vibrations will be recorded on the paper.

The brush of the pendulum and that of the vibrator are set as closely together as possible.

If the pendulum's zero is at A and the vibrator's at B, then in going from A to C it executes $n$ oscillations, and the vibrator executes M oscillations in an equal distance measured from B.

Hence $\frac{T_p}{T_v} = \frac{M}{n}$, where $T_p$ is the period of the heavy rigid pendulum. $T_p$

is now determined by recording the time 20, 40, 60, 80, 100, etc., vibrations.

Finally $\text{T}v = \text{T}p\,\frac{n}{\text{M}}$ seconds.

This also enables students to determine the variation of T when the length of the vibrator is increased or decreased. (T$p$ for the pendulum used in the South African College Laboratory is 0·8 secs. Minimum T$p$ for the above pendulum is 0·68 secs.)

Applied Mathematics Laboratory,
South African College, Cape Town.

# A NEW ALOE FROM SWAZILAND.

By I. B. Pole Evans.

(Read July 21, 1915.)

(Plate XLIV.)

**ALOE SUPRAFOLIATA**, spec. nov. Swaziland.

**Aloe suprafoliata**, Pole Evans ; species nova et distinctissima, nulli alii arctius affinis, sectionem propriam constituere debet.

*Superpositæ* Pole Evans.

Acaules ; folia disticha, superposita, carnosa, immaculata, lanceolata, sensim acuminata, dentibus marginalibus armata. Pedunculus simplex, vacue bracteatus, racemus sublaxus ; bracteae late lanceolatae apice acutae, flores trigono-cylindracei.

*Herba* succulenta, acaulis vel brevissime candescens. Folia ca. 12, stricte, disticha, glauco-viridia, patentia vel venuste arcuata, superposita, rigida, carnosa, lanceolata, acuminata, 17–30 cm. longa, basi 4 cm. lata, supra subcanaliculata, subtus convexa, ad margines dentibus 3 mm. longis rubro-brunneis pungentibus 5–9 mm. inter se distantibus armata, et linea cartilaginea rubella cincta.

*Inflorescentiæ* 35 cm. altae scapus simplex, basi nudus, superne bracteis 9–10 vacuis late lanceolata-acutis munitus ; racemus ca. 15 cm. longus et ca. 30-florus, sublaxus ; bracteae lanceolato-acutae, plurinerviae, 15 mm. longae et 10 mm. latae ; pedicelli 10–12 mm. longi, erecto-patuli.

*Perianthium* rosaceum, 38–40 mm. longum et 6 mm. latum, base levissime stipitatum, anguste cylindraceum, distincte trigonum ; segmentis exterioribus medium connatis, acutis, apice viridulis ; antherae vix exsertae.

This rather remarkable *Aloe* was first brought to me from Swaziland by Mr. R. A. Davis in June, 1914. At first I was inclined to regard it as an immature specimen. When received, it was in the condition shown in Fig. 1. Further specimens which were obtained from the same locality showed very little variation from the original specimen either in size or general character. The leaves were always exactly distichous and were superimposed one above the other in a most regular fashion. After being planted out for nearly a year, all began to show evidence of a flower bud from the centre of each plant towards the early part of May, and by the first week of June last were in full bloom. It then became apparent that the plants were fully grown specimens, and that they belonged to a hitherto undescribed species. I have accordingly described the plant as *Aloe suprafoliata*, spec. nov. Its general habit is unlike any other *Aloe* known to me. It must be regarded as a unique species, for which I propose a new Section *Superpositae* under Berger's *Humiles*.

*Aloe suprafoliata* may be recognised at once by its distichous leaves, which are rigid, somewhat fleshy, and patent or gracefully recurved.

The flower spike is slender, unbranched, and bears rather loosely attached rose doree flowers.

The plants are usually found on the tops of quartzite kopjes, and have been sent to me from Stegi, Lebombo Range, and Forbes Reef by the following gentlemen: Mr. R. A. Davis, Mr. B. H. Warner, Mr. Thos. Honey and Mr. A. Roberts.

*Description.*—Herb succulent, stemless, or with a very short stem. Leaves usually 12, exactly distichous, bluish or glaucous-green, patent or gracefully arcuate, lying above the other, rigid, somewhat fleshy, lanceolate, acuminate, 17–30 cm. long, 4 cm. broad at the base, somewhat channelled above, convex below, armed along the edges with sharp reddish-brown teeth 3 mm. long and 5–9 mm. apart, on a red cartilaginous border.

*Inflorescence,* about 35 cm. high, unbranched, naked at the base, clothed above with 9–10 broadly lanceolate-acute bracts; raceme about 15 cm. and composed of about 30 flowers, somewhat loose; bracts lanceolate-acute, many-nerved, 15 mm. long and 10 mm. broad; pedicels 10–12 mm. long, erect-patent.

*Perianth* rose doree (R.C.S.),* 38–40 mm. long, 6 mm. broad, very slightly stipitate at the base, narrowly cylindrical, distinctly trigonous; outer segments connate to the middle, acute, greenish at the apex, anthers just exserted.

## EXPLANATION OF PLATE XLIV.

FIG.
1. General habit of plant.
2. Plant in flower.
3. Flowers.

Figs. 1 and 2 much reduced, Fig. 3 natural size.

* (R.C.S.) refers to colours taken from Ridgway's "Color Standards and Color Nomenclature," Washington, 1913.

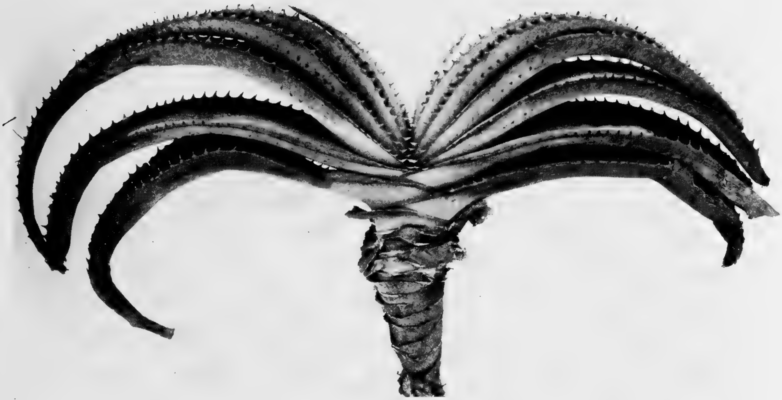


Fig. 1.

Fig. 2.

Fig. 3.

*I. B. Pole Evans photo.* *Adlard & West Newman.*

# THE GROWTH-FORMS OF NATAL PLANTS.

By J. W. Bews.

(Communicated by Professor H. H. W. Pearson.)

(Read August 18, 1915.)

Contents.



## INTRODUCTION.

The investigation of the growth-forms of plants in relation to their environment is being recognised as a very important, if not the most important, branch of Plant Ecology. The study of the various plant communities, and their determination by the environmental factors, presents a more general aspect of the subject, and has hitherto perhaps, on the whole, received more attention from plant ecologists, though, of course, it includes a certain amount of the study of the separate growth-forms. It is, however, in the more detailed study of the "epharmony" of the species of plants that a deeper insight is gained into the cause and effect relationship existing between the environment and plant life.

In its widest sense there is practically no branch of Botany that has not a direct bearing on this subject, since the aim of Botany is to explain why plants are as they are. There is a danger, therefore, in restricting oneself to a single line of inquiry, neglecting the others. For instance, Warming (23) points out that the influence of the environment on species is complicated by hereditary tendencies, of which the causes are not yet understood. One result of this is that different species adapt themselves to the same environment in widely different ways. To quote the example given by Warming: "While one species may adapt itself to a dry habitat by means of a dense coating of hairs, another may in the same circumstances produce not a single hair, but may elect to clothe itself with a sheet of wax, or to reduce its foliage and assume a succulent stem, or it may become ephemeral in its life-history." Warming is here obviously referring not to the environment as a whole, but to one main factor of the environment—in this case a "dry habitat." It may be doubted whether in Nature any two plants exist under absolutely identical environmental factors, though even if they did, they would not be identical in every respect, for it can hardly be supposed that the environments of any two species have remained identical throughout their evolution. If we had a full record of their past histories, we might be able to say why in reaction to dry conditions one species produces hairs, another wax, another reduces its foliage, and so on. It is hardly necessary to refer to "hereditary tendencies" until we have exhausted the possibilities. It is dangerous to lay stress on the reaction to one factor of the environment, neglecting the others, yet in most systems of classification of growth-forms this is what is done, and at the present state of our knowledge it is perhaps excusable. It is only to be expected, however, that species will be found reacting to that single factor when constant, in widely different ways, as in the example quoted from Warming.

On the other hand, different environmental factors may produce essentially the same growth-form. The effects of a dry atmosphere and "physiological drought," for example, may be the same, and when we take various combinations of external factors which differ among themselves, we often find more or less identical growth-forms resulting. The classification of growth-forms cannot, therefore, be based entirely on the adaptations resulting from definite and particular factors of the environment.

A further point which has been noted by the writer as being particularly true with regard to the growth-forms of Natal plants, is that many species are so very variable that they belong to more than one growth-form. Many lianes (*e.g. Scutia commersonii*) often grow as stout trees, yet lianes and trees form two of the six different main classes of growth-forms according to Warming's system of classification. In the same way certain species come into any one of the four subdivisions of phanerophytes, according to Raunkiaer's system (20, 22).

Such difficulties and limitations are, of course, sufficiently clearly recognised. We are a long way from the ultimate goal of a proper ecological interpretation of the various growth-forms. At present any investigation of the subject must follow certain lines.

The first essential is as thorough a knowledge as possible of the complete life-history (autecology) of each species. How very far we are from this ideal is being realised more and more clearly by all plant ecologists. In a recent paper (16) Prof. F. W. Oliver remarks: "Of the 120 species of flowering plants that form the known flora of Blakeney Point, it is doubtful whether we can truly assert that we are really familiar with the full life-histories of more than two or three." If this is true of a country like England, where there are so many workers, the difficulties confronting a single worker in a country like Natal can be better appreciated.

Of the habits of Natal plants and their full life histories, as studied in the field, really very little is known. Many of them are only known as herbarium specimens, and many more—in fact, the majority—have been named and described in the only available systematic work, *The Flora Capensis*, by botanists who have never seen them growing. It is not surprising, therefore, to find that growth-forms have received either very scant attention or none at all, or what is worse, incorrect information has been given. Apart from this, however, to a plant ecologist working in a new country, it is very useful to have some sort of a "Flora," or at least a list of species, to serve as a guide. Medley Wood's *List of Natal Plants* (26) is, therefore, of great assistance. Nor is it to be supposed that the *Flora Capensis* is in any way inferior to other similar works, in respect to the descriptions of growth-forms. As already remarked, "Growth-forms are too often very imperfectly described, even in the standard British floras" (22). Sim's *Forests and Forest Flora of the Cape of Good Hope* (21) contains much information regarding the growth-forms of the trees and shrubs.

The choice of a system of classification for growth-forms is a matter of the greatest difficulty. The guiding principle must be natural—*i.e.* the system must in itself show the dependence of the growth-forms on external factors—but the present state of our knowledge is such that any attempt at such a system must remain incomplete and unsatisfactory.

A short historical summary of the various systems that have been proposed is given in Warming's *Ecology of Plants*, ch. ii. The earliest is that of Humboldt (1805)—a purely physiognomic system, not founded on ecology (7, 8, 9). Grisebach (1872) put forward another physiognomic system, which he claimed, without good grounds, showed the influence of environment, particularly climate.

The systems of Drude (4), Krause (10), Pound and Clements (19), Raunkiaer (20), and Warming followed, all based on various ecological principles. It is unnecessary in this paper to repeat the summary of each given by Warming. The systems of Drude, Pound and Clements and

Raunkiaer agree more or less in emphasising the importance of the adaptations which enable plants to live through the adverse season. Warming's system is built on a broader foundation. He takes into account all the main adaptations and the main factors of the environment. His system shows a marked contrast to that of Raunkiaer, in that the latter chooses one main factor and to a large extent neglects the others.

Any worker who has to select a system will find that he must be guided by two principles :

1. Which system is most natural and scientific and interprets best the ecological facts.

2. Which system, under any given circumstances, can be applied most usefully.

As far as the first principle is concerned, in the writer's opinion, Warming's system is preferable to any of the others, though it, too, leaves much to be desired. But in attempting to apply it to the vegetation of Natal, the writer found that his knowledge of the facts was not sufficient to enable him to do so successfully.

Raunkiaer's system is much easier to use. It has been adopted by other Danish botanists, such as Ostenfeld (17) and Paulsen (18). An excellent account of it is given by W. G. Smith in the *Journal of Ecology*, vol. i, No. 1 (22). Not only is it easier to use, but it has the further advantage of lending itself to statistical and therefore comparative methods. The basis of the system is the nature and degree of protection possessed by the buds or shoot apices during the adverse season—*i.e.* in the case of Natal during the winter dry season. Raunkiaer has modified his system slightly since 1903. In a paper published in 1908 he adopts the following ten main classes of growth-forms or "life-forms":

| | | | |
|---|---|---|---|
| 1. S. | = Stem-succulents. | 6. Ch. | = Chamaephytes. |
| 2. E. | = Epiphytes. | 7. H. | = Hemicryptophytes. |
| 3. M.M. | = Megaphanerophytes and Mesophanerophytes. | 8. G. | = Geophytes. |
| 4. M. | = Microphanerophytes. | 9. H.H. | = Helophytes and Hydrophytes. |
| 5. N. | = Nanophanerophytes. | 10. Th. | = Therophytes. |

Phanerophytes are the trees and shrubs having their buds in the air. The buds may be naked or scaly, large or small. Phanerophytes may be deciduous or evergreen. Megaphanerophytes grow over 30 metres high (100 ft.). Mesophanerophytes, 8–30 metres (26–100 ft.). Microphanerophytes, 2–8 metres (6–26 ft.). Nanophanerophytes, less than 2 metres (6 ft.).

Chamaephytes include a variety of forms that have their shoot apices on the surface of the ground or not more than 25 centimetres (10 in.) above it. This does not mean that the plant during the vegetative season is not more than 25 centimetres high. The herbaceous parts may grow tall, but die down at the approach of winter. Small cushion forms and plants with long diageotropic shoots also come into this class.

Hemicryptophytes have their dormant shoot apices just below the surface of the soil during winter. The aerial parts die down. It is often very difficult to separate this class from the classes Chamaephytes and Geophytes. They naturally grade into one another.

Geophytes are plants with underground bulbs, rhizomes, and tubers of various kinds. The food material thus stored enables the renewal buds to be more deeply situated in the soil.

Helophytes are marsh plants which have their dormant buds at the bottom of the water or in the mud. Somewhat difficult often to separate from previous classes.

Hydrophytes are water-plants with winter buds or rhizomes.

Therophytes are annual plants—"plants of the favourable season." They live through the adverse season as seeds. In Natal it is not necessary to distinguish "summer" and "winter annuals."

Beginning with the Phanerophytes, those classes of growth-forms are arranged in a series showing increased protection against the unfavourable season. Phanerophytes are characteristic of favourable climatic conditions. Therophytes, if they predominate, show desert conditions.

In the following paper Raunkiaer's main scheme has been adhered to with very slight modifications, and consequently Raunkiaer's statistics and conclusions for other countries can be utilised for purposes of comparison. Where further subdivision was considered advisable, Raunkiaer has not been necessarily followed, seeing that Natal naturally differs from the countries in the Northern Hemisphere, to which Raunkiaer's papers refer.

## MEGAPHANEROPHYTES.

Only slight reference need be made to this class, seeing that very few trees in Natal grow over 30 metres (100 ft.) high.

The Yellow-wood, *Podocarpus elongatus*, reaches a height of 120 ft. The other species, *Podocarpus thunbergii*, grows up to 100 ft. These are the dominant trees forming the upper canopy of the Yellow-wood Bush of Natal (1).

## MESOPHANEROPHYTES.

These are the trees and lianes which grow over 8 metres (26 ft.). There are certain features, which belong more or less to the group as a whole. The buds are usually very small and not protected by conspicuous scales. In some cases, however, there are large stipules. The wood is usually hard and close-grained, and, in a great many species, of high specific gravity. The species are generally slow-growing. It is doubtful whether the rings in the wood are always, properly speaking, annual rings. A species may be in full growth at the end of summer, stop for a short time in mid-winter, begin again in spring, and stop for a short time in midsummer. This is certainly very noticeable in such trees as the Orange and *Pinus insignis*, as cultivated in Natal.

The total number of Mega-mesophanerophytes is *cir.* 95. A number of lianes of the ropy, woody type are included. They are the familiar "monkey-ropes" that are so abundant in the forests of Natal. The number included in the class Mesophanerophytes might easily be increased, but the others are included in the next class—Microphanerophytes—as being more often under than over 8 metres. In Warming's system the lianes are separated from the trees and shrubs—in fact, they form one of his six main classes of growth-forms. This is undoubtedly more natural, but as far as protection against the adverse season is concerned, there is no reason why they should be separated. By including them with the trees and shrubs we avoid a further difficulty in that many woody lianes, in the absence of support, grow as shrubs or small trees—*e.g. Scutia commersonii, Dalbergia obovata,* and others.

There are certain general features of the Mega-mesophanerophytes that may be summed up as follows:

(1) Great VARIATION IN SIZE AND FORM exhibited by the same species, depending on differences in the environment, particularly (*a*) the differences between Sand-dune Bush, other coast-bush, and inland-bush; (*b*) the differences between open Rocky Hillside, Thorn Veld, Stream Bush, and Close Bush. The details concerning each of those environments have been given by the writer in former papers (1, 2) and need not be repeated here. The point on which emphasis is desired to be laid is that many species in this class exhibit great plasticity or power of adaptability to widely differing environmental conditions.

The examples of lianes growing as trees and shrubs may be requoted, and, in addition, the following species illustrate this point:

*Kiggelaria africana, Toddalia lanceolata, Ekebergia capensis, Trichilia emetica, Apodytes dimidiata, Pteroxylon utile, Rhus laevigata, Schotia latifolia, Milletia caffra, Albizzia fastigiata, Plectronia obovata, Nuxia congesta, Myrsine melanophleus, Cordia caffra, Celtis kraussiana, Ficus capensis.*

(2) VARIATION IN FOLIAGE of the same species depending on the same differences in environment as the last. The leaves of certain species are more succulent nearer the coast. The leaves of others are larger nearer the coast, or the shape of the leaf may change from the coast, inland. There is variation also, according to whether the tree grows isolated (Thorn Veld, Rocky Hillside), semi-isolated (Stream Bush), or in dense forest.

Examples: *Scolopia zeyheri, Kiggelaria africana, Calodendron capense, Xanthoxylon capense, Ekebergia capensis, Ilex capensis, Celastrus peduncularis, Nuxia congesta, Apodytes dimidiata, Cussonia spicata.*

(3) The DEGREE OF PUBESCENCE varies greatly in the same species and in different species.

(4) A DECIDUOUS TENDENCY is seen in *Commiphora caryaefolia, Schmidelia melanocarpa, Bersama tysoniana, Albizzia fastigiata, Celtis kraussiana, Zizyphus mucronata, Pteroxylon utile, Rhus laevigata, Plectronia mundii, Rauwolfia natalensis, Croton sylvaticus,* some of which are almost always wholly deciduous, others being irregularly deciduous or semi-deciduous. The deciduous tendency is more pronounced inland and at higher altitudes than on the coast, as shown by the species, *Erythrina caffra, Calodendron capense, Cordia caffra, Celtis kraussiana,* which are deciduous inland, but usually more or less evergreen on the coast.

Some species are evergreen, or semi-deciduous or deciduous, according to locality and general environment, apart from proximity to the coast, *e.g. Trimeria alnifolia, Ekebergia capensis, Elaeodendron croceum, Plectronia mundii.* Altogether, about 20 per cent. of the species show the deciduous tendency to a greater or less extent—a reaction to the adverse environment of the dry winter season.

(5) SPINOSITY.—The majority of the thorn trees of the Thorn Veld, etc., belong to the next class, Microphanerophytes, and the whole question of thorn development will be discussed more fully when that group is dealt with. Some of the Acacia species with thorns, though included in the next class, occasionally exceed 8 metres in height. Several of the taller trees included in the above list show a variable amount of thorn development, *e.g. Scolopia zeyheri, Xanthoxylon thunbergii, Zizyphus mucronata, Scutia commersonii, Erythrina caffra.*

(6) A THICK BARK is a feature of a considerable number. It is particularly noticeable where the species grow in such situations that they are exposed to grass fires, and it doubtless acts as a protection. The following species show it:

*Apodytes dimidiata, Trichilia emetica, Bersama tysoniana, Albizzia fastigiata, Odina caffra, Pygeum africanum, Cunonia capensis, Eugenia cordata, Cussonia spicata, Cussonia umbellifera, Curtisia faginea, Plectronia obovata, Myrsine melanophleus, Sideroxylon inerme, Olea foveolata, Olea laurifolia, Rauwolfia natalensis, Commiphora caryaefolia, Ocotea bullata.*

The same feature is characteristic of many included among Microphanerophytes.

(7) A FREE DEVELOPMENT OF COPPICE SHOOTS often modifies the original growth-form considerably, giving the appearance of an abnormally large trunk, or the main stem may die away and become replaced by a cluster of coppice stems.

Examples: *Xymalos monospora, Ocotea bullata, Kiggelaria africana, Rhus laevigata, Milletia caffra, Milletia sutherlandi, Nuxia congesta.*

(8) The EFFECT OF EXPOSURE, particularly along the seashore, in causing branching from the base, is seen in *Sideroxylon inerme, Mimusops caffra,* and others.

Taken as a whole, the class of Mesophanerophytes show certain progressive adaptations to unfavourable conditions, of which the most important are, decrease in size (which is often very marked), increase in succulence and other xerophytic characters in the foliage, increase of pubescence, a tendency towards becoming deciduous, increased branching from the base and formation of coppice shoots, which often replace the main stem, a development of thick bark, and spinosity.

Not only are those features and tendencies illustrated by the species making up the whole class, but also by the individuals of single species, often in a most striking manner. Among unfavourable conditions we must include not only the adverse conditions of the winter dry season, but also exposure, proximity to the sea, and other factors which serve to differentiate the various habitats at all seasons of the year.

While we use the degree of protection of the buds or resting shoot apices as the main character serving to determine the class as a whole, we are able to use any of the other features mentioned to serve as a basis for further subdivision. For instance, we might choose the somewhat artificial distinction of thickness in the bark, and arrange the species in a series accordingly. Or we might form subgroups as follows: Evergreen, semi-deciduous, deciduous.

Whatever system of subdivision might be adopted, the variability of single species would be found very troublesome, and the class, as a whole, is not so large that any subdivision is necessary. At the same time, it is necessary to notice as clearly as possible the various tendencies exhibited by the class. This must be our excuse for presenting them in tabulated form above.

## MICROPHANEROPHYTES.

It will be obvious that no sharp line of distinction can be drawn between any of the groups of Phanerophytes or other classes of growth-forms. Such forms as *Celtis kraussiana* or *Myrsine melanophleus* might be classed as Nano-, Micro-, or Mesophanerophytes, according to circumstances. Many of those included in the list of Mesophanerophytes only occasionally reach the necessary dimensions. On the other hand, a few of those included among Microphanerophytes sometimes exceed 8 metres (26 ft.) in height. There are numerous instances, again, of the same species assuming different growth-forms—shrub, tree, or woody liane, *e.g. Dalbergia obovata.* In fact, this great variability in the same species, as will be illustrated throughout this paper, is one of the most striking features of Natal vegetation, and it cannot be too much emphasised. It is due, doubtless, in the first instance, to the very great range of differences in the natural conditions, and it proves also that the native plants of Natal possess great plasticity, in that single species are thus able to adapt themselves to very distinct environments.

The total number of Mesophanerophytes is *cir.* 420. The main features to be noted of this group are:

(1) Proportion of Lianes.—Over 30 per cent. of the Mesophanerophytes of Natal are climbers. Certain large genera, such as *Vitis* and *Ipomaea*, with sixteen species in each, help to swell the number. A notable feature is the number of shrubby species, which, in the absence of support, grow erect and may even form small trees, yet under suitable conditions become scandent. Almost every known variety of liane is found (except root-climbers).

Some are simple scramblers, with the usual elongated type of stem, but with none of their organs specially modified for climbing; others possess various kinds of tendrils. Many are spiny. Some are semi-herbaceous perennials—the annuals are, of course, not included here—but the majority are of a woody type.

The watch-spring tendrils of the woody Dalbergias, etc., are well known. The various stout lianes of the forest are popularly known as "Monkey Ropes." They form dense festoons and masses, and make it somewhat difficult to penetrate through the bush. They are particularly abundant in the Sand-dune Bush of the coast, in which there is little other undergrowth. From the economic standpoint, those "monkey ropes" must be ranked as the most pernicious weeds of the forest, since they often smother and kill the trees over which they climb. Their presence in such abundance alters the ecological character of the bush as a whole. They fill in the gaps, so that very little light penetrates, and the undergrowth of shrubs and herbs is very scanty, being confined more or less to the margin of the bush. The lianes also influence the regrowth of the forest. In the denser shade produced by them, the seedlings of light-demanding trees are killed, so that these also are confined to the outside margin of the bush.

An increase in the number of lianes, therefore, leads to a decrease in the number of Nanophanerophytes and Chamaephytes, etc., inside the bush, and the lianes also modify the growth-forms and influence the distribution of the Mesophanerophytes. No better instance could be found of the vegetation itself as a factor influencing the vegetation. The dependence of the lianes themselves on the phanerophytes (trees) over which they climb is, of course, still more obvious.

(2) Variation in the Growth-forms of the separate Species.—This follows more or less the same lines as the Mesophanerophytes. The great plasticity of certain species is again noticeable. The size, amount of

branching, general form, shape and size and structure of the leaves, degree of succulence and pubescence, all vary according to whether the species grows isolated or in the bush, and according to the plant formation of which it forms a part—Bush, Stream Bush, Sand-dune Bush, Rocky Hillside, or Thorn Veld. A much-branched shrub, given suitable conditions, may develop as a small tree. This is what is to be expected, and hardly calls for further remark. The tendency of shrubs to become lianes, as already mentioned, is more noteworthy.

(3) The DECIDUOUS TENDENCY is not perhaps quite so well marked as in the case of Mesophanerophytes. The species that show it are deciduous or evergreen, according to circumstances, *e.g. Dombeya dregeana, Ehretia hottentottica, Rhus spp., Excoecaria africana, Excoecaria reticulata, Erythrina tomentosa, Acacia spp.*

(4) As a result, partly perhaps of grass fires, THICK BARK is a feature of most of the species that grow isolated or semi-isolated in the thorn veld, on rocky hillsides, or on the outer margin of the bush.

Another effect of grass fires is seen in Microphanerophytes and also in Nanophanerophytes. Many shrubs and even small trees in similar situations (veld and outer margin of bush) are constantly burned down to the ground. The result is that there is a succession of annual shoots from a permanent root crown.

(5) INFLUENCE OF FROSTS.—On the coast belt, frosts are practically unknown, and many species grow there which are not found at the higher altitudes inland. The growth-forms of other species differ in the two regions (coast and inland) owing to the fact that in the latter they have to endure frosts. The upper shoots die off, and the result is as if the shrub had been pruned back. New shoots quickly develop in spring, and we thus get a succession of annual branches from a certain height. This effect is therefore similar to that of fires, but it is not so drastic. The difference in growth-form depending on this factor may be seen not only in comparing coast plants with those inland, but also among the inland plants themselves. In the Midlands there are many localities where frosts are rare, *e.g.* sheltered side valleys opening out into a deeper main valley where the cold air is drained off. Also the higher ridges and hills, where the gradient is sufficient to allow of rapid cold-air drainage, do not suffer so much as the main valleys. In such places species are not so much affected by frosts.

(6) SPINOSITY.—The question of the cause of thorn development is one that has of recent years given rise to a good deal of discussion, and it cannot be said, as yet, to have been satisfactorily answered.

A. Lothelier (1890–93) published the result of researches on *Ulex europaeus, Berberis, Crataegus,* etc., in which he showed that dryness of the atmosphere and intense illumination favoured thorn production. He found that in moist air, or in feeble light, branches which normally developed as spines became leafy shoots.

Cockayne found the same in the case of *Discaria toumatou* and supported Lothelier's view.

Zeidler (1911) opposed Lothelier's views. He found that under moist conditions and in feeble light thorns were developed in *Ulex*, and he regarded the leafy shoots obtained by Lothelier as being juvenile forms, the thorny shoots being the adult.

In his reply to Zeidler's criticism, Lothelier (1912) defends his former position, and states that if the leafy shoots are produced only in moist air the latter must be considered as the cause of their production; and if Zeidler's view is correct, the leafy "juvenile" form ought to become spiny towards the growing end. This, however, is not so.*

MacDougall (1912) tested the actual behaviour of the spines of *Echinocactus* with regard to atmospheric moisture. He found that they were hygroscopic, and could take up and lose water "as any bit of dry wood might do it," but he concluded that the resulting changes in weight of *Echinocactus*, due directly to humidity, do not affect the succulence of the living tissues. So that even if we accept Lothelier's views that spines are caused by intense illumination and vigorous transpiration, it is not yet clear what their exact physiological significance is or how the plant benefits, if it benefit at all.

Another view not necessarily entirely opposed to the above is that thorns serve to protect plants against animals. Very little positive evidence can be brought forward in support of this view, and the hypothesis is in the main a purely teleological one. As Warming points out, "it is evident that spiny plants, by reason of their armed nature, may defeat unarmed species, and become more widely distributed, but for all this we are not entitled to assume that thorns are a *direct* adaptation to animals, or that they arise in a country rich in herbivorous animals." In Arctic countries, however, there are large herds of large, herbivorous animals—*e.g.* reindeer and musk-ox—yet there are no thorns, because the conditions of humidity are not suitable for their production.

The only way in which the question of the function of thorns is likely to be cleared up is by controlled experiments, preferably carried out in the field, but certain facts may be noted concerning the thorny species of Natal as follows:

(*a*) The majority of the thorny species grow in dry situations—*e.g.* the thorn veld, sand-dunes, rocky places. Of these the various species of *Acacia* are typical.

(*b*) On the other hand, certain species that grow in the Close Bush under

* For a review and abstract of Lothelier's 1912 paper, see Journal of Ecology, i, 2, p. 123.

moist conditions are thorny also—*e.g. Xanthoxylon capense, Scolopia zeyheri,* and various lianes. In the case of the latter the thorns may be considered as organs modified to assist in climbing, though it is doubtful whether this explanation applies in all cases.

(*c*) Certain of the more accommodating species occur both in the Close Bush and also in the dry Thorn Veld. In such cases there is usually a much greater development of thorns in the latter. Sometimes a species may be thornless in the Close Bush and possess long spines in the Thorn Veld—*e.g. Celastrus buxifolius.*

(*d*) In the same way species are sometimes more thorny on the sand-dunes than elsewhere. In other cases, however, the foliage is more succulent in this situation and less prickly—*e.g. Xanthoxylon capense.* It is worthy of note that *Scolopia zeyheri,* according to Sim (21), is usually thornless on the sand-dunes.

(*e*) Though in the individual species increased thorn development with increased aridity is the rule, there is often a certain variability in thorn development which does not seem to depend on that factor or on more intense illumination. Young plants of Acacia are sometimes—in fact, one might say as a rule—very thorny, and become less so as they grow. A passing reference may be made here again to Zeidler's theory. He supposed that leafy shoots of Ulex are "juvenile"; thorny shoots "adult." The Natal Acacias show exactly the opposite phenomenon. Juvenile plants are very thorny indeed; adult ones less so. Frequently there is a large thorn development on coppice shoots. These alone may be thorny and the rest of the tree unarmed, as *e.g.* in *Plectronia mundii, P. pauciflora, Aberia tristis,* etc.; or the spines in the coppice shoots may be more abundant and much larger than those on other parts of the tree.

*Aberia caffra* is often thornless in the tree form, but very thorny if kept cut as a hedge. Marloth is quoted by Warming (23) as having called attention "to specialised adaptation exhibited by certain species, in that the longest and strongest spines occur on young individuals or on root shoots which are most accessible to animals, while the branches subsequently produced on tall trees are quite devoid of spines." Warming further adduces the case of *Ilex aquifolium,* the upper leaves of which are usually not prickly when once the plant has grown into a tree.

Here, then, we seem to have certain facts which support the "protection against animals" theory. But like many other cases, where a theory has to be supported simply by observed facts in Nature and not by controlled experiments, the amount of support given to the theory depends largely on how the facts are presented. In the case under discussion, certain other facts must be considered, to reach a fair conclusion. In the various Acacias, the dominant trees of the Thorn Veld, there is a considerable variation in growth-form, as well as in degree of spinosity. The "umbrella" form is most typical—a short bole and a wide-spreading crown—a growth-form adopted in relation to the dry, hot winds, to which the trees are fully exposed. This umbrella form is brought about by slow, regular growth, with branching at the apex. The lower branches are the oldest, and are not the result of vigorous branch development from dormant buds. In such cases those lower branches are often destitute of spines and are covered with lichens. This umbrella form is typically a more leafy form, and has fewer and smaller spines than other forms. Leaf development and spine development, as is well known, usually vary inversely.

In other cases, the species of Acacia show more upright, irregularly branched, straggling growth, due largely to more vigorous development. Lower branch buds in these forms frequently develop rapidly, forming the so-called "gourmand" shoots. On such branches, spines are larger and stronger. *It is not therefore a case of the lower branches as such showing a greater degree of spinosity, but branches that are growing more vigorously.* This applies also to young plants and coppice shoots and to *Aberia caffra*, when kept as a hedge.

On the other hand, in such a case as *Scolopia zeyheri*, the spines (which may be absent altogether) are often absent from the crown and present on the main trunk 6–8 in. long. Here it is the older part of the tree, which is armed. But it is difficult in this case to see what protection this affords to the foliage of the tree.

The evidence, in the main, seems to support Lothelier's view, that spine development is the result of dry conditions and intense illumination. The thorny species which occur in the Close Bush do not disprove Lothelier's view, for, as is pointed out elsewhere (1, 2), the Close Bush of Natal has certain xerophytic characters, and is, in fact, intermediate between sclerophyllous woodland and tropical rain forest. The foliage of many of the Close Bush trees is of a distinctly xerophytic type, *e.g.* that of *Podocarpus*, the dominant tree of the Yellow-wood Bush. It is not surprising, therefore, to find some of the species in the Close Bush also possessing thorns. With drier conditions the spinosity undoubtedly increases, and that in a most striking manner, until it culminates in the vegetation of the Thorn Veld and dry, rocky hillsides of the Low Veld region. The production of thorns may then be looked upon as one of the visible results of the process of lignification, which is characteristic of xerophytes, the physiological significance of which is still somewhat obscure, but which the researches of Lothelier, as well as the evidence presented by the growth-forms and distribution of the species of plants concerned, have shown to be favoured by dryness of the atmosphere and intense illumination.

Accepting this, we may still ask whether, being produced in this way, they may not then serve as a protection against animals. This is a very different position from supposing that thorns have been *evolved* as a protection against animals. It is not necessary to suppose that in all cases they do so serve, and, as a matter of fact, if we did attempt to show that the producing of thorns is a method adopted by the plant to defend itself, all that can be said is that, in certain cases, the plant has shown itself singularly maladroit, protecting parts that do not seem to need protection, and leaving other important parts—its crown and foliage generally—unprotected, *e.g. Scolopia zeyheri.*

The palm, *Phoenix reclinata,* calls for special mention. The leaves are 4–8 ft. long, with the lower pinnae reduced to sharp spines. These surround the crown of the stem, which contains a sugary sap. The possession of spines by palms, especially those inhabiting the Amazonian forests (*Astrocaryum* and *Bactris*) is certainly somewhat difficult to explain by Lothelier's theory (23).

As Warming also points out, "In the north, temperate, moist climate, there occur many thorny growths, the significance of which is at present obscure." Indeed, it must be admitted that there is much in the whole subject that remains at present obscure, and it has been the writer's object to bring forward the facts as far as Natal plants are concerned, and not at present to attempt to argue strongly for one view or the other, though, as already stated, in his opinion, the facts in the main support the views of Lothelier, Cockayne, and others—views that agree in supposing that thorn development is a reaction to dryness of the atmosphere.

## NANOPHANEROPHYTES.

The determination of the growth-forms belonging to this and the following two classes has been a matter of much greater difficulty than the preceding. The actual height of the plant does not serve as a guide, for if it be a herbaceous or suffruticose form it may or may not die down in winter. The information given in the *Flora Capensis* is, therefore, of little use. At the present state of our knowledge, and dealing with such a country as Natal, it is impossible for anyone to give details regarding the life-history of each species. A knowledge of the habitats is of great assistance. It is safe to assume that typical veld plants either die down or get burned down to the ground in winter. Since the class of Geophytes (bulbous plants, etc.) is a fairly definite one, where any doubt exists, it lies between the classes—Hemicryptophytes and Chamaephytes. Doubtless mistakes have been made in the enumeration, but it is hoped that these will to a certain extent neutralise one another, so that the percentages will not be affected; nor is it likely they will be, since we are dealing with such large numbers. Species growing inside the bush or in other situations where they are not affected by fire, though they may be herbaceous or very weakly lignified, commonly persist through the winter, and even continue their growth, *e.g.* species of

Acanthaceae. Among the most troublesome are those forms (the Labiate type of undershrub of Warming) where considerable parts of the flowering shoots die after blossoming. Since one is naturally acquainted more with the appearance of the plant at the time when it flowers, one is often inclined to put it down as Nanophanerophyte when it ought to be classed as Chamaephyte.

The total number of Nanophanerophytes is *cir.* 430. They form a somewhat heterogeneous class, much more so than any of the preceding classes. This being the case, some further subdivision is possible, and such subdivision can follow various lines.

As is well known to all botanists, certain large families of flowering plants have a striking similarity in their vegetative parts, so much so that it is often possible to tell at a glance to what family a plant belongs, without examining the flowers. Taking advantage of this fact, we might pick out certain types of growth-form from this class and name each after the natural order, of which it is most characteristic.

Such a simple scheme of subdivision is one that readily suggests itself. The earliest writer on growth-forms, *Humboldt* (1805), adopted it. He treated in detail the forms of the palm, banana, malvaceous and bombaceous plants, mimosa, heath, cactus, orchid, casuarina, conifer, pothos, liane, aloe, grass, fern, lily, willow, myrtle, melastomaceous plant, laurel.

Though it is interesting enough to recognise such "family resemblances" in growth-forms, yet if we attempt to push it very far it has really very little scientific value, as the scheme is not based on ecological facts. The members of no family of plants all belong to the same growth-form, and after we have removed the forms belonging to each of the types mentioned above, or to any similar collection of types, we are left with a still more heterogeneous collection, to which we have been unable to assign places in any of the types. Not only, therefore, is such a scheme not based on ecological facts, but it is not exhaustive. It is simply a somewhat superficial recognition of certain resemblances in the vegetative organs of plants without any reference to any underlying principle or explanation.

The attempt to apply it generally, as Humboldt did, to the whole of the flowering plants must necessarily fail. At the same time, there is much that is attractive about the system of nomenclature. It can be made quite scientific if we adopt some definite ecological factor as a basis for the scheme, and it can be applied successfully provided we are dealing with one definite ecological group, such as the Nanophanerophytes. In other words, though it cannot successfully be applied as a basis for the main ecological divisions, yet it can be used in minor subdivisions. There is little likelihood of any confusion arising from introducing systematic names into ecology. No one, for instance, is likely to suppose that when we speak of "Heath form" or "Acanthaceous form" we restrict ourselves to Ericaceae and

Acanthaceae respectively. The ecological factor selected as a basis is the degree of lignification and xeromorphy. Thus we can arrange the Nanophanerophytes in a series, showing increased amount of lignification and xeromorphy according to variation in the environment, as follows :

(1) Soft-stemmed herbaceous perennials, with persistent aerial parts, *e.g. Phytolacca spp.* These are somewhat rare as Nanophanerophytes, but abundant as Chamaephytes (*vide infra*).

(2) Acanthaceous Type.—Weakly lignified undershrubs with thin leaves. They are commonly shade-loving bush plants, growing in the more open parts of the bush, or around the bush margin in a moist habitat. Many of them flower in winter, *e.g.* various species of Acanthaceae, Verbenaceae, Labiatae, *Piper capense*, etc.

(3) Leguminous Type.—Woody, much-branched shrubs, more characteristic of open spaces and veld, and often reduced to Chamaephytes by grass fires.

(4) Composite Type.—Shrubby Compositae, etc., often growing rather tall, but having various xerophytic modifications, such as thick leaves (*Osteospermum*), dense coating of hairs, etc., particularly abundant on the Drakensberg at high altitudes.

(5) Ericaceous Type (or Heath Type).—Almost too well known to require further description. It includes the Ericaceae (eighteen species) as well as isolated forms, occurring in widely separated families. Rosaceae (*Cliffortia*), Thymeliaceae (*Passerina, Lasiosiphon*)—another Alpine type.

(6) Succulent Type.—Fleshy plants, with persistent aerial parts over 25 cm. tall—Aloes and certain Crassulaceae.

(7) Lianes.—Species of Asclepiadaceae, etc., many of which are also Geophytes. The lianes, as in all the other classes, form a group by themselves.

The number of intermediate types might be multiplied considerably, but it is hardly necessary to do so. Every gradation in xeromorphy is naturally shown within the limits of a large class, such as the Nanophanerophytes. The types mentioned above simply mark certain definite stages.

We have now dealt with all the Phanerophytes, and, considering the group as a whole, we notice a progressive tendency towards greater protection during the adverse season. This is shown by a decrease in size, and this simple fact has been selected by Raunkiaer as a basis for his divisions. Further, it is noticeable that Mesophanerophytes tend to be reduced to Nanophanerophytes, and these in turn to Chamaephytes.

It may be remarked here that mere size or rather height is not, in all respects, a very satisfactory basis for classification. It is quite true that, taking into account only the inorganic factors of the environment, a taller plant is less protected than a shorter one, other features being equal. But where plants grow in such intimate relationship to one another, as they do in the bush for example, one plant affects another and the non-living environment is highly modified. The result is that the same species varies very greatly, according to whether it grows gregariously in the bush or isolated outside the bush. This presupposes, of course, that the species is sufficiently accommodating to do so, but the examples of trees and shrubs which are of this nature are very numerous in Natal.

However, this difficulty would arise, no matter what basis for subdivision were selected. Raunkiaer's system, as a whole, endeavours to arrange growth-forms in a definite series, showing increased protection to the growing apices during the adverse season. The Nanophanerophytes are supposed to show greater protection than the Microphanerophytes. In the main this is the case, yet we find Microphanerophytes—*e.g. Acacia spp.* and numerous other trees—fully exposed to the dry, hot winds, and extremely adverse environment of the Thorn Veld; while Nanophanerophytes—*e.g.* species of *Justicia* and other Acanthaceae, *Piper capense*, etc.—occupy the sheltered, moist environment of the Bush. Here, then, are members of a class, which, according to Raunkiaer's scheme, ought to show greater protection, occupying a habitat where such greater protection is not required.

As a matter of fact, except in height, such species do *not* show greater protection. Most of them are distinctly mesophytic. The difficulty arises again from the choice of a single factor as a basis for classification. By choosing height as the basis for subdividing the Phanerophytes, Raunkiaer certainly gained by making his system very easy to apply. In temperate regions, where the forests in winter do not afford the same protection to the undergrowth and where frost and snow have to be taken into consideration, the height of a species is a more certain guide than in a subtropical country like Natal, and shows a truer ecological relationship. But in all countries, and especially in countries with evergreen forest, the height of species must remain a somewhat artificial basis for classification.

The dominant trees of the forest are certainly taller than the trees of the Thorn Veld, the latter thereby showing reaction to more adverse conditions, but the undergrowth of the forest enjoys a more favourable environment than the trees that afford it a protection; yet the undergrowth cannot from the nature of things obviously grow taller. It is not necessary to labour the point. Enough has been said to show that Raunkiaer's scheme does not in its details show strictly the reaction to the adverse season. At the same time, it is difficult to improve it without detracting from its chief merit—the ease with which it can be applied. There does not seem to be any other single character that would suit better than height as a basis for the subdivision of the Phanerophytes.

## CHAMAEPHYTES.

This class includes all the forms which lie on the surface of the ground during winter or have their shoot-apices not more than 25 cm. above it. The next class, Hemicryptophyte, is also a large one, and as the two grade into each other, it is not an easy matter to separate them. As a result of the tendency mentioned above, the Chamaephytes of Natal have been increased at the expense of the Phanerophytes, and are much more numerous than in the world's flora as a whole (the normal spectrum of Raunkiaer).

Among Chamaephytes, Raunkiaer distinguished four sub-types as exemplified by the European flora.

(1) Active Chamaephytes, with shoots diageotropic and persistent throughout their whole length—*Empetrum nigrum, Lysimachia nummularia,* etc.

(2) Passive Chamaephytes, with weak stems which lie on the ground—*Stellaria holostea, Cerastium trigynum,* etc.

(3) Suffruticose Chamaephytes, in which the herbaceous parts die down—species of Labiatae, Papilionaceae, etc.

(4) Cushion Plants.

All four sub-types are well represented in Natal, as well as certain others.

The total number of Chamaephytes (excluding Pteridophyta) is *cir.* 570.

The four types of Chamaephytes distinguished by Raunkiaer are well represented in Natal, and in addition there are other types which do not fit well into any of Raunkiaer's. As in the case of Nanophanerophytes, we can arrange the Chamaephytes in a fairly definite series, showing progressive adaptation to more rigorous conditions, as follows:

(1) Streptocarpus Type.—There are sixteen species of Streptocarpus in Natal. They are found usually in damp situations, near streams in the bush. The peculiar growth-form, with its single, permanent cotyledon which slowly increases in size, is quite distinctive and unlike anything else.

(2) Herbaceous Chamaephytes.—There are numerous species which have herbaceous but persistent aerial portions, *e.g.* species of *Geranium, Pelargonium, Lobelia, Wahlenbergia,* etc. They continue their vegetative work right through the winter, though not in most cases actively. They vary according to situation. If growing in a dry or exposed place, a species may die down to the ground, yet the new growth commences just above the soil. Such forms—*e.g.* many grasses—come very near the Hemicryptophytes.

Other examples of this type of herbaceous Chamaephytes, when growing in unfavourable situations, become annuals, *e.g. Hebenstreitia spp., Polygonum spp., Chenopodium spp.,* and many grasses. This is quite common. In fact, the majority flower and seed in their first year, so that they are not dependent on vegetative existence during winter. In certain situations, and in particular in cultivated soil, they are always annuals.

(3) PASSIVE CHAMAEPHYTES, as defined by Raunkiaer, are weak-stemmed Chamaephytes, which lie on the ground. They ought, perhaps, to be included in the last class. There are numerous examples similar to those quoted by Raunkiaer, *e.g.* species of Caryophyllaceae and Ficoideae, *Alysicarpus rugosus, Cyathula sp., Amarantus sp.*, Cucurbitaceae.

Herbaceous and passive Chamaephytes are particularly abundant around the foot of spreading thorn-trees, and among clumps of them in the Thorn Veld.

(4) CUSHION PLANTS, *e.g.* species of *Muraltia, Selago, Helichrysum*, etc.—characteristic of the higher altitudes.

(5) ACTIVE CHAMAEPHYTES.—Shoots diageotropic and persistent—species of Leguminoseae, *Oligomeris dregeana, Monsonia ovata*, species of Malvaceae.

It is rare to find these persistent through their whole length. They usually die back more or less, the extent to which they do so depending on situation. Often, as in other types, they die back and leave a small root-crown above the ground.

(6) FLESHY-LEAVED CHAMAEPHYTES are rather numerous in Natal, mostly species of Crassulaceae and *Mesembryanthemum.* Many of the Crassulaceae are rosette forms. The older leaves die off in winter.

(7) SUFFRUTICOSE CHAMAEPHYTES.—These all die back considerably in winter, *e.g.* species of Labiatae (the Labiate type of Warming), Leguminoseae, Compositae, Rubiaceae, Verbenaceae, Selagineae, etc. The commonest type of all in Natal.

(8) Forms which invariably die down so far that they are ALMOST HEMICRYPTOPHYTES. All the Chamaephytic grasses, except one or two, such as *Arundinaria tesselata*, "the Berg Bamboo," are of this type. Since the two classes (Ch. and H.) grade into each other, there are naturally many intermediate forms. Perhaps too many of these have been included as Chamaephytes, but apart from the doubtful species the class is undoubtedly a very large one in Natal—a fact which requires some explanation. As a result of his careful analyses of various floras in the Northern Hemisphere, Raunkiaer found that Chamaephytes increased northwards in the Arctic region, and are particularly characteristic of the circumpolar regions, where, during the adverse season, a covering of snow helps to protect them. They also increase in warm regions which have a dry season. Raunkiaer's figures show a high percentage for Aden and the Libyan Desert.

The Hemicryptophytes are characteristic of the cold temperate regions, where there is sufficient precipitation, but where there are severe winter frosts without a constant covering of snow.

The Phanerophytes are most abundant in warm regions with uniform temperature and large rainfall.

In Natal we have practically no snow—on the coast belt not even frost. The frosts are nowhere very severe, the soil rarely being frozen. The winters in Natal are, however, very dry, and there are occasional hot winds, which add greatly to the dessicating effect. Phanerophytes are confined to the sheltered places, where the rainfall and mists are greatest—the southern and south-eastern slopes of the hills and edges of the terrace plateaux—except in the case of the trees and shrubs of the Thorn Veld—a very xerophytic type. The dryness of the winters, therefore, combined with the hot winds, deprive Natal of a Phanerophytic climate.

The absence of severe frosts and the dry winters again make the climate of Natal not a Hemicryptophytic one. The high percentage of Chamaephytes may, therefore, be put down as being caused by the dryness of the winters, combined with the absence of severe frosts and intensified by occasional hot winds. Natal can then be compared with places like Aden and the Libyan Desert. We shall find, however, that there are important respects in which Natal differs from those places. The percentage of Chamaephytes is about the same, but the percentage of Therophytes (Annuals) is very much less for Natal—in fact, it is abnormally low. This point will be discussed more fully later on, but it is mentioned now because one feels constrained to pause and ask whether the above explanation of the high percentage of Chamaephytes is the only one, and sufficient in the case of Natal.

The Chamaephytic growth-form, reduced as it is to within 25 cm. of the ground during winter, is well adapted to withstanding drought. The shoot apices are often protected by the older parts, which have died away, and so have formed a certain amount of *débris*. Phanerophytes, as we have seen, tend to become reduced to Chamaephytes by the adverse environmental factors. But among Chamaephytes we have included sixteen species of *Streptocarpus*, and many soft-stemmed herbaceous plants. These are not adapted to withstanding our adverse winter conditions. They do so successfully, because a moist, protected habitat is supplied to them by the Phanerophytes that compose the bush.

Take away the Phanerophytes, and the bulk of those species of Chamaephytes would disappear also. Stress ought to be laid on this fact, for to a certain extent it contradicts the view that an increase in the number of Chamaephytes indicates the influence of drought in warm countries. Even some of the more xerophytic Chamaephytes are found usually below the thorn trees of the Thorn Veld. Such facts illustrate once more the complexity of the whole problem, especially with regard to the influence of one type of growth-form on the others.

## HEMICRYPTOPHYTES.

The aerial portions here are wholly herbaceous and die away at the approach of winter, leaving dormant shoot apices just below the surface of the soil. The difficulty of separating this class from the preceding one has already been sufficiently emphasised.

The total number of Hemicryptophytes is *cir.* 540. It is noteworthy that out of this number about 200 belong to the Compositae (including a large number of rosette and half-rosette forms), 100 to the Gramineae, and about 40 to the Cyperaceae. With regard to the latter, it should be noted that in the wetter parts of the veld we have grasses and sedges, also characteristic of the vleis, and it is not easy to determine which belong to the Hemicryptophytes and which to the Helophytes.

The Hemicryptophyte class, as a whole, is much more homogeneous than the last one, and there is therefore less need of subdivision. The rosette or half-rosette form is common.

In colder countries, where the Phanerophytes are mostly deciduous, the Hemicryptophyte class includes a large number of woodland plants. These are not abundant in Natal. There is not very much undergrowth, except around the edge of the bush, and what there is consists mostly of Nanophanerophytes and Chamaephytes, especially the Acanthaceous type of the former.

The Natal Hemicryptophytes are mostly veld plants, but, as pointed out in former papers (1, 2), the veld of Natal has several ecological features similar to deciduous woods—*i.e.* as regards the associated plants. The fall of the leaves from the trees in the one case, and the burning of the grass in the other, exposes the ground during winter. Herbaceous plants, in both cases, lose their aerial parts. In spring they grow quickly, and a great many of them get their flowering over before the leaves appear on the trees or the grass grows tall enough to shade them. The next class, Geophytes, are similar in this respect, and further reference will be made to the question when these are dealt with.

Another question dealt with at considerable length in former papers by the writer (1, 2) is that of changes in the veld due to the influence of man, both direct and indirect, through the agency of fire. A careful study of the growth-forms of the grasses, with reference to the principle underlying Raunkiaer's system of classification, throws a good deal of light on the subject. *Aristida junciformis* and other coarse, wiry species oust the more valuable fodder species, such as *Anthistiria imberbis*, with the result that, from the farmer's standpoint, the veld deteriorates. That the change is due to the burning of the grass is shown by the fact that it is greatest along the railway, where the grass is always burned early in the year. The resulting "secondary" associations of Aristida, etc., are perfectly stable. *Anthistiria* is a Chamaephyte, *Aristida* a Hemicryptophyte. *Anthistiria* has the innovation shoots intravaginal, protected by the sheathing bases of the leaves. When the plant is burned, the fire may not only consume the withered leaves, but may also injure the innovation buds. If this does not happen, the buds, as a result of the fire, appear to be stimulated to grow, especially if the burning is done early, before the end of the rainy season. When winter comes the young stems are apt to be killed by the frosts and winter drought. *Aristida junciformis*, on the other hand, has the innovation shoots extravaginal, and sometimes it is stoloniferous. The innovation buds are protected by scales. This grass further grows in dense tussocks, and soil collects around and between the bases of the culms. When the veld grasses are burned—(1) the innovation buds of this species, being under the surface of the soil, are not liable to be injured by the fire, and (2) new growth does not take place so quickly, so that injury from frost and drought does not follow.

Those two species have been selected because each is the commonest example of its type. The other grasses resemble one or the other.

The Hemicryptophytes, with their innovation buds, extravaginal or at any rate below the level of the surface of the ground, are better adapted to withstanding grass fires, and hence, owing to the influence of these fires, are tending to oust the Chamaephytes, where the renewal buds are less efficiently protected. At the same time it must be remembered that *Anthistiria*, a typical Chamaephyte, is dominant in natural, unchanged veld. It must be assumed that but for grass fires the protection afforded the young buds by the sheathing leaves and layer of decaying foliage is quite efficient, and the fact that new growth can take place quickly in spring must be an advantage to the species in the absence of the disturbing factor, fire.

The above illustrates how a careful study of the autecology of a species very often affords an easy solution to questions of economic importance. To counteract the "deterioration" in the veld farmers should cease burning the grass.

## GEOPHYTES.

In this class we have the greatest amount of protection during winter of all perennial plants, the renewal buds being deeply embedded in the soil. The subterranean portions are bulbs, tubers, corms, rhizomes, root buds and root tubers, and these contain a storage of food which enables the plant to flower early in spring—as a rule, before the work of assimilation is renewed. This is an abundant class in South Africa, including all our various bulbous monocotyledons. As in the case of the last class, the Geophytes of Natal are mostly veld plants, and the type resembles, in some respects, the floor vegetation of deciduous woodland in colder, temperate regions. The majority of the bulbous veld plants (Geophytes) are able to get their flowering over before the grass grows tall enough to shade them, in the same way as bulbous woodland plants in deciduous woods flower before the leaf canopy appears on the trees. Being, for the most part, deeply rooted, they occupy a different stratum of the soil from the grasses.

Geophytes, according to Raunkiaer's "normal spectrum," only form 3 per cent. of the world's flora as a whole. In Natal the proportion is about 18 per cent., or six times the normal, so that this must be considered quite a characteristic South African type. Their great abundance depends partly on the same conditions as we have seen have led to an increase in the number of Chamaephytes and Hemicryptophytes—the need for protection against drought, etc., in winter—partly on the further need for producing seed early in spring, before the Chamaephytes and Hemicryptophytes (grasses) grow tall enough to shade them.

The Geophytes share their habitat with the Hemicryptophytes, both being mostly veld plants. The H. class is below the normal, according to Raunkiaer's normal spectum. The percentage is 18 instead of 27 (see table on p. 632). But if we combine the two classes, which we are justified in doing, seeing that they are alike in so many respects, we get for Natal 18 + 18, or 36 per cent. of H. and G; for the world, as a whole, 27 + 3, or 30 per cent. of H. and G. The increase in the number of Geophytes in Natal may, therefore, be considered to have taken place at the expense of the Hemicryptophytes. When we take the two together, we get a higher percentage than the normal (36 per cent. as against 30 per cent.).

The total number of Geophytes is *cir.* 550, including 120 Asclepiadaceae, 135 Orchidaceae, 49 Irideae, 58 Amaryllidaceae, 150 Liliaceae, all except 38, therefore, belonging to these five families.

In the Asclepiadaceae we get either a tuberous "rootstock," which in some species (*e.g. Raphionacme*) is very large, or a cluster of tuberous roots. Many of the climbing species included in the lists of Phanerophytes also have tubers. The family, as a whole, has a milky latex.

In the Orchidaceae the species included in the above list are the terrestrial orchids, with tubers usually ovoid or globose, sometimes lobed. The bulk of the Natal orchids are terrestrial (for the Epiphytes *vide* p. 631).

In the Irideae we usually get a corm, as in species of *Moraea, Tritonia, Watsonia, Gladiolus, Homeria miniata*, etc., but sometimes a short, creeping rhizome, *e.g.* in *Moraea iridioides.*

A number of Irideae have no tuberous underground organs, and are included among Hemicryptophytes.

In the Amaryllidaceae we get a corm in *Hypoxis spp.*, and *Curculigo;* a bulb in the others.

In the Liliaceae the rootstock is tuberous in *Eriospermum* and *Tulbagia;* rootstock obscure in *Anthericum;* rootstock small, roots wiry or fleshy in *Chlorophytum;* and in the other genera we get a tunicated bulb, which is the favourite storage organ in this family.

The Aroideae (*Richardia*) have thick, fleshy rhizomes.

*Oxalis* has tuberous roots.

Geophytes may naturally be subdivided on the basis of the various types of storage organ, and each type is well represented in Natal, as has just been shown.

It is interesting also to note that certain species of *Dioscorea, Asparagus, Smilax, Behnia,* and various Asclepiads are climbing Phanerophytes, and, at the same time, Geophytes. This is, of course, a different thing from the case of species such as *Hebenstreitia,* etc., which sometimes occur as Chamaephytes or Hemicryptophytes, and, given other conditions, occur as Therophytes (Annuals).

If, as indicated above, we group together the Hemicryptophytes and Geophytes, we find that no fewer than 800 species of these belong to the seven natural orders—Compositae, Gramineae, Asclepiadaceae, Orchidaceae, Liliaceae, Amaryllidaceae, Irideae; and these all occupy the same habitat—the veld—and most of them flower about the same time.

The extraordinary profusion of flowers in the veld in early spring, and especially of representatives of those natural orders, is a fact which is never forgotten by the botanist who has once seen it. Not only is the number of species large, but many of them are found all over the country, and the type must be held to constitute a very important part of the vegetation of Natal.

## HELOPHYTES.

Helophytes, or marsh plants, occur in the numerous Vleis. As has been shown in former papers, the Vleis of Natal can be graded according to (1) the amount of water; (2) the degree of stagnation of the water. There are also all gradations between veld and vlei, and certain species—*e.g.* Tambootie grass (*Andropogon nardus* var. *marginatus*)—occur either in veld or vlei. It therefore becomes a matter of some difficulty to determine which of such intermediate species are to be assigned to the present class, and which to the class already dealt with.

The Cyperaceae are, on the whole, mostly vlei plants, but a number—included above among the Hemicryptophytes—grow in the veld.

The class, Helophytes, it must be remembered, does not include all the so-called marsh plants. Some of the marsh Cyperaceae are annuals (Therophytes), and other plants which are typically found in the vleis are shrubs (Phanerophytes) or bulbous Monocotyledons (Geophytes). The class, Helophytes, is composed of perennial marsh plants, usually with creeping rhizomes, which have their renewal buds in the mud.

The total number of Helophytes is *cir.* 143 (including 81 Cyperaceae). Of these only 26 are Dicotyledons. There is no necessity in such a uniform and small class for any further subdivision. The bulk of them are sedges.

## HYDROPHYTES.

These are the purely aquatic forms, and they are included by Raunkiaer with the Helophytes, the two together forming the class H.H. In Natal, Hydrophytes are scarce. There are no lakes of any size, owing to the steep rise of the land from the sea to the Drakensberg. In the dry winter season, in most districts, there are few pools of water even. The Hydrophytes, therefore, are mainly stream plants, but they are nowhere abundant.

The total number of Hydrophytes is 25. The total number of Helohydrophytes (Class H.H.) is *cir.* 168.

Raunkiaer gives 1 per cent. as the normal amount of H.H. This number seems to the writer to be too low. At any rate, in Natal it is at least five times that amount—5 per cent.

This higher proportion of marsh plants might be taken to indicate that much of the land in Natal is marshy. This is not the case. Vleis are exceedingly numerous, but not, as a rule, very large. The arrangement of successive terrace plateaux, with the rivers eating their way back through them, and with the general rate of denudation exceedingly rapid, leads to a network of small streams. These, wherever the ground is more or less flat, spread themselves out and form vleis. Consequently we have vleis at all altitudes and under every different kind of external condition known in Natal. Though, in spite of this, there is more uniformity in the vlei vegetation than in any other plant formation in Natal, yet the total number of vlei species (Helophytes) is greater than if the same total area of vlei had been confined, say, to the lowlying coast lands.

The high proportion of Helophytes therefore does not mean that a large proportion of the total area is marsh, but that there is a greater diversity than usual in the types of marsh.

## THEROPHYTES.

These are the plants of the favourable season, the annuals. In temperate regions, Aestival or Summer Annuals, and Hibernal or Winter Annuals are distinguished. In Natal this distinction is not necessary, since they are all summer annuals. The vegetative period varies from one to several months. Therophytes are not numerous in Natal, the percentage being only one-half that of Raunkiaer's normal spectrum. A high percentage of Therophytes is characteristic—(1) of desert regions, particularly regions with dry, hot summers; and (2) of localities where the soil is regularly and periodically disturbed (cultivated land, sea-shore, sand, etc.). The Natal Therophytes belong mostly to the latter class, being the weeds of cultivated land. Many of them are exotic or doubtfully native of Natal.

It has been pointed out by the writer elsewhere (1, 2) that when cultivated land is allowed to revert to veld, the annual species are gradually replaced by perennials.

The total number of Therophytes is *cir.* 197, including thirty-six species of grasses. Several species here classed as annuals also occur as perennials while certain species classed as perennials always flower the first year and may be annuals.

Since the majority of the annuals which do occur in Natal are, as already mentioned, the weeds of cultivated land, and a high proportion of them are exotic, the climate of Natal is obviously not a Therophytic one. Though the drought is severe in winter, there is plenty of rain in summer.

The comparative scarcity of Therophytes must therefore be put down to two causes:

(1) The fact that Natal is not a country under high cultivation. The small area under mealies, etc., is out of all proportion to the vast stretches of virgin veld. It is true that a good deal of land is now being planted with Wattle (*Acacia mollissima*), but in the Wattle plantations weeds and all kinds of undergrowth are very scarce.

(2) The fact that Natal is a region of summer rainfall. On the west and south-west side of South Africa the rainfall is in winter, and the summers are dry. Annuals are undoubtedly more abundant there. An analysis of the flora of South Africa, as a whole, would show a higher percentage of annuals. Though the writer is not in a position to put forward such an analysis, there are plenty of facts to support this statement. For instance, 27 species of *Senecio* were included in the class "Annui" by Harvey in vol. iii of the *Flora Capensis*. That was published in 1864, and now the list might be extended.

In Natal, though *Senecio* is one of our largest genera (*cir.* 80 species and varieties) only one or two are annuals, and not one of Harvey's original 27 is recorded for Natal. Again, *Phyllopodium* has 18 South African species, of which 12 are annuals. Only one of the 12 belongs to Natal. Examples might be multiplied.

The hot, dry summers of the western portion of South Africa give a Therophytic climate which contrasts strongly with the eastern side.

The classes of growth-forms described so far form a fairly definite series from Phanerophytes to Therophytes, showing increased protection for the renewal buds during the adverse season. There are certain smaller classes of growth-forms which do not come into the series. Of these, Raunkiaer included two—the Stem Succulents and Epiphytes. A third is here added—the Heterophytes.

## STEM SUCCULENTS.

These belong to a very few genera in the family Asclepiadaceae, viz.: *Caralluma lutea* (stems $1\frac{1}{2}$–4 in.), *Stapelia gigantea*, and *Stapelia woodii*, *Huernia hystrix*, *Sarcostemma viminale*, *Cynanchum sarcostemmatoides*, and about 23 species of *Euphorbia*.

The total number of Stem Succulents is therefore *cir*. 30.

The genus *Euphorbia* is very well represented in Natal and is one of the most heterogeneous in its growth-forms. It includes common field weeds and large trees, *e.g. E. tirucalli* and *E. grandidens*. The tree Euphorbias are very abundant in the dry river valleys and rocky hillsides of the Low Veld region. The Euphorbiaceae have not yet been dealt with in the *Flora Capensis*.

All stem succulents, like the other members of the families to which they belong, have a milky latex. This distinguishes the African forms from the similar "Cactoid" forms of America. The latex in both Euphorbias and Asclepiads is contained in the coenocytic type of laticiferous element. The readiness with which it flows shows that in most cases it is under high pressure in the plant.

## EPIPHYTES.

If we restrict ourselves to the seed-bearing plants, the Epiphytes of Natal are about equal in number to the Stem Succulents. A large number of Pteridophyta and Bryophyta might, however, be added.

The total number of Epiphytes is *cir*. 34, the bulk of them being Orchids. They are not particularly abundant individually. The species *Rhipsalis cassytha*, our only representative of the family Cactaceae, is a fleshy, cord-like plant hanging from trees, but often found also on rocks. Hence it might have been included among Stem Succulents.

*Dermatobotrys saundersii* (Scroph.), a recently discovered species of *Cyrtanthus* (*C. epiphyticus* J. M. Wood), and two species of *Peperomia*, with *cir*. 30 species of Orchids belonging to the genera *Polystachya*, *Angraecum*, and *Mystacidium*, complete the list. *Ficus natalensis* begins its life as an epiphyte.

## HETEROPHYTES.

These, though a small group, formed one of Warming's six main classes, and rightly so, for they differ from all other growth-forms among flowering plants.

In Natal we have the following: *Cuscuta* (4 species) and *Cassytha capensis* (holo-parasitic stem parasites), *Loranthus* (5 species), *Viscum* (8 species) (hemi-parasitic stem parasites).

The following Scrophulariaceae: *Melasma* (6 species), *Striga* (6 species), *Cycnium* (3 species), *Rhamphicarpa* (2 species), *Harveya* (5 species) (hemi-parasitic root parasites).

A few orchids are saprophytic or nearly so.

The total number of Heterophytes is *cir.* 40. The total number of species dealt with (including Heterophytes) is *cir.* 3074.

Since Heterophytes were not included by Raunkiaer as a separate class, we may neglect these and reckon, for statistical purposes, the total number of species included in the analysis as being 3034, distributed as follows:

| | S. | E. | M.M. | M. | N. | Ch. | H. | G. | H.H. | Th. |
|---|---|---|---|---|---|---|---|---|---|---|
| Total number belonging to each growth form | 30 | 34 | 95 | 420 | 430 | 570 | 540 | 550 | 168 | 197 |
| Per cent. belonging to each form | 1 | 1 | 3 | 14 | 14 | 19 | 18 | 18 | 5·5 | 6·5 |

The following table is taken from the paper on Raunkiaer's "Life-forms and Statistical Methods," by W. G. Smith, *Journal of Ecology*, vol. i, No. 1, and the results obtained for Natal are included in it for purposes of comparison:

*Examples of Biological Spectra.*

| | Total number of species. | Percentage of species belonging to each life form. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S. | E. | M.M. | M. | N. | Ch. | H. | G. | H.H | Th. |
| Normal spectrum | 400 | 1 | 3 | 6 | 17 | 20 | 9 | 27 | 3 | 1 | 13 |
| *Eastern N. America*: | | | | | | | | | | | |
| Baffin's Land | 129 | — | — | — | — | 1 | 30 | 51 | 13 | 3 | 2 |
| Labrador coast | 246 | — | — | 2 | 1 | 8 | 17 | 52 | 9 | 5 | 6 |
| Georgia | 717 | 0·1 | 0·4 | 5 | 7 | 11 | 4 | 55 | 4 | 6 | 8 |
| Danish West Indies | 904 | 2 | 1 | 5 | 23 | 30 | 12 | 9 | 3 | 1 | 14 |
| *Western N. America*: | | | | | | | | | | | |
| St. Lawrence (Alaska) | 126 | — | — | — | — | — | 23 | 61 | 11 | 4 | 1 |
| Sitka | 222 | — | — | 3 | 3 | 5 | 7 | 60 | 10 | 7 | 5 |
| Death Valley | 294 | 3 | — | — | 2 | 21 | 7 | 18 | 2 | 5 | 42 |
| *Western Europe, etc.*: | | | | | | | | | | | |
| Francis Joseph Land | 25 | — | — | — | — | — | 32 | 60 | 8 | — | — |
| Spitzbergen | 110 | — | — | — | — | 1 | 22 | 60 | 13 | 2 | 2 |
| Iceland | 329 | — | — | — | — | 2 | 13 | 54 | 10 | 10 | 11 |
| Denmark | 1084 | — | 0·1 | 1 | 3 | 3 | 3 | 50 | 11 | 11 | 18 |
| Stuttgart | 862 | — | — | 3 | 3 | 3 | 3 | 54 | 10 | 7 | 17 |
| Madeira lowlands | 213 | — | — | — | 1 | 14 | 7 | 24 | — | 3 | 51 |
| Libyan Desert (Egypt) | 194 | — | — | — | 3 | 9 | 21 | 20 | 4 | 1 | 42 |
| Aden | 176 | 1 | — | — | 7 | 26 | 27 | 19 | 3 | — | 17 |
| Seychelles | 258 | 1 | 3 | 10 | 23 | 24 | 6 | 12 | 3 | 2 | 16 |
| **NATAL** | **3034** | **1** | **1** | **3** | **14** | **14** | **19** | **18** | **18** | **5·5** | **6·5** |

The normal spectrum is given by Raunkiaer as approximately that of the whole world's flora. It was obtained by computation and checked in various ways. The other spectra must be judged by the amount of variation from the normal in each of the separate life-forms, and not by the highest percentage of each. Raunkiaer's statistics refer only to the Northern Hemisphere. He uses them to establish certain regional climatic zones, for a full explanation of which Smith's paper may be consulted (22). It is unfortunate that no statistics are available for the Southern Hemisphere. No climate zone can as yet be established here, but from the above table certain general conclusions can be drawn which apply to Natal as to other countries.

If the optimum point of the Biological spectrum is toward the left—*i.e.* in the groups M.M. and M.—it means that we have a favourable type of climate for tree growth—*i.e.* a Phanerophytic climate. A shifting of the optimum point to the right means increasing drought or other adverse conditions (frosts, etc.), particularly at one season of the year. We thus pass first to a Chamaephytic and then to a Hemicryptophytic type of climate. Still more severe conditions, dry summers, or general drought leads to a desert type or Therophytic type, the Therophytes being very abundant. The application of this Therophyte test enabled Ove Paulsen (18) to class the Transcaspian lowlands as desert rather than steppe. The Therophytes also increase in more highly cultivated areas—*e.g.* Denmark, Stuttgart.

## GENERAL SUMMARY AND CONCLUSIONS.

The analysis of the flora shows that in Natal we have every type of life-form represented, indicating a rich and varied flora and corresponding variation in the environmental conditions. The same thing is shown by the large total number of species, 3074 (which does not include quite all the known species), and also by the variability seen in the growth-forms of the same species, especially among the Phanerophytes. The Megaphanerophytes are few in number and the Mesophanerophytes also fall below the normal, the class M. M. being 3 per cent. in Natal as compared with 6 per cent. in the normal spectrum. Tall trees are therefore not characteristic of Natal. Microphanerophytes (trees and shrubs below 8 metres) reach 14 per cent. as compared with 17 per cent., and Nanophanerophytes (shrubs under 2 metres) are 14 per cent. as compared with 20 per cent. in the normal spectrum.

Taking the Phanerophytes as a whole we see that they fall considerably below the normal, 31 per cent. instead of 43 per cent.

Seychelles, with a typical Phanerophytic climate, has 57 per cent. Phanerophytes, Danish West Indies 58 per cent. On the other hand, Natal has many more than the temperate regions of the Northern Hemisphere. Denmark has only 7 per cent., Stuttgart 10 per cent. Aden approaches nearest to Natal, but it has no Mesophanerophytes. All its trees are below 8 metres.

The presence of 1 per cent. of Epiphytes is interesting. The normal is 3 per cent., the same as Seychelles. Epiphytes are confined practically to countries with some degree of a Phanerophytic climate. The Danish West Indies also has 1 per cent., the same as Natal.

Natal does possess a Phanerophytic climate—in parts. The trees have to contend with adverse factors generally, but in certain situations these are lessened; or, to put it otherwise, a Phanerophytic climate is not general in Natal. Forests are confined to the south-eastern slopes of the hills, and in other plant-formations trees occur but grow isolated—*e.g.* in the Thorn Veld.

In the forests a very large number of species of Phanerophytes grow intermingled. There is not the same uniformity and marked dominance of one or two species that is found in the forests of the Northern Hemisphere. Considering how much more extensive the veld is than the bush in Natal, it is surprising to find that the percentage of Phanerophytes is so great as it is. The individual species show great plasticity and consequently great variation, according to differences in environmental conditions. In the larger classes the species may be arranged in a series showing increased xeromorphy. There must be taken into consideration, not only the effect of the non-living environment, but also the influence of one part of the vegetation on the rest. The Phanerophytes thus not only influence one another (and one class of Phanerophytes another class), but also other distinct classes. A considerable number of Chamaephytes are present in the bush, and owe their existence there to the presence of the Phanerophytes.

Hemicryptophytes and Geophytes, on the other hand, are not abundant in the evergreen bush of Natal as they are in deciduous woodland elsewhere. There is a large number of lianes among Natal Phanerophytes.

Considering next the three classes Ch., H., and G., we find that the percentages for Natal are respectively 19, 18, 18 as compared with 9, 27, and 3 in the normal spectrum. The climate of Natal to a great extent favours the greater protection of renewal buds, and therefore a much greater area is occupied by veld formation made up of those classes of growth-forms.

The grasses are either Ch. or H., but the present tendency is for the latter to oust the former. The high proportion of G. is explained when we take into consideration the fact that this type is best suited for association with the grasses in the veld owing to the necessity for early flowering, etc., as well as protection during winter, and, being more deeply situated in the soil, they do not directly compete with the grasses. The increase in the number of Geophytes corresponds to a decrease in the number of Hemicryptophytes. They are both veld types.

The number of Chamaephytes has been increased by the inclusion of species which depend on the presence of Phanerophytes, as explained above. The high percentage of Chamaephytes also shows the effect of drought. Aden, it will be seen, shows a similar effect. If the temperature were lower in winter there would be fewer Chamaephytes and more Hemicryptophytes, as shown by the figures for colder, temperate regions. Denmark, for instance, has only 3 per cent. Ch. and 50 per cent. H.

That this is not explained by the Chamaephytes being increased by the presence of Phanerophytes, is shown by the figures for Seychelles, which has a more Phanerophytic climate than that of Natal. They are 6 per cent. Ch. and 12 per cent. H.

The climate of Natal may be looked upon as mainly Chamaephytic, but not pronouncedly so. The high percentage of Geophytes (six times the normal) is so characteristic of Natal (and of South Africa as a whole), that this might be called the country of Geophytes.

The class, H.H., as will be seen from the table, varies greatly in different countries. In Natal we have 5·5 per cent., which seems to be about an average, though Raunkiaer gives 1 per cent. as the normal, a figure which is surely too low. This class of growth form composes the vlei formation of Natal. Vleis are very numerous at all altitudes, but nowhere very large. There are no lakes.

Therophytes in Natal are not very abundant. The percentage is 6·5, or exactly half the normal. Natal is certainly far removed from the desert type, and it is not under high cultivation. Probably the west side of South Africa has a much higher percentage of Therophytes, owing to the much more arid conditions prevailing there.

## LITERATURE CITED.

(1) Bews, J. W., 1912.—The Vegetation of Natal. Annals of Natal Museum, vol. ii, pt. 3.

(2) ——— 1913.—An Ecological Survey of the Midlands of Natal, with special reference to the Pietermaritzburg district. Annals of Natal Museum, vol ii, pt. 4.

(3) Coulter, Barnes, and Cowles.—Text-book of Botany, vol. ii; Ecology.

(4) Drude, O., 1890.—Handbuch der Pflanzengeographie.

(5) ——— 1896.—Deutschlands Pflanzengeographie.

(6) Haberlandt, 1909.—Physiologische Pflanzenanotomie.

(7) Humboldt, A., 1805.—Aspects of Nature. Eng. Ed., Lond., 1849.

(8) ——— 1806.—The Physiognomy of Plants. Eng. Ed., Lond., 1849.

(9) ——— 1807.—Essai sur le geographie de plantes. Paris.

(10) Krause, E. H. L., 1891.—Die Eintheilung der Pflanzen nach ihrer Dauer. Ber. Deut. Bot., Ges. ix.

(11) Lothelier, A., 1890.—Influence de l'état hygrometrique de l'air sur la production des piquants. Bull. Soc. Bot. France, xxxvii.

(12) ——— 1891.—Influence de l'éclairement sur la production des piquants des plantes. Comptes Rendus. Paris, cxii.

(13) ——— 1893.—Recherches sur les plantes à piquants. Rev. Gen. de Bot., v.

(14) ——— 1812.—De l'influence de l'humidité de l'air sur le développement des épines de l'Ulex europaeus. Rev. gen. de Bot., xxiv.

(15) MacDougall, D. T., 1912.—The Water Balance of Desert Plants. Annals of Botany, vol. xxvi, c. i.

(16) Oliver, F. W., 1913.—Some Remarks on Blakeney Point, Norfolk. Journ. of Ecol., vol. i, No. 1.

(17) Ostenfeld, C. H., 1908.—The Land Vegetation of the Faroes.

(18) Paulsen, Ove., 1912.—Studies of the Vegetation of the Transcaspian Lowlands.

(19) Pound, R., and Clements, F. E., 1898.—The Phytogeography of Nebraska. ——— 1898.—The Vegetation Regions of the Prairie Province. Bot. Gazette, xxv.

(20) Raunkiaer, C.—Statistik der Lebensformen als Grundlage für die biologische Pflanzengeographie. Beih. Bot. Centralbl., 87, 1910.

(21) Sim, T. R., 1907.—Forests and Forest Flora of the Colony of the Cape of Good Hope.

(22) Smith, W. G., 1913.—Raunkiaer's "Life-forms" and Statistical Methods. Journ. of Ecol., vol. i, No. 1.

(23) Warming, E., 1909.—Oecology of Plants.

(24) Wood, J. M.—Natal Plants. Durban.

(25) ——— 1907.—Handbook to the Flora of Natal.

(26) ——— Revised List of the Flora of Natal. Trans. of S. African Phil. Soc.

# THE SOUTH AFRICAN RUST FUNGI.

## I. The Species of Puccinia on Compositae.

By I. B. Pole Evans.

(From the Botanical Laboratories, Union of South Africa, Pretoria.)

(Read August 18, 1915.)

(Plates XLV–XLIX.)

The following descriptions and accompanying notes are based mainly upon material which the author and his colleagues have collected during the past ten years in South Africa, and which is now represented in the Mycological Herbarium of the Union of South Africa at Pretoria.

The material has been collected primarily with the object of elucidating the life-histories of the various rusts which are so destructive to many of our economic crops, and it is hoped that the descriptions of these parasites, of which this is the first instalment, may promote a more widespread interest in this group of plants and may be the means of adding considerably to our present very imperfect knowledge of these fungi.

What has hitherto been published on the South African rusts is very largely due to the labours of MacOwan in the Cape, and Medley Wood in Natal. The greater portion of the material was culled from the collections of these two botanists, and from botanical collectors who visited the country from time to time.

The descriptions of practically all the species were consequently published by European mycologists in scientific journals of European origin, many of which are not obtainable in South Africa to-day, and in many instances the descriptions were based on scanty and immature material.

It will not be surprising, therefore, to find that the number of species occurring in South Africa must be considerably added to, while existing species may require amending.

The descriptions of the species in this and following contributions will in the main be those of P. and H. Sydow's *Monographia Uredinearum*, although I shall not scruple to amend them from my own observations whenever this may appear necessary. I also propose to follow the arrangement of species as is done by P. and H. Sydow in the above-named work. For descriptions of new species I alone am responsible. All the species which are known to occur in South Africa will be included whether they be aliens or not, and every species of which specimens are available will be figured in its essential parts.

All the spores are drawn to the same magnification of 600 times unless it is stated to the contrary.

1. The Species of *Puccinia* on Compositae.

Sydow's *Monographia Uredinearum,* published in 1904, records seven species of *Puccinia* on Compositae from South Africa.

Of these, *Puccinia Stobaeae* MacOwan, *P. Kalchbrenneri* De Toni, *P. Printziae* Thuem., *P. aecidiiformis* Thuem., and *P. oedipus* Cke., are recorded from South Africa only, while *P. MacOwani* Wint. is reported from South and Central Africa, and *P. africana* Cke. from Abyssinia, Madagascar, South and Tropical Africa.

The present paper records fourteen species of *Puccinia* on Compositae in South Africa, and describes four new species. Of the remainder, *Puccinia vernonicola* P. Henn. has previously been recorded from Tropical East Africa, while *P. Chrysanthemi* Roze and *P. Hypochoeridis* Oud. have a wide distribution.

The descriptions of the species on Compositae are as follows :

## **BERKHEYA** Ehrh.

### 1. **Puccinia Stobaeae** MacOwan.

*Puccinia cryptica* Cke. Grevillea xx, p. 108; Sacc. Syll. xi, p. 190.
*Puccinia Stobaeae* MacOwan. Grevillea xi, p. 23; Sacc. Syll. vii, p. 615. Sydow, Monogr. i, p. 158, f. 137.

*Aecidiospores.*—Aecidia hypophyllous, on orbicular spots up to $\frac{1}{2}$ cm. diam., sometimes confluent yellow-brownish, aggregated in groups 3–5, white, margin fimbriate-lacerate; spores globose or subglobose, angular, verruculose, hyaline, somewhat yellowish, 21–36 $\mu$ diam.

*Uredospores.*—Sori amphigenous, hidden in the lower surface under the araneose pubescence of the leaf, pulverulent on the upper surface, scattered or running together in irregular clusters, black-fuscous; spores globose or ellipsoid-globose, strongly echinulate, fuscous-brownish, 25–40 $\mu$ diam.

*Teleutospores.*—Sori mostly hypophyllous, scattered or in groups of 4–7, rotund, black, about 1 mm. in diam.; spores ellipsoid or oblong strongly thickened at the apex (up to 14 $\mu$) and mostly more or less lengthened, rarely subrotund, slightly constricted at the middle, mostly rounded at the base, rarely attenuated in the pedicel, smooth, fuscous, 40–68 × 21–32 $\mu$; pedicel hyaline, persistent, thick, slightly thickened at the base, up to 124 $\mu$ long.

First recorded on leaves of *Berkheya membranifolia* and *speciosa* near Somerset East (MacOwan).

On *Berkheya latifolia*, Pretoria (I. B. Pole Evans), 12 : 11 : 1906. (Pole Evans, 204.) I.

On *Berkheya latifolia*, Irene, Pretoria District (I. B. Pole Evans), 2 : 11 : 1908. (Pole Evans, 539.) I.

On *Berkheya latifolia*, Koodoespoort, Pretoria (I. B. Pole Evans), 18 : 11 : 1908. (Pole Evans, 747.) O. and I.

On *Berkheya* sp., Barberton (I. B. Pole Evans), 4 : 11 : 1911. (Pole Evans, 1155.) I, II, and III.

On *Berkheya latifolia*, Garstfontein, Pretoria District (P. J. Pienaar), 8 : 4 : 1911. (Pole Evans, 1437.) III.

On *Berkheya Zeyheri*, Spelonken, Zoutpansberg (E. M. Doig), 14 : 8 : 1911. (Pole Evans, 1814.) III.

On *Berkheya Zeyheri*, Barberton (I. B. Pole Evans), 29 : 8 : 1911. (Pole Evans, 1855.) III.

On *Berkheya latifolia*, Garstfontein, Pretoria District (P. J. Pienaar, 6 : 12 : 1911. (Pole Evans, 1948.) I.

On *Berkheya* sp., Zuurvlakte, Aliwal North (P. J. Pienaar), 15 : 1 : 1912. (Pole Evans, 2006.) I, II, and III.

On *Berkheya latifolia*, Garstfontein, Pretoria District (P. J. Pienaar), 15 : 2 : 1912. (Pole Evans, 2148.) II and III.

On *Berkheya seminivea*, Garstfontein, Pretoria District (I. B. Pole Evans), 30 : 3 : 1912. (Pole Evans, 2185.) II and III.

On *Berkheya latifolia*, Garstfontein, Pretoria District (P. J. Pienaar), 14 : 5 : 1913. (Pole Evans, 6659.) III. Plate XLV, figs. 1 and 2.

On *Berkheya latifolia* and *B. seminivea* the uredosori are usually on the upper surface of the leaf, and the teleutosori on the under surface.

### 1a. **Puccinia Stobaeae** McOwan var. **Woodii** Syd.

*Aecidium Stobaeae* Kalchbr. and Cke. Grevillea viii, p. 70; Sacc. Syll. vii, p. 800.

*Puccinia Stobaeae* MacOwan. var. *Woodii* Syd. Sydow, Monogr. i, p. 160, f. 138.

*Aecidiospores.*—Aecidia hypophyllous, partly hidden by the tomentum of the leaf, solitary or in groups of 3–5, yellowish, cylindrical, with a pale yellow-white fimbriate-lacerate margin; spores globose, subglobose or ellipsoid, 24–33 μ diam., hyaline-pale yellow, epispore, with numerous large crowded prismatic warts, each about 2–2·5 μ wide.

*Uredospores.*—Sori hypophyllous, forming purple-brown orbicular spots on the upper surface; spores globose, regular, echinulate, obscurely brown, 20–28 μ diam.

*Teleutospores.*—Spores broadly ellipsoid, rarely sub-oblong, strongly thickened at the apex (up to 11 μ), but always broadly and obtusely rounded at the base, not or very slightly constricted at the middle, obscurely brown, 43–57 × 27–38 μ, pedicel hyaline, persistent, up to 54 μ long, 6 μ thick, thinner at the base.

First recorded on leaves of *Berkheya speciosa* from Natal (J. Medley Wood).

On *Berkheya* sp., Maritzburg (I. B. Pole Evans), 7 : 4 : 1911. (Pole Evans, 1446.) II and III.

*Berkheya umbellata*, Eshowe, Zululand (I. B. Pole Evans), 20 : 1 : 1912. (Pole Evans, 2023.) II and III.

On *Berkheya discolor*, Eshowe, Zululand (I. B. Pole Evans), 30 : 1 : 1912. (Pole Evans, 2028.)

On *Berkheya* sp., Umgeni Beach, Durban (I. B. Pole Evans), 4 : 6 : 1912. (Pole Evans, 2413.) I.

On *Berkheya* sp., Winter's Kloof, Maritzburg (E. M. Doidge), 30 : 6 : 1912. (Pole Evans, 2518.) II and III.

On *Berkheya* sp., Estcourt, Natal (I. B. Pole Evans), 29 : 7 : 1912. (Pole Evans, 5145.) III. Plate XLV, fig. 3; Plate XLVI, fig. 4.

The aecidiospores of this species are readily distinguished from those of *P. Stobaeae* by the presence of the large prismatic warts on the surface of the spores, whereas the spores of *P. Stobaeae* are delicately verruculose.

This very evident difference between the aecidiospores does not appear to have been noted before.

## CHRYSANTHEMUM L.

### 2. Puccinia chrysanthemi Roze.

*Uredo chrysanthemi* Roze, Plowright, in Trans. Brit. Mic. Soc. i, 1898.

*Puccinia chrysanthemi-chinensis*, Henn., in Hedw. xl, 26 (1901).

*Puccinia chrysanthemi* Roze, Bull. Soc. Myc. Fr., 1900, p. 92; Sacc. Syll, xvi, 296; Sydow, Monogr. i, 46, 854; McAlpine, Rusts of Australia. p. 153, f. 251–5 and pl. E, f. 21; Fischer, Ured. Schweiz, p. 190, f. 150; Grove, The British Rust Fungi, p. 131–3, f. 83–4.

*Uredospores.*—Sori generally hypophyllous, on irregular pallid-yellow or brown spots, scattered or in clusters, about 1–1½ mm. diam., frequently circinate, pulverulent, cinnamon; spores globose, subglobose, or ellipsoid, echinulate, brown, 24–32 × 17–27 μ.

(*Teleutospores.*—Mixed with the uredospores, ellipsoid or oblong-ellipsoid, rounded at the apex, slightly thickened, scarcely constricted, usually rounded at the base, minutely warted, chestnut-brown, 35–43 × 20–25 μ; pedicel stout, hyaline, persistent, 35–60 μ long; mesospores subglobose or pyriform, rounded at the apex, slightly thickened, minutely warted, chestnut.)

On leaves of cultivated Chrysanthemum (*Chrysanthemum indicum* and *C. sinense*) throughout South Africa, and is to be found in the uredo stage all the year round.

Barberton, 14 : 3 : 1905. (Pole Evans, 500.)
Johannesburg, 25 : 5 : 1905. ( „ „ 177.)
Pretoria, March, 1909. ( „ „ 660.)
Natal, 12 : 4 : 1912. ( „ „ 2326.)
Port Elizabeth, 12 : 4 : 1912. ( „ „ 2235.)

I have not as yet seen teleutospores in any South African material.

Europe, Japan, North America, Australia.

## **DIMORPHOTHECA** Vaill.

### 3. **Puccinia dimorphothecae** Pole Evans, n.sp.

Soris teleutosporiferis amphigenis, sparsis vel irregulariter aggregatis, minute, rotundatis, epidermide lacerata cinctis compactiusculis, castaneo-atris ; teleutosporis late ellipsoideis vel oblonga-ellipsoideis, utrinque rotundatis, apice leniter incrassatis, medio non vel vix constrictis, subbilitissime verruculosis, castaneo-brunneis, 33–40 × 24–26 $\mu$; pedicello hyalino, crasso, deciduo, saepe lateraliter inserto, brevi.

On leaves of *Dimorphotheca ecklonis*, Garstfontein, Pretoria District (P. J. Pienaar), 2 : 5 : 1911. (Pole Evans, 1499.) Plate XLVI, fig. 5.

## **GERBERA** Gron.

### 4. **Puccinia gerberae** Pole Evans, n.sp.

Soris teleutosporiferis amphigenis, maculis brunneolis vel purpureis insidentibus, sparsis vel in greges pulvinatis epidermide lacerata cincta, pulverulento - compactiusculis, obscure castaneo - brunneis ; teleutosporis ellipsoideis, utrinque rotundatis, medio leniter constrictis, levibus, castaneis, 30–36 × 18–20 $\mu$; pedicello hyalino, brevi, deciduo.

On leaves of *Gerbera plantaginea*, Garstfontein, Pretoria District (Miss J. Erasmus), 3 : 5 : 1913. (Pole Evans, 6599.) At same locality (P. J. Pienaar), 3 : 3 : 1915. (Pole Evans, 8887.) Plate XLVI, fig. 6.

## **HELICHRYSUM** Gaertn.

### 5. **Puccinia Kalchbrenneri** De Toni.

*Uredo lepisclinis* Thuem. in Mycoth. Univ. n. 1644.
*Puccinia helichrysi* Kalchbr. and Cke. Grevillea ix, p. 21.
*Puccinia Kalchbrenneri* De Toni. Sacc. Syll. vii, p. 645 ; Sydow, Monogr. i, p. 93, f. 83.

*Uredospores.*—Sori mostly hypophyllous, spots indistinct, often confluent, of variable size and diverse colour, scattered or subgregarious, minute, at first covered, convex, firm, finally free, ochraceous ; spores globose, subglobose or ellipsoid, verruculose, yellow, 20–30 × 19–26 $\mu$.

*Teleutospores.*—Sori hypophyllous, on the same spots, scattered or gregarious, minute, brown; spores oblong or subclavate, thickened at the apex, attenuated or rarely detruncate, constricted at the middle, smooth obscurely brown, 40–57 × 15–22 μ, rarely up to 27 μ broad; pedicel coloured, short, deciduous.

On leaves of *H. quinquenerve*, Barberton, Transvaal (I. B. Pole Evans), 4:2:1911. (Pole Evans, 1158.)

On leaves of *Helichrysum* sp., Paardeplaats, Lydenburg District (P. J. Pienaar), 2:5:1911. (Pole Evans, 1491.)

On leaves of *Helichrysum quinquenerve*, Barberton, Transvaal (I. B. Pole Evans), 29:8:1911. (Pole Evans, 1860.)

On leaves of *Helichrysum quinquenerve*, Eshowe, Zululand (I. B. Pole Evans), 30:1:1912. (Pole Evans, 2026.) Plate XLVI, fig. 7.

This fungus was first collected by MacOwan at Somerset East on *Helichrysum petiolatum* in 1879. This material has not been examined by the author. Sydow states that the pedicels are hyaline; in the majority of specimens that I have examined they are distinctly coloured.

### 6. **Puccinia MacOwani** Wint.

*Aecidium truncatum* Kalchbr. in herb.

*Puccinia MacOwani* Wint. Hedw., 1885, p. 255; Sydow, Monogr. i, p. 93, f. 82.

*Aecidiospores.*—Aecidia hypophyllous, on orbicular spots about 2 mm. diam., yellowish or brownish, often confluent, solitary or more often deposited loosely in groups of 2–10, white, elongated, closed at first then open, with an erect incised margin; spores angular-globose, verrucose, subhyaline, 23–32 μ diam.

*Uredospores.*—Sori amphigenous, scattered or in groups of 2–5, of medium size, rounded, long, covered by the epidermis, yellowish-brown; spores globose, subglobose, or ellipsoid, echinulate, yellowish-brown, 18–24 × 24–27 μ.

*Teleutospores.*—Sori hypophyllous or amphigenous, often mingled with the aecidia; spots similar, scattered or frequently a few aggregated, rotund, minute, ½–1 mm. diam., pulverulent, fuscous-brownish; spores elongated, subclavate or broadly fusiform, attenuated at both ends, strongly thickened (up to 9 μ) at the apex, slightly constricted at the middle, smooth, light brown, 45–60 × 18–27 μ; pedicel thick, persistent, hyaline, equal in length to the spore or shorter than it.

On leaves of:

*Helichrysum petiolatum*, Boschberg, Somerset East (MacOwan), July, 1877.

*Helichrysum* sp., Belfast, Transvaal (E. M. Doidge), February, 1909. (Pole Evans, 554.)

*Helichrysum* sp., Pretoria (E. M. Doidge), May, 1909. (Pole Evans, 683.)

*Helichrysum* sp., Lydenburg, Transvaal (P. J. Pienaar), 25 : 1 : 1911. (Pole Evans, 1072.)

*Helichrysum* sp., Garstfontein, Pretoria District (P. J. Pienaar), 26 : 3 : 1911. (Pole Evans, 1269.)

*Helichrysum* sp., Garstfontein, Pretoria District (P. J. Pienaar), 8 : 4 : 1911. (Pole Evans, 1421.)

*Helichrysum* sp., Garstfontein, Pretoria District (Miss J. Erasmus), 13 : 4 : 1911. (Pole Evans, 1430.)

*Helichrysum* sp., Paardeplaats, Lydenburg District (P. J. Pienaar), 2 : 5 : 1911. (Pole Evans, 1492.)

*Helichrysum* sp., Garstfontein, Pretoria District (Miss J. Erasmus), 15 : 1 : 1912. (Pole Evans, 2082.) Plate XLVII, fig. 8.

The aecidia are rarely seen in the Transvaal, and their place would appear to be taken by uredospores, which occur commonly on Transvaal material, and which have not hitherto been recorded for this species.

### 7. **Puccinia Pienaarii** Pole Evans, n.sp.

Aecidiis amphigenis in villo nidulantibus, solitariis vel gregariis, pallidis, margine laciniato; aecidiosporis angulato-globosis vel ellipsoideis, subtiliter verruculosis, subhyalinis, 21–30 × 15–22 $\mu$; soris teleutosporiferis amphigenis, sine maculis, saepe aecidiis immixtis, sparsis vel gregariis, rotundatis, ca. 1 mm. diam. primo tomento folii tectis, dein nudis, pulverulentis, brunneo-atris; teleutosporis difformibus, ellipsoideis vel oblongis, apice rotundatis vel truncatis, medio parum constrictis, basi plerumque rotundatis, ad marginem irregulariter incrassatis (usque 7 $\mu$), flavo-brunneis, levibus, 33–48 × 18–27 $\mu$; pedicello hyalino, brevi, caduco.

On leaves of *Helichrysum* sp. Paardeplaats, Lydenburg District (P. J. Pienaar), 2 : 4 : 1911. (Pole Evans, 1489.) Plate XLVII, fig. 9.

This species is remarkable for the irregularly thickened walls of the teleutospores. In some cases the walls might well be described as being flanged.

*Aecidiospores.*—Aecidia amphigenous embedded in pubescence, solitary or gregarious, pallid, with a laciniate margin; spores angular-globose or ellipsoid, delicately verruculose, subhyaline, 21–30 × 15–22 $\mu$.

*Teleutospores.*—Sori amphigenous, without spots, often mingled with the aecidia, scattered or gregarious, rotund, about 1 mm. diam., at first covered by the leaf pubescence, afterwards exposed, pulverulent, brownish black; spores of unusual shape, ellipsoid or oblong, rounded at the apex or truncated, usually a little constricted at the middle, mostly rounded at the base, irregularly thickened at the margins (up to 7 $\mu$), yellowish-brown, smooth, 33–48 × 18–27 $\mu$; pedicel hyaline, short, caducous.

## HYPOCHOERIS L.

### 8. **Puccinia Hypochoeridis** Oud.

*Uredo hysoeridis* Schum. Pl. Saell. ii, p. 233 (1801).

*Puccinia Hypochoeridis* Oud. in Nederl. Kruidk. Archief. ii, ser. 1, p. 175 (1873); Sydow, Monogr. i, 100; Fischer, Ured. Schweiz., p. 232; McAlpine, Rusts of Australia, p. 159, f. 62–3; Grove, The British Rust Fungi, p. 148–9, f. 100–1.

*Uredospores.*—Sori amphigenous or often caulicolous, generally forming minute spots, scattered, pulverulent, cinnamon, primary of medium size, secondary minute; spores globose, subglobose, or ellipsoid, echinulate, pale brown, 22–28 $\mu$ diam., with two germ pores.

*Teleutospores.*—Sori amphigenous, often caulicolous, scattered, pulviniform, black; spores ellipsoid or ovate-ellipsoid rounded at both ends, rarely attenuated, not thickened, not or scarcely constricted at the middle, delicately verruculose, brown, 30–46 × 18–24 $\mu$; epispore thin; pedicel short, hyaline.

On *Hypochoeridis radicata*, Newlands, Cape Town (H. H. W. Pearson), 12:11:1912. (Pole Evans, 5595.) Plate XLVII, fig. 10.

Europe, Siberia, North America, Chili, Australia.

Grove *l.c.*, p. 149, states: "The alleged punctations of the teleutospores were invisible in all the specimens I have seen." These are, I find, clearly visible in the Cape Town material.

## PRINTZIA Cass.

### 9. **Puccinia Printziae** Thuem.

*Puccinia Printziae* Thuem. in Myc. Univ. n. 742; Sacc. Syll. vii, p. 704; Sydow, Monogr. i, p. 137–8, f. 118.

*Teleutospores.*—Sori hypophyllous, scattered, forming round yellowish-fuscous spots, minute, but often spreading into larger ones, verruciform, pulvinate, firm, date-brown-chestnut; spores oblong or subclavate, rounded at the apex or attenuated, strongly thickened (up to 12 $\mu$), constricted at the middle, attenuated below, smooth, light brown, 40–65 × 16–22 $\mu$; pedicel hyaline, persistent, thick, up to 55 $\mu$ long.

On leaves of *Printzia Huttoni*, near Somerset East (MacOwan, 1278). (Pole Evans, No. 8846.) Plate XLVII, fig. 11. Material kindly supplied to me by the Director of the South African Museum, Cape Town.

## SENECIO L.

### 10. **Puccinia aecidiiformis** Thuem.

*Puccinia aecidiiformis* Thuem. on Flora, 1875, p. 378, and 1880, p. 318; Sacc. Syll. vii, p. 704; Sydow, Monogr. i, p. 128, f. 108.

*Teleutospores.*—Sori hypophyllous or caulicolous, scattered or gregarious, on orbicular yellow spots, of medium size, often confluent on the stem, ochraceous, compact; spores oblong, rounded at the apex or attenuated, thickened above (up to 8 $\mu$), slightly constricted at the middle, attenuated below, smooth, pale yellow or subhyaline, 52–75 × 20–28 $\mu$; pedicel hyaline, deciduous, up to 38 $\mu$ long.

On leaves and stem of (*Nidorella mespilifolia*) *Seneci o deltoidis* D.C., in Boschberg Mountains, autumn 1875. (MacOwan, 1105; Pole Evans, 8845.) Plate XLVIII, fig. 12.

I am indebted to the Director of the South African Museum, Cape Town, for material of this species, and also for allowing me to examine the Museum sheets of this fungus.

The host was originally regarded as *Nidorella mespilifolia*, but it has since been determined as *Senecio deltoidis* D.C.

### 11. **Puccinia oedipus** Cke.

*Puccinia oedipus* Cke. in Grevillea x, p. 126; Sacc. Syll. vii, p. 608; Sydow, Monogr. i, p. 143, f. 122.

*Uredospores.*—Sori hypophyllous, minute, scattered, fuscous; spores globose, echinulate, yellow-brownish, 30–38 $\mu$ diam.

*Teleutospores.*—Sori hypophyllous, scattered, minute, black-brownish, pulverulent; spores broadly ellipsoid or oblong-ellipsoid, rounded at both ends, thickened at the apex (up to 11 $\mu$), slightly constricted at the middle, somewhat smooth, a beautiful chestnut, 50–54 × 27–35 $\mu$, pedicel hyaline, persistent, thick, sometimes twisted, up to 90 $\mu$ long, often inserted obliquely.

On leaves of *Senecio pandurifolia*, Inanda, Natal. (J. Medley Wood, 561.) May, 1881. (Pole Evans, 369.) Plate XLVIII, fig. 13.

## **SPILANTHES** L.

### 12. **Puccinia africana** Cke.

*Puccinia africana* Cke. in Grevillea viii, p. 71 (1879); Sacc. Syll. vii, p. 706; Sydow, Monogr. i, p. 156, f. 132.

*Teleutospores.*—Sori hypophyllous, forming minute green spots, scattered or deposited circinately, minute, compact, black-brown; spores clavate or fusiform, rounded at the apex or narrowed, thickened (up to 8 $\mu$), constricted at the middle, attenuated at the base, smooth, light brown, 43–58 × 14–19 $\mu$, pedicel hyaline shorter than the spore.

On leaves of *Spilanthes acmella* Kentani (Pegler, 1922), 19 : 11 : 1913. (Pole Evans, 7088.) Plate XLVIII, fig. 14.

## VERNONIA Schreb.

### 13. Puccinia vernoniicola P. Henn.

*Puccinia vernoniicola* P. Henn., in Engler Oostafrikan Pflanzenwelt, p. 50 (1895); Sacc. Syll. xiv, p. 317; Sydow, Monogr. i, p. 177, f. 155.

*Teleutospores.*—Sori hypophyllous, spots dark, absent or rudimentary, scattered, round, 2–2½ mm. diam., pulvinate, ochraceous; spores club-shaped, rounded at the apex, not thickened, slightly constricted at the middle, attenuated at the base, smooth, hyaline-yellow, 45–70 × 20–27 μ, epispore very thin; pedicel hyaline, thick, persistent, up to 100 μ long.

On leaves of *Vernonia angulifolia*, Table Mountain Location, Natal (C. Fuller), 18:5:1911. (Pole Evans, 1618.) Winkle Spruit, Natal, 6:8:1912. (Pole Evans, 2498.) Plate XLIX, fig. 15.

This fungus was first recorded in 1895 on a *Vernonia* from Tropical East Africa at Marangu.

### 14. Puccinia inflorescenticola Pole Evans, n.sp.

Soris teleutosporiferis in inflorescentibus evolutis et maxime hypertrophico-deformatis insidentibus, nigris, confluentibus, irregularibus, bullas fusiformes et gallaeformes usque 3–4 cm. longas efformantibus; teleutosporis cylindricis cylindrico-clavatis vel fusiformibus, apice plerumque rotundatis vel interdum acutiusculis, valde incrassatis (usque 9 μ), medio leniter constrictis, basi attenuatis, levibus, flavobrunneis, 40–60 × 18–22 μ; pedicello colorato, crasso, persistenti, usque 63 μ longo.

Hab. in inflorescentibus *Vernoniae* sp., Rosehaugh, Transvaal (T. R. Sim), 3:6:1914. (Pole Evans, 7802.) Plate XLIX, fig. 16.

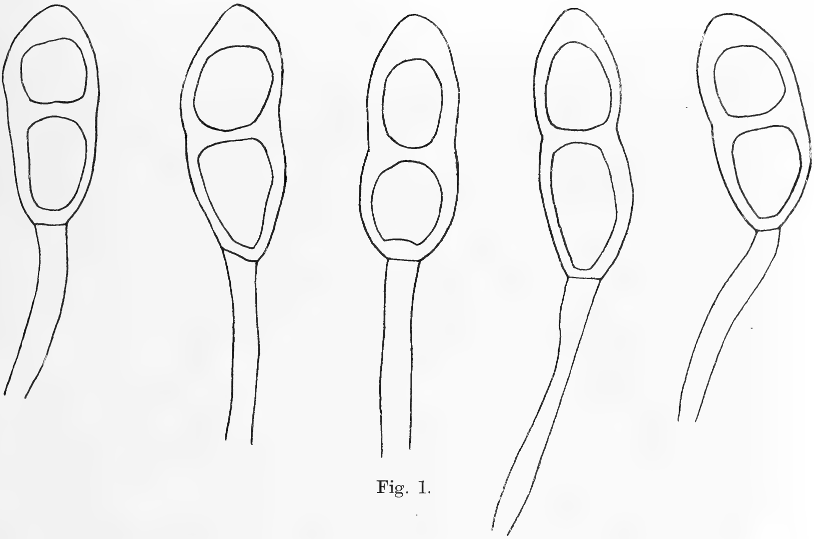


Fig. 1.

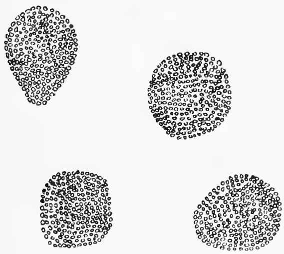


Fig. 2.

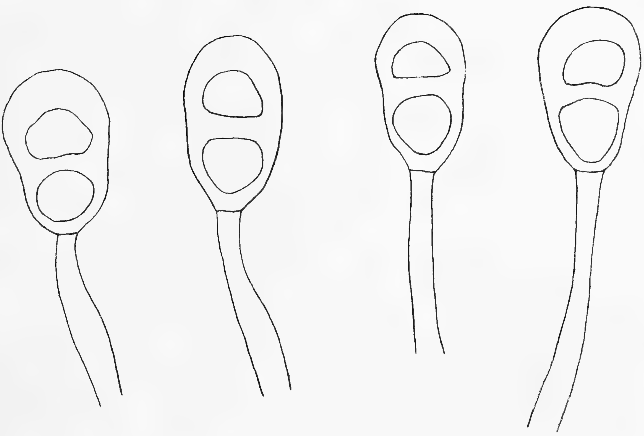


Fig. 3.

*I. B. Pole Evans del.* *Adlard & West Newman.*

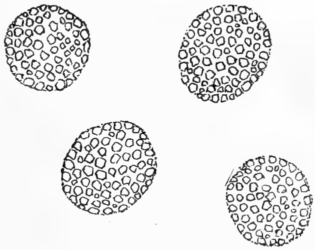


Fig. 4.

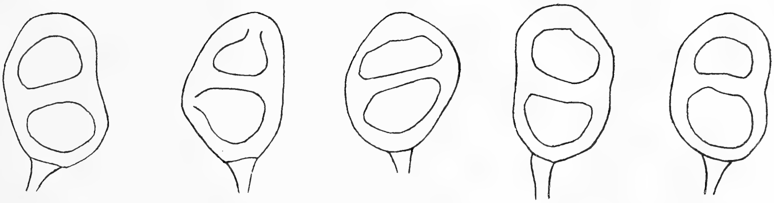


Fig. 5.

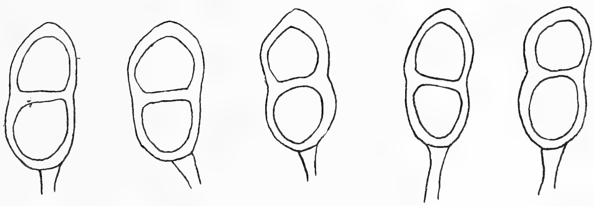


Fig. 6.

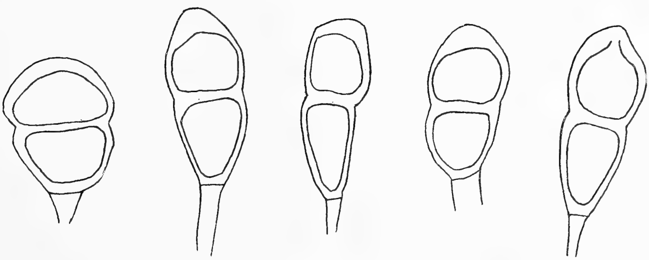


Fig. 7.

*I. B. Pole Evans del.* *Adlard & West Newman.*

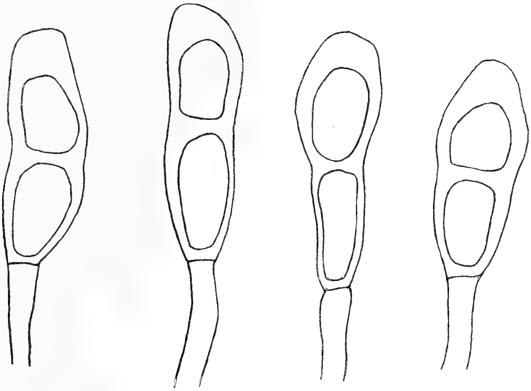


Fig. 8.

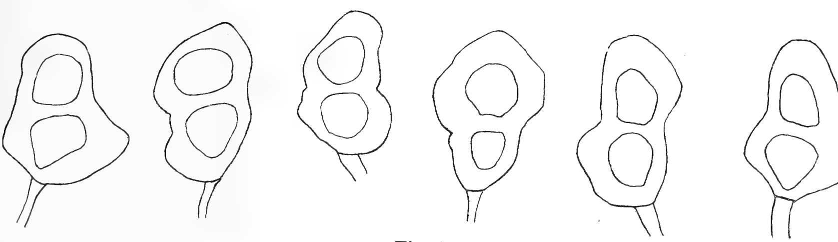


Fig. 9.

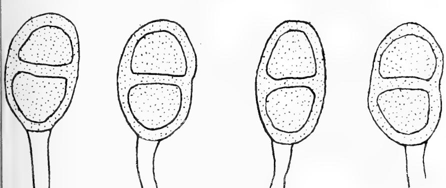


Fig. 10.

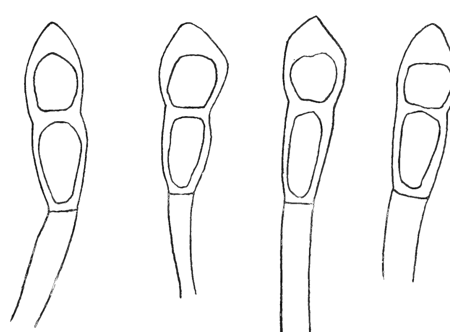


Fig. 11.

*I. B. Pole Evans del.* *Adlard & West Newman.*

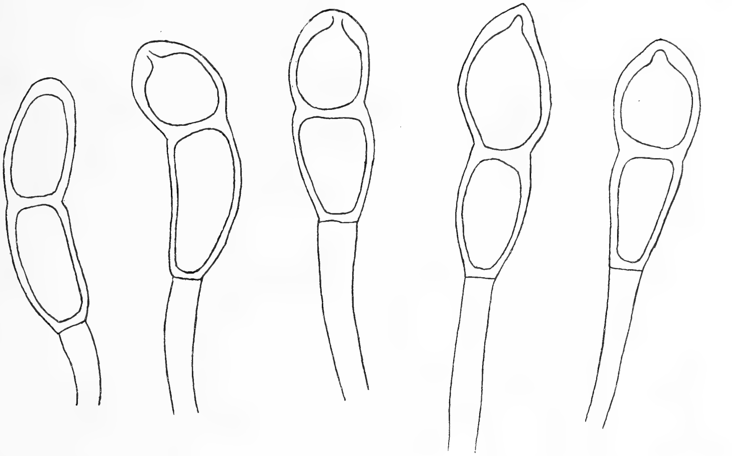


Fig. 12.

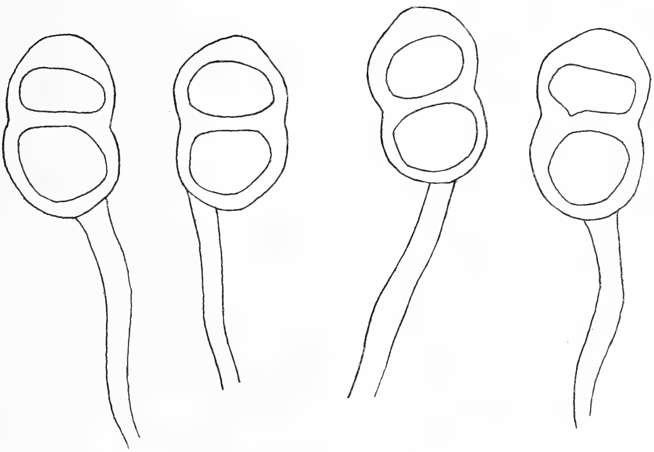


Fig. 13.

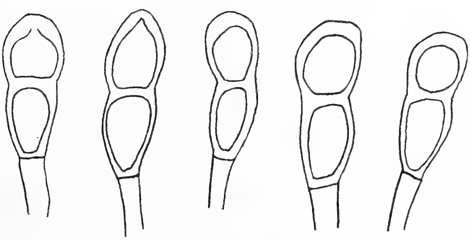


Fig. 14.

*I. B. Pole Evans del.* *Adlard & West Newman.*

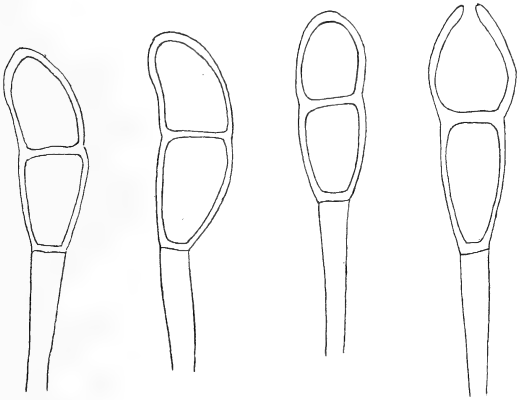


Fig. 15.

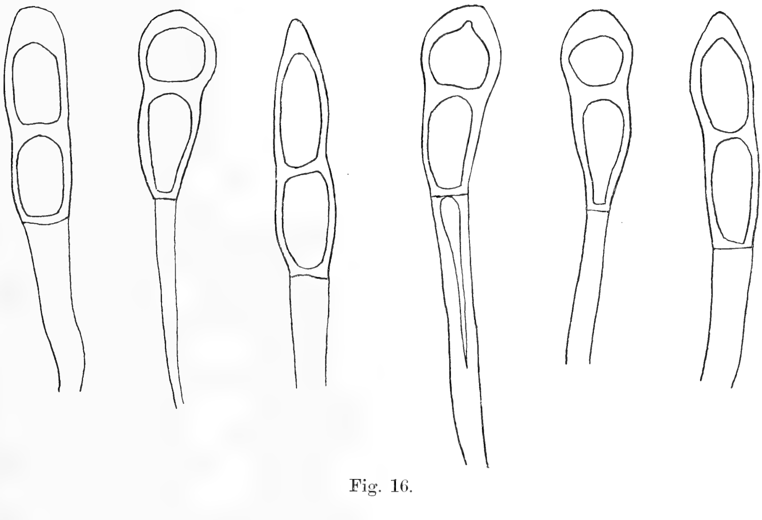


Fig. 16.

*I. B. Pole Evans del.* *Adlard & West Newman.*

# HEATING AND COOLING APPARATUS FOR RÖNTGEN CRYSTALLOGRAPHIC WORK.

By J. Steph. van der Lingen.
(From the Applied Mathematics Laboratory, South African College.)

(Read August 18, 1915.)

One of the many problems of modern physics is the energy of atoms and its relation to temperature. Since the publication of De Bye's extension of

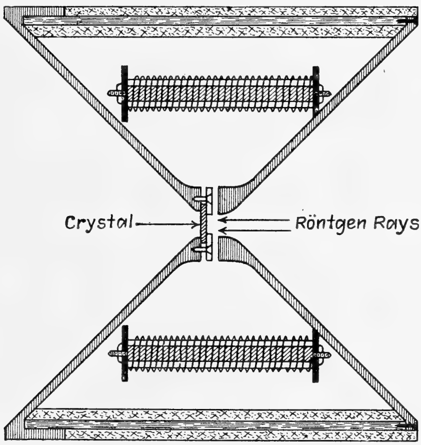



Fig. I.

von Lane's theory of Röntgen interference, several experiments were carried out with a view to determine, firstly, the validity of De Bye's theory, and, secondly, the variation of atomic energy due to "heat motion." *

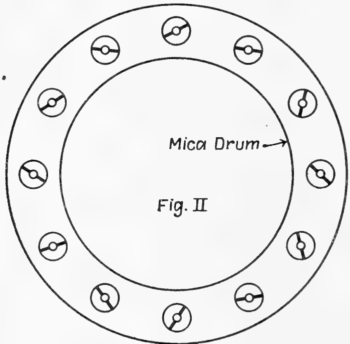
In order to facilitate the work of those who wish to carry on the research

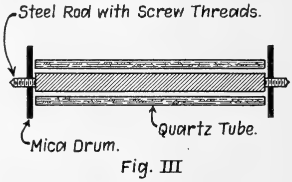
* See von Lane and Author: Phys. Zeit., January, 1914; Die Naturwissenchaften, March 27 and April 10, 1914.

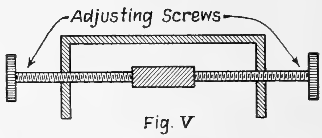
on the determination of the energy of an atom at zero temperature, the following pieces of apparatus are described.

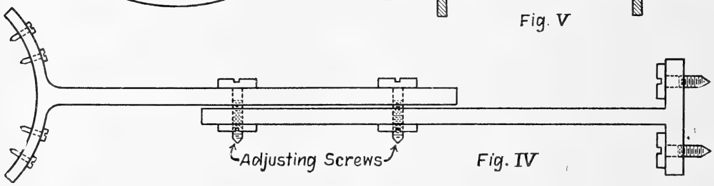
## Construction of Heating Oven.

Two cones of copper are cast from models in which the vertical angle of the cone is a right angle.




These cones are then cut down so as to fit over a copper cylinder. (See Fig. 1.)

One cone is permanently screwed on the cylinder; the other has a cap on it so that it just slips over the cylinder.

The movable cone is then drilled so that four screws may clamp the crystal at its vertex.

These screws are sunk in the holder so that the crystal-carrying cone may be moved flush against the fixed cone.

The cylinder is lined with asbestos packing both inside and outside.

Two rings are now cut out of a fairly thick piece of mica (Fig. 2).

Small holes are drilled through each of these rings so that the threads of the steel rods (Fig. 3) may pass through them.

These steel rods are screwed on to one of the rings, and then quartz tubes are slipped over them.

Spirals of platinum wire are now made and slipped over the quartz tubes.*

The second ring is slipped over the projecting ends of the steel rods, and is then screwed down.

Each spiral is now covered in with kaolin, so that the "turns" are electrically insulated.

Two small holes are drilled through the side of the cylinder and quartz tubes inserted in them.

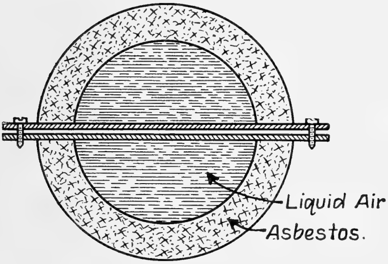



Fig. VI

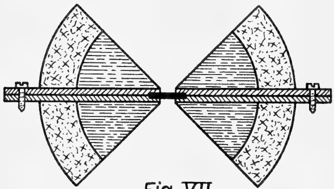


Fig. VII

The drum is now placed inside the cylinder and the free ends of the "series wound" spirals passed through the quartz tubes.

A hole is drilled vertically above the position of the crystal so that a a platinum-platinum rhodium thermocouple's junction may be put in contact with the crystal.

The cylinder is now screwed on to an adjustable holder (Fig. 4).

Two screws, which may slide in slots, enable one to adjust the height of the cylinder, whereas two adjusting screws (Fig. 5) allow one to rotate the crystals towards or away from the diaphragm.

The movable cone enables the experimenter to rotate the crystal round a perpendicular axis.†

The free ends of the platinum wire are now connected to a pair of well-insulated terminals.

* Nickel wire does not serve this purpose. It generally breaks down at weak points after a few hours.

† A cylindrical foot piece—like that of the diaphragm generally used—would allow of an extra rotation. This, however, is hardly necessary, as the cone itself allows for small adjustments.

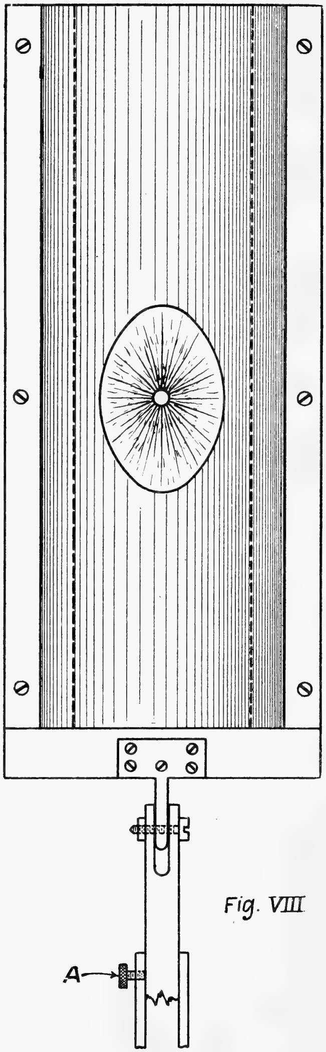



Fig. VIII

This apparatus allows one to heat crystals up to 600° C. without any trouble.*

## Construction of Cooling Apparatus.

The absorption of Röntgen rays in liquids is so great that the exposures must be continued for many hours before a trace of a photogram can be obtained.

To avoid absorption, four concentric semi-cylinders are soldered on to two pieces of rectangular copper plates (Fig. 6).

The space between the cylinders is packed with asbestos wool.

The foot piece of the cylinders consists of two pairs semi-circular discs of copper. The space between each pair is also packed with asbestos.

At a central point below the middle of the cylinders a cone is inserted (Figs. 7 and 8) in each pair of cylinders, opening 5 mm.

The upper part of the cylinders is closed by a thin plate of copper.

The apparatus is mounted on its carrier, which is similar to carrier of the oven.

The screw, A, enables one to alter the height of the crystal, which is clamped between the cones.

The whole of the apparatus nickel-plated and polished.

This apparatus does away with the absorption, and at the same time retains liquid air for a considerable number of hours, when the whole of the upper part is covered with a sheet of asbestos.

* The lead box containing the apparatus is lined with wood and asbestos, and is well ventilated behind the oven. Asbestos sheets screen the films from heat radiations.

# THE ARRANGEMENT OF SUCCESSIVE CONVERGENTS IN ORDER OF ACCURACY.

By Alexander Brown.

(From the Applied Mathematics Laboratory, South African College.)

(Read September 15, 1915.)

§ 1. One of the most important uses of simple continued fractions is for the solution of the problem *to find the fraction, whose denominator does not exceed a given integer, which shall most closely approximate to a given number commensurable or incommensurable.* A practically complete solution was provided by Lagrange in 1769 in his paper "Sur la Resolution des Equations Numériques" * and his treatment, involving the use both of principal convergents (*fractions principales*) and of intermediate convergents (*fractions secondaires*), has become the classic exposition in text-books of algebra. His results give the fraction nearest in defect, and the fraction nearest in excess, satisfying the conditions. He does not consider the question of deciding which of these two fractions is nearest in absolute value to the given number.

Chrystal, in his *Algebra*,† vol. ii, p. 424, Ex. 10, gives a rule "enabling us in most cases to save calculation in deciding between the closeness" of the fraction in defect and that in excess, but the rule is not easy to apply; while Serret, in his *Cours d'Algèbre Supérieure*,‡ p. 24, leaves the question as Lagrange dealt with it. The present paper was written to give an easy method of deciding between the two fractions, and to arrange the successive convergents in such a scheme that the nearest in absolute value satisfying the stated condition could be at once picked out. Afterwards a short note by Muir § was found *On Convergents*, in which the same method of discrimination is given without proof. This note seems to have been overlooked by later writers.

* "Mémoires de l'Académie royale des Sciences et Belles-Lettres de Berlin," t. xxiii, 1769. "Œuvres de Lagrange" (Serret), 1868, vol. ii, p. 568.

† "Algebra" (Chrystal), 1859, part ii.

‡ Sixth edition, 1910.

§ Report of the British Association for the Advancement of Science for 1876.

I give below a proof of the rule and a method of arranging the convergents in one set so as to show the nearest in defect, the nearest in excess and the nearest in absolute value, satisfying the stated condition.

§ 2. Consider the simple continued fraction

$$x = a_1 + \frac{1}{a_2} + \frac{1}{a_3} + \ldots + \frac{1}{a_s} + \ldots$$

and let the successive principal convergents be $p_1/q_1, p_2/q_2, \ldots p_s/q_s \ldots$

Arrange the sets of quantities :

$$0/1, p_1/q_1, p_3/q_3 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(A)},$$
$$1/0, p_2/q_2, p_4/q_4 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(B)},$$

and between any successive two $p_l/q_l$ and $p_{l+2}/q_{l+2}$ interpolate the set

$$\frac{p_l + p_{l+1}}{q_l + q_{l+1}}, \frac{p_l + 2p_{l+1}}{q_l + 2q_{l+1}} \cdots \frac{p_l + (a_{l+1} - 1)\, p_{l+1}}{q_l + (a_{l+1} - 1)\, q_{l+1}}$$

(intermediate convergents).

When the sets are completed they give fractions increasing in complexity and respectively increasing and decreasing in magnitude, which continually approach $x$. These sets provide solutions to the problem of finding the fraction of given complexity (*i. e.* with denominator less than a given number) nearest in defect or nearest in excess to $x$. A doubt is left as to which of the two is nearest in absolute value.

Of the two fractions here mentioned it is known that one (at least) must be a principal convergent.* The final problem is thus restricted to a comparison between a principal convergent of one set and an intermediate convergent of the other set.

For precision let $p_l/q_l$ and $p_{l+2}/q_{l+2}$ be two successive principal *odd* convergents ; $p_{l+1}/q_{l+1}$ is a principal even convergent, and the question is whether $p_{l+1}/q_{l+1}$ or $(p_l + rp_{l+1})/(q_l + rq_{l+1})$ is nearer $x$, where $r$ can have any integral value from 1 to $a_{l+2} - 1$.

Let $x_{l+1}$ be defined by

$$x = a_1 + \frac{1}{a_2} + \ldots + \frac{1}{a_l} + \frac{1}{x_{l+1}}$$

so that
$$x_{l+2} = a_{l+2} + \frac{1}{a_{l+3}} + \ldots$$

Then
$$x = (p_l + x_{l+2} \cdot p_{l+1})/(q_l + x_{l+2} \cdot q_{l+1})$$

Also, since $l$ is supposed odd,

$$p_{l+1}/q_{l+1} > x > (p_l + rp_{l+1})/(q_l + rq_{l+1})$$

The differences $D_1$ and $D_2$ of these fractions from $x$ are

$$D_1 = x - (p_l + rp_{l+1})/(q_l + rq_{l+1})$$
$$= \frac{p_l + x_{l+2} \cdot p_{l+1}}{q_l + x_{l+2} \cdot q_{l+1}} - \frac{p_l + rp_{l+1}}{q_l + rq_{l+1}}$$
$$= \frac{x_{l+2} - r}{(q_l + x_{l+1}\, q_{l+1})\,(q_l + rq_{l+1})}$$

* Chrystal, *loc. cit.*, pp. 421–2.

since
$$p_{l+1} \cdot q_l - p_l q_{l+1} = +1$$
$$D_2 = p_{l+1}/q_{l+1} - x$$
$$= \frac{1}{q_{l+1}(q_l + x_{l+2} q_{l+1})}$$

$\therefore D_1 \gtrless D_2$ according as
$$\frac{x_{l+2} - r}{q_l + r q_{l+1}} \gtrless \frac{1}{q_{l+1}}$$
*i. e.* as
$$x_{l+2} - r \gtrless q_l/q_{l+1} + r$$
*i. e.* as
$$r \lesseqgtr \frac{1}{2}(x_{l+2} - q_l/q_{l+1})$$

(Chrystal's result, already referred to, follows easily.)

We now observe that
$$x_{l+2} = a_{l+2} + \frac{1}{a_{l+3}} + \ldots$$
and
$$\frac{q_l}{q_{l+1}} = \frac{1}{a_{l+1}} + \frac{1}{a_l} + \ldots + \frac{1}{a_2}$$

In selecting the convergents nearest in absolute value to $x$, we seek to exclude those intermediate convergents which are further from $x$ in absolute value than is $p_{l+1}/q_{l+1}$: *i. e.* the $r$'s to be excluded satisfy the inequality $D_1 > D_2$
$$\textit{i.e. } r < \frac{1}{2}\left\{a_{l+2} + \frac{1}{a_{l+3}} + \ldots - \left(\frac{1}{a_{l+1}} + \frac{1}{a_l} \ldots + \frac{1}{a_2}\right)\right\}$$

The cases of $a_{l+2}$ odd and $a_{l+2}$ even must be distinguished.

(1) $a_{l+2}$ odd $= 2m + 1$ (say).

Since $\frac{1}{a_{l+2}} + \ldots$ and $\frac{1}{a_{l+1}} + \ldots$ are both proper fractions, the inequality is satisfied by $r = 1, 2, \ldots m$ only.

(2) $a_{l+2}$ even $= 2m$ (say).

It is certain that values of $r$ up to $(m-1)$ are to be excluded.

The value $r = m$ is to be excluded only if
$$\frac{1}{a_{l+3}} + \frac{1}{a_{l+4}} + \ldots > \frac{1}{a_{l+1}} + \frac{1}{a_l} \ldots + \frac{1}{a_2}$$

*i.e.* if $a_{l+3} < a_{l+1}$

or if $a_{l+3} = a_{l+1}$ and $a_{l+4} > a_l$

or if $a_{l+3} = a_{l+1}$, $a_{l+4} = a_l$, $a_{l+5} < a_{l-1}$

etc.

The test is an easy one to apply in practice, for we are comparing partial quotients respectively right and left of a particular partial quotient.

A difficulty arises when the comparison has to be carried so far that one of the partial fractions terminates; this can be overcome by adding $\infty$'s as partial quotients at the end, as many as necessary. Thus we may write

$a_2 = a_2 + \frac{1}{\infty} + \frac{1}{\infty} \ldots$; and we note that for the purposes of the comparison we replace $a_1$ by $\infty$.

An interesting special case occurs when the two partial fractions compared are actually equal; this requires that all the corresponding partial quotients be equal in pairs:

$$i.\,e.\ a_{k+1}=a_{k-1},\ a_{k+2}=a_{k-2}\ \ldots\ a_{2k-2}=a_2.$$

In this case the intermediate convergent and the principal convergent under comparison are equidistant in value from $x$. The value of $x$ is thus half the sum of these two convergents, and we may write

$$a_1 + \frac{1}{a_2} \cdots + \frac{1}{a_l} + \frac{1}{2m} + \frac{1}{a_l} \cdots + \frac{1}{a_2} = \frac{1}{2}\left\{\frac{p_{l+1}}{q_{l+1}} + \frac{p_l + mp_{l+1}}{q_l + mq_{l+1}}\right\}$$

a result which can be got by applying the properties of symmetrical continuants.*

The reasoning, used above for $l$ odd, gives identical results for $l$ even.

§ 3. To obtain a convenient scheme of arrangement take an example

$$2 + \tfrac{1}{2} + \tfrac{1}{3} + \tfrac{1}{4} + \tfrac{1}{2} + \tfrac{1}{5}.$$

Write down the principal odd and the principal even convergents, and interpolate the intermediate convergents. We have the two sets,

0/1; 2/1, (7/3), 12/5; 17/7, 90/37; 163/67.

1/0; 5/2, (22/9), (39/16), 56/23; 73/30, (236/97), (399/164), 562/231, 725/298; 888/365.

Certain of the intermediate convergents may now be removed as being further from the true value than is a principal convergent with a smaller denominator.

In the set between 2/1 and 17/7 $a_{l+1} = 3$, and we remove 7/3 only.

In the set between 5/2 and 73/30 $a_{l+1} = 4$, and we remove 22/9 certainly and possibly 39/16; here $a_{l+2}$ is 2 and $a_l$ is 3, *i.e.* $a_{l+2} < a_l$ and so 39/16 must be removed; and so on.

Those to be removed are enclosed by brackets in the above list, and the fractions left have the property that between two of them consecutive in complexity no simpler fraction can be inserted as near in absolute value to the fraction as the less complex of the two.

The following arrangement in groups which *end* instead of *begin* with a principal convergent has advantages:

| Fractions in defect. | Fractions in excess. |
|---|---|
| 0/1 | 1/0 |
| (1/1), 2/1 | (3/1), 5/2, |
| (7/3), 12/5, 17/7 | (22/9), (39/16), 56/23, 73/30 |
| 90/37, 163/67 | (236/97), (399/164), 562/231, 725/298, 888/365 |

The method of construction is as follows:

* Muir, Proc. Roy. Soc. Edin., 1873–4.

Write down 0/1 and 1/0

$$\text{then } \frac{0+1}{1+0}, \frac{0+2\times 1}{1+2\times 0}, \textit{ i. e. } 1/1, \text{ and } 2/1$$

$$\text{then } \frac{1+2}{0+1}, \cdot\frac{1+2\times 2}{0+2\times 1}, \textit{ i. e. } 3/1 \text{ and } 5/2$$

and so on, the number of terms in each set being determined by the corresponding partial quotient.

The terms to be removed are now the earlier members of a set.

When these are removed we obtain a series of fractions of least complexity nearest $x$ in absolute value by reading along the successive lines completely from left to right, *e. g.* the fractions nearest 888/365 with denominators less than 10, 20, 40, 100 are 17/7, 17/7, 90/37, 163/67, all being in defect.

The particular fraction 1/0 is exceptional.

The actual differences are tabulated below in the order of the previous table:

| | |
|---|---|
| 2·43 | $\infty$ |
| (1·43), ·43 | (·57), ·067 |
| (·10), ·033, ·0042 | (·0115), (·0046), ·0019, ·00054 |
| ·00045, ·000041 | (·00011), (·000050), ·000023, ·000009, 0. |

A further example is added to show the special points mentioned in § 2:

$$2 + \tfrac{1}{4} + \tfrac{1}{2} + \tfrac{1}{4} + \tfrac{1}{2}.$$

The table of convergents is

| | |
|---|---|
| 0/1 | 1/0 |
| 1/1, 2/1 | (3/1), (5/2), 7/3, 9/4 |
| 11/3, 20/9 | (29/13), 49/22, 69/31, 89/40 |
| (109/49), 198/89 | (287/129), 485/215, 683/307, 881/396. |

The convergents 3/1, 29/13, and 287/129 can be removed at once.

In settling the doubtful ones remember that we use $\infty$ instead of the first partial quotient, and $\infty$ for any partial quotient after the last or before the first.

For exclusion of 1/1 $4 < \infty$. $\therefore$ 1/1 is excluded.

For 5/2 $2 < \infty$. $\therefore$ 5/2 is excluded.

For 11/3 $4 = 4$, $2 > \infty$; this not true. $\therefore$ 11/3 is included.

For 49/22 $2 = 2$, $4 = 4$, $\infty = \infty$. $\therefore \frac{49}{22}$ and $\frac{20}{9}$ are equidistant.

For 109/49 $4 = 4$, $\infty > 2$. $\therefore$ 109/49 is excluded.

485/218 $\infty < 2$; this is not true. $\therefore$ 485/218 is included.

# THE USE OF A STANDARD PARABOLA FOR DRAWING DIAGRAMS OF BENDING MOMENT AND OF SHEAR IN A BEAM UNIFORMLY LOADED.

By Alexander Brown.

(From the Applied Mathematics Laboratory, South African College.)

(Read September 15, 1915.)

§ 1. The important stresses in a uniform continuous beam are the shear and the bending moment; they are best shown in the form of graphs, where length along the beam is taken as abscissa and the required function as ordinate. The values of the bending moment at the points of support can be obtained by the equation of three moments, and the variation between supports follows the parabolic law. The diagram of bending moment may therefore be drawn point by point. The pressures may be got by using the equation giving pressure in terms of three bending moments, or by taking moments about successive points of support.

The form of bending moment graph generally used by engineers for a continuous beam of several spans is derived from the graphs for the separate spans considered as discontinuous beams; the difference between the bending moments for the two cases is a linear function of the distance along the beam; the linear function is obtained from knowledge of the bending moments at the points of support; and the bending moment for the continuous beam is represented graphically as the difference of the ordinates of the graph for discontinuous beams, and of a straight line. This method is particularly valuable in irregular loading of the beam.

For a uniformly loaded beam a simpler method may be used, and in what follows it is shown that a parabola of standard *latus rectum* may be used to obtain the graph of bending moment, the shear diagram, and the values of the pressures without further calculation than is required to give the values of the bending moment at the points of support. The case of a uniform beam loaded at isolated points is included, the isolated points being considered as points of support.

The method holds for beams of variable section provided the bending moments at the points of support have been determined, the variation of bending moment and of shear between such points depending only on the intermediate loading.

§ 2. Let $x$ be the distance of a point P on a uniform continuous beam from a fixed point on the beam; let G be the bending moment at P (considered positive when the concavity is upwards), and $w$ the weight per foot run, then

$$G = K + Lx - \tfrac{1}{2} wx^2$$

where K and L are constants, which are different for each span.

The term $-\frac{1}{2} wx^2$ is the same for all spans, and so the various parts of the bending moment graph are all parabolas of the same *latus rectum* with their axes perpendicular to the length of the beam.

Suppose we have lines drawn through the points of support perpendicular to the beam, and lengths set off on them to represent on a proper scale the bending moments at these points. To get the bending moment graph between these points we have to draw through the ends of the perpendicular lines a parabola with the proper *latus rectum* and with its axis perpendicular to the beam. If we have a parabola of suitable *latus rectum* cut out of cardboard, the work can be done by adjusting this cardboard parabola, keeping its axis perpendicular to the beam, till it passes through both points. If pins are put through the points the adjustment is quickly made.

The shear may be easily got from the same figure. If H is the shear

$$H = -\frac{dG}{dx}.$$

$\frac{dG}{dx}$ is proportional to the slope of the parabola, which again is proportional to the distance from the vertex measured parallel to the tangent at the vertex. Thus in drawing and cutting out the parobola, care should be taken that for any point on the parabola the abscissa of the point can be easily read off. If the parabola is properly adjusted in place, its boundary is the bending moment graph, and the abscissa readings represent the shear on some scale. When the shear is known at two adjacent points of support, the shear diagram is completed by drawing a straight line. When the shears on two sides of one point of support are known, their difference gives their pressure on that support.

§ 3. Consider the question of suitable scale for the parabola.

Let $x$ be the distance in feet along a uniform beam from a point where the shear is zero, and the bending moment $G_0$, then

$$G = G_0 - \tfrac{1}{2} wx^2, \ H = wx.$$

We propose to use a parabola $\eta = k\xi^2$ drawn on squared paper to represent the values of G and H corresponding to any value of $x$; $\xi$ is to represent length along the beam and also shear, while $\eta$ is to represent $G_0 - G$.

Suppose the scale of the figure is such that one unit of $\xi$ represents $n$ feet; then on some scale $\xi$ represents shear and $\eta$ bending moment.

Suppose one unit of $\xi$ represents $\lambda$ units of shear (lb. weight)

and ,, ,, $\eta$ ,, $\mu$ ,, bending moment (foot-lbs.).

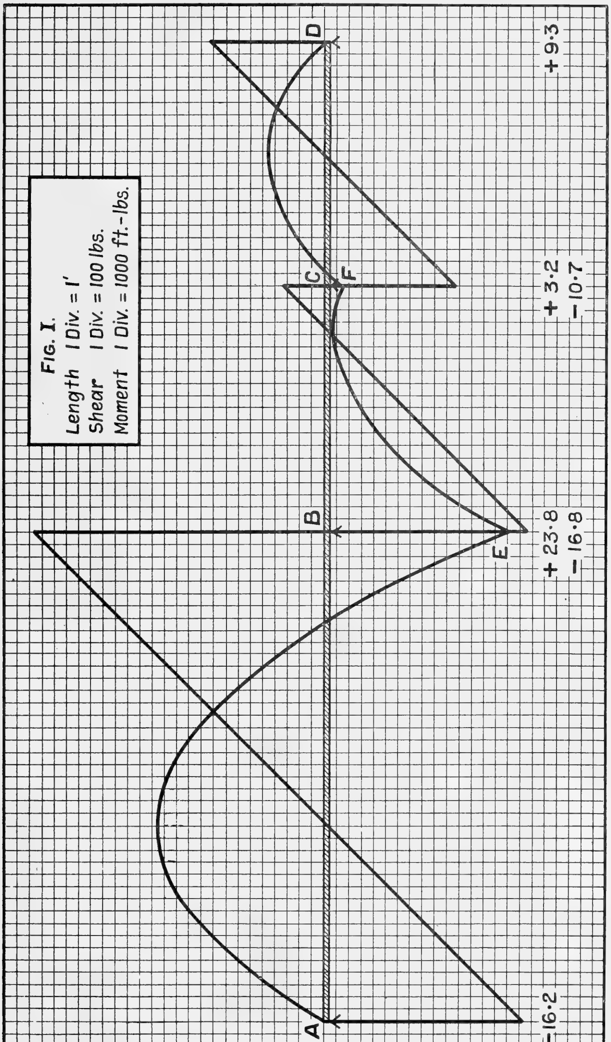
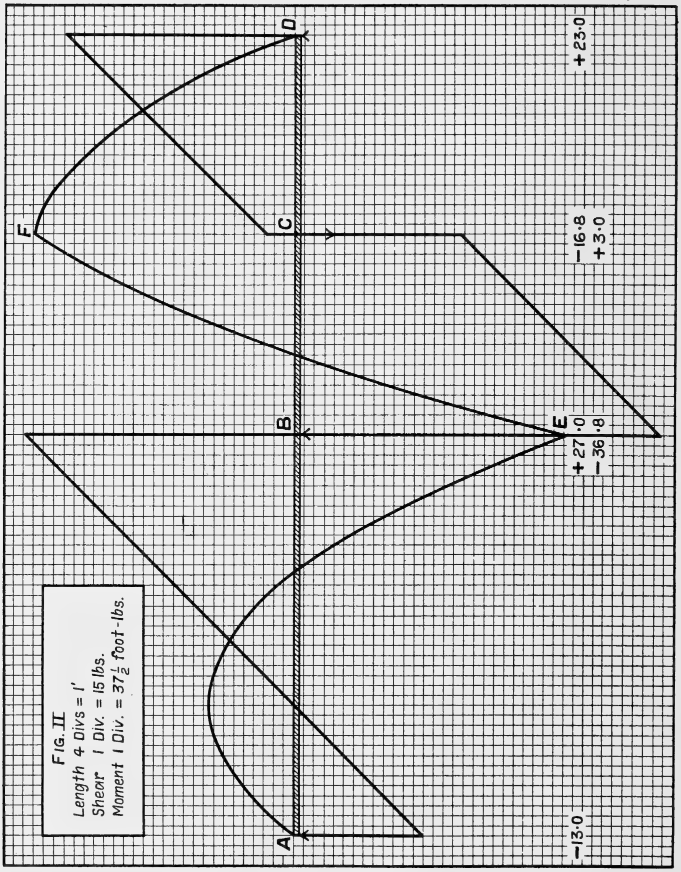


Fig. I.
Length 1 Div. = 1′
Shear 1 Div. = 100 lbs.
Moment 1 Div. = 1000 ft.-lbs.
A
B
C
D
E
F
+9·3
+3·2
−10·7
+23·8
−16·8
−16·2

At a distance of $x$ feet, the value of $\xi$ is $\frac{x}{n}$, representing shear $\lambda \cdot \frac{x}{n}$; the




value of $\eta$ is $k\xi^2$, *i. e.* $k \cdot \frac{x^2}{n^2}$ representing $\frac{\mu k}{n^2} \cdot x^2$ units of bending moment.

Comparing these with the values of H and of $G_0 - G$, we have

$$w = \frac{\lambda}{n} \text{ and } \tfrac{1}{2}w = \frac{\mu k}{n^2}$$

$$\text{or } \lambda = wn,\ \mu = \frac{n^2}{2k} \cdot w.$$

Since $w$ occurs as a linear factor both in shear and in bending moment it may be neglected at present; results got for 1 lb. per foot run can be used for any number ($w$) of lbs. per foot run if we multiply the results for shear and for bending moment by the same factor $w$.

We therefore take $\lambda = n$, $\mu = \dfrac{n^2}{2k}$.

It is open now to choose $k$ so as to have a parabola of suitable shape. If the *latus rectum* is too great, the part near the vertex is difficult to draw and cut out accurately; but again the parabola must be wide enough to allow easy spanning between two points of support.

A convenient shape was a parabola drawn on squared paper with semi-*latus rectum* 20 divisions. Thus the equation $\eta = k\xi^2$ is satisfied by $\xi = 20$, $\eta = 20$; hence $k = \frac{1}{20}$.

With this parabola we have $\lambda = n$, $\mu = 10n^2$.

The parabola has been drawn out for a range $\xi = -40$ to $\xi = +40$. If we use $n = 1$, the greatest breadth of span for which this would serve would be 80′, and then only if the bending moment for that span were symmetrical. With ordinary loading and supports the results for a span of 60′ could generally be got; for broader spans a change in the value of $n$ would be necessary.

The parabola was drawn on 2 mm. squared paper pasted on cardboard and cut out; the part used was the remainder of the paper after the area of the parabola had been removed; the use of this part makes it easy to take the abscissa readings.

When the parabola is placed in position, attention must be paid to the sign of the shear which is positive when the slope of the parabola is down.

§ 4. Two examples are shown in the figure; they have been constructed to show lack of symmetry.

(1) A bar 80′ long, 100 lbs. per foot run is supported at the ends, at the middle, and at one point midway between the middle and the ends, all the supports being at the same level.

As the largest span is 40′ we are safe in using the parabola with $n = 1$.

In Fig. I, A, B, C, D are the points of support.

The bending moments at B and C for a bar of 1 lb. per foot run are obtained from the equations:

$$120G_2 + 20G_3 = -\tfrac{1}{4}(64000 + 8000)$$
$$20G_2 + 80G_3 = -\tfrac{1}{4}(8000 + 8000)$$
$$\text{whence } G_2 = -148,\ G_3 = -13,$$

On the lines through B and C perpendicular to the rod are set off lengths −14·8 and −1·3, giving the points E and F.

Pins are inserted at A and at E, and the cardboard parabola adjusted till it is in contact with these points, its axis being perpendicular to the beam;

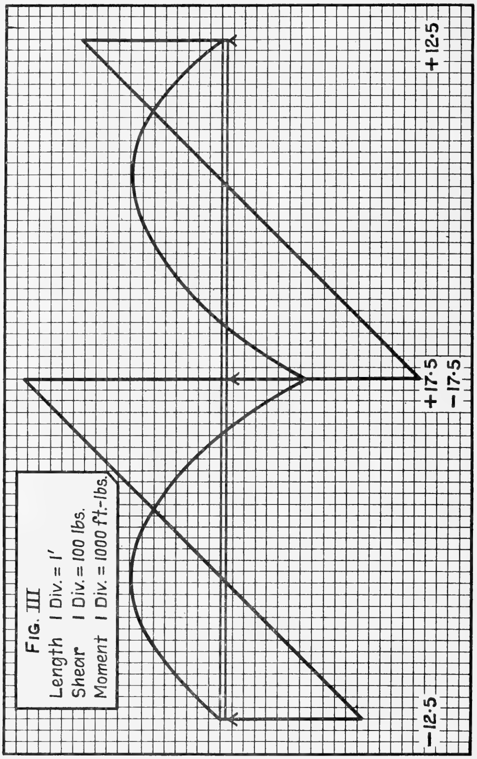



FIG. III
Length 1 Div. = 1′
Shear 1 Div. = 100 lbs.
Moment 1 Div. = 1000 ft.-lbs.

this orientation is ensured by keeping lines of the cardboard parallel to the corresponding lines of the paper.

The abscissa readings of A and E on the cardboard are noted down (−16·2 and +23·8).

The same process for E and F gives abscissa readings −16·8 and 3·2; and for F and D −10·7 and 9·3.

These abscissa readings are shears; they are set off on the perpendiculars through the points of support, and the shear diagrams completed by joining consecutive pairs.

This gives the pressures in order as 16·2, 40·6, 13·9, and 9·3 units, *i. e.* 1620, 4060, 1390, and 930 lbs.

The calculated values are 1630, 4043, 1391, 935 lbs.

(2) A concrete beam, 20′ long weighing 60 lbs. per foot, is supported at the ends and at the middle point, the points being at the same level, and carries a weight of 300 lbs. halfway between the middle point and one end.

If we reduce to 1 lb. per foot run, the added weight should be 5 lbs.

Let $y_1$ be the droop of the point to which the weight is attached, then

$$30G_2 + 5G_3 = -\tfrac{1}{4}\left\{1000 + 125\right\} - 6K \cdot \frac{y_1}{5}$$

$$5G_2 + 20G_3 = -\tfrac{1}{4}\left\{125 + 125\right\} + 6K \cdot \frac{2y_1}{5}$$

$$\tfrac{1}{5}G_2 - \tfrac{2}{5}G_3 + \tfrac{1}{2} \cdot 10 = -5$$

$$\text{whence } G_2 = -\frac{275}{16},\ G_3 = \frac{525}{32}.$$

The spans here are 5′ and 10′, too small to show well on the scale used in (1).

Take the scale 1 div. $= \frac{1}{4}'$ so that $n = \frac{1}{4}$; then $G_2$ and $G_3$ will be represented on the figure as −27·5 and +26·25 respectively.

The drawing of the diagram proceeds as before.

The final scales are shear 1 div. = $(wn)$ lbs., *i. e.* 15 lbs.

Bending moment 1 div. = $10wn^2$ ft.-lbs., *i. e.* $37\frac{1}{2}$ ft.-lbs.

The pressures are 13·0, 63·8, −19·8, 23·0 units, *i. e.* 195, 957, −297, 345 lbs.

The calculated values are $196\frac{7}{8}$, $956\frac{1}{4}$, −300, $346\frac{7}{8}$.

The figures in the cases shown have been drawn on squared paper; but it should be observed that this is not essential. Blank drawing paper will suffice, but a scale must be used to set off lengths which agrees with the scale on which the standard parabola is drawn: *e. g.* with the parabola used above, it will be sufficient to have blank paper and a scale graduated in millimetres.

The method holds for supports at different levels, and also for parts which cut at so small an angle that the thrust along the length of the beam may be neglected.

§ 5. One case where the diagrams can be drawn without any heavy calculation is where the points of support are so arranged that the pressures on all are equal, or have given ratios. Each pressure can be obtained at once by division, and from these the shear diagrams drawn. Starting from the left we have zero moment at the end, and the abscissa value of the end point known; thus the parabola is placed in position for the first span and

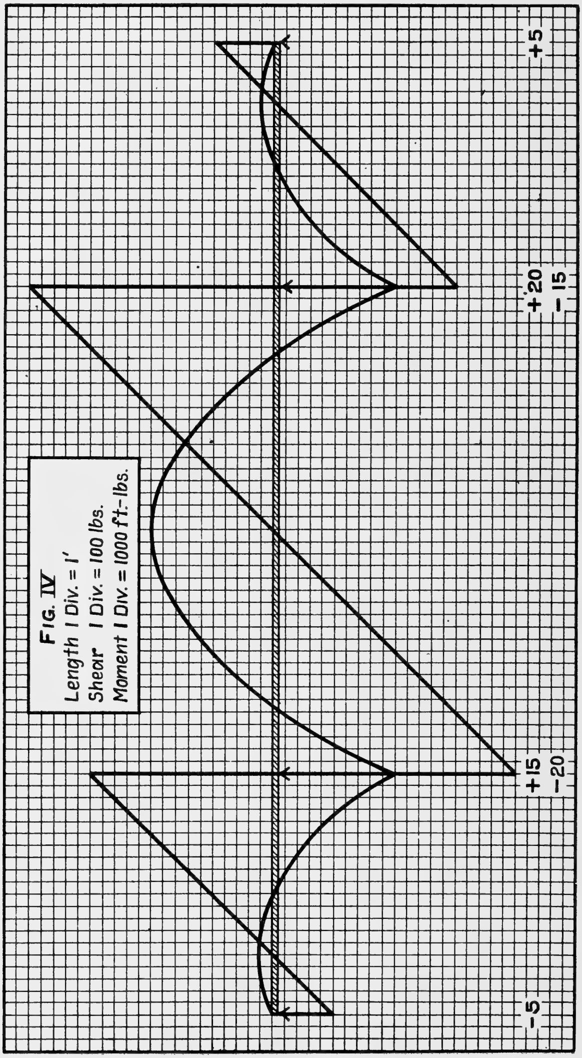



FIG. IV
Length 1 Div. = 1′
Shear 1 Div. = 100 lbs.
Moment 1 Div. = 1000 ft.-lbs.

the bending moment diagram drawn. The same procedure applies to each span in turn; so that the complete diagram is obtained at once.

§ 6. Another problem in which the method can be used is that of determining the adjustment of supports so that the maximum bending moment be as little as possible. To secure this we should have maximum positive bending moment numerically equal to the maximum negative moment.

Between two supports, at one of which the moment is zero, we have to adjust the position of the parabola till the negative value on the second support is equal numerically to the maximum positive value for the span. The position of the parabola may readily be got by trial, and this completely solves the problem for a uniform beam supported at the ends and at an intermediate point.

Fig. III shows the adjustment for a whole length of 60′ divided into two equal spans, the weight being 100 lb. per foot run.

The same solution would apply to a 3-span girder if the middle span is sufficiently short. If the middle span is long, the parabola can be adjusted first to the middle span, arranging it so that the negative end values of the bending moment are equal to the maximum positive moment throughout the span.

Fig. IV shows the diagrams for a beam of 80′ length, 100 lb. per foot run, supported at the ends and at points 20′ from the ends, the middle span being thus 40′.

# TRANSACTIONS

OF THE

# South African Philosophical Society.

The following volumes have been published :—

| VOL. | PUB. | s. | d. |
|---|---|---|---|
| I.—Part 1* | 1878 | | |
| Part 2 | 1879 | 2 | 6 |
| Part 3 | 1880 | 2 | 6 |
| II.—Part 1 | 1881 | 5 | 0 |
| Part 2 | 1881 | 2 | 6 |
| Part 3 | 1882 | 2 | 6 |
| III.—Part 1 | 1884 | 2 | 6 |
| Part 2 | 1885 | 10 | 0 |
| IV.—Part 1 | 1887 | 2 | 6 |
| Part 2* | 1888 | | |
| V.—Part 1* | 1888 | | |
| Part 2 | 1889 | 2 | 6 |
| VI.—Part 1 | 1890 | 2 | 6 |
| Part 2 | 1892 | 2 | 6 |
| VII.—Part 1 | 1893 | 10 | 0 |
| Part 2 | 1896 | 20 | 0 |
| VIII.—Part 1 | 1893 | 2 | 6 |
| Part 2 | 1896 | 5 | 0 |
| IX.—Part 1 | 1897 | 5 | 0 |
| Part 2 | 1898 | 7 | 6 |
| X.—Part 1 | 1897 | 15 | 0 |
| Part 2 | 1898 | 7 | 6 |
| Part 3 | 1899 | 7 | 6 |
| XI.—Part 1 | 1900 | 12 | 6 |
| Part 2 | 1900 | 12 | 6 |
| Part 3 | 1901 | 7 | 6 |
| Part 4 | 1902 | 12 | 6 |
| XII.—(Pp. 1–560) | 1901 | 25 | 0 |
| (Pp. 561–896) | 1902 | 14 | 0 |
| (Pp. 897–920) | 1903 | 2 | 0 |
| XIII.—(Pp. 1–288) | 1904 | 12 | 6 |
| (Pp. 289–546) | 1907 | 8 | 6 |
| (Pp. 547–752) | 1908 | 10 | 0 |
| XIV.—Part 1 | 1903 | 5 | 6 |
| Part 2 | 1903 | 8 | 6 |
| Part 3 | 1903 | 11 | 0 |
| Part 4 | 1903 | 5 | 0 |
| Part 5 | 1904 | 3 | 0 |
| XV.—Part 1 | 1904 | 3 | 6 |
| Part 2 | 1904 | 8 | 6 |
| Part 3 | 1904 | 17 | 0 |
| Part 4 | 1905 | 7 | 6 |
| Part 5 | 1905 | 12 | 6 |
| XVI.—Part 1 | 1905 | 10 | 0 |
| Part 2 | 1905 | 10 | 0 |
| Part 3 | 1906 | 5 | 0 |
| Part 4 | 1906 | 17 | 0 |
| Part 5 | 1907 | 3 | 6 |
| XVII.—Part 1* | 1907 | | |
| Part 2* | 1908 | | |
| XVIII.—Part 1 | 1907 | 9 | 0 |
| Part 2 | 1908 | 12 | 0 |
| Part 3 | 1907 | 4 | 6 |
| Part 4 | 1909 | 7 | 0 |

Copies may be obtained from the Honorary Secretary of the Royal Society of South Africa; or from Messrs. Wm. Wesley & Son, 28, Essex Street, Strand, London.

*Members of the Society may obtain the publications, from the Secretary only, at half of the above prices.*

* Part 1 of vol. I., Part 2 of vol. IV., Part 1 of vol. V., and vol. XVII., Parts 1 and 2, are out of print.

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH [illegible]

| | | | |
|---|---|---|---|
| Vol. I. | Part 1 | 1909 | Price [illegible] |
| ,, I. | Part 2 | 1910 | Price [illegible] |
| ,, II. | Part 1 | 1910 | Price [illegible] |
| ,, II. | Part 2 | 1911 | Price [illegible] |
| ,, II. | Part 3 | 1912 | Price [illegible] |
| ,, II. | Part 4 | 1912 | Price [illegible] |
| ,, II. | Part 5 | 1912 | Price [illegible] |
| ,, III. | Part 1 | 1913 | Price [illegible] |
| ,, III. | Part 2 | 1913 | Price [illegible] |
| ,, III. | Part 3 | 1913 | Price [illegible] |
| ,, IV. | Part 1 | 1914 | Price [illegible] |
| ,, IV. | Part 2 | 1914 | Price [illegible] |
| ,, IV. | Part 3 | 1915 | Price [illegible] |
| ,, V. | Part 1 | 1915 | Price [illegible] |
| ,, V. | Part 2 | 1915 | Price [illegible] |
| ,, V. | Part 3 | 1915 | Price [illegible] |
| ,, V. | Part 4 | 1916 | Price [illegible] |
| ,, V. | Part 5 | 1916 | Price [illegible] |

Copies may be obtained from the Honorary Secretary [illegible]

Messrs. Wm. Wesley & Son, 28, Essex Street, Strand, [illegible]

*Members of the Society may obtain the [illegible]*

*Secretary only, at half of the above prices.*

# TRANSACTIONS

OF THE

# [illegible]AL SOCIETY OF SOUTH AFRICA.

[illegible]UME V.—PART 6.

1917.



[illegible] TOWN:
[illegible] THE SOCIETY.

[illegible] [Price £1 2s. 6d.

# CONTENTS.

# INDEX SLIP.

Pole Evans, I. B.—Descriptions of Some New Aloes from the Transvaal.
Trans. R. Soc. S. Afric., vol. v, 1916, p. 703.

Aloes from the Transvaal, Descriptions of some New.
I. B. Pole Evans. Trans. R. Soc. S. Afric., vol. v, 1916, p. 703.

Transvaal, Descriptions of some New Aloes from the.
I. B. Pole Evans. Trans. R. Soc. S. Afric., vol. v, 1916, p. 703.

Doidge, Ethel M.—South African Perisporiales.
Trans. R. Soc. S. Afric., vol. v, 1916, p. 713.

Perisporiales, South African.
Ethel M. Doidge. Trans. R. Soc. S. Afric., vol. v, 1916, p. 713.

Minutes of Proceedings of the Royal Society of South Africa.
Trans. R. Soc. S. Afric., vol. v, 1916, p. xvii.

Proceedings of the Royal Society of South Africa, Minutes of.
Trans. R. Soc. S. Afric., vol. v, 1916, p. xvii.

Royal Society of South Africa, Minutes of Proceedings of the.
Trans. R. Soc. S. Afric., vol. v, 1916, p. xvii.

Extracts from Reports of Recipients of Grants in Aid of Research.
Trans. R. Soc. S. Afric., vol. v, 1916, p. xxxiii.

Reports of Recipients of Grants in Aid of Research, Extracts from.
Trans. R. Soc. S. Afric., vol. v, 1916, p. xxxiii.

Grants in Aid of Research, Extracts from Reports of Recipients of.
Trans. R. Soc. S. Afric., vol. v, 1916, p. xxxiii.

# FURTHER MAGNETIC OBSERVATIONS IN SOUTH AFRICA DURING THE YEARS 1913–1915.

By J. C. Beattie, D.Sc., Professor of Physics, South African College, Cape Town.

(Read October 20, 1915.)

The results * given in this paper were calculated from observations made at different stations in the Orange Free State, Transvaal, and the Cape Provinces. In earlier work in these regions certain parts had not been touched, and it was found difficult to draw the magnetic lines with accuracy until more stations were occupied.

The method of taking the observations has already been fully described in other communications.† The magnetic instruments were magnetometer 73 (Elliott Bros.); dip-circle 142 (Dover). The chronometer employed was No. 1048 (Reed and Son). A 5-in. theodolite, No. 6084 (T. Cooke and Sons), was used for the determination of latitude, longitude, and the azimuth required for the calculation of the magnetic declination.

The reductions have been carried out by Mr. W. H. Finlay, M.A., to whom I again wish to express my thanks for the care he has given to this part of the work.

The values given for the various elements are those obtained from the observations. No correction for secular or daily variation has been introduced, nor has any instrumental correction been employed.

* The writer has gratefully to acknowledge grants from the Royal Society of South Africa and from the Education Department of the Union towards the expenses of the work.

† "Report of a Magnetic Survey of South Africa," by J. C. Beattie, London, 1909, Appendix, p. 12. "Further Magnetic Observations in South Africa." Transactions of the Royal Society of South Africa, 1914, vol. iv, part 1, p. 11.

## Summary of Results.

| Place. | Date. | Latitude. | Longitude. | Declination. | Dip. | Horizontal intensity. |
|---|---|---|---|---|---|---|
| | | S. | E. | W. | S. | |
| Alexandersfontein | July 10, 1914 | 28°49′·2 | 24°46′·0 | 22°52′·0 | 60°18′·6 | ·17665 |
| Barkly West | Jan. 12, 1915 | 28 33·5 | 24 32·0 | 22 31·0 | 60 17·6 | ·17643 |
| Bloemhof | Jan. 15, 1915 | 27 38·3 | 25 37·0 | 22 02·6 | 59 49·7 | ·17929 |
| Boshoff | July 8, 1914 | 28 32·9 | 25 14·0 | 22 48·0 | 60 03·8 | ·17758 |
| Bultfontein | June 28, 1914 | 28 18·9 | 26 10·0 | 21 39·7 | 60 17·9 | ·17802 |
| Campbell | Jan. 26, 1915 | 28 48·5 | 23 43·0 | 23 37·7 | 60 00·0 | ·17689 |
| Christiana | Jan. 14, 1915 | 27 54·3 | 25 11·0 | 22 10·9 | 59 46·8 | ·17865 |
| Daniel's Kuil | Jan. 20, 1915 | 28 11·1 | 23 32·0 | 23 34·2 | 59 31·2 | ·17897 |
| Dealesville | June 29, 1914 | 28 41·8 | 25 43·5 | 22 48·3 | 60 44·6 | ·17605 |
| Douglas | Jan. 28, 1915 | 29 02·0 | 23 47·0 | 23 29·9 | 60 09·2 | ·17610 |
| Griquatown | Jan. 23, 1915 | 28 53·4 | 23 14·0 | 19 35·9 | 59 43 4 | ·17555 |
| Jacobsdal | July 6, 1914 | 29 08·8 | 24 46·5 | 23 09·8 | 60 17·4 | ·17599 |
| Jagersfontein | July 3, 1914 | 29 45·0 | 25 31·0 | 23 00·7 | 61 00·3 | ·17373 |
| Klein Boetsap | Jan. 18, 1915 | 27 58·6 | 24 27·0 | 25 00·4 | 59 43·5 | ·17813 |
| Koffyfontein | July 5, 1914 | 29 25·2 | 25 01·0 | 23 30·5 | 60 22·2 | ·17653 |
| Koopmansfontein | Jan. 19, 1915 | 28 14·0 | 24 05·0 | 22 52·4 | 59 41·0 | ·17836 |
| Luckhoff | July 4, 1914 | 29 46·0 | 24 47·0 | 23 40·7 | 60 25·9 | ·17552 |
| Matjesfontein | June 22, 1914 | 33 14·2 | 20 36·0 | 26 38·9 | 61 14·0 | ·17000 |
| Niekerk's Hope | Jan. 25, 1915 | 29 20·2 | 22 50 0 | 24 52·4 | 57 52·0 | ·19588 |
| Paardeberg | July 7, 1914 | 29 00 0 | 25 04·0 | 23 14·3 | 60 19·2 | ·17668 |
| Petrus | July 9, 1914 | 29 07·0 | 25 24·0 | 23 01·7 | 60 19·4 | ·17624 |
| Postmasburg | Jan. 21, 1915 | 28 20·8 | 23 03·5 | 22 55·9 | 59 04·2 | ·18237 |
| Saratoga | Jan. 29, 1915 | 29 17 5 | 23 59·5 | 23 26·1 | 60 15·8 | ·17564 |
| Schmidt's Drift | Jan. 27, 1915 | 28 42·1 | 24 04·0 | 23 05·0 | 60 06·0 | ·17672 |
| Schweizer Reneke | Jan. 16, 1915 | 27 11·4 | 25 19·0 | 21 33·0 | 59 34·3 | ·17899 |
| Taungs | Jan. 17, 1915 | 27 34·8 | 24 45·0 | 21 46·1 | 59 43·6 | ·17825 |
| Witwater | Jan. 24, 1915 | 29 04·0 | 22 50·0 | 24 06·6 | 61 09·3 | ·16906 |

# TRUE ISOGONICS AND ISOCLINALS FOR SOUTH AFRICA FOR THE EPOCH JULY 1, 1913.

By J. C. Beattie, D.Sc., Professor of Physics, South African College, Cape Town.

(Read October 20, 1915.)

A first series of magnetic maps for South Africa was published in 1909,* and consisted of seven maps, showing the true lines for declination, dip, horizontal intensity, total intensity, vertical intensity, northerly intensity, and westerly intensity. These maps embodied the results at approximately 400 stations.

A second series of maps was published in 1914.† These dealt with the magnetic elements in the western parts only of South Africa, and embodied the earlier and a number of additional results in this region. Three maps were given, showing the declination, dip, and horizontal intensity respectively for the epoch July 1, 1908.

The two maps dealt with in this paper embody the results for declination and dip for all stations at which observations have so far been taken in South Africa—667 in all. The observations have been taken chiefly in 1903 and in 1909, and the results for these years and for other periods have been published from time to time.‡ In addition, the results obtained by Father E. Goetz, S.J., and Mr. Wood in Rhodesia in 1914 have been supplied to me. A full report of their work will be published by them later.

The reduction to the epoch was effected by the application of results obtained at repeat stations§—about forty in all. The distribution of these stations was satisfactory, except in Damaraland || and Rhodesia. In the latter

* "Report of Magnetic Survey of South Africa," by J. C. Beattie, 1909.

† "True Isogonics, Isoclinals, and Lines of Horizontal Intensity for the North-Western Parts of the Union of South Africa," etc. Transactions Royal Society of South Africa, 1914, vol. iv, part 1, p. 57.

‡ "Secular Variation of the Magnetic Elements in South Africa during the Period 1900–1913." Transactions of the Royal Society of South Africa, 1915, vol. iv, part 3, p. 182.

§ "The Secular Variation of the Magnetic Elements in South Africa," by J. C. Beattie. Transactions of the Royal Society of South Africa, 1915, vol. iv, p. 181.

|| In previous publications this country is referred to as German South-West Africa.

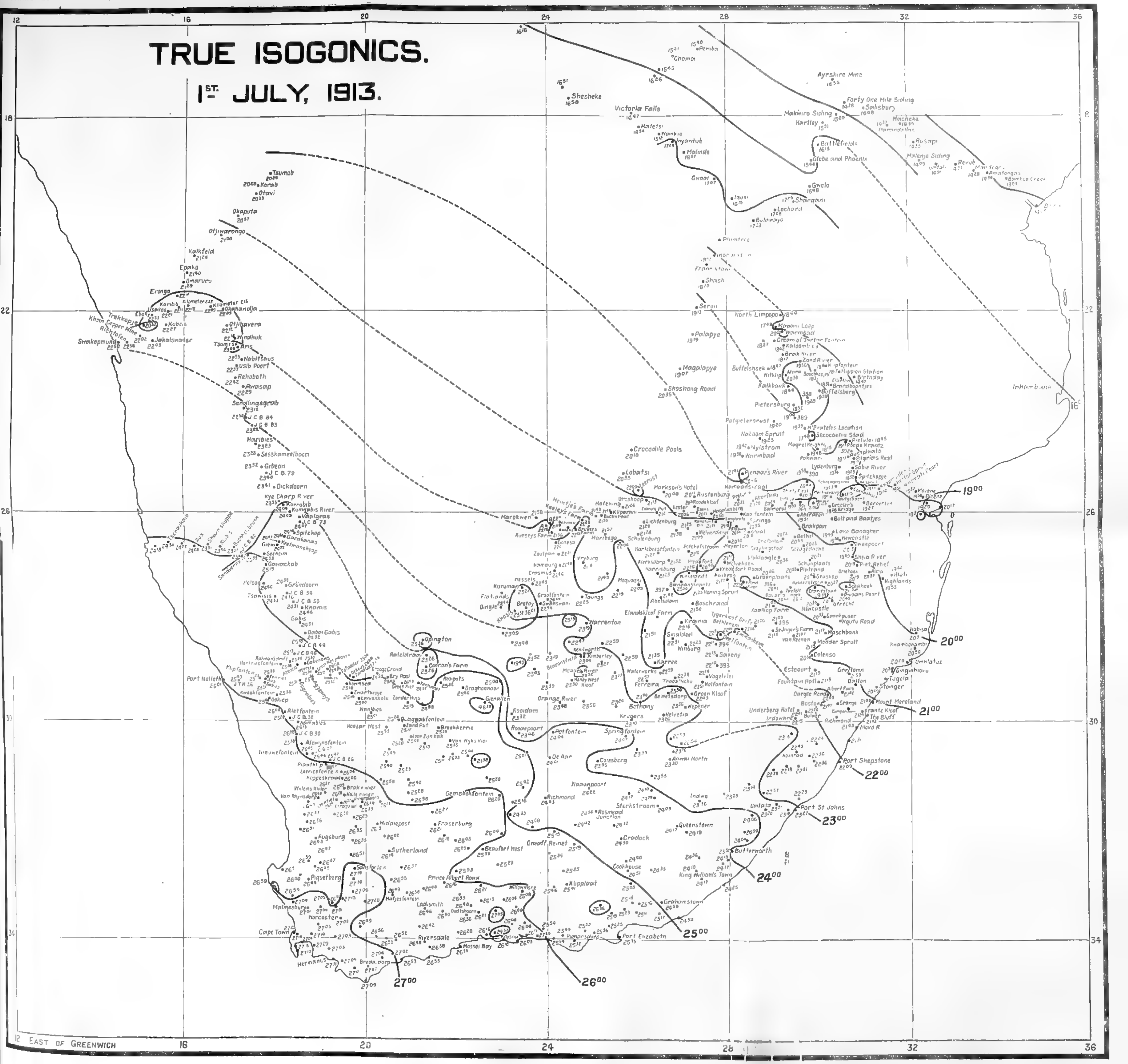
there are only three repeats—one at Bulawayo, one at the Victoria Falls, and one at Beira. Between longitudes 28° E. and 34° E., and north of latitude 24° S., it was not found convenient to reoccupy a station. In Damaraland no station has been reoccupied. In these two regions the reductions applied leave something to be desired.

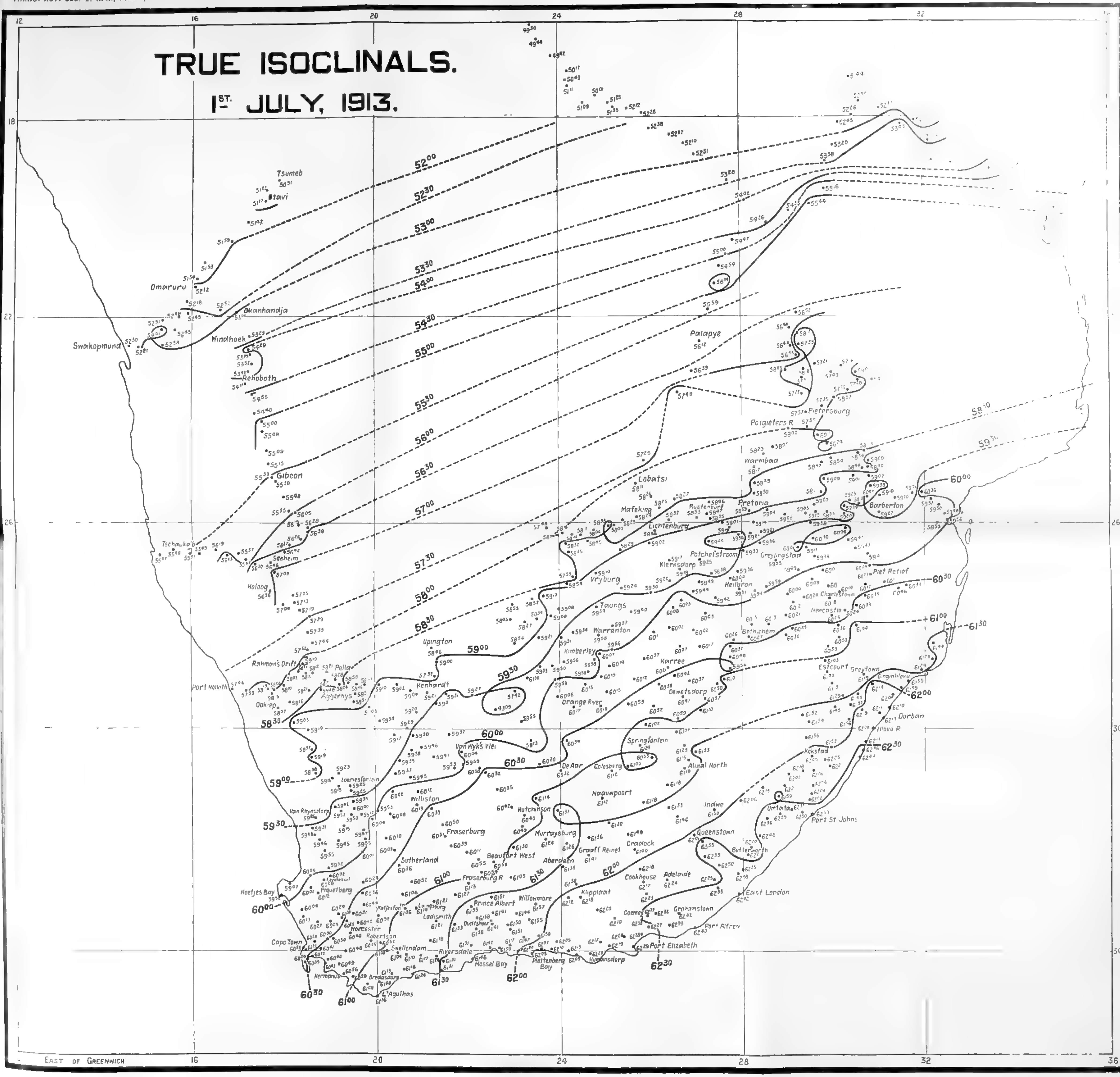
In the 1903 maps no results, except in the extreme south, were given for the Cape Province west of 20° E., and none west of 25° E. in the country north of the Orange River. In the present maps results are given for practically all the region south of the Orange River, a considerable part of Damaraland, a region extending from the Orange River to the Molopo, and from 25° E. to 23° E. In addition, the declination and the dip are given for a considerable number of additional stations in the Orange Free State, the Western Transvaal, and the Cape Colony.

The declination, which is westerly (Map I), show throughout a decrease. In the south-west, in the neighbourhood of Cape Town, the decrease amounts to roughly a degree and a half in ten years. On the eastern coast, from East London to Durban and Beira, the change is as much as two degrees in the same period. Thus in the 1903 map the 28° 30′ isogonic occupies roughly the same position as the 27° line in the present map. The 25° isogonic in the 1913 map passes close to Port Alfred and inland through Graaff Reinet, following approximately the direction of the 27° line in the earlier map. Farther inland the lines open outwards more than was the case at the previous epoch, the result of a small secular change towards the north.

The greatest anomalies in the declination are shown at Glenallen, where the magnet points about 20° more west than is to be expected there, and at Bretby, where the anomaly is about 12°. Both these stations are in regions where magnetic ores are present. There are other smaller anomalies in various parts, particularly in the East Transvaal and in the district around Gemsbokfontein, Britstown, De Aar, and Nelspoort. Additional stations in this region will probably throw considerable light on the disturbance which undoubtedly exists.

The southerly (Map II) dip has increased in the period 1903–1913. In the 1903 map the 62° S. isoclinal just appears at Port St. Johns; in 1913 the dip at that place is 62° 59′. The increase in the east is between 50′ and 60′ in the ten years. At Cape Town the increase in the same period has been between 80′ and 90′. The most striking anomaly is again at Glenallen, where the southerly dip is approximately 15° less than the mean value for that neighbourhood. The other anomalies are small and particularly numerous in the East Transvaal.


TRUE ISOGONICS.
1st JULY, 1913.
12
16
20
24
28
32
36
18
22
26
30
34
16°
19 00
20 00
21 00
22 00
23 00
24 00
25 00
26 00
27 00
EAST OF GREENWICH
Victoria Falls
Sesheke
Bulawayo
Salisbury
Gwelo
Tsumeb
Otavi
Okaputa
Otjiwarongo
Kalkfeld
Omaruru
Karibib
Okahandja
Swakopmund
Windhuk
Rehoboth
Gibeon
Keetmanshoop
Pietersburg
Lydenburg
Barberton
Rustenburg
Mafeking
Vryburg
Kimberley
Kuruman
Upington
Warrenton
Bloemfontein
Winburg
Ladysmith
Estcourt
Greytown
Port Shepstone
Port St Johns
Umtata
Butterworth
Queenstown
Cradock
Graaff Reinet
Beaufort West
Fraserburg
Sutherland
Richmond
De Aar
Colesberg
Port Elizabeth
Grahamstown
Mossel Bay
Riversdale
Cape Town
Malmesbury
Worcester
Hermanus
Port Nolloth
Inhambane


TRUE ISOCLINALS.
1ST. JULY, 1913.
EAST OF GREENWICH
12
16
20
24
28
32
36
18
22
26
30
34
52°00
52°30
53°00
53°30
54°00
54°30
55°00
55°30
56°00
56°30
57°00
57°30
58°00
58°30
59°00
59°30
60°00
60°30
61°00
61°30
62°00
62°30
Tsumeb
Otavi
Omaruru
Okanhandja
Swakopmund
Windhoek
Rehoboth
Gibeon
Seeheim
Holoog
Rahman's Drift
Port Nolloth
Pella
Aggenys
Ookiep
Kenhardt
Upington
Palapye
Pietersburg
Potgieters R.
Warmbad
Lobatsi
Mafeking
Rustenburg
Pretoria
Lichtenburg
Barberton
Potchefstroom
Klerksdorp
Greylingstad
Heilbron
Vryburg
Taungs
Warrenton
Kimberley
Piet Retief
Charlestown
Newcastle
Bethlehem
Karree
Dewetsdorp
Orange River
Estcourt
Greytown
Durban
Springfontein
De Aar
Colesberg
Aliwal North
Van Wyk's Vlei
Williston
Naauwpoort
Kokstad
Hutchinson
Umtata
Port St Johns
Indwe
Queenstown
Murraysburg
Graaff Reinet
Cradock
Fraserburg
Beaufort West
Aberdeen
Sutherland
Fraserburg R.
Cookhouse
Adelaide
Butterworth
East London
Prince Albert
Willowmore
Klipplaat
Grahamstown
Port Alfred
Piquetberg
Hoetjes Bay
Van Rhynsdorp
Ladismith
Worcester
Robertson
Cape Town
Swellendam
Riversdale
Mossel Bay
Plettenberg Bay
Humansdorp
Port Elizabeth
Hermanus
Bredasdorp
C. Agulhas

SUMMARY OF DECLINATIONS AND DIPS FOR THE EPOCH JULY 1, 1913.

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 1 | Abbasis | 28° 54′·0 S. | 18° 30′·0 E. | — | 58° 21′ S. |
| 2 | Abelsdam | 27 37·1 | 26 29·6 | 21° 48′·0 W. | 60 08 |
| 3 | Aberdeen (C.P.) | 32 29·1 | 24 03·0 | 25 34·0 | 61 38 |
| 4 | Aberdeen (Trans.) | 26 03·8 | 29 33·0 | 19 31·0 | 59 38 |
| 5 | Aberdeen Road | 32 46·0 | 24 20·0 | 25 25·0 | 61 30 |
| 6 | Aberfeldy | 25 45·7 | 28 34·5 | 20 30·0 | 59 04 |
| 7 | Abiekwa Put | 30 22·0 | 20 46·0 | 25 19·5 | 59 38 |
| 8 | Adelaide | 32 43·0 | 26 18·0 | 24 33·0 | 62 24 |
| 9 | Aggennys | 29 12·9 | 18 49·0 | 25 36·0 | 58 48 |
| 10 | Albert Falls | 29 26·0 | 30 29·0 | 21 42·0 | 61 45 |
| 11 | Alexandersfontein | 28 49·2 | 24 46·0 | 23 04·0 | 60 12 |
| 12 | Alexandria | 33 30·0 | 26 32·4 | 25 17·0 | 62 33 |
| 13 | Alewynsfontein | 30 26·6 | 18 36·0 | 25 38·1 | 59 19 |
| 14 | Alicedale | 33 18·9 | 26 02·5 | 25 16·0 | 62 32 |
| 15 | Aliwal North | 30 41·7 | 26 42·0 | 23 30·0 | 61 19 |
| 16 | Alma | 27 07·6 | 31 05·5 | 20 37·0 | 60 11 |
| 17 | Amabele Junction | 32 43·1 | 27 19·2 | 24 10·0 | 62 25 |
| 18 | Amaranja | 31 14·7 | 29 30·0 | — | 62 04 |
| 19 | Amatongas | 19 11·2 | 33 45·0 | 14 34·0 | 54 28 |
| 20 | Aris | 22 45·8 | 17 10·0 | — | 53 39 |
| 21 | Ashton | 33 50·0 | 20 04·0 | — | 60 52 |
| 22 | Assegai Bosch | 33 56·7 | 24 20·5 | 25 49·0 | — |
| 23 | Augsburg | 32 10·4 | 18 53·0 | 26 43·4 | 59 55 |
| 24 | Aus (C.P.) | 29 12·9 | 17 48·0 | 25 30·5 | 58 10 |
| 25 | Aus | 26 40·3 | 16 12·0 | 24 28·4 | 55 49 |
| 26 | Avontuur | 33 44·2 | 23 13·0 | 26 08·0 | 61 47 |
| 27 | Awasap | 23 31·7 | 17 06·0 | 22 28·7 | 54 55 |
| 28 | Ayrshire Mine | 17 11·5 | 30 23·0 | 14 55·0 | 51 44 |
| 29 | Balmoral | 25 51·3 | 28 58·0 | 20 24·0 | 59 08 |
| 30 | Bamboo Creek | 19 16·5 | 34 12·0 | 13 24·0 | 54 36 |
| 31 | Bankpan | 26 18·0 | 29 35·0 | — | 60 38 |
| 32 | Barber's Pass | 26 36·0 | 25 35·0 | 22 04·0 | — |
| 33 | Barberton | 25 47·3 | 31 00·0 | 19 27·0 | 59 27 |
| 34 | Barkly West | 28 33·5 | 24 32·0 | 22 47·0 | 60 07 |
| 35 | Barrington | 33 55·2 | 22 52·0 | 24 57·0 | 61 17 |
| 36 | Battlefields | 18 36·4 | 30 00·0 | 16 13·0 | 53 20 |
| 37 | Bavaria | 27 30·7 | 29 08·4 | 20 40·0 | 60 12 |
| 38 | Baviaanskrantz | 27 19·0 | 26 55·0 | 25 00·0 | 59 44 |
| 39 | Beaconsfield | 28 45·0 | 24 44·0 | — | 59 56 |
| 40 | Beaufort West | 32 20·9 | 22 34·1 | 25 39·4 | 60 59 |
| 41 | Beaulieu | 26 14·5 | 24 14·0 | 21 51·6 | 58 14 |
| 42 | Beira | 19 49·2 | 34 50·0 | 14 05·0 | 55 24 |
| 43 | Belleville | 33 49·0 | 18 39·0 | — | 60 29 |
| 44 | Berg River Mouth | 32 46·5 | 18 10·0 | 26 50·7 | 59 47 |
| 45 | Bethal | 26 28·1 | 29 27·5 | 20 55·0 | 59 11 |
| 46 | Bethany | 29 37·0 | 26 02·0 | 23 00·0 | 60 52 |
| 47 | Bethesda Road | 31 55·3 | 24 38·0 | 24 42·0 | 61 36 |
| 48 | Bethlehem | 28 13·8 | 28 17·3 | 22 04·0 | 60 15 |
| 49 | Bethulie | 30 30·5 | 25 59·0 | 23 39·0 | 60 55 |
| 50 | Beukesfontein | 32 55·1 | 19 43·0 | 27 14·2 | 60 36 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 51 | Biesjespoort . . . | 31° 43·′8 S. | 23° 12′·0 E. | 24° 33′·0 W. | 60° 49′ S. |
| 52 | Birthday . . . | 23 19·5 | 30 46·0 | 14 47·0 | 59 58 |
| 53 | Blaauwbosch . . | 30 38·9 | 22 14·1 | 25 06·0 | 60 08 |
| 54 | Blaauwkrantz . . | 33 57·0 | 23 35·0 | 26 17·0 | 62 07 |
| 55 | Blaauwpoort. . . | 30 39·2 | 21 42·0 | 25 10·7 | 59 53 |
| 56 | Bloemhof . . . | 27 38·3 | 25 37·0 | 22 19·0 | 59 39 |
| 57 | Bluff, The . . . | 29 52·5 | 31 04·0 | 21 32·0 | 62 13 |
| 58 | Bohane . . . . | 26 02·5 | 32 20·0 | 18 31·0 | 58 53 |
| 59 | Boons . . . . | 25 57·9 | 27 18·0 | 20 21·0 | 58 55 |
| 60 | Boschkopjes . . . | 23 11·5 | 29 55·0 | 18 31·0 | 57 49 |
| 61 | Boschrand . . . | 27 45·8 | 27 12·0 | 21 50·0 | 60 03 |
| 62 | Boshof . . . . | 28 32·9 | 25 14·0 | 22 59·0 | 59 56 |
| 63 | Boston . . . . | 29 41·0 | 30 01·0 | 21 47·0 | 61 45 |
| 64 | Botha's Berg . . | 25 25·0 | 29 49·0 | 20 44·0 | 58 53 |
| 65 | Brak River . . . | 22 52·2 | 29 13·0 | 18 17·0 | 56 55 |
| 66 | Brak River . . . | 31 15·6 | 19 30·0 | 26 09·0 | 59 35 |
| 67 | Brandboontjes . . | 23 28·0 | 30 16·0 | 18 32·0 | 57 35 |
| 68 | Bredasdorp . . . | 34 32·2 | 20 03·0 | 27 07·0 | 61 08 |
| 69 | Breekkerrie . . . | 30 06·7 | 21 35·0 | 25 35·0 | 59 37 |
| 70 | Bretby . . . . | 27 50·1 | 23 31·0 | 36 00·6 | 50 34 |
| 71 | Britstown . . . | 30 35·0 | 23 33·0 | 25 00·8 | 60 20 |
| 72 | Bruwer's Farm . . | 26 18·7 | 24 36·0 | 22 00·0 | 58 45 |
| 73 | Bry Paal . . . | 29 10·0 | 20 28·0 | 25 03·0 | 59 02 |
| 74 | Buchholzbrunn . . | 26 41·6 | 17 04·0 | 23 37·0 | 55 57 |
| 75 | Buckwheat . . . | 26 02·7 | 25 11·0 | 21 54·6 | 58 09 |
| 76 | Buffelsberg . . . | 23 36·7 | 30 01·0 | 19 35·0 | 58 07 |
| 77 | Buffelshoek . . . | 23 08·3 | 28 55·0 | 18 47·0 | 58 05 |
| 78 | Buffelsklip . . . | 33 31·7 | 22 52·5 | 27 05·0 | 61 50 |
| 79 | Bulawayo . . . | 20 09·1 | 28 36·3 | 17 33·0 | 54 26 |
| 80 | Bulshoek . . . | 31 58·7 | 18 47·0 | 26 32·8 | 59 46 |
| 81 | Bult and Baatjes . . | 26 08·0 | 30 16·0 | — | 60 06 |
| 82 | Bultfontein . . . | 28 18·9 | 26 10·0 | 21 51·0 | 60 11 |
| 83 | Bulwer . . . . | 29 48·4 | 29 41·0 | 22 24·0 | — |
| 84 | Burghersdorp . . | 31 00·0 | 26 18·0 | 23 53·0 | 61 18 |
| 85 | Bushmanskop . . | 32 20·8 | 22 14·5 | 26 02·8 | 60 55 |
| 86 | Butterworth . . . | 32 21·3 | 28 04·0 | 23 59·0 | 62 21 |
| 87 | Caledon River . . | 30 16·8 | 26 41·7 | 23 52·6 | 61 23 |
| 88 | Calitzdorp . . . | 33 32·1 | 21 41·0 | 26 50·0 | 61 33 |
| 89 | Campbell . . . | 28 48·5 | 23 43·0 | 23 52·0 | 59 49 |
| 90 | Camperdown . . | 29 44·0 | 30 37·0 | — | 62 19 |
| 91 | Cango . . . . | 33 24·8 | 22 14·5 | 26 48·0 | 61 58 |
| 92 | Capetown (R.O.) . . | 33 56·1 | 18 28·7 | 27 14·0 | 60 22 |
| 93 | Cathcart . . . | 32 18·0 | 27 09·0 | — | 62 39 |
| 94 | Ceres . . . . | 33 22·5 | 19 15·0 | 26 51·2 | 60 30 |
| 95 | Ceres Road . . . | 33 25·6 | 19 19·0 | 27 00·6 | 60 29 |
| 96 | Charlestown . . . | 27 24·9 | 29 54·0 | 19 39·0 | 60 18 |
| 97 | Choma . . . . | 16 49·0 | 26 48·0 | 15 41·0 | 50 06 |
| 98 | Christiana . . . | 27 54·3 | 25 11·0 | 22 26·0 | 59 37 |
| 99 | Clarkson . . . | 34 01·0 | 24 10·0 | — | 62 15 |
| 100 | Coerney . . . | 33 27·6 | 25 44·0 | 25 23·0 | 62 30 |
| 101 | Coega . . . . | 33 45·0 | 25 38·0 | 25 18·0 | 62 28 |
| 102 | Colenso . . . . | 28 44·0 | 29 50·0 | 20 50·0 | 61 03 |
| 103 | Colesberg . . . | 30 42·8 | 25 08·0 | 23 55·0 | 61 12 |
| 104 | Connan's Farm . . | 28 58·4 | 21 19·3 | 23 26·0 | 57 32 |
| 105 | Cookhouse . . . | 32 44·0 | 25 48·0 | 24 51·0 | 62 17 |
| 106 | Cotswold Hotel . . | 30 42·7 | 29 53·4 | 22 26·0 | 62 21 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 107 | Cradock . . . | 32° 09′·6 S. | 25° 38′·0 E. | 24° 30′·0 W. | 61° 40′ S. |
| 108 | Cream of Tartar Fon. . | 22 35·3 | 29 01·0 | 18 27·0 | 56 44 |
| 109 | Crocodile Pools . . | 24 46·7 | 25 50·0 | 20 18·0 | 57 25 |
| 110 | Dabai Gabis . . . | 28 19·9 | 18 40·0 | 24 34·2 | 57 44 |
| 111 | Dabenoris . . . | 28 55·4 | 18 39·0 | 25 29·8 | 58 12 |
| 112 | Dalton . . . . | 29 16·0 | 30 42·0 | — | 62 14 |
| 113 | Dambiesfontein . . | 31 24·2 | 21 17·6 | 25 55·7 | 60 33 |
| 114 | Daniel's Kuil . . | 28 11·1 | 23 32·0 | 23 48·0 | 59 20 |
| 115 | Dannhauser . . . | 28 01·2 | 30 05·0 | 20 33·0 | 60 36 |
| 116 | Dargle Road . . . | 29 29·1 | 30 11·0 | 22 05·3 | 61 29 |
| 117 | Darling . . . | 33 22·1 | 18 22·0 | 27 03·5 | 60 13 |
| 118 | De Aar . . . . | 30 40·0 | 24 02·0 | 24 00·9 | 60 32 |
| 119 | Dealesville . . . | 28 41·8 | 25 44·0 | 22 59·0 | 60 37 |
| 120 | De Doorns . . . | 33 29·0 | 19 36·0 | — | 60 40 |
| 121 | Deelfontein . . . | 30 05·8 | 26 31·7 | 23 31·0 | 61 07 |
| 122 | Deelfontein Farm. . | 28 20·0 | 27 48·0 | — | 60 26 |
| 123 | De Jager's Farm . . | 28 15·9 | 28 57·9 | 21 15·0 | 60 30 |
| 124 | De Kruis . . . | 32 35·7 | 18 44·0 | 26 39·0 | 60 05 |
| 125 | De Neus . . . | 29 11·3 | 19 39·0 | 24 59·0 | 58 46 |
| 126 | Dewetsdorp . . . | 29 26·1 | 26 39·3 | 23 53·7 | 60 41 |
| 127 | Dickdoorn . . . | 25 30·0 | 17 58·0 | 23 40·7 | 55 48 |
| 128 | Dingle . . . . | 27 48·9 | 22 59·0 | 22 44·2 | 58 43 |
| 129 | Doorn Bosch . . | 31 58·0 | 19 15·0 | — | 59 45 |
| 130 | Doorn River . . . | 31 52·1 | 18 41·0 | 26 26·2 | 59 40 |
| 131 | Douglas . . . | 29 02·0 | 23 47·0 | 23 43·0 | 59 58 |
| 132 | Downes . . . . | 31 30·4 | 19 55·0 | 26 17·6 | 59 53 |
| 133 | Draaikraal . . . | 31 45·3 | 19 43·0 | 26 29·0 | 59 57 |
| 134 | Draghoender . . | 29 22·3 | 22 07·4 | 25 46·4 | 59 27 |
| 135 | Drew . . . . | 33 59·5 | 20 13·0 | 26 56·0 | 61 09 |
| 136 | Driefontein . . . | 26 29·4 | 29 13·0 | 20 33·0 | 60 01 |
| 137 | Driehoek . . . | 27 11·6 | 30 41·0 | 20 19·0 | 60 17 |
| 138 | Drooge Grond . . | 29 07·3 | 20 15·0 | 24 59·0 | 59 10 |
| 139 | East London . . | 33 00·0 | 27 56·0 | 24 25·0 | 62 42 |
| 140 | Ebony . . . . | 22 04·9 | 15 16·0 | 22 53·0 | 52 51 |
| 141 | Eendekuil . . . | 32 41·2 | 18 52·0 | 26 44·6 | 60 08 |
| 142 | Eenriet . . . . | 29 11·1 | 17 50·0 | 25 35·0 | 58 00 |
| 143 | Elandshoek . . . | 25 30·0 | 30 41·0 | — | 60 47 |
| 144 | Elandskloof Farm . | 28 00·0 | 26 24·0 | — | 60 02 |
| 145 | Elands Put . . . | 25 58·4 | 26 21·0 | 21 21·0 | 58 37 |
| 146 | Elim . . . . | 34 35·8 | 19 46·0 | 27 11·0 | 61 08 |
| 147 | Ellerton . . . | 23 19·0 | 30 30·0 | — | 57 48 |
| 148 | Elliot . . . . | 31 18·0 | 27 54·0 | 23 05·0 | 62 06 |
| 149 | Elsburg . . . | 26 15·0 | 28 11·0 | 20 34·0 | 59 05 |
| 150 | Emmasheim . . . | 28 17·2 | 28 07·3 | 22 04·0 | 60 27 |
| 151 | Epako . . . . | 21 13·9 | 16 03·0 | 21 40·0 | 51 54 |
| 152 | Erasmus . . . | 27 08·0 | 24 08·0 | 22 45·7 | 58 54 |
| 153 | Erongo . . . . | 21 42·2 | 15 51·0 | 22 10·7 | 52 16 |
| 154 | Estcourt . . . | 29 00·9 | 29 54·0 | 21 19·0 | 61 03 |
| 155 | Ferreira . . . | 29 12·0 | 26 11·0 | 22 57·0 | 60 38 |
| 156 | Fish River . . . | 31 55·3 | 25 27·0 | 24 32·0 | 61 48 |
| 157 | Flatlands . . . | 27 33·0 | 22 58·0 | — | 58 53 |
| 158 | Forty-one-mile Siding . | 17 43·0 | 30 33·0 | 14 36·0 | 52 37 |
| 159 | Fountain Hall . . | 29 15·8 | 29 59·0 | 21 19·0 | 61 13 |
| 160 | Francistown . . . | 21 04·0 | 27 32·0 | — | 54 54 |
| 161 | Francistown (10 miles S. of) | — | — | — | 55 05 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 162 | Fraserburg . . . | 31° 55′·2 S. | 21° 31′·3 E. | 26° 21′·3 W. | 60° 31′ S. |
| 163 | Fraserburg Road . . | 32 46·0 | 22 00·0 | 25 52·6 | 61 13 |
| 164 | Gabis . . . . . | 28 08·5 | 18 34·0 | 24 50·6 | 57 33 |
| 165 | Gamtoos River Bridge . | 33 55·2 | 25 02·5 | 25 36·0 | 62 19 |
| 166 | Gansfontein . . . | 32 43·6 | 19 42·0 | 27 14·2 | 60 24 |
| 167 | Garakanas . . . | 26 29·4 | 18 09·0 | 24 01·5 | 56 27 |
| 168 | Garub . . . . | 26 36·4 | 15 56·0 | 24 22·2 | 55 31 |
| 169 | Gawachab . . . | 27 01·8 | 17 48 0 | 25 14·7 | 57 09 |
| 170 | Gemsbokfontein . . | 31 22·8 | 22 57·5 | 26 19·8 | 60 42 |
| 171 | Genesa . . . . | 26 35·4 | 24 10·0 | 22 00·8 | 58 35 |
| 172 | Georgetown . . . | 33 57·0 | 22 29·0 | — | 61 42 |
| 173 | Gibeon . . . . | 25 07·2 | 17 42·0 | 23 32·3 | 55 33 |
| 174 | Ginginhlovu . . . | 29 01·7 | 31 35·0 | 20 58·0 | 61 55 |
| 175 | Glenallen . . . | 29 39·0 | 22 36·0 | 46 29·6 | 43 09 |
| 176 | Glencairn. (*See* No. 505) | | | | |
| 177 | Glenconnor . . . | 33 25·0 | 25 10·0 | 26 36·0 | 62 10 |
| 178 | Globe and Phœnix . | 18 56·0 | 29 48·0 | 15 44·0 | 53 38 |
| 179 | Gobas . . . . | 26 38·0 | 18 02·0 | 24 21·8 | 56 42 |
| 180 | Goedgedacht . . | 26 38·9 | 29 37·0 | 20 23·0 | 59 38 |
| 181 | Gordon's Bay . . | 34 08·0 | 18 55·0 | — | 60 43 |
| 182 | Graaff Reinet . . | 32 16·9 | 24 36·0 | 25 19·0 | 61 41 |
| 183 | Grahamstown . . | 33 19·7 | 26 32·0 | 24 59·0 | 62 42 |
| 184 | Grange . . . . | 29 37·9 | 30 23·0 | — | 61 57 |
| 185 | Graskop . . . . | 27 15·0 | 29 53·0 | 20 40·0 | 60 11 |
| 186 | Grauwater . . . | 30 56·4 | 19 16·0 | 26 03·6 | 59 15 |
| 187 | Greylingstad . . | 26 44·6 | 28 45·5 | 20 19·0 | 59 55 |
| 188 | Greytown . . . | 29 04·9 | 30 38·0 | 21 50·0 | 61 19 |
| 189 | Griquatown . . . | 28 53·4 | 23 14·0 | 19 49·0 | 59 32 |
| 190 | Grobler's Bridge . . | 25 53·5 | 30 13·0 | 19 08·0 | 59 20 |
| 191 | Groenkloof . . . | 29 28·4 | 27 11·4 | 22 43·4 | 60 57 |
| 192 | Groenplaats . . . | 27 16·0 | 28 33·8 | 20 36·0 | 59 59 |
| 193 | Grootdrift . . . | 31 28·2 | 18 55·4 | 26 48·1 | — |
| 194 | Grootfontein (B.) . . | 27 39·0 | 24 00·0 | 23 59·5 | 59 08 |
| 195 | Grootfontein. . . | 33 07·6 | 21 15·0 | 26 44·4 | 61 21 |
| 196 | Groot Riet . . . | 29 17·5 | 20 46·0 | 24 49·0 | 59 04 |
| 197 | Groot Rosynbosch . | 29 04·8 | 18 54·0 | 25 12·0 | 58 21 |
| 198 | Gründoorn . . . | 27 25·7 | 18 15·0 | 24 30·4 | 57 05 |
| 199 | Gwaai . . . . | 19 17·5 | 27 42·2 | 17 07·0 | 53 28 |
| 200 | Gwelo . . . . | 19 28·2 | 29 47·0 | 16 48·0 | 55 18 |
| 201 | Hamaanskraal . . | 25 24·3 | 28 17·0 | 20 46·0 | 58 30 |
| 202 | Hamburg . . . | 27 01·4 | 24 16·0 | 22 28·2 | 57 59 |
| 203 | Hankey . . . | 33 52·0 | 24 53·0 | 25 33·0 | 62 17 |
| 204 | Haribes . . . | 24 41·5 | 17 34·0 | 23 23·0 | 55 09 |
| 205 | Harrisburg . . . | 27 09·0 | 26 24·0 | 21 23·0 | 59 16 |
| 206 | Hartebeestfontein . | 26 45·5 | 26 24·0 | 21 27·0 | 59 27 |
| 207 | Hartley . . . | 18 08·3 | 30 08·0 | 15 31·0 | 52 45 |
| 208 | Hector Spruit . . | 25 26·2 | 31 40·5 | 18 51·0 | 59 01 |
| 209 | Heidelberg (C.P.) . . | 34 05·3 | 20 58·0 | 26 48·0 | 61 17 |
| 210 | Heilbron . . . | 27 18·2 | 27 58·0 | 21 27·0 | 59 51 |
| 211 | Helvetia . . . | 29 52·1 | 26 33·0 | 23 26·3 | 60 59 |
| 212 | Henkriesfontein . . | 28 57·2 | 18 08·0 | 25 38·0 | 58 02 |
| 213 | Hermanus . . . | 34 25·3 | 19 16·0 | 27 11·0 | 60 56 |
| 214 | Hermon . . . | 33 26·7 | 18 58·0 | 27 04·4 | 60 25 |
| 215 | Hex River . . . | 32 27·0 | 18 57·0 | 26 47·0 | 59 52 |
| 216 | Highlands . . . | 27 16·0 | 31 23·0 | 19 53·0 | 60 46 |
| 217 | Hlabisa . . . | 28 18·5 | 32 06·0 | 20 01·0 | 61 44 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 218 | Hluti . . . . | 27° 11′·6 S. | 31° 35′·0 E. | 19° 46·0′ W. | 60° 33′ S. |
| 219 | Hoetjes Bay . . . | 33 01·0 | 17 57·0 | 26 59·2 | 59 52 |
| 220 | Hoezar West . . | 30 07·1 | 20 27·0 | 25 23·0 | 59 17 |
| 221 | Holfontein . . . | 29 14·9 | 27 22·5 | 22 50·8 | 60 50 |
| 222 | Hollerivier . . . | 31 22·0 | 19 32·0 | 26 20·0 | 60 00 |
| 223 | Holoog . . . . | 27 24·0 | 17 44·0 | 24 46·2 | 56 56 |
| 224 | Honey Nest Kloof . | 29 12·2 | 24 33·0 | 23 58·0 | 60 15 |
| 225 | Honing Spruit . . | 27 27·0 | 27 25·0 | 21 25·0 | 59 42 |
| 226 | Hopefield . . . | 33 14·4 | 18 21·0 | 26 53·5 | 60 04 |
| 227 | Howhoek . . . | 34 12·7 | 19 10·0 | 27 03·0 | 60 49 |
| 228 | Howmoed . . . | 29 19·3 | 19 33·0 | 25 18·0 | 58 50 |
| 229 | Huguenot . . . | 33 45·3 | 19 00·0 | 27 04·7 | 60 34 |
| 230 | Humansdorp . . | 34 02·0 | 24 38·5 | 25 32·0 | 62 20 |
| 231 | Hutchinson . . . | 31 29·6 | 23 15·0 | 25 16·2 | 60 43 |
| 232 | Ibisi Bridge . . . | 30 24·4 | 29 54·5 | 22 24·0 | 61 53 |
| 233 | Idutywa . . . | 32 00·8 | 28 20·4 | 24 04·0 | 62 46 |
| 234 | Igusi . . . . | 19 40·8 | 28 06·0 | 16 15·0 | 54 02 |
| 235 | Illovo River . . . | 30 06·1 | 30 51·0 | 21 43·0 | 62 08 |
| 236 | Imvani . . . . | 32 02·0 | 27 05·0 | 24 19·0 | 62 33 |
| 237 | Indowane . . . | 29 57·5 | 29 26·7 | 22 15·0 | 61 54 |
| 238 | Indwe . . . . | 31 27·8 | 27 21·0 | 23 36·0 | 61 50 |
| 239 | Inhambane . . . | 23 49·2 | 35 22·0 | 16 00·0 | 58 42 |
| 240 | Inoculation . . . | 20 49·7 | 27 38·0 | 18 02·0 | 55 00 |
| 241 | Inyantué . . . | 18 32·5 | 26 41·8 | 17 23·0 | 52 10 |
| 242 | Jacobsdal . . . | 29 08·8 | 24 47·0 | 23 25·0 | 60 10 |
| 243 | Jagersfontein . . | 29 45·0 | 25 31·0 | 23 24·0 | 60 53 |
| 244 | Jakalswater . . . | 22 36·1 | 15 18·0 | 22 44·3 | 52 58 |
| 245 | Kaalfontein . . . | 26 00·5 | 28 16·5 | — | 59 14 |
| 246 | Kaalkop Farm . . | 27 47·3 | 28 58·3 | 21 05·0 | 60 21 |
| 247 | Kaapmuiden . . . | 25 31·7 | 31 19·0 | 19 14·0 | 59 20 |
| 248 | Kadebis . . . | 26 16·6 | 24 25·0 | — | 58 17 |
| 249 | Kakinje Riv. M. . . | 16 20·2 | 23 30·0 | — | 49 27 |
| 250 | Kalkbank . . . | 23 31·5 | 29 20·0 | 18 49·0 | 57 22 |
| 251 | Kalkfeld . . . | 20 53·5 | 16 13·0 | 21 23·7 | 51 53 |
| 252 | Kalomo . . . . | 17 01·5 | 26 22·0 | 15 46·0 | 51 32 |
| 253 | Kaloombies . . . | 22 39·3 | 29 14·0 | 18 42·0 | 57 35 |
| 254 | Kamabies . . . | 30 02·3 | 18 29·0 | 25 13·4 | 59 19 |
| 255 | Karibib . . . | 21 56·3 | 15 53·0 | 22 11·0 | 52 45 |
| 256 | Karmoe . . . | 31 44·0 | 19 18·0 | 26 30·4 | 59 15 |
| 257 | Karree . . . . | 28 52·5 | 26 21·0 | 21 35·0 | 60 21 |
| 258 | Karreebosch . . . | 31 34·5 | 19 54·0 | 26 32·8 | 60 04 |
| 259 | Katambora Rapids . | 17 48·2 | 25 15·0 | — | 51 35 |
| 260 | Kathoek . . . | 34 23·3 | 20 20·0 | 27 04·0 | 61 13 |
| 261 | Keeley's Farm . . | 26 08·6 | 24 44·0 | 22 28·0 | 58 04 |
| 262 | Keetmanshoop . . | 26 34·7 | 18 04·0 | 24 06·7 | — |
| 263 | Kenhardt . . . | 29 18·1 | 21 09·0 | 24 57·3 | 59 21 |
| 264 | Kenilworth (Kimberley) | 28 42·0 | 24 47·0 | — | 58 57 |
| 265 | Kenkelbosch . . . | 33 30·0 | 25 52·0 | 25 11·0 | 62 24 |
| 266 | Khamis . . . . | 27 51·6 | 18 35·0 | 24 46·0 | 57 29 |
| 267 | Khan Copper Mine . | 22 30·0 | 15 00·0 | 22 01·7 | 53 11 |
| 268 | Khosis . . . . | 27 52·9 | 23 16·0 | 23 31·7 | 58 27 |
| 269 | Kilometer 233 . . | 21 54·6 | 16 05·0 | 22 14·6 | — |
| 270 | Kilometer 275 . . | 21 53·0 | 16 35·0 | 22 09·0 | 52 52 |
| 271 | Kimberley . . . | 28 43·0 | 24 46·0 | — | 60 07 |
| 272 | King William's Town . | 32 52·5 | 27 25·0 | 24 17·0 | 62 33 |
| 273 | Klaarstroom . . . | 33 20·0 | 22 32·5 | 26 13·0 | 61 41 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 274 | Klein Boetsap . . | 27° 58′·6 S. | 24° 27′·0 E. | 25° 15′·0 W. | 59° 32′ S. |
| 275 | Klerksdorp . . . | 26 52·3 | 26 38·0 | 21 52·0 | 59 18 |
| 276 | Kliparani . . . | 25 59·4 | 25 22·0 | 21 44·4 | 58 23 |
| 277 | Klipfontein . . . | 29 12·7 | 17 40·0 | 25 23·0 | 58 13 |
| 278 | Klipfontein (C.P.) . | 30 42·1 | 22 23·5 | 21 38·0 | 60 32 |
| 279 | Klipfontein (Tr.) . . | 23 05·7 | 30 10·0 | 18 14·0 | 57 16 |
| 280 | Klipplaat . . . | 33 02·0 | 24 26·0 | 25 41·0 | 62 18 |
| 281 | Knysna . . . . | 34 01·7 | 23 03·0 | 26 10·0 | 62 00 |
| 282 | Koffyfontein . . . | 29 25·2 | 25 01·0 | 23 46·0 | 60 15 |
| 283 | Kokstad . . . | 30 32·8 | 29 28·0 | 22 43·0 | 62 05 |
| 284 | Komati Poort . . | 25 26·0 | 31 54·0 | — | 60 36 |
| 285 | Komgha . . . | 32 35·6 | 27 54·5 | 24 17·0 | 62 38 |
| 286 | Koopmansfontein . . | 28 14·0 | 24 05·0 | 23 07·0 | 59 30 |
| 287 | Koppeskraal . . . | 31 04·4 | 19 28·0 | 26 06·0 | 59 25 |
| 288 | Korab . . . . | 19 27·6 | 17 33·0 | 20 28·7 | 51 03 |
| 289 | Korrobib . . . | 25 51·5 | 18 10·0 | 24 03·7 | 56 05 |
| 290 | Koster . . . . | 25 58·0 | 26 58·0 | 20 36·0 | 58 53 |
| 291 | Kraal . . . . | 26 25·1 | 28 26·0 | 20 18·0 | 59 36 |
| 292 | Krantz Kloof . . | 29 48·0 | 30 54·0 | 21 24·0 | 62 11 |
| 293 | Krantz Kop . . . | 30 48·8 | 20 45·4 | 25 33·3 | 59 45 |
| 294 | Kromm River . . | 27 19·0 | 28 18·8 | 22 18·0 | 59 54 |
| 295 | Krugers . . . | 29 57·1 | 25 50·0 | 23 10·0 | 61 02 |
| 296 | Kruispad . . . | 32 56·8 | 20 33·3 | 26 55·0 | 61 06 |
| 297 | Kubas . . . . | 22 16·3 | 15 35·0 | 22 26·8 | 52 43 |
| 298 | Kuibis . . . . | 26 40·7 | 16 48·0 | 23 54·0 | 56 03 |
| 299 | Kumnabis River . . | 25 59·5 | 18 19·0 | 24 08·5 | 56 15 |
| 300 | Kuruman . . . | 27 27·9 | 23 25·0 | 23 21·4 | 58 57 |
| 301 | Kwambonambi . . | 28 36·2 | 32 05·0 | 20 50·0 | 61 28 |
| 302 | Kweekfontein . . | 29 30·0 | 18 02·0 | 25 35·6 | 58 16 |
| 303 | Kye Charp River . . | 25 42·4 | 18 04·0 | 23 53·2 | 55 55 |
| 304 | Laat Rivier . . . | 29 38·2 | 21 19·3 | 24 57·7 | 59 31 |
| 305 | Ladysmith (C.P. . | 33 29·0 | 21 17·0 | 26 46·0 | 61 21 |
| 306 | L'Agulhas . . . | 34 50·0 | 20 00·0 | 27 09·0 | 61 16 |
| 307 | Laingsburg . . . | 33 12·0 | 20 52·0 | 26 58·2 | 61 14 |
| 308 | Lake Banagher . . | 26 22·0 | 30 19·0 | 19 49·0 | 59 45 |
| 309 | Langlaagte . . . | 26 11·8 | 28 01·0 | 21 19·0 | 59 56 |
| 310 | Lealin . . . . | 15 14·6 | 23 10·0 | 16 08·0 | 47 50 |
| 311 | Leeuwenfontein . . | 33 17·4 | 19 30·0 | 27 15·4 | 60 31 |
| 312 | Leeuwkolk . . . | 30 25·3 | 21 17·0 | 25 10·0 | 59 41 |
| 313 | Leeuwriet . . . | 31 28·3 | 19 20·0 | 26 23·5 | 59 52 |
| 314 | Letjesbosch . . . | 32 34·0 | 22 18·0 | — | 60 54 |
| 315 | Levveskolk . . . | 29 35·5 | 19 50·0 | 25 00·0 | 59 03 |
| 316 | Libode . . . . | 31 32·1 | 29 01·5 | 23 21·0 | 62 31 |
| 317 | Lichtenburg . . . | 26 10·2 | 26 06·0 | 21 29·0 | 58 56 |
| 318 | Lobatsi . . . . | 25 13·8 | 25 40·0 | 20 55·0 | 58 11 |
| 319 | Lochard . . . | 19 55·3 | 29 03·0 | 17 08·0 | 54 33 |
| 320 | Loeriesfontein . . | 30 56·9 | 19 26·0 | 26 04·4 | 59 25 |
| 321 | Lorenço Marques . . | 25 58·9 | 32 36·0 | 20 17·0 | 59 56 |
| 322 | Louw Zyn Kolk . . | 30 17·4 | 21 00·0 | 25 02·0 | 59 46 |
| 323 | Luckhoff . . . | 29 46·0 | 24 47·3 | 23 56·0 | 60 19 |
| 324 | Lydenburg . . . | 25 05·8 | 30 26·0 | 19 14·0 | 59 01 |
| 325 | Machadodorp . . | 25 39·9 | 30 15·0 | 19 11·0 | 59 39 |
| 326 | Macheke . . . | 18 08·3 | 31 51·0 | 14 55·0 | 52 58 |
| 327 | Mafeking . . . | 25 52·0 | 25 39·0 | 21 25·5 | 58 24 |
| 328 | Magalapye . . . | 23 06·8 | 26 50·0 | 19 07·0 | 56 39 |
| 329 | Magaliesberg . . | 26 00·0 | 27 37·0 | 20 30·0 | 59 01 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 330 | Magnet Heights | 24° 44′·8 S. | 29° 58′·0 E. | 18° 15′·0 W. | 58° 54′ S. |
| 331 | Magondo Island | 17 30·3 | 24 30·0 | — | 50 52 |
| 332 | Makwiro Siding | 17 57·3 | 30 25·0 | 15 20·0 | 52 26 |
| 333 | Malagas | 34 18·5 | 20 36·0 | 27 02·0 | 61 16 |
| 334 | Malenje Siding | 18 55·2 | 32 15·0 | 14 49·0 | 53 53 |
| 335 | Malinde | 18 45·0 | 27 01·3 | 16 57·0 | 52 51 |
| 336 | Malmesbury | 33 28·0 | 18 43·0 | 27 01·3 | 60 27 |
| 337 | Mandegos | 19 07·0 | 33 28·0 | 14 28·0 | 54 15 |
| 338 | Mapani Loop | 22 17·5 | 29 03·0 | 17 49·0 | 56 48 |
| 339 | Maquassi | 27 20·0 | 25 59·0 | 22 09·0 | 59 30 |
| 340 | Mara | 23 08·0 | 29 21·0 | — | 58 16 |
| 341 | Marandellas | 18 11·3 | 31 32·9 | 14 37·0 | 53 44 |
| 342 | Maribogo | 26 25·1 | 25 15·0 | 21 57·0 | 58 29 |
| 343 | Markson's Hotel | 25 35·3 | 26 32·0 | 20 48·0 | 58 27 |
| 344 | Marokwen | 26 07·8 | 23 44·0 | 21 58·0 | 57 48 |
| 345 | Matetsi | 18 12·5 | 26 01·5 | 16 54·0 | 52 38 |
| 346 | Matjesfontein | 33 14·2 | 20 36·0 | 26 49·0 | 61 06 |
| 347 | Matola | 25 48·0 | 32 22·0 | 19 25 0 | 59 54 |
| 348 | Meintjes's Farm | 26 04·4 | 25 02·2 | 21 43·4 | 58 33 |
| | Merriman. (*See* Richmond Road.) | | | | |
| 349 | Meyerton | 26 33·2 | 28 01·0 | 20 52·0 | 59 30 |
| 350 | Middelberg | 34 00·0 | 24 09·0 | 25 54·0 | 62 09 |
| 351 | Middlepost | 31 54·2 | 20 14·0 | 26 13·2 | 60 10 |
| 352 | Middleton | 32 57·8 | 25 51 0 | 25 05·0 | 62 23 |
| 353 | Mill River | 33 36·0 | 22 55·0 | — | 61 51 |
| 354 | Miller Siding | 33 05·4 | 24 08·0 | 25 46·0 | 62 12 |
| 355 | Miller's Point | 34 14·2 | 18 26·0 | 27 10·4 | 60 35 |
| 356 | Misgund | 33 45·5 | 23 32·0 | 26 06·0 | 61 58 |
| 357 | Mission Station | 23 12·7 | 30 27·0 | 18 12·0 | 58 01 |
| 358 | Modderfontein | 32 36·8 | 18 59·0 | 26 47·3 | 60 02 |
| 359 | Modder River | 29 03·0 | 24 45·0 | 20 52·0 | 59 58 |
| 360 | Modder Spruit | 28 28·9 | 29 53·0 | 21 13·2 | 60 53 |
| 361 | Molteno | 31 24·0 | 26 21·0 | 24 09·0 | 61 33 |
| 362 | Mossel Bay | 34 10·8 | 22 09·5 | 26 33·0 | 61 46 |
| 363 | Mount Ayliff | 30 48·2 | 29 31·5 | 22 41·0 | 62 16 |
| 364 | Mount Frere | 30 53·5 | 28 59·0 | 22 39·0 | 62 02 |
| 365 | Mount Moreland | 29 38·4 | 31 11·0 | 21 05·0 | 62 10 |
| 366 | Movene | 25 34·0 | 32 07·0 | 15 57·0 | 59 57 |
| 367 | M'Phatele's Location | 24 19·8 | 29 41·0 | 19 39·0 | 60 11 |
| 368 | Mukwangwa Isl. | 16 58·4 | 24 10·0 | — | 50 00 |
| 369 | Mundale | 15 45·1 | 23 20 0 | — | 49 00 |
| 370 | Murraysburg | 31 56·0 | 23 43·0 | 24 58·0 | 61 24 |
| 371 | Naauwpoort | 31 14·0 | 24 55·0 | 24 22·0 | 61 12 |
| 372 | Nabitsaus | 22 58·5 | 17 14·0 | 22 35·3 | 53 52 |
| 373 | Naboomspruit | 24 31·3 | 28 43·0 | 19 23·0 | 58 05 |
| 374 | Nalisa | 17 23·6 | 24 15·0 | 16 51·0 | 50 54 |
| 375 | Namies | 29 09·0 | 19 12·0 | 25 32·2 | 58 24 |
| 376 | Nanibies | 29 51·3 | 20 05·0 | 25 01·0 | 59 34 |
| 377 | Nelspoort | 32 07·7 | 23 01·0 | 26 04·4 | 61 30 |
| 378 | Nelspruit | 25 28·1 | 30 58·5 | 19 00·0 | 59 18 |
| 379 | Nieuwefontein | 30 36·0 | 18 41·0 | 25 45·0 | 58 38 |
| 380 | Newcastle (Natal) | 27 45·3 | 29 58·0 | 20 34·0 | 60 25 |
| 381 | Newcastle (Trans.) | 26 32·1 | 30 27·0 | 19 58·0 | 59 47 |
| 382 | Ngambwi Rapids | 17 16·4 | 24 12·0 | — | 50 26 |
| 383 | Niekerk's Hope | 29 20·2 | 22 50·0 | 25 06·0 | 57 41 |
| 384 | Nooitgedacht | 25 38·1 | 30 31·0 | 17 15·0 | 58 13 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 385 | Norval's Pont . . | 30° 39′·0 S. | 25° 27′·0 E. | — | 61 00′ S. |
| 386 | 'Nqutu Road . . . | 28 05·0 | 30 26·0 | — | 61° 04 |
| 387 | Nylstrom . . . | 24 42·4 | 28 26·0 | 19° 42′ 0 W. | 58 29 |
| 388 | Okahandja . . . | 21 58·9 | 16 51·0 | 22 04·9 | 53 00 |
| 389 | Okaputa . . . | 20 05·0 | 17 07·0 | 20 57·0 | 51 42 |
| 390 | Omaruru . . . | 21 24·7 | 15 59·0 | 21 29·0 | 52 12 |
| 391 | O'okiep . . . . | 29 35·5 | 17 53·0 | 25 40·0 | 58 07 |
| 392 | Oorlogskloof . . . | 31 30·9 | 19 27·0 | 26 36·7 | 59 50 |
| 393 | Orange River . . | 29 38·0 | 24 16·0 | 23 48·0 | 60 17 |
| 394 | Orjida . . . . | 33 26·0 | 23 19·0 | 26 00·1 | 61 55 |
| 395 | Otavi . . . . | 19 38·2 | 17 30·0 | 20 33·0 | 51 17 |
| 396 | Otjihavera . . . | 22 17·9 | 16 57·0 | 22 12·0 | — |
| 397 | Otjiwarongo . . . | 20 27·1 | 16 45·0 | 21 08·0 | 51 59 |
| 398 | Ottoshoop . . . | 25 44·6 | 26 09·0 | 21 13·0 | 58 25 |
| 399 | Oudemuur . . . | 31 05·8 | 20 19·1 | 25 59·1 | 60 02 |
| 400 | Oudtshoorn . . . | 33 35·2 | 22 12·5 | 26 36·0 | 61 38 |
| 401 | Ougrabies . . . | 29 15·5 | 18 32·0 | 25 30·5 | 58 21 |
| 402 | Paardeberg . . . | 29 00·0 | 25 04·0 | 23 29·0 | 60 09 |
| 403 | Pardevlei . . . | 30 36·1 | 21 54·0 | 25 32·7 | 59 59 |
| 404 | Paarl . . . . | 33 45·0 | 18 57·0 | — | 60 30 |
| 405 | Palapye . . . | 22 33·4 | 27 07·0 | 19 19·0 | 56 12 |
| 406 | Pampoenpoort . . | 31 03·5 | 22 39·1 | 25 20·0 | 60 35 |
| 407 | Papekuil . . . | 32 27·9 | 19 40·0 | 26 50·5 | — |
| 408 | Payne's Farm . . | 30 36·9 | 29 47·5 | 22 36·0 | 62 25 |
| 409 | Pella . . . . | 29 02·0 | 19 08·0 | 25 40.0 | 58 28 |
| 410 | Pemba . . . . | 16 31·2 | 27 16·0 | 15 40·0 | 50 27 |
| 411 | Petrus . . . . | 29 07·0 | 25 24·0 | 23 17·0 | 60 12 |
| 412 | Picene . . . . | 25 40·8 | 32 18·5 | 18 56·0 | 59 50 |
| 413 | Pienaar's River . . | 25 12·7 | 28 19·0 | 21 41·0 | 58 49 |
| 414 | Pietersburg . . . | 23 50·3 | 29 27·0 | 18 52·0 | 57 57 |
| 415 | Piet Potgietersrust . | 24 11·2 | 29 01·0 | 19 20·0 | 58 02 |
| 416 | Piet Retief . . . | 27 00·5 | 30 48·5 | 20 15·0 | 60 23 |
| 417 | Pilgrim's Rest . . | 24 56·8 | 30 45·0 | 19 19·0 | 58 40 |
| 418 | Piquetberg . . . | 32 55·0 | 18 43·0 | 26 43·7 | 60 12 |
| 419 | Pivaan's Poort . . | 27 33·8 | 30 28·0 | 20 40·0 | 60 33 |
| 420 | Plaatklip . . . | 30 47·8 | 19 06·0 | 26 07·0 | 59 16 |
| 421 | Platrand . . . | 27 06·4 | 29 29·0 | 20 52·0 | 60 09 |
| 422 | Plettenberg Bay . . | 34 02·2 | 23 21·0 | 26 03·0 | 62 05 |
| 423 | Plumtree . . . | 20 30·0 | 27 50·0 | — | 54 47 |
| 424 | Pofadder . . . | 29 07·0 | 19 24·0 | 25 39·0 | 58 50 |
| 425 | Pokwani (Tr.) . . | 24 52 2 | 29 46·0 | 19 48·0 | 58 37 |
| 426 | Port Alfred . . . | 33 35·8 | 26 54·0 | 24 54·0 | 62 40 |
| 427 | Port Beaufort . . | 34 23·8 | 20 49·0 | 26 53·0 | 61 24 |
| 428 | Port Elizabeth . . | 33 58·0 | 25 37·0 | 25 35·0 | 62 29 |
| 429 | Port Nolloth . . | 29 15·6 | 16 51·0 | 26 01·4 | 57 46 |
| 430 | Port Shepstone . . | 30 43·7 | 30 27·0 | 22 09·0 | 62 44 |
| 431 | Port St. Johns . . | 31 37·8 | 29 33·0 | 23 27·0 | 62 59 |
| 432 | Postmasburg . . | 28 20·8 | 23 04·0 | 23 09·0 | 58 53 |
| 433 | Potchefstroom . . | 26 42·8 | 27 05·0 | 21 10·0 | 59 25 |
| 434 | Potfontein . . . | 30 12·2 | 24 07·0 | 24 04·0 | 60 34 |
| 435 | Pretoria . . . | 25 45·3 | 28 12·0 | 20 32·0 | 58 59 |
| 436 | Prince Albert . . | 33 13·2 | 22 03·0 | 26 32 7 | 61 35 |
| 437 | Prince Albert Road . | 32 58·7 | 21 42·0 | 26 16·0 | 61 27 |
| 438 | Quaggasfontein . . | 29 59·1 | 20 42·0 | 25 20·0 | 59 29 |
| 439 | Queenstown . . . | 31 54·0 | 26 52·0 | 24 17·0 | 62 01 |
| 440 | Rahman's Drift . . | 28 51·9 | 18 20·0 | 25 35·5 | 58 17 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 441 | Randfontein | 26° 10′·7 S. | 27° 42′·0 E. | 21° 01′·0W. | 59° 19′ S. |
| 442 | Rateldraai | 28 45·7 | 21 17·9 | 23 26·2 | 59 00 |
| 443 | Rateldrift | 31 31·6 | 20 17·6 | 26 14·3 | 60 08 |
| 444 | Rehoboth | 23 19·6 | 17 05·0 | 22 41·5 | 54 17 |
| 445 | Revué | 18 59·0 | 33 03·0 | 14 36·0 | — |
| 446 | Richmond (C.P.) | 31 25·7 | 23 56·0 | 24 43·0 | 61 31 |
| 447 | Richmond (Natal) | 29 54·0 | 30 20·0 | — | 61 56 |
| 448 | Richmond Road | 31 13·0 | 23 38·0 | 25 42·0 | 61 14 |
| 449 | Richtofen | 22 37·8 | 14 42·0 | 22 58·0 | 52 21 |
| 450 | Rietfontein | 29 52·1 | 18 12·0 | 26 00·2 | 59 03 |
| 451 | Rietkuil Farm | 30 14·4 | 29 22·0 | 22 15·0 | 61 56 |
| 452 | Rietpoort | 31 04·4 | 20 55·1 | 25 41·8 | 60 12 |
| 453 | Rietvlei | 24 35·0 | 30 40·0 | 18 45·0 | 58 23 |
| 454 | Rietvlei (C.P.) | 33 32·0 | 22 29·0 | 26 21·0 | 61 41 |
| 455 | Riversdale | 34 05·0 | 21 16·9 | 26 48·0 | 61 26 |
| 456 | Rivierplaats | 32 08·5 | 20 24·0 | 26 01·6 | 60 09 |
| 457 | Rivierplaats | 31 30·1 | 19 41·0 | 26 17·5 | 59 52 |
| 458 | Roadside | 30 44·3 | 20 25·5 | 25 39·8 | 59 37 |
| 459 | Robertson | 33 48·8 | 19 53·0 | 26 49·0 | 60 55 |
| 460 | Rodekrantz | 24 38·0 | 30 35·0 | 19 17·0 | 58 34 |
| 461 | Roodekloof | 25 49·7 | 27 14·0 | 20 33·0 | 58 47 |
| 462 | Roodepoort | 30 13·0 | 23 22·0 | 23 46·1 | 59 13 |
| 463 | Rooidam | 29 50·7 | 23 11·8 | 23 31·5 | 59 55 |
| 464 | Rooidraai | 26 21·0 | 27 08·0 | 21 35·0 | — |
| 465 | Rooiputs | 29 17·4 | 21 38·6 | 25 32·1 | 59 31 |
| 466 | Rooival | 32 12·0 | 21 58·3 | 26 05·0 | 60 11 |
| 467 | Rosmead Junction | 31 39·6 | 25 05·0 | 24 34·0 | 61 30 |
| 468 | Rotkuppe | 26 42·4 | 15 19·0 | 24 18·0 | 55 47 |
| 469 | Rouxville | 30 31·6 | 26 47·3 | 23 16·0 | 61 13 |
| 470 | Rumsey's Farm | 26 24·3 | 24 03·0 | 21 56·0 | 58 32 |
| 471 | Rusapi | 18 32·0 | 32 08·0 | 14 35·0 | 53 25 |
| 472 | Rustenburg | 25 40·0 | 27 15·0 | 20 11·0 | 58 46 |
| 473 | Rustplaats | 24 50·6 | 30 38·0 | 19 17·0 | 58 44 |
| 474 | Ruyterbosch | 33 55·7 | 22 02·0 | 26 28·0 | 61 31 |
| 475 | Rystkuil | 32 38·7 | 22 54·0 | 25 23·0 | 61 05 |
| 476 | Sabie River | 25 06·1 | 30 45·0 | 19 23·0 | 59 07 |
| 477 | Sabies | 29 17·2 | 17 46·0 | — | 58 15 |
| 478 | Salisbury | 17 50·3 | 31 03·0 | 14 48·0 | 52 32 |
| 479 | Sandflats | 33 20·0 | 25 57·0 | 25 18·0 | 62 39 |
| 480 | Sandverhaar | 26 50·4 | 17 22·0 | 25 34·7 | 56 30 |
| 481 | Saratoga | 29 17·5 | 24 00·0 | 23 39·0 | 60 05 |
| 482 | Saxony | 28 44·1 | 27 44·4 | 22 12·7 | 60 48 |
| 483 | Schietfontein | 32 41·7 | 20 46·6 | 26 36·7 | 60 52 |
| 484 | Schikhoek | 27 24·6 | 30 34·0 | 21 17·0 | 60 39 |
| 485 | Schmidt's Drift | 28 42·1 | 24 04·0 | 23 19·0 | 59 55 |
| 486 | Schoemanshoek | 25 27·9 | 30 21·0 | 19 23·0 | 59 23 |
| 487 | Schulenburg | 26 25·5 | 25 58·0 | 21 28·0 | 59 02 |
| 488 | Schuilplaats | 26 54·2 | 29 47·0 | 20 21·0 | 60 01 |
| 489 | Schuurkraal | 31 57·0 | 19 46·0 | 26 34·6 | 59 55 |
| 490 | Schweizer Reneke | 27 11·4 | 25 19·0 | 21 49·0 | 59 24 |
| 491 | Secocoeni's Stad | 24 28·3 | 29 52·0 | 17 48·0 | 56 24 |
| 492 | Seeheim | 26 48·5 | 17 44·0 | 24 32·5 | 56 46 |
| 493 | Senanga | 16 03·8 | 23 25·0 | 16 16·0 | 49 33 |
| 494 | Sendlingsgrab | 23 57·8 | 17 18·0 | 23 12·2 | 54 40 |
| 495 | Seruli | 21 55·7 | 27 19·0 | 19 13·0 | 55 59 |
| 496 | Sesheke | 17 30·0 | 24 45·0 | 16 58·0 | 50 42 |

SUMMARY ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 497 | Sesskameelboom . . | S 24° 52′·7 S. | 17° 38′·0 E. | 23° 28′·0 W. | 55° 15′ S. |
| 498 | Shakals Kuppe . . | 26 38·2 | 16 32·0 | 23 50·8 | 56 19 |
| 499 | Shangani . . . | 19 45·8 | 29 24·0 | 17 29·0 | 55 41 |
| 500 | Shashi . . . . | 21 23·2 | 27 27·0 | 18 20·0 | 58 04 |
| 501 | Shela River . . . | 26 51·0 | 30 43·0 | 19 49·0 | 60 00 |
| 502 | Shoshong Road . . | 23 34·8 | 26 34·0 | 20 35·0 | 57 48 |
| 503 | Signal Hill . . . | 33 55·0 | 18 24·3 | 27 24·5 | 60 26 |
| 504 | Simonstown (Rifle R.) . | 34 12·0 | 18 26·0 | 27 15·8 | 60 34 |
| 505 | Simonstown (Glencairn) | 34 10·8 | 18 26 0 | 27 06·0 | 60 29 |
| 506 | Sioma . . . . | 16 40·2 | 23 50·0 | — | 49 25 |
| 507 | Sir Lowry's Pass . . | 34 07·3 | 18 55·0 | 27 29·1 | 60 40 |
| 508 | Siyundu . . . | 17 47·8 | 25 30·0 | — | 51 55 |
| 509 | Smaldeel . . . | 28 24·3 | 26 44·0 | 22 31·0 | 60 07 |
| | Somkele. (*See* Hlabisa.) | | | | |
| 510 | Spitzkop . . . | 26 25·5 | 18 23·0 | 24 14·4 | 56 26 |
| 511 | Spitzkopje . . . | 25 18·2 | 30 49·0 | 18 52·0 | 59 38 |
| 512 | Springfontein . . | 30 16·7 | 25 44·0 | 24 07·0 | 61 24 |
| 513 | Springs . . . . | 26 13·0 | 28 27·0 | 20 35·0 | 59 21 |
| 514 | Stanford . . . | 34 26·7 | 19 28·0 | 27 09·0 | 60 59 |
| 515 | Stanger . . . | 29 21·1 | 31 15·0 | 20 49·0 | 62 07 |
| 516 | Steenkampspoort . . | 32 06·3 | 21 44·1 | 26 11·6 | 6[illegible] 39 |
| 517 | Stellenbosch . . . | 33 56·0 | 18 50·0 | 27 14·2 | 60 41 |
| 518 | Sterkstroom . . . | 31 34·5 | 26 33·0 | 24 09·0 | 61 46 |
| 519 | Steynsburg . . . | 31 18·5 | 25 48·0 | 24 17·0 | 61 18 |
| 520 | Still Bay . . . | 34 22·0 | 21 25·0 | 26 53·0 | 61 31 |
| 521 | Stompiesfontein . . | 32 13·5 | 19 41·0 | 26 32·7 | 60 01 |
| 522 | Stormberg Junction . | 31 17·5 | 26 16·0 | 24 10·0 | — |
| 523 | Storms River . . | 33 58·0 | 23 49·5 | 27 55·0 | 62 10 |
| 524 | Strandfontein . . | 34 05·3 | 18 34·0 | 27 24·0 | 60 32 |
| 525 | Sutherland . . . | 32 25·0 | 20 39·3 | 26 14·1 | 60 36 |
| 526 | Swakopmund . . | 22 40·7 | 14 32·0 | 22 58·1 | 52 30 |
| 527 | Swanswani . . . | 27 46·6 | 23 50·0 | 22 54·0 | 59 08 |
| 528 | Swellendam . . . | 34 02·0 | 20 27·0 | 26 53·0 | 61 04 |
| 529 | Taungs . . . . | 27 34·8 | 24 45·0 | 22 05·0 | 59 33 |
| 530 | Thaba 'Nchu . . | 29 10·7 | 26 49·0 | 22 38·0 | 60 37 |
| 531 | Thirty-first . . . | 25 40·6 | 29 37·6 | 20 19·0 | 59 20 |
| 532 | Tinfontein . . . | 30 24·0 | 26 54 8 | 22 54·0 | 61 33 |
| 533 | Toise River . . . | 32 27·3 | 27 28·7 | 24 36·0 | 62 50 |
| 534 | Touws River . . | 33 21·0 | 20 03·0 | 27 28·0 | 60 52 |
| 535 | Trekkopje . . . | 22 17·3 | 15 07·0 | 20 37·0 | 54 01 |
| 536 | Tsawisis . . . | 27 38·4 | 18 00·0 | 24 32·6 | 57 04 |
| 537 | Tschaukaib . . . | 26 34·5 | 15 37·0 | 24 34·0 | 55 40 |
| 538 | Tsolo . . . . | 31 18·2 | 28 45·6 | 22 57·0 | 61 59 |
| 539 | Tsumeb . . . | 19 13·3 | 17 50·0 | 20 24·0 | 50 51 |
| 540 | Tsumis . . . . | 23 44·0 | 17 10·0 | 23 08·7 | 54 29 |
| 541 | Tugela . . . . | 29 12·0 | 31 25·0 | — | 61 59 |
| 542 | Tulbagh Road . . | 33 19·3 | 19 10·0 | 27 04·6 | 60 24 |
| 543 | Tweepoort . . . | 26 36·7 | 30 43·0 | 20 13·0 | 59 41 |
| 544 | Twee Rivieren . . | 33 50·3 | 23 56·5 | 25 54·0 | 62 09 |
| 545 | Twelfelhoek . . . | 27 27·4 | 29 20·4 | 20 10·0 | 60 24 |
| 546 | Tygerfontein . . | 34 10·0 | 21 35·5 | 26 38 0 | 61 31 |
| 547 | Tygerkloof Drift . . | 28 10·8 | 28 35·2 | 21 05·7 | 60 19 |
| 548 | Uitenhage . . . | 33 47·0 | 25 24·0 | 25 25·0 | 62 28 |
| 549 | Uitkyk . . . . | 25 49·5 | 29 25·0 | 19 39·0 | 59 05 |
| 550 | Uitspan Farm . . | 31 41·2 | 21 27·2 | 26 26·7 | 60 50 |
| 551 | Umgwezi River Mouth | 17 39·1 | 25 00·0 | — | 51 08 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 552 | Umhlatuzi . . . | 28° 51′·7 S. | 31° 54′·0 E. | 20° 20′·0 W. | 61° 29 |
| 553 | Umhlengana Pass . | 31 36·0 | 29 19·6 | 23 18·0 | 62 50 |
| 554 | Umtali . . . . | 18 59·2 | 32 39·0 | 14 31·0 | 53 49 |
| 555 | Umtata . . . . | 31 35·9 | 28 47·1 | 23 20·0 | 62 35 |
| 556 | Umtwalumi . . . | 30 28·0 | 30 40·0 | — | 62 36 |
| 557 | Umzinto . . . | 30 19·4 | 30 39·0 | 21 33·0 | 62 13 |
| 558 | Underberg Hotel . . | 29 47·9 | 29 30·5 | 22 41·0 | 61 52 |
| 559 | Upington . . . | 28 27·7 | 21 14·9 | 25 36·0 | 58 46 |
| 560 | Usakos . . . . | 22 00·1 | 15 38·0 | 22 21·2 | 52 48 |
| 561 | Usib Poort . . . | 23 06·7 | 17 09·0 | 22 36·6 | 53 42 |
| 562 | Utrecht . . . . | 27 39·9 | 30 16·0 | 20 42·0 | 60 24 |
| 563 | Vaalgras . . . | 26 05·6 | 18 30·0 | 24 02·5 | 56 28 |
| 564 | Van Reenen . . . | 28 22·2 | 29 24·5 | 21 07·0 | — |
| 565 | Van Rhynsdorp . . | 31 29·7 | 18 44·0 | 26 43·3 | 59 26 |
| 566 | Van Wyk's Farm . . | 33 49·4 | 21 12·0 | 26 42·0 | 61 18 |
| 567 | Van Wyk's Vlei . . | 30 22·3 | 21 50·0 | 25 34·7 | 60 04 |
| 568 | Ventersdorp . . . | 26 20·0 | 26 50·0 | 21 38·0 | — |
| 569 | Victoria Falls . . | 17 55·6 | 25 51·0 | 16 47·0 | 52 26 |
| 570 | Villiersdorp . . . | 33 59·5 | 19 19·0 | 27 03·0 | 60 48 |
| 571 | Virginia . . . | 28 07·5 | 26 55·0 | 22 16·0 | 60 02 |
| 572 | Vlaklaagte . . . | 26 50·6 | 29 05·0 | 20 34·0 | 59 49 |
| 573 | Vogelvlei . . . | 29 08·3 | 27 31·1 | 22 13·8 | 61 01 |
| 574 | Vondeling . . . | 33 19·8 | 23 04·0 | 26 04·0 | 61 44 |
| 575 | Vredefort . . . | 27 01·2 | 27 22·9 | 20 46·0 | 58 38 |
| 576 | Vredefort Road . . | 27 07·0 | 27 45·0 | — | 60 04 |
| 577 | Vryburg . . . | 26 57·1 | 24 43·0 | 21 18·0 | 59 14 |
| 578 | Wakkerstroom . . | 27 21·5 | 30 09·0 | 20 27·0 | 60 14 |
| 579 | Wankie . . . . | 18 22·3 | 26 28·5 | 15 12·0 | 52 07 |
| 580 | Warmbad (Waterberg) | 24 53·0 | 28 20·0 | 19 50·0 | 58 11 |
| 581 | Warmbad (Zoutpansberg) | 22 24·9 | 29 12·0 | 20 00·0 | 58 17 |
| 582 | Warrenton . . . | 28 06·9 | 24 52·0 | 23 10·0 | 59 58 |
| 583 | Waschbank . . . | 28 18·8 | 30 08·0 | 21 17·0 | 60 50 |
| 584 | Waterworks . . . | 29 04·5 | 26 28·0 | 22 39·0 | 60 42 |
| 585 | Welverdiend . . | 26 22·7 | 27 17·0 | 21 09·0 | 59 44 |
| 586 | Wepener . . . | 29 43·6 | 27 03·7 | 23 35·9 | 61 10 |
| 587 | Wessels . . . | 27 23·7 | 23 40·0 | 22 43·0 | 59 17 |
| 588 | Willems Rivier . . | 31 20·6 | 19 06·0 | 26 27·4 | 59 42 |
| 589 | Williston . . . | 31 20·4 | 20 55·2 | 25 27·9 | 60 19 |
| 590 | Willowmore . . . | 33 09·4 | 23 30·0 | 26 08·0 | 61 57 |
| 591 | Winburg . . . | 28 31·2 | 27 03·0 | 22 23·0 | 60 17 |
| 592 | Windhoek . . . | 31 44·4 | 18 38·0 | 26 37·1 | 59 31 |
| 593 | Windhuk . . . | 22 33·8 | 17 05·0 | 22 16·2 | 53 29 |
| 594 | Winkeldrift . . . | 27 10·6 | 27 07·6 | 22 26.0 | 59 49 |
| 595 | Witklip . . . | 23 16·5 | 29 17·0 | 20 38·0 | 57 31 |
| 596 | Witmoss . . . | 32 33·0 | 25 45·0 | 24 40·0 | 62 18 |
| 597 | Witwater . . . | 29 04·0 | 22 50·0 | 24 22·0 | 60 58 |
| 598 | Wolvefontein . . | 33 19·0 | 24 55·0 | — | 62 20 |
| 599 | Wolvehoek . . . | 26 54·9 | 27 50·0 | 21 11·0 | 59 36 |
| 600 | Wonderfontein . . | 25 48·3 | 29 53·0 | 21 51·0 | 58 55 |
| 601 | Woodville . . . | 33 56·3 | 22 41·0 | 26 16·0 | 61 50 |
| 602 | Worcester . . . | 33 39·0 | 19 26·0 | 27 09·0 | 60 40 |
| 603 | Wortel . . . . | 29 02·0 | 18 49·0 | 25 34·0 | 58 21 |
| 604 | Zak Rivier . . . | 30 30·9 | 20 31·0 | 25 49·2 | 59 35 |
| 605 | Zand Gat . . . | 29 11·0 | 19 43·0 | 24 58·0 | 58 41 |
| 606 | Zand Put . . . | 30 05·7 | 20 49·0 | 25 17·0 | 59 38 |

SUMMARY, ETC.—(*continued*).

| No. | Name of station. | Latitude. | Longitude. | Declination (D). | Dip (θ). |
|---|---|---|---|---|---|
| 607 | Zand Rivier | 23° 03′·8 S. | 29° 34′·0 E. | 19° 56′·0 W. | 57° 21′ S. |
| 608 | Zeekoegat | 33 03·0 | 22 31·0 | 26 21·0 | 61 51 |
| 609 | Zeerust | 25 32·6 | 25 59·0 | 22 05·0 | 58 26 |
| 610 | Zimba | 17 18·8 | 26 09·0 | 16 26·0 | 50 59 |
| 611 | Zonder Huis | 29 40·0 | 20 54·0 | 25 15·0 | 59 20 |
| 612 | Zoutpan | 26 48·7 | 24 13·0 | 22 30·7 | — |
| 613 | Zoutpansdrift | 33 09·9 | 19 43·0 | 27 05·6 | 60 44 |
| 614 | Zuurbraak | 34 00·3 | 20 39·0 | 26 52·0 | 60 10 |
| 615 | Zuurfontein | 32 51·0 | 18 35·0 | 26 50·1 | 60 02 |
| 616 | Zuurpoort | 32 02·9 | 24 08·0 | 25 15·0 | 61 26 |
| 617 | Zwartkopje | 29 29·0 | 19 39·0 | 25 14·0 | 58 51 |
| 618 | Bashee | 31 42·0 | 28 30·0 | 24 06·0 | 62 36 |
| 619 | East of Komgha | 32 32·6 | 27 58·3 | 24 15·0 | 62 35 |
| 620 | North of Limpopo | 22 07·2 | 29 10·0 | 18 44·0 | 56 52 |
| 621 | Outspan | 32 13·4 | 28 10·4 | 24 04·0 | 62 20 |
| 622 | Ugie (on road to) | 31 08·3 | 28 26·2 | 23 14·0 | 62 13 |
| 623 | 388 | 23 42·7 | 29 44·0 | 19 28·0 | 57 35 |
| 624 | 389 | 24 08·0 | 29 28·0 | 19 04·0 | 57 55 |
| 625 | 390 | 25 09·8 | 29 44·8 | 19 53·0 | 59 09 |
| 626 | 391 | 25 47·5 | 29 36·0 | 19 15·0 | 59 25 |
| 627 | 392 | 24 47·0 | 30 40·0 | — | 59 00 |
| 628 | 393 | 28 54·6 | 27 44·1 | 22 10·0 | 59 54 |
| 629 | 394 | 28 31·6 | 27 42·3 | 22 10·8 | 60 32 |
| 630 | 395 | 28 06·7 | 29 03·1 | 21 09·0 | 60 35 |
| 631 | 396 | 27 22·7 | 29 00·0 | 20 41·0 | 60 04 |
| 632 | 397 | 27 30·0 | 26 38·3 | — | 60 03 |
| 633 | 401 | 31 26·0 | 29 31·5 | 22 23·0 | 62 02 |
| 634 | 402 | 31 00·6 | 29 30·5 | — | 62 06 |
| 635 | 403 | 30 49·7 | 29 15·5 | 22 18·0 | 62 18 |
| 636 | 404 | 31 06·0 | 28 52·0 | — | 62 21 |
| 637 | J.T.M. 26 | 29 15·8 | 17 11·0 | 25 42·5 | 57 59 |
| 638 | J.C.B. 26 | 30 44·3 | 19 12·0 | 25 47·4 | 59 23 |
| 639 | J.C.B. 27 | 30 36·2 | 18 51·0 | 25 45·5 | — |
| 640 | J.C.B. 30 | 30 15·7 | 18 28·0 | 26 01·5 | 58 52 |
| 641 | J.C.B. 32 | 29 59·0 | 18 19·0 | 25 27·7 | — |
| 642 | J.C.B. 48 | 28 44·0 | 18 25·0 | 25 13·0 | 59 10 |
| 643 | J.C.B. 49 | 28 34·7 | 18 33·0 | 25 18·3 | 57 53 |
| 644 | J.C.B. 53 | 27 44·6 | 18 24·0 | 24 31·2 | 57 19 |
| 645 | J.C.B. 54 | 27 35·4 | 18 15·0 | 24 36·0 | 57 13 |
| 646 | J.C.B. 62 | 26 47·8 | 17 14·0 | 23 49·1 | 55 57 |
| 647 | J.C.B. 73 | 26 11·6 | 18 29·0 | 24 07·0 | 56 38 |
| 648 | J.C.B. 79 | 25 13·5 | 17 48·0 | 23 40·0 | 55 38 |
| 649 | J.C.B. 83 | 24 18·4 | 17 30·0 | 23 21·5 | 55 09 |
| 650 | J.C.B. 84 | 24 09·2 | 17 22·0 | 22 50·0 | 55 00 |
| 651 | A. | 26 14·7 | 23 56·8 | 22 16·0 | 58 04 |
| 652 | B. | 26 12·0 | 24 01·0 | 22 11·0 | 58 16 |
| 653 | | 31 28·7 | 18 50·0 | — | 59 33 |

# THE HEATING COEFFICIENTS OF RHEOSTATS AND THE CALCULATION OF RESISTANCES FOR CURRENTS OF SHORT AND MODERATE DURATIONS.

By H. Bohle, Cape Town.

(Read October 20, 1915.)

Stefan's Law of Radiation.—Stefan's law of radition for black or grey bodies in vacuum reads—

$$P_R = AS\ (\delta_f^4 - \delta_b^4) \quad . \quad . \quad . \quad . \quad . \quad 1.$$

where $S_C$ is the radiating surface, $\delta_f$ and $\delta_b$ the absolute temperatures of heated body and surroundings respectively, and A a coefficient which varies with the nature of the surface and the surrounding media.

When $\delta_f$ differs little from $\delta_b$, *i. e.* when the temperature rise s small, we may write

$$P_R = 4AS\ \delta_b^3(\delta_f - \delta_b) = A'S_C\delta \quad . \quad . \quad . \quad . \quad 2.$$

where $\delta = \delta - \delta_b$ = temperature size.

When $\delta_f$ is very great, $\delta_b$ may be neglected, and

$$P_R = AS_C\delta_f^4 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad 3.$$

For electrical apparatus these formulæ hold very approximately only, equation 2 being the one which is generally used for machines and rheostats. The coefficient A′, which may be called the emissivity, or the heat radiated per unit cooling surface for a temperature difference of one degree, is thereby assumed constant and independent of the temperature.

Test results indicate that A′ is by no means a constant quantity if formula 2 is used. Where the air is stationary, formula 1 is more correct, *i. e.* the power radiated varies still with a high power of the temperature. For pure radiation the ratios of the powers radiated according to equations 1 and 2 are given in fig. 1, for temperatures up to 500° C., which clearly indicate that the use of formula 2 may give results which are altogether unreliable, as soon as the temperature rise exceeds a few degrees, whenever the power radiated varies with a high power of the temperature.

When a current of I amperes flows through a resistance of R ohms the heat generated in unit time is

$$P_H = I^2R = I^2\rho\frac{l}{s}$$
$$= i^2\rho ls \text{ Watts} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad 4.$$

where $i = \frac{I}{s}$ = current density,

$\rho$ = resistivity.

$l$ = length of conductor.

$s$ = cross section thereof.

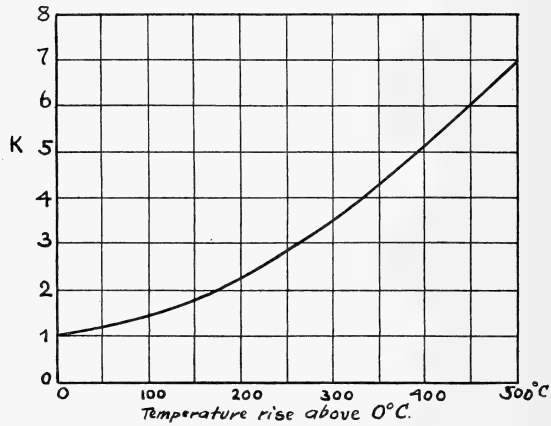



Fig. 1.

Tht rate of temperature increase is

$$\frac{d\delta}{dt} = \frac{\text{rate of heat gain}}{\text{total heat}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad 5.$$

Let C be the specific heat, G the specific gravity, then the heat per unit volume is CG, so that the total heat is CG$sl$. But the total heat lost per second is

$$P_R = AS_C(\delta_f^4 - \delta_b^4) = APl(\delta_f^4 - \delta_b^4)$$

where P is the perimeter of the conductor, and, since the heat gain is the difference between the heat generated and the heat lost, we obtain

$$\frac{d\delta}{dt} = \frac{d(\delta_f - \delta_b)}{dt} = \frac{i^2\rho sl - APl(\delta_f^4 - \delta_b^4)}{CGsl} \quad . \quad . \quad . \quad . \quad 6.$$

We have assumed Stefan's law to be correct for our conductors; but as this is not the case for machines and rheostats, and as the law varies with each apparatus, according to size, system of construction, and locality, it is preferable to employ the approximate formula 2 *assuming* A′ *to be constant for the purpose of integration only.* We then obtain

$$\frac{d\delta}{dt}=\frac{i^2\rho sl - A'Pl\delta}{CGsl} \qquad . \quad . \quad . \quad . \quad . \quad . \quad 7.$$

Integrated

$$\delta=\frac{i^2\rho s}{A'P}\left\{1 - \epsilon^{-\frac{A'Pt}{CGs}}\right\} \qquad . \quad . \quad . \quad . \quad . \quad . \quad 8.$$

This is the well-known law of the heating curve.

The integration holds for constant A′ and $\rho$. The variation of $\rho$ for most resistance materials is negligible, but that of A′ may be 20 or more per cent. To be able to integrate we should use an average value or proceed in steps. In practice it is the maximum temperature rise, which is of importance, for which A′ may be more easily assumed correctly.

When $P_H=P_R$ no further rise takes place, and we get

$$P_H=P_R=A'S_C(\delta_\infty-\delta_t)=A'S_C\delta_m \qquad . \quad . \quad . \quad . \quad . \quad 9.$$

whence

$$\delta_m=\frac{P_H}{A'S_C}=\frac{I^2\rho l}{A'Pls}=\frac{I^2\rho}{A'Ps}=\frac{i^2\rho s}{A'P} \qquad . \quad . \quad . \quad . \quad . \quad 10.$$

and

$$\delta=\delta_m\left\{1 - \epsilon^{-\frac{A'Pt}{CGs}}\right\} \qquad . \quad . \quad . \quad . \quad . \quad 11.$$

Let

$$t_o=\frac{CGs}{A'P}=\frac{CGsl}{A'Pl}=\frac{CGsl\delta}{A'Pl\delta}=\frac{\text{heat required to reach final temp.}}{\text{rate of generation of heat}} \qquad . \quad 12.$$

=heat required to reach actual final temperature if there were no cooling. Owing to the latter, the actual temperature rise only reaches $\left(1-\frac{1}{\epsilon}\right)$, or 63·4 per cent. of its steady value in time $t_o$. We call $t_o$ the time constant. Hence

$$\delta=\delta_m\left\{1 - \epsilon^{-\frac{t}{t_o}}\right\} \qquad . \quad . \quad . \quad . \quad . \quad . \quad 13.$$

It will be obvious from these equations that the accuracy of the pre-calculation of the temperature rise of a rheostat, or the size of its conductors for a given rise and specified load conditions, will entirely depend upon the correct assumption of A′ or $\frac{1}{A'}$. These can, however, be obtained from tests alone, and even then great care has to be exercised, as A′ may vary considerably when simply turning the rheostat over, whereby the ventilation is affected.

In figs. 2, 3, 4, and 5 values of A′ and $\frac{1}{A'}$ have been plotted from tests carried out.

For fig. 2 the resistances consisted of spiral wires of No. 22 S.W.G. thickness (0·71 mm.), wound on mandrils $\frac{5}{8}$ in. thick, and freely suspended

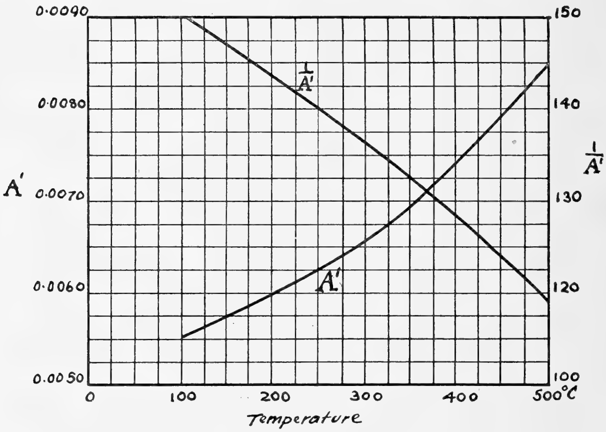



Fig. 2.

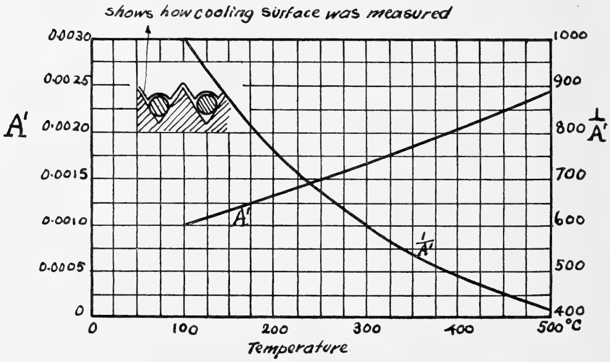



Fig. 3.

between the ends, giving excellent ventilation. We see that with an increase in the temperature the emission of heat improves, $\frac{1}{A'}$, dropping from 150 at

100° to 117 at 500°. The suspension of coils in this manner gives the best cooling arrangement; but the mechanical construction is weak, as the wires sag.

In fig. 3 the heating coefficient is given for the same wire, which is now wound on porcelain rods 1 in. in diameter and provided with a standard

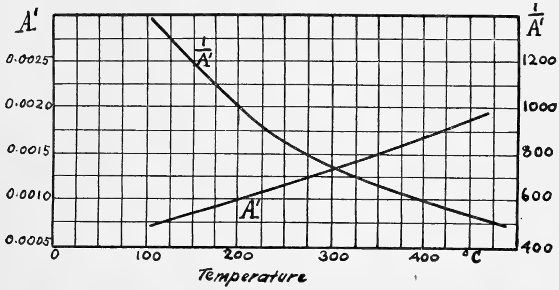



Fig. 4

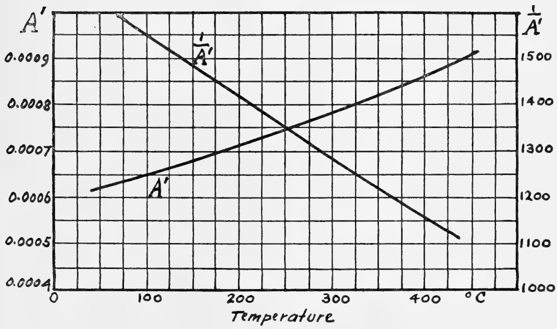



Fig. 5.

screw-thread twelve to the inch. The total cooling surface has been measured for the evaluation of A′ in the manner indicated in the inset. We see that now a much greater cooling surface is required to emit the same amount of heat, $\frac{1}{A'}$ being 1000, whereas for freely suspended coils it was 150 for the same temperature—viz. 100° C.

Fig. 4 gives the coefficients for asbestos-woven rheostats, forming sheets, about $\frac{3}{8}$ in. apart, the area of the sheets being taken for the evaluation of A′.

Fig. 5 holds for a grid resistance, the cross section of the conductor being $9 \times 5$ mms.[2] The grids were closely packed, the distance between the conductors being about equal to their thickness. As was to be expected, the emission of heat was rather poor, and for high temperatures very irregular for different parts of the grid. The curves give average values.

In all experiments the rheostats were quite open at the top, so that the hot air could get away. When the asbestos-woven resistance and the grids were turned over, so that the top was shielded by an iron plate, the temperature rose much higher, showing that a generalisation of values for heating coefficients is absurd. For every particular type data should be obtained experimentally, and the position and manner of fixing should be clearly stated.

The heating coefficient A′, being a function of the temperature, may be expressed by an equation. For fig. 2 we get

$$A' = 0{\cdot}0026\delta^{0{\cdot}158}$$

whence—

$$\delta_m = \sqrt[1{\cdot}158]{\frac{P_H}{0{\cdot}0026S_C}} = \sqrt[1{\cdot}158]{\frac{385P_H}{S_C}}$$

Compared with Stefan's law we get $P_R = AS_C(\delta_f^{2{\cdot}04} - \delta_b^{2{\cdot}04})$ where A is now constant and $\delta_f$ and $\delta_b$ are absolute temperatures.

On the whole, it will be more convenient to use equation 10, and to take A′, or better $\frac{1}{A'}$, from the curves.

$\frac{1}{A'}$ indicates the size of the cooling surface per watt lost for 1° C. rise.

Rheostats for Loads of Short Duration.—The time in which a resistance reaches its final temperature for a given load depends upon the heat capacity and the ventilation. The freely suspended coils used for fig. 2 required $2\frac{1}{2}$ minutes, when wound on the porcelain rods 45 minutes, while the cast-iron grid rheostat took 92 minutes. This time does not vary much with the load, but the time constant does, as A′ increases with the temperature. It will thus be impossible to say offhand what constitutes a load of short duration. For freely suspended coils of thin wire even a minute is a load of long duration, as its temperature will then be near the maximum, whereas for the same wire wound on porcelain the cooling effect during this time is negligible. Oil-insulated rheostats do not reach their steady temperature until hours have passed.

The initial rise is expressed by

$$\frac{d\delta}{dt}=\frac{\text{rate of generation of heat}}{\text{thermal capacity}}$$

$$=\frac{i^2\rho sl}{CGsl}=Ki^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad 14.$$

if we assume $\rho$ and C constant, which is approximately correct for constantan and manganin, but not for iron, copper, etc. The temperature coefficient for iron grids is, however, usually much lower than for ordinary iron.

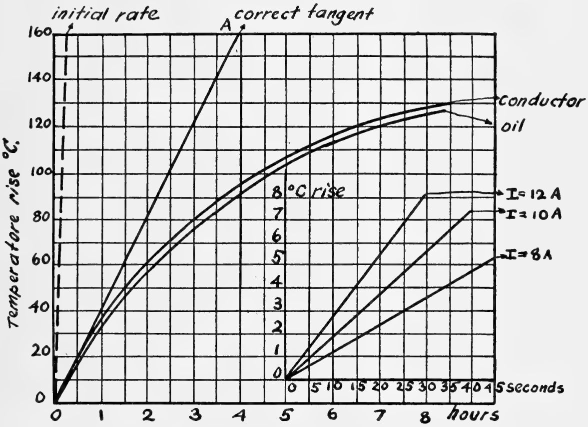



Fig. 6.

Equation 14 holds for bare conductors. For those wound on insulating material or embedded in oil, sand, or enamel we have

$$\frac{d\delta}{dt}=\frac{I^2\rho sl}{\Sigma(CGsl)\times s^2}$$

$$=\frac{I^2R}{\Sigma(MC)} \quad . \quad . \quad . \quad . \quad . \quad . \quad 15.$$

where M is the weight and C the specific heat of the materials used.

Of importance is the case when conductors are immersed in oil, for which we have

$$\frac{d\delta}{dt}=\frac{I^2R}{MC+M_oC_o} \quad . \quad . \quad . \quad . \quad . \quad . \quad 15a.$$

When designing a starter with oil insulation for short duration starting, the question arises, How much oil is to be taken into account? Evidently only a small portion is heated during the time required to start a motor, as there is no time for circulation to set in. Experiments carried out with freely suspended coils of No. 22 S.W.G. copper wire showed that the time elapsing before circulation takes place depends upon the current density. The results of the test are shown in fig. 6. When the current was 8 amperes it took 70 seconds, for 10 amperes 40, and for 12 amperes 30 seconds. The rates of temperature rise during these times are also indicated in the inset on the right. The quantity of oil affected was approximately the same in all cases—1·25 kilograms out of 24 kilograms contained in the vessel. A large vessel for short duration starters thus means waste of material.

Analysing the results, it was found that for the same temperature rise in air-cooled and oil-insulated rheostats for short duration loads, when cooling is negligible, the current density in the latter case may be about four times higher than in the former. It must, however, be remembered that for air-cooled resistances much higher temperature rises are allowable, depending upon the mechanical design, whereas the maximum temperature of oil should not exceed 100° C. if sludging and deterioration is to be avoided. The saving of material in oil-insulated starters is thus illusory, even if we neglect the cost of the vessel and the expense of the oil. As a matter of fact, the oil is used mainly for safety in places where sparking is dangerous, as in coal-mines, where all switching has to take place under oil.

For rheostats embedded in sand or enamel the current density may be about twice as high as for air-cooled resistances, assuming the same temperature rise, which may be considerably higher than oil permits, so that now resistance material is saved.

Rheostats for Loads of Moderate Duration.—The general law of heating reads

$$\delta = \delta_m \left(1 - \varepsilon^{-\frac{t}{t_o}}\right)$$

As all heating curves have the same shape we may plot one for $\delta_m = 1$ and $t_o = 1$, as has been done in fig. 7. We next determine $t_o$ and the ratio $\frac{t}{t_o}$, whence for a given value of $\delta_m$ the rise is also determined.

$$\left.\begin{aligned} \delta_m &= \frac{I^2\rho}{A'Ps} \text{ generally} \\ &= \frac{4I^2\rho}{A'd^3} \text{ for circular conductors} \end{aligned}\right\} \quad . \quad . \quad . \quad 16.$$

$$\left.\begin{aligned} t_o &= \frac{CGs}{A'P} \text{ generally} \\ &= \frac{CGd}{4A'} \text{ for circular conductors} \end{aligned}\right\} \quad . \quad . \quad . \quad 17.$$

where $d$ denotes the diameter.

We see that the accuracy of the calculation depends again upon the correct assumption of A′ or $\frac{1}{A'}$. But this quantity depends itself upon the temperature, and as the latter is unknown, A′ is unknown. For a new design there is nothing left but to assume A′ and to make several trial calculations until A′ and $\delta$ correspond.

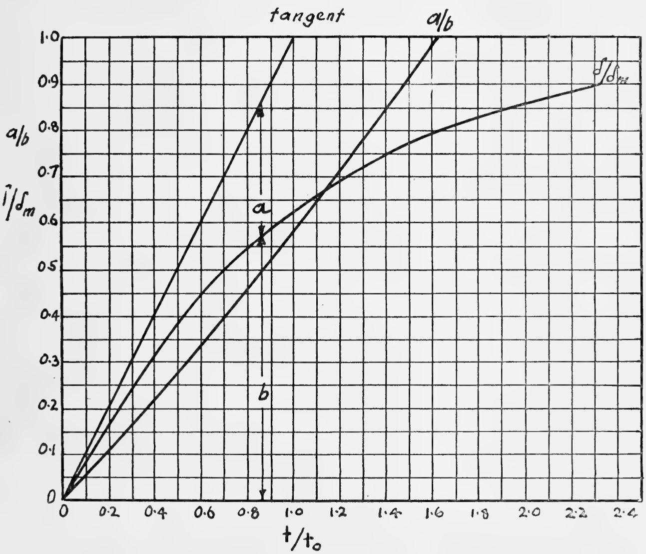



*Fig. 7.*

When a resistance has been constructed, it is best to find $t_0$ experimentally, as the calculated value is always too small, except perhaps for freely suspended wires with little heat capacity and excellent ventilation. A heat run is thus essential. For small rheostats this does not take long; but for large apparatus the time required and the cost of a heat run may be considerable. The time may, however, be reduced as follows:

We carry out a test and plot the temperature rise against time until the curve commences to bend towards the abcisse axis. This time should not exceed one or one and a half hours even for the largest rheostats. In fig. 7 a second curve has been plotted, which gives the ratio

$$\frac{\text{temp. rise if there were no cooling} - \text{actual temp. rise}}{\text{actual temp. rise}} = \frac{a}{b}$$

as function of $\frac{t}{t_o}$. The temperature rise which neglects cooling is given by the tangent to the curve, hence with $\frac{a}{b}$ known, we take from the figure the corresponding ratio $\frac{t}{t_o}$, and then from the first curve the value $\frac{\delta}{\delta_m}$, whence $\delta_m$ is determined.

The accuracy of this method depends upon the correct drawing of the tangent. The latter can in most cases not be drawn from the initial temperature rises, unless the heat capacity is very small. This is clearly shown in fig. 6, in which the initial rate is given by the dotted line on the left, whereas the correct tangent lies far to the right, for reasons explained previously. The tangent must therefore be guessed as correctly as possible, which is not very difficult if one draws a complete set of tangents starting where the experiment was interrupted and moving towards the origin, thus enveloping the heating curve with tangents. Once the tangent in the origin is known, the construction of the whole heating curve is simple, and clearly indicated in fig. 7, which is self-explanatory.

The experimental values of $t_o$ usually lie between 0 and about 50, according to the size and construction of the resistance. For the grid rheostat the calculated value was 12 minutes, the experimental one 17 and 19 minutes for maximum temperatures of 290° and 210° C. respectively.

For a known maximum rise the time constant follows from—

$$t_o = \frac{t}{ln\left(\frac{\delta_m}{\delta_m - \delta}\right)}$$

so that only the rise $\delta$ in the time $t$ has to be noticed.

# NOTE ON THE SO-CALLED VAHLEN RELATIONS BETWEEN THE MINORS OF A MATRIX.

By Sir Thomas Muir.

(Received November 3, 1915.)

(1) Relations between the elements of a rectangular array, though not looked upon as such, make their appearance very early in the history of determinants. In 1748, for example, Fontaine, using a peculiar notation for $|a_1\ b_2|$, states in regard to the array

$$\begin{matrix} a_1 & a_2 & a_3 & a_4 \\ b_1 & b_2 & b_3 & b_4 \end{matrix}$$

the identity

$$|a_1b_2|\cdot|a_3b_4| - |a_1b_3|\cdot|a_2b_4| + |a_1b_4|\cdot|a_2b_3| = 0 \quad . \quad . \quad . \quad (a)$$

In 1779 along with a series of related results Bezout gives in regard to the array

$$\begin{matrix} a_1 & b_1 & c_1 & d_1 & e_1 & f_1 \\ a_2 & b_2 & c_2 & d_2 & e_2 & f_2 \\ a_3 & b_3 & c_3 & d_3 & e_3 & f_3 \end{matrix}$$

the identity

$$|a_1b_2c_3|\cdot|d_1e_2f_3| - |a_1b_2d_3|\cdot|c_1e_2f_3| + |a_1c_2d_3|\cdot|b_1e_2f_3| - |b_1c_2d_3|\cdot|a_1e_2f_3| = 0 \quad (\beta)$$

And, again, in 1809, Monge, in regard to the 3-by-5 array,

$$\begin{matrix} a_1 & b_1 & c_1 & d_1 & e_1 \\ a_2 & b_2 & c_2 & d_2 & e_2 \\ a_3 & b_3 & c_3 & d_3 & e_3 \end{matrix}$$

gives five relations of the form

$$|a_1b_2c_3|\cdot|a_1d_2e_3| - |a_1b_2d_3|\cdot|a_1c_2e_3| + |a_1b_2e_3|\cdot|a_1c_2d_3| = 0 \quad . \quad . \quad (\gamma)$$

each one of the ten minors of the array being involved three times.

(2) Of course, these three identities were soon recognised as belonging to the same family, and were included in one general identity. To this result several writers contributed; but the theorem is spoken of somewhat loosely as Sylvester's, and as giving an expression for the product of two $n$-line determinants in the form of an aggregate of like products.

Fontaine's is the case of this for $n = 2$; Bezout's is the case for $n = 3$; and Monge's is obtainable from Bezout's by putting the $f$'s equal to the corresponding $a$'s. It is important to note, however, that Monge's is with at least equal interest viewable as what is technically called an "extensional" of Fontaine's. Thus, turning to ($\gamma$) and dropping the $a_1$ in it which begins every one of the six minors, we find remaining

$$|b_2c_3| \cdot |d_2e_3| - |b_2d_3| \cdot |c_2e_3| + |b_2e_3| \cdot |c_2d_3| = 0,$$

which is the equivalent of ($\alpha$).

(3) It would appear that for long this theorem of Sylvester's formed the usual means of investigating relations between the primary minors of an oblong array. All such investigations therefore dealt with relations that were quadratic; any others, like Monge's cubic relations, may be passed over, because they were directly deducible from those of lower degree.

In the year 1893, however, Vahlen published his paper professedly devoted to the subject, the title being *Ueber die Relationen zwischen den Determinanten einer Matrix* (*Crelle's Journal*, cxii, 306–310*), and he struck out a new course. The theorem which he used was one regarding the multiplication of one $n$-line determinant by the $(n-1)^{\text{th}}$ power of another, the product being given in the form of a compound determinant. It is most easily established by substituting for the multiplier the adjugate of the second determinant, and noting that every row-multiplication gives an $n$-line determinant for result. Thus, the two determinants being $|a_1b_2c_3|$ and $|x_1y_2z_3|$, we have

$$\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} \cdot \begin{vmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ z_1 & z_2 & z_3 \end{vmatrix}^2 = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} \cdot \begin{Vmatrix} |y_2z_3| & |y_3z_1| & |y_1z_2| \\ |x_3z_2| & |x_1z_3| & |x_2z_1| \\ |x_2y_3| & |x_3y_1| & |x_1y_2| \end{Vmatrix}$$

$$= \begin{Vmatrix} |a_1y_2z_3| & |x_1a_2z_3| & |x_1y_2a_3| \\ |b_1y_2z_3| & |x_1b_2z_3| & |x_1y_2b_3| \\ |c_1y_2z_3| & |x_1c_2z_3| & |x_1y_2c_3| \end{Vmatrix}$$

where the element in the place $(r, s)$ of the right-hand member is the result of putting the $r^{\text{th}}$ row of $|a_1b_2c_3|$ in place of the $s^{\text{th}}$ row of $|x_1y_2z_3|$. The theorem, or rather an extensional of it, seems to have been first put on record by Bazin in 1851 †; since then, and prior to Vahlen, it has been restated by several writers—for example, by Zehfuss in 1862.

(4) Vahlen's mode of using it in connection with the subject under

* Pascal in his "Determinanti" gives a full account of it. (See pp. 148–152; or in Leitzmann's translation, pp. 115–117.)

† Bazin, H., "Sur une question relative aux déterminants," *Journ.* (de Liouville) *de Math.*, xvi, pp. 145–160.

discussion is to take every primary minor of the given array in succession for the multiplicand, and the adjugate of the first of them for the constant multiplier and make application of the theorem. If the array consist of $k$ rows and $m$ columns, there are thus $(m)_k$ multiplications to be performed, and in regard to these he reasons as follows. First of all the multiplicand may have *all* its columns in common with the first minor, in which case the outcome is manifestly nugatory. Or it may have $k-1$ columns in common, when there is a like outcome, as the right-hand member reduces at once to exactly the same form as the left-hand member. The number of such cases is $k(m-k)$, there being one for every way in which we can replace a column of the multiplicand by an outside column. All the other cases,

$$(m)_k - 1 - k(m-k)$$

in number, are real relations between the primary minors of the array. Not only so, but it is affirmed that all these latter relations are mutually independent, the reason being that each one involves a minor, the multiplicand, which necessarily does not appear in any of the others.

(5) All this needs to be received with some caution and scrutiny. As a matter of fact, in the case of every one of the

$$(m)_k - 1 - k(m-k)$$

multiplications viewed by Vahlen as effective, the $(n-2)^{th}$ power of the first of the primary minors can be removed from both sides, leaving on the left-hand the product of two minors, and on the right-hand an aggregate of products of pairs of other minors—leaving, that is to say, what Sylvester's theorem would have given at once.

(6) As the matter is of some moment, let us illustrate by the case of a 4-by-9 array, say the array

$$\begin{matrix} a_1 & b_1 & c_1 & d_1 & \cdots & h_1 & i_1 \\ a_2 & b_2 & c_2 & d_2 & \cdots & h_2 & i_2 \\ a_3 & b_3 & c_3 & d_3 & \cdots & h_3 & i_3 \\ a_4 & b_4 & c_4 & d_4 & \cdots & h_4 & i_4 \end{matrix}$$

Here the number of minors is 126, and of the 126 multiplications 21 are properly called nugatory; for example, the columnwise multiplication of

$$|a_1 b_2 c_3 h_4| \text{ by } |A_1 B_2 C_3 D_4|$$

gives

$$\begin{vmatrix} |a_1b_2c_3d_4| & \cdot & \cdot & \cdot \\ \cdot & |a_1b_2c_3d_4| & \cdot & \cdot \\ \cdot & \cdot & |a_1b_2c_3d_4| & \cdot \\ |h_1b_2c_3d_4| & |a_1h_2c_3d_4| & |a_1b_2h_3d_4| & |a_1b_2c_3h_4| \end{vmatrix}$$

$$i.e. \ |a_1b_2c_3d_4|^3 . |a_1b_2c_3h_4|,$$

so that we end exactly as we started. Of the remaining 105 considered to be effective and independent we may select that in which the multiplicand is $|a_1f_2g_3h_4|$, there being in this only one column that occurs also in $|a_1b_2c_3d_4|$. The result of multiplying by $|A_1B_2C_3D_4|$ now comes out in the form

$$\begin{vmatrix} |a_1b_2c_3d_4| & . & . & . \\ |f_1b_2c_3d_4| & |a_1f_2c_3d_4| & |a_1b_2f_3d_4| & |a_1b_2c_3f_4| \\ |g_1b_2c_3d_4| & |a_1g_2c_3d_4| & |a_1b_2g_3d_4| & |a_1b_2c_3g_4| \\ |h_1b_2c_3d_4| & |a_1h_2c_3d_4| & |a_1b_2h_3d_4| & |a_1b_2c_3h_4| \end{vmatrix}$$

whence, of course, it is concluded that

$$|a_1f_2g_3h_4| \cdot |a_1b_2c_3d_4|^2 = \begin{vmatrix} |a_1f_2c_3d_4| & |a_1b_2f_3d_4| & |a_1b_2c_3f_4| \\ |a_1g_2c_3d_4| & |a_1b_2g_3d_4| & |a_1b_2c_3g_4| \\ |a_1h_2c_3d_4| & |a_1b_2h_3d_4| & |a_1b_2c_3h_4| \end{vmatrix},$$

and there Vahlen allows the matter to rest. If, however, we expand the compound determinant here in terms of the elements of the first row and their complementary minors, we find by what we have called the extensional of Fontaine's identity that the said minors all have $|a_1b_2c_3d_4|$ for a factor, being equal to

$$|a_1b_2g_3h_4|.|a_1b_2c_3d_4|, \quad -|a_1b_2c_3d_4|.|a_1c_2g_3h_4|, \quad |a_1b_2c_3d_4|.|a_1d_2g_3h_4|;$$

so that there results the simple equality

$$|a_1f_2g_3h_4|.|a_1b_2c_3d_4| = |a_1f_2c_3d_4|.|a_1b_2g_3h_4| - |a_1b_2f_3d_4|.|a_1c_2g_3h_4| + |a_1b_2c_3f_4|.|a_1d_2g_3h_4|$$

in agreement with Sylvester's theorem.

(7) The first to note and to establish the reducibility of Bazin's theorem, to Sylvester's was Rubini in 1878.* The theorem, in fact, found in Rubini another discoverer, one too who was not content merely to state and prove his theorem, but to note special instances of it, draw deductions from it, view it from more than one standpoint, and indicate its affinities. The connected question, however, of the relations between the minors of a matrix he did not specifically refer to. This was left for Pascal, who in 1896 drew pointed attention to it in a paper whose title could leave no doubt as to its object.† In the first section of this he establishes what he calls his "fundamental identity A"—not recognised, strange to say, as Sylvester's—then shows how the so-called Vahlen relations are dependent on it, and ends with the words "in general all the possible relations between the

* Rubini, R., "Formole di trasformazioni nella teorica dei determinanti." *Giornale di Mat.,'* xvi, pp. 198–208.

† Pascal, E., "Sulle varie forme che possono darsi alle relazioni fra i determinanti di una matrice rettangolare. *Annali di Mat.*, xxiv, pp. 241–253.

determinants of a matrix are but opportune transformations of the formula A."

(8) With this pronouncement most mathematicians would agree. Unfortunately it does not appear to have led in twenty years to any better understanding of the subject: and one is thus induced to inquire on what grounds the application of Bazin's theorem to the matter can be viewed as an "opportune transformation." What advantage, for example, is there to be got by multiplying each of the $(m)_k$ minors of the given array by the $(n-1)^{th}$ power of the first of them, as Vahlen directs, rather than by the first power of the said minor in accordance with Sylvester's theorem? For one thing the sifting of the results into

$$1+k(m-k) \text{ nugatory}$$

and $$(m)_k-1-k(m-k) \text{ effective}$$

cannot be the reason, because the same sifting takes place in both cases. Thus, the array being

$$\begin{matrix} a_1 & b_1 & c_1 & d_1 & e_1 & f_1 \\ a_2 & b_2 & c_2 & d_2 & e_2 & f_2 \\ a_3 & b_3 & c_3 & d_3 & e_3 & f_3 \end{matrix}$$

we multiply, according to Vahlen, each of the 20 minors by $|a_1b_2c_3|^2$, finding 10 cases nugatory, 9 cases in which the result has to be simplified by the removal of the first power of $|a_1b_2c_3|$, and only 1 case, namely,

$$|d_1e_2f_3|.|a_1b_2c_3|^2 = \begin{vmatrix} |d_1b_2c_3| & |a_1d_2c_3| & |a_1b_2d_3| \\ |e_1b_2c_3| & |a_1e_2c_3| & |a_1b_2e_3| \\ |f_1b_2c_3| & |a_1f_2c_3| & |a_1b_2f_3| \end{vmatrix},$$

which is considered to be useful as found; in other words, if we arrange the 20 minors in dictionary order and denote them by their order numbers, Vahlen's result is

$$\begin{aligned} 8\cdot1 &= 6\cdot2 - 5\cdot3 & \qquad 14\cdot1 &= 12\cdot2 - 11\cdot3 \\ 9\cdot1 &= 7\cdot2 - 5\cdot4 & 15\cdot1 &= 13\cdot2 - 11\cdot4 \\ 10\cdot1 &= 7\cdot3 - 6\cdot4 & 16\cdot1 &= 13\cdot3 - 12\cdot4 \end{aligned}$$

$$\begin{aligned} 17\cdot1 &= 12\cdot5 - 11\cdot6 \\ 18\cdot1 &= 13\cdot5 - 11\cdot7 \\ 19\cdot1 &= 13\cdot6 - 12\cdot7 \end{aligned}$$

$$20\cdot1^2 = \begin{vmatrix} 11 & 5 & 2 \\ 12 & 6 & 3 \\ 13 & 7 & 4 \end{vmatrix},$$

the nugatory cases being those whose left-hand members are—

$$1\cdot1^2,\ 2\cdot1^2,\ \ldots,\ 7\cdot1^2,\ 11\cdot1^2,\ 12\cdot1^2,\ 13\cdot1^2.$$

Instead of all this the other procedure only requires that we write down the simply identity

$$|\alpha\beta\gamma| \cdot |123| = |\alpha\beta 1| \cdot |\gamma 23| + |\alpha\beta 2| \cdot |1\gamma 3| + |\alpha\beta 3| \cdot |12\gamma|,$$

where the determinants are denoted by their column-numbers, and put the triad $\alpha$, $\beta$, $\gamma$ equal to each of the 20 triads

$$1, 2, 3; \quad 1, 2, 4; \quad . \ . \ .; \quad 4, 5, 6,$$

in succession. Line for line the outcome is the same until we come to the last, when we obtain at once

$$|456| \cdot |123| = |145| \cdot |236| - |245|\,|136| + |345| \cdot |126|$$

*i.e.*,

$$20{\cdot}1 = 8{\cdot}13 - 14{\cdot}7 + 17{\cdot}4,$$

which is what Vahlen's last reduces to when we express the compound determinant in it in terms of the elements of the last row and their complementary minors.

(9) It is interesting to note in passing that the compound determinant just referred to has every one of its nine primary minors exactly divisible by $|a_1b_2c_3|$; indeed Vahlen's first nine relations are statements to that effect. The expression for 20·1 which the first row and its complementary minors have just furnished can thus be matched by using any one of the other rows or any one of the columns, the six equivalents obtained being

$$\begin{array}{r} 11{\cdot}10 - 5{\cdot}16 + 2{\cdot}19, \\ -12{\cdot}9 + 6{\cdot}15 - 3{\cdot}18, \\ 13{\cdot}8 - 7{\cdot}14 + 4{\cdot}17, \\ 11{\cdot}10 + 12{\cdot}9 + 13{\cdot}8, \\ -5{\cdot}16 + 6{\cdot}15 - 7{\cdot}14, \\ 2{\cdot}19 - 3{\cdot}18 + 4{\cdot}17. \end{array}$$

On this point may be consulted a paper in the *Proceed. R. Soc. Edinburgh*, xxv (1904), pp. 366–371, on "The three-line determinants of a six-by-three array."

(10) The property utilised in the preceding paragraph holds for all orders, and deserves to be noted quite apart from its connection with the present subject. Stated in its simplest form it is that *every minor of a Bazin compound determinant is a determinant of the same kind.*

(11) The additional term for the expression 20·1 is, of course, due to the fact that the determinants 1 and 20 have no column in common. As, however, there are nine of the determinants of the array that have one column in common with 20, there are necessarily nine expressions of the shorter type which all involve 20, and of which one could be used to make the set of ten relations more uniform; for example,

$$20{\cdot}2 = 8{\cdot}15 - 9{\cdot}14.$$

In this connection it is important to note that there is considerable advantage in writing the vanishing trinomials of the Monge type as Pfaffians: thus

$$\begin{vmatrix} 2 & 8 & 9 \\ & 14 & 15 \\ & & 20 \end{vmatrix} = 0.$$

They can then be grouped in interesting sets of five, namely, the five primary minors of a quasi-Pfaffian. Written in this way the complete set of thirty is:

$$0 = \left\| \begin{matrix} 1 & 2 & 3 & 4 \\ & 5 & 6 & 7 \\ & & 8 & 9 \\ & & & 10 \end{matrix} \right\| = \left\| \begin{matrix} 1 & 2 & 3 & 4 \\ & 11 & 12 & 13 \\ & & 14 & 15 \\ & & & 16 \end{matrix} \right\| = \left\| \begin{matrix} 1 & 5 & 6 & 7 \\ & 11 & 12 & 13 \\ & & 17 & 18 \\ & & & 19 \end{matrix} \right\|$$

$$= \left\| \begin{matrix} 2 & 5 & 8 & 9 \\ & 11 & 14 & 15 \\ & & 17 & 18 \\ & & & 20 \end{matrix} \right\| = \left\| \begin{matrix} 3 & 6 & 8 & 10 \\ & 12 & 14 & 16 \\ & & 17 & 19 \\ & & & 20 \end{matrix} \right\| = \left\| \begin{matrix} 4 & 7 & 9 & 10 \\ & 13 & 15 & 16 \\ & & 18 & 19 \\ & & & 20 \end{matrix} \right\|,$$

and from the thirty the chosen set of ten is got at once by taking the nine which involve 1 and any one of the nine which involve 20.

# DESCRIPTIONS OF SOME NEW ALOES FROM THE TRANSVAAL.

## Part II.

By I. B. Pole Evans.

(With Plates L—LVI.)

(Read October 20, 1915.)

In a previous paper* the author described six new *Aloes* from the Transvaal, and in a subsequent communication† a short account and description of a rather remarkable *Aloe* from Swaziland was given. The present paper includes descriptions of six more species, and from material which the author has at his disposal it is evident that many more species await description before the genus *Aloe* can be regarded as having been satisfactorily worked out in so far as South Africa is concerned.

The accompanying descriptions have been made from plants growing in the rockeries in the grounds of the Botanical Laboratories of the Union of South Africa at Pretoria.

### Aloe verecunda, spec. nov.

Transvaal.

(Plate L.)

*Aloe verecunda*, Pole Evans; species nova, distincta et pulcherrima, *A. Buchananii*, Bak., affinis, sed minor et perianthium est distinctissime trigonum.

*Herba* succulenta, acaulis, disticha. Folia 8–10, decidua, anguste linearia, 25–35 cm. longa et 8–10 mm. lata, canaliculata, dorso rotundata, basi copiose minute albopunctata, marginibus denticulis crebris ciliata.

*Pedunculus* validus, 25 cm. longus, bracteis vacuis late ovatis breviter cuspidatis multinerviis pluribis vestitus; racemus capitatus, densus; pedicelli 25 mm. longi; bracteae ovato-acutae 20 mm. longae et 15 mm. latae.

* Trans. R. Soc. S. Africa, vol. v, 1915, p. 25.

† *Ibid.*, pt. 5.

*Perianthium* laete rubrum vel coccineum, sub-viride ad apicem, rectum, conspicue trigonum, 26–30 mm. longum, basi leniter stipitatum ; segmenta libera.

*Genitalia* non vel vix exserta.

This handsome little *Aloe* was collected by Mr. P. J. Pienaar on the Wolkberg, near Haenertsberg, Zoutpansberg District.

It usually flowers towards the latter part of December, and is conspicuous with its dark red racemes.

It differs from *A. Cooperi*, Bak., in the shape of its flowers and in having its leaves rounded at the back. It would appear to be more closely related to *A. Buchananii*, Bak., but is smaller in habit. The pedicels also are much shorter and the perianth more trigonous. As soon as winter sets in, the leaves wither and disappear.

**Description.**—*Herb* succulent, stemless, distichous.

*Leaves* 8–10, deciduous, narrowly linear, 25–35 cm. long and 8–10 mm. broad at the base, distinctly channelled, rounded at the back, with numerous minute raised white spots at the base, armed along the edges with delicate white teeth 2–7 mm. apart.

*Peduncle* stout, 25 cm. long, clothed with broad ovate-shortly cuspidate green empty bracts. Raceme capitate, dense; pedicels 25 mm. long; bracts ovate-acute 20 mm. long and 15 mm. broad.

*Perianth* rich peach red-scarlet (R.C.S.),* greenish towards the apex, straight, very markedly trigonous, very slightly stipitate at the base, 26–30 mm. long and 12 mm. broad, contracted towards the mouth; segments free.

*Style* and *stamens* not or scarcely exserted.

## ALOE SIMII, spec. nova.

Transvaal.

(Plate LI.)

*Aloe Simii*, Pole Evans; species nova, affinis et *A. transvaalensi*, O. Ktze., sed differt foliis longioribus et latioribus, etiam immaculatis et non irregulariter fasciatis. Perianthium est longius et basi magis globoso-inflatum.

*Herba* succulenta, acaulis. Folia 15–18, dense rosulata, erecto-patentia, apice leniter recurvata, lanceolata, 25–35 cm. longa, 8–9 cm. lata, carnosa, pallide glauco-viridia, interdum supra paucis obscure maculis albidis, supra canaliculata, subtus convexa, ad margines cartilagineos sinuato-dentata,

* *N.B.*—(R.C.S.) refers in all cases to colours taken from Ridgway's "Colour Standards and Colour Nomenclature," Washington, 1912.

dentibus corneis deltoideis brunneis pungentibus 3–4 mm. longis et 10 mm. distantibus.

*Inflorescentia* ca. 1–1·3 m. alta, ramosa super medium, rami 5–7, erecto-patentia, subtus nudi; racemi elongati, laxi, 30–45 cm. longi; bracteae lanceolato-acuminatae, sub-carnosae, pedicellos aequantes; pedicelli 10–17 mm. longi.

*Perianthium* rubicundum, luteo-viride versus apicem, 38–40 mm. longum, cylindraceum, leniter decurvatum, conspicue basi globoso-inflatum et 11–13 mm. diam., supra ovarium constrictum deinde clavato-ampliatum, distincte lateraliter compressum, exteriora segmenta sub-acuta per 10–13 mm. libera, interiora obtusiuscula.

*Genitalia* vix exserta.

This *Aloe* was first collected by Mr. T. R. Sim at Fletcher Station, near Sabie, in February, 1914. The plants which Mr. Sim brought me at that time had almost finished flowering. After being planted out in the Laboratory grounds they came into bloom in February, 1915, and it gives me great pleasure to be able to associate Mr. Sim's name with this new species.

The plant resembles *A. transvaalensis*, O. Ktze., in its general habit of growth, but is at once distinguished from it by its more branched inflorescence and by its unspotted leaves.

**Description.**—*Herb* succulent, stemless.

*Leaves* 15–18 in a dense rosette, erect-spreading, slightly recurved at the apex, lanceolate, 25–30 cm. long and 8–9 cm. broad, fleshy, channelled above, convex below, bright green, sometimes with a few faint white spots on the upper surface, sinnately toothed at the margins with brown, horny deltoid teeth, which are about 10 mm. apart and 3–4 mm. long.

*Inflorescence* from 1–1·3 m. high, branched above the middle, branches 5–7, erect-spreading, naked below; racemes elongated, loosely flowered, 30–45 cm. long; bracts lanceolate-acuminate, somewhat fleshy, as long as the pedicels; pedicels 10–17 mm., green.

*Perianth* strawberry pink (R.C.S.), yellowish-green towards the mouth. 38–40 mm. long, cylindrical, slightly decurved, conspicuously globosely inflated at the base and 11–13 mm. diam., constricted above the ovary and then ampliated. Outer segments somewhat acute, free for 10–13 mm. from tip, inner segments broader.

*Style* and *stamens* just exserted.

ALOE BARBERTONIAE, spec. nov.

Transvaal and Swaziland.

(Plate LII.)

*Aloe Barbertoniae*, Pole Evans ; species nova, affinis *A. constrictae*, Bak., sed differt longior pedicellos et bracteas.

*Herba* succulenta, acaulis. Folia 20–23, dense rosulata, ca. 45 cm. diam. erecto-patentia, carnosa, plerumque ad apices languescentes, lanceolata, gradatim attenuata, 30–40 cm. longa, 10–11 cm. lata, supra subcanaliculata et viridi-rubescentia, maculisque oblongis albidis irregulariter fasciatim seriatis picta, subtus convexa et pallide glauco-viridia immaculata, ad margines linea cornea brunnea cincta aculeisque brunneis deltoideis valde pungentibus 5–6 mm. longis et 11–16 mm. inter se distantibus armata.

*Inflorescentiae* saepe 2 ex eadem rosula, ca. 1 metre altae 5–7 rami, arcuato-erecti, infimi bracteis ca. 8 cm. longis ad apices paucis parvibus aculeis subtendi; racemi 25–30 cm. longi, laxi; bracteae deltoideo-acutae, 20 mm. longae, plurinerviae; pedicelli 13 mm. longi.

*Perianthium* laete rubrum, 37 mm. longum, basi globoso-inflatum, et 12 mm. diam., supra ovarium valde constrictum et decurvatum, faucem versus ampliatum, segmentis oblongis obtusis, 8–12 mm. longis, marginibus pallidioribus ; antherae vix exsertae. Capsula oblongo-cylindrica, 28–30 mm. longa et 13 mm. lata ; semina triquetra, fusca, alata, 3–5 mm. longa.

This plant was sent to me by Mr. George Thorncroft in March, 1914. It was obtained by Mr. Thorncroft from Rimer's Creek, near Barberton. It flowered in Pretoria towards the latter part of May, 1915.

*Aloe Barbertoniae* makes a handsome and ornamental plant for rockeries, as the leaves are very conspicuously spotted on the upper surface, while the flowers are a jasper red and have a dull bloom on them. Specimens of the same species have also been collected in Swaziland by Mr. R. A. Davis.

**Description.**—*Herb* succulent, stemless.

*Leaves* 20–30 in a dense rosette, and which is about 45 cm. across, erect-spreading, fleshy, usually withered at the tips, lanceolate, gradually attenuated, 30–40 cm. long, 10–11 cm. broad, slightly channelled down the face, greenish red above, with distinct white spots arranged in irregular transverse bands, convex below, pale greenish-white and unspotted, margins wavy with a distinct brown cartilaginous border and beset with stout brown deltoid thorns, which are 5–6 mm. long and 11–16 mm. apart.

*Inflorescence*, often two from the same rosette, about 1 m. high, branched, from 5–7 branches, arcuate-erect, lowest subtended by bracts about 8 cm. long, and which have a few small thorns at the tips ; racemes

25–30 cm. long, loosely flowered; bracts deltoid-acute, about 20 mm. long, many-nerved.

*Perianth* jasper red (R.C.S.), 37 mm. long, conspicuously inflated at the base and 12 mm. diam., thence sharply constricted, 5 mm. diam. at constriction, rather strongly decurved and ampliated towards the mouth; segments oblong-obtuse, 8–12 mm. long, free edges paler in colour.

*Anthers* oblong-cylindrical, 28–30 mm. long and 13 mm. broad; seeds triquetrous, fuscous, winged, 3–5 mm. long.

## Aloe petricola, spec. nov.

Transvaal.

(Plates LIII and LIV.)

*Aloe petricola*, Pole Evans; species nova certe affinis est *A. verae*, L., sed species distinctissima, differt praecipue foliis coriacioribus, et filamentibus distincte exsertis.

*Herba* succulenta, acaulis. Folia ca. 20–30, dense rosulata, lanceolato-ensiformia, 30–40 cm. longa, 8–10 cm. lata, erecto-patentia, apice leniter incurvula, supra subcanaliculata, subtus convexa, glauca, coriacea, summo apice carinata et aculeis 4–5 instructa, marginibus aculeis pungentibus castaneo-fuscis 4–6 mm. longis armata.

*Inflorescentia* ca. 50 cm.–1 m. alta, plerumque 1–3 ramis erectis; racemi elongati, 30–50 cm. longi, densi, multiflora; bracteae 10–16 mm. longae, 5–6 mm. latae, lanceolato-acutae scariosae, 3–5 nerviae, deinde reflexae; pedicelli 2 mm. longi.

*Perianthium* cylindraceo-ventricosum 24–30 mm. longum, luteolum vel luteum et rubro-tinctum, segmenta exteriora usque ad 8–10 mm. connata, apice paullum recurvula, nervis 3-5 viridibus notata, interiora obtusiora.

*Filamenta* ca. per 12–14 mm. exserta, brunneo-atra.

*Stylus* filamenta aequans, luteus.

*Capsula* trigona, 17 mm. longa et 10 mm. lata, utrinque obtusa, viridia-rubra, deinde exsuccata.

This *Aloe* was first collected and photographed by myself at Nelspruit in September, 1905. It occurs chiefly on the granite outcrops in this locality, and has also been collected here by Mr. T. R. Sim. Mr. George Thorncroft has sent the same plant to me from granite rocks at Elands Hoek and in the Kaap Valley.

It usually flowers in July and August. The unopened flower buds vary in colour from a bright Nopal red to orange-chrome (R.C.S.).

**Description.**—*Herb* succulent, stemless.

*Leaves* 20–30 in a dense rosette, lanceolate-ensiform, 30–40 cm. long, 8–10 cm. broad, erect-spreading, slightly incurved at the apex, somewhat channelled above, convex below, glaucous, leathery, ending at the apex with a stout thorn and furnished with 4–5 thorns along the keel, marginal thorns sharp, chestnut-fuscous, 4–6 mm. long.

*Inflorescence* from 50 cm. to 1 m. high, usually with 1–3 erect branches, clothed at the base with numerous empty brown scarious bracts, which are cylindrical-acute, 10–17 mm. long; racemes cylindrical-elongated, 30–50 cm., densely flowered, flowers at first bright Nopal red or orange-chrome (R.C.S.), becoming pale chalcedony yellow to orange-buff when open; bracts 10–16 mm. long, 5–6 mm. broad, lanceolate-acute, scarious, 3–5 nerved, finally reflexed; pedicels 2 mm. long.

*Perianth* cylindrical ventricose, 24–30 mm. long, pale chalcedony yellow or orange-buff (R.C.S.), outer segments free for 14–15 mm., slightly recurved at the apex, with 3–4 green nerves, inner segments more obtuse, recurled at the tips.

*Style* and *stamens* exserted for 12–14 mm., almost straight filaments warm blackish-brown, anthers salmon-orange, style pale chalcedony or sulphur-yellow.

*Capsule* distinctly trigonous, 17 mm. long and 10 mm. broad, obtuse at both ends, greenish-red, finally becoming dry.

## Aloe sessiliflora, spec. nov.

Transvaal.

(Plate LV.)

*Aloe sessiliflora*, Pole Evans; species nova, affinis *A. castaneae*, Schonl., sed foliis patenti-recurvatis et floribus capsulisque brevioribus facile distinguenda.

*Herba* succulenta, frutescens, caules usque 90 cm. alti. Folia dense rosulata, patula vel recurvula, carnosiuscula, supra canaliculata, subtus convexa, pallide viridia vel interdum omnino supra rubra, glabra 45–60 cm. longa, 6–8 cm. lata, ad margines linea tenui cartilaginea rosea cincta dentibusque minutis regulariter instructa.

*Scapus* simplex, lateraliter compressus, laete rufobrunneus, ca. 60–75 cm. longus, bracteis vacuis oblongo-deltoideis brunneis numerosis instructus; racemus 25–30 cm. longus, dense multiflorus; bracteae ovato-cuspidatae, scariosae, 3-nerviae, 10 mm. longae et 7 mm. latae; flores sessiles, campanulato-cylindracei.

*Perianthium* 14 mm. longum; segmenta libera, exteriora 5 mm. lata, spathulata, carnosa tincta et cum longitudine 3-nervis atris, interiora 8 mm. lata, ad margines luteola et rubro vel viridio medio linea.

*Stamina* et *stylum* per 8–10 mm. exserta.

*Capsula* perigonio sicco involuta, parva, cylindraceo-oblonga, 9–10 mm. longa.

*Semina* triquetra, grisea, angustissime alata, 3 mm. longa.

*Aloe sessiliflora* was collected in the Barberton District by Mr. Wickens, and the plants first flowered at the Union Buildings in June and July of 1914.

Specimens of this plant have also been collected near Barberton by Mr. George Thorncroft.

The inflorescence is not very attractive. During the winter months the foliage is of a distinct reddish colour, while in the summer it is bright green.

The characters of the inflorescence and general structure of the flowers leave no doubt but that the plant must be regarded as being related to *A. castanea*, Schon. It differs from *A. castanea*, Schon., in having a less robust habit of growth, while its leaves are spreading and not quite so fleshy. The flowers and seed-capsules are also much smaller than those of *A. castanea*, Schon.

**Description.**—*Herb* succulent, becoming fruticose, stems up to 90 cm. high. Leaves in a dense rosette, spreading recurved, somewhat fleshy, channelled above, convex below, light green or sometimes entirely red above, glabrous, 45–60 cm. long, 6–8 cm. broad, with a reddish margin and armed with small pink cartilaginous recurved thorns 1–1·5 mm. long and 7–10 mm. apart.

*Scape* simple, laterally compressed, dark reddish brown, about 60–75 cm. long, provided with numerous oblong-deltoid, light brown, scarious empty bracts, mostly 3-nerved, raceme 25–30 cm. long, very densely multi-flowered; bracts ovate-cuspidate, scarious, 3-nerved, 10 mm. long, 7 mm. broad; flowers sessile, campanulate-cylindrical, flower buds pale reddish brown striped with green at the tips.

*Perianth* 14 mm. long, segments free, outer 5 mm. broad, spathulate, flesh-coloured with three longitudinal dark nerves, inner 8 mm. broad yellowish at the edges and with a reddish or greenish median line.

*Stamens* and *style* protruding 8–10 mm. beyond the perianth.

*Capsule* enwrapped with dry perianth, small, cylindrical-oblong, 9–10 mm. long. *Seeds* triquetrous, greyish, very narrowly winged, 3 mm. long.

## Aloe Thorncroftii, spec. nov.

Transvaal.

(Plate LVI.)

*Aloe Thorncroftii* Pole Evans; species distinctissima, nulli alii arctius affinis, sectionem propriam constituere debet.

*Herba* succulenta, acaulis vel subcaulescens.

*Folia* 25–30, dense rosulata, erecto-patentia, laete viridia, 25–30 cm. longa, 8–10 cm. basi lata, gradatim attenuata, ad margines linea cartilaginea purpureo-tincta cincta, sinuata-denticulata ; dentibus 3 mm. longis, pallide brunneis et 5–8 mm. inter se distantibus, supra plana sed prope apicem canaliculata, subtus convexa.

*Inflorescentiae* saepe 2 ex eadem rosula, pedunculus erectus, simplex (?) 60–1·5 m. albus, bracteis vacuis late ovato-acutis rosaceis tectus ; bracteae late lanceolato-ovatae, crassiusculae, plurinerviae, 15 mm. longae, 7 mm. latae ; pedicelli validi 15–17 mm. longi, primo erecti, deinde distincte apice decurvati.

*Perianthium* roseum, 52 mm. longum, trigono-cylindraceum ; segmenta exteriora apice acutiuscula, libera per ca. 18 mm., interiora obtusiora apice viridia et exteriora superantia.

*Stamina* vix exserta, antheris rubicundis.

*Stylus* demum exsertus, luteo-viridis.

The plant described above is unlike any other South African *Aloe* known to me. It is distinguished from all previously described species by its inflorescence, which consists of a loosely flowered raceme which bears large old rose-Eugenia red (R.C.S.) coloured flowers.

All the plants (7) which so far have flowered in Pretoria have borne an unbranched inflorescence, but Mr. George Thorncroft, who first sent me specimens of this *Aloe* and after whom it has been named, writes me that the inflorescence is branched in the case of some plants.

*Aloe Thorncroftii* occurs at an altitude of about 5,000 ft. in the Barberton District, and does not appear to be very plentiful in the locality in which it is found. The plants flower during September, and when in flower make very attractive and ornamental rock plants.

**Description.**—*Herb* succulent, stemless or with a short stem. Leaves 25–30, in a dense rosette, erect-spreading, dark green, very slightly glaucous, 25–30 cm. long, 8–10 cm. broad at the base, gradually narrowed at the apex, upper surface flat towards the base, channelled towards the apex, lower surface convex, with a narrow sinuous purplish toothed margin, teeth 3 cm. long, pale brown, separated by intervals of 5–8 mm.

*Inflorescences* usually two from the same crown ; peduncle erect, simple (?) 60 cm.-1·5 metres high, clothed below with broad empty ovate-acute bracts 20 mm. long ; flowering bracts broadly lanceolate-ovate, rather thick, many-nerved, 15 mm. long, 7 mm. broad ; pedicels short, 15–17 mm. long, erect at first, then strongly decurved at the apex.

*Perianth* old rose-Eugenia red (R.C.S.), 52 mm. long, somewhat 3-angled though rounded, cylindrical, outer segments acute at tip, free for 18 mm.

from tip, inner segment protruding 2–3 mm. beyond outer, more obtuse and greenish at apex.

*Stamens* just exserted, anthers bitter-sweet pink (R.C.S.).

*Style* finally exserted, yellowish-green.

THE BOTANICAL LABORATORIES OF THE UNION OF SOUTH AFRICA, PRETORIA.

---

## EXPLANATION OF PLATES L—LVI.

### PLATE L.

*Aloe verecunda.*

FIG.

1. Plant flowering at Laboratory, Pretoria.
2. *Aloe* from Cooper's farm, Zoutpansberg, December 25, 1914. Raceme.
3. *Aloe* from Cooper's farm, Zoutpansberg, December 26, 1914. Flowers with bracts at different stages of development.

### PLATE LI.

*Aloe Simii.*

1. Plant in flower at Laboratory, Pretoria, February 6, 1915.
2. Flowers at different stages of development.

### PLATE LII.

*Aloe Barbertoniae.*

1. Plant flowering at Pretoria.
2. Flowers at different stages of development.

### PLATE LIII.

*Aloe petricola.*

1. *Aloe glaucous* on granite outcrop, Hall's siding, Nelspruit, February 25, 1914.
2. *Aloe glaucous* in fruit on granite outcrop at Hall's siding, Nelspruit, February 25, 1914.

### PLATE LIV.

*Aloe petricola.*

1. Plant in flower at Laboratory, Pretoria, August 11, 1915.
2. Raceme.
3. Flowers at different stages of development with bracts.

## PLATE LV.

*Aloe sessiliflora.*

FIG.

1. Plants flowering at Union Buildings, Pretoria, July 1, 1914. The *Aloe* in flower in the background is *A. Marlothii*, Berg.
2. Lower portion of raceme, just before flowers have opened.
3. Flowers at different stages of development.

## PLATE LVI.

*Aloe Thorncroftii.*

1. Plant flowering at Pretoria, September 26, 1915.
2. Flowers at different stages of development.

Fig. 1.

Fig. 2.

Fig. 3.

*I. B. Pole Evans photo.* *Adlard & West Newman.*

Fig. 2.

Fig. 1.

*I. B. Pole Evans photo.*

*Adlard & West Newman.*

Fig. 2.

Fig. 1.

*I. B. Pole Evans photo.* *Adlard & West Newman.*

Fig. 1.

Fig. 2.

*I. B. Pole Evans photo.* *Adlard & West Newman.*

Fig. 3.

Fig. 2.

Fig. 1.

I. B. Pole Evans photo. Adlard & West Newman.

Fig. 1

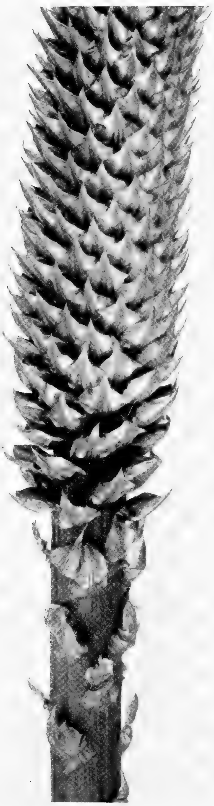


Fig. 2.

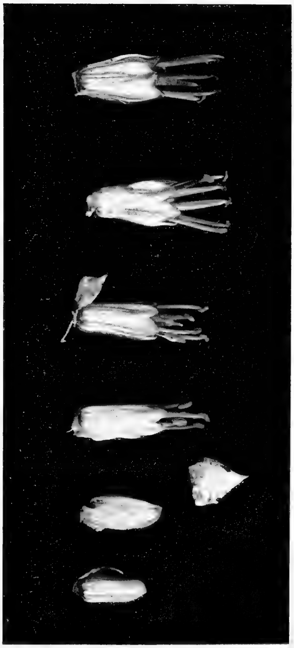


Fig. 3.

*I. B Pole Evans photo.* *Adlard & West Newman.*

Fig. 1.

Fig. 2.

I. B. Pole Evans photo.

Adlard & West Newman.

# SOUTH AFRICAN PERISPORIALES.

## I. Perisporiaceae.

By Ethel M. Doidge, D.Sc., F.L.S., Mycologist, Union Department of Agriculture.

(With Plates LVII—LXVI.)

(Read September 15, 1915.)

The Perisporiaceae and allied fungi are very plentiful in South Africa, especially in forest regions and in warm districts with a fairly plentiful rainfall. The specimens in the Union Mycological Herbarium are mostly from the Woodbush forests in the Zoutpansberg, from the Knysna, and from the coast regions of Natal; there is also a fair sprinkling from other parts of the coast and from Natal as far inland as Pietermaritzburg. The Middle and High Veld of the Transvaal are only represented by a single specimen, a species of *Dimeriella* collected at Bandolier Kop.

All that is known of the South African Perisporiales up to the present is comprised in diagnoses and descriptions of fungi collected by Professor MacOwan and Dr. J. Medley Wood, and published for the most part by Kalchbrenner and Cooke in *Grevillea*, 1880–1882, and in a few descriptions of fungi more recently collected and published in the *Annales Mycologici* and elsewhere. All the earlier work was done in the Grahamstown district and the coast region of Natal, so that a large part of the Union was left totally unexplored so far as this group was concerned.

In working through the material in the herbarium, a number of new species have come to light. It seems advisable, therefore, to publish a list of the species at present known without attempting to make the collection more complete.

Through the courtesy of Dr. Schönland and of Dr. Peringuey, of the South African Museum, I have been able to examine all of Professor MacOwan's fungi which are in their possession. Dr. Medley Wood has donated his private collection to Mr. Pole Evans, and it is deposited in the Union Mycological Herbarium. He has also kindly loaned me the sheets of Perisporiales in the Natal Herbarium collection. I have thus had access to nearly all the type specimens of the fungi described by Kalchbrenner and Cooke.

Many of these have been described only in general terms, and in some cases wrongly diagnosed, and this has caused considerable confusion. Those species which have been adequately described have been published in periodicals not readily accessible. I have therefore given in full the descriptions of known species as well as of new ones.

I am indebted to Miss S. M. Stent for the determination of the greater part of the host plants, and to Dr. J. Medley Wood, Professor J. W. Bews, and Miss M. Franks (Mrs. Howard Flanders) for the identification of a number of plants collected in Natal. I should also like to express my indebtedness to Miss A. Pegler and others who have contributed a number of interesting specimens.

A series of permanent microscopic preparations has been made of all the fungi examined, and is kept for reference in the Union Botanical Laboratory, Pretoria, where it may be seen by anyone who is interested in this group of fungi. The method adopted in preparing the slides is a modification of that used by Gaillard, the procedure being as follows: The fungus colony on the leaf surface is covered with a drop of collodion made according to the following formula:

| | |
|---|---|
| Soluble guncotton . . . . . | 4 parts. |
| Absolute alcohol . . . . . | 10 ,, |
| Ether . . . . . . . . | 32 ,, |
| Castor oil . . . . . | 2 ,, |
| Lactic acid . . . . . . | 2 ,, |

This formula, which is the one used by Gaillard, was found to form a collodion rather too thick for most purposes, and can be made more fluid by diluting by one-third to one-half with a mixture of—

| | |
|---|---|
| Alcohol absolute . . . . . | 10 parts. |
| Ether . . . . . . . . | 32 ,, |

The drop of collodion is allowed to dry on the leaf, and the pellicle thus formed is then carefully detached and placed on a glass slide. The fungus colony adheres to the collodion, and can thus be placed on the slide in the exact position which it occupied on the leaf. The collodion is now redissolved by means of the mixture of alcohol and ether mentioned above, and the preparation may be dehydrated and mounted in Canada balsam.

In the enumeration of species which follows, unless otherwise stated, the numbers in brackets refer to the numbers in the Union Mycological Herbarium, which have been quoted by Sydow as I. B. Pole Evans' numbers. Among the specimens in the herbarium by far the greater number belong to the genus *Meliola,* of which over thirty species are described; and in the grouping of the species of this genus Gaillard's classification is followed, which is based on the septation of the spores and the presence and form of mycelial and perithecial setae.

All drawings have been made with the aid of the *camera lucida,* and are on the same scale. Perithecia were drawn with Zeiss objective D and No. 2 ocular; mycelium and spores with the same objective and a No. 5 ocular; and all appendages of mycelium and perithecia with a No. 4 ocular.

The colour of the mycelium, etc., is recorded as seen by transmitted light under the microscope, and the references are to Ridgway's "Colour Standards and Nomenclature."

## Perisporiaceae.

Mycelium superficial, usually conspicuous and covering the substratum with a dark growth; rarely absent and rarely forming a stroma. Perithecia formed on the mycelial hyphae or rarely on a stroma, black, more or less globose, astomous, asci numerous, usually aparaphysate. Spores very various. In some genera several forms of conidia are produced as well as ascospores, and some, *e. g. Capnodium*, are very rich in the number of their conidial forms, and comparatively rarely produce perithecia.

In a number of genera the hyphae of the perithecigerous mycelium bear small lateral processes, known as hyphopodia. These are very various in form, and are usually 1–2-celled.

The Perisporiaceae chiefly occur on living leaves and young parts of plants; several genera, however, are found on decaying vegetable matter.

### *Key to Genera.*

A. Spores 2-celled.
- *a.* Aerial mycelium conspicuous.
  - 1. Perithecia containing a single ascus. — *Balladyna.*
  - 2. „ „ numerous asci.
    - *o.* Spores hyaline.
      - *x.* Perithecia smooth. — *Dimerosporium.*
      - *xx.* Perithecia setulose. — *Dimeriella.*
    - *oo.* Spores fuscous.
      - *x.* Perithecia smooth. — *Dimerium.*
      - *xx.* Perithecia setulose. — *Phaeodimeriella.*
- *b.* Aerial mycelium none or poorly developed. — *Parodiella.*

B. Spores 3- or more celled.
- *a.* Spores transversely septate.
  - 1. Spores hyaline. — *Zukalia.*
  - 2. Spores brown. — *Meliola.*
- *b.* Spores muriform. — *Capnodium.*

## Balladyna.

Mycelium fuscous, septate; hyphopodia continuous or septate; mycelial setae long, rigid. Perithecia ovate-globose, black, stipitate, mono-ascate. Asci globose, 8-spored. Spores brown, smooth, one-septate.

*Balladyna velutina* (B. & C.) v. Höhn.
Annales Mycologici, vol. x (1912), p. 16.
(*Asterina phaeostroma* (Cke.), Grevillea, vol. x (1882), p. 130.)
(*Asterella phaeostroma* (Cke.), Sacc. Syll. Fung. ix, p. 396.)

Amphigenous, forming thin, effuse black colonies, frequently confluent. Hyphae radiating, branched, light-brown, 6–7 μ thick, frequently septate, bearing numerous hyphopodia. Hyphopodia unilateral or alternate, unicellular, sub-globose with truncated angles, or narrow ovate. Mycelial setae numerous around the perithecia, simple, more or less flexuous or curved, black, opaque, about 100 × 5–6 μ. Perithecia numerous, small, membranaceous, sub-pellucid when immature, smooth, 65–70 μ diam. Asci one in each perithecium, aparaphysate, globose, 35–40 × 25–30 μ, 8-spored. Spores conglobate, fuscous, 2-celled, cells subequal, slightly constricted at the septum, 21–22 × 9–11 μ.

On leaves of *Pavetta natalensis*, Inanda, Natal, September, 1881, J. Medley Wood (Wood No. 656).

On leaves of *Pavetta obovata* and *P. Bowkeri*, Isipingo, Natal, 13/5/13, E. M. Doidge (6627 and 6634).

On leaves of *Pavetta* sp., Kentani, 15/3/15, A. Pegler (8895), (Pegler No. 2305); Woodbush, Zoutpansberg Dist., 4/8/11, E. M. Doidge (1768).

On leaves of *Tricalysia lanceolata*, Stella Bush, near Durban, 2/7/12, E. M. Doidge (2523).

On leaves of *Tricalysia floribunda*, Umgeni, near Durban, 27/5/15, E. M. Doidge (8981).

## Dimerosporium

Mycelium well developed, black, usually sub-crustaceous. Perithecia superficial, depressed-globose, sub-membranaceous, carbonaceous. Asci clavate to ovate, 8-spored. Spores 2-celled, hyaline.

*Dimerosporium Osyridis* Wint.
Sacc. Syll. Fung. ix, p. 401.
Winter, Flora, 1884, p. 7.

Mycelial hyphae fuscous, branched, radiating, forming black, round, irregular spots up to 2 mm. diam. Perithecia in groups, depressed-globose, rugulose, glabrous, black; under the microscope almost pellucid, fuscous, 150–210 μ diam. Asci cylindrical-clavate, very briefly stipitate, 8-spored, 42–52 × 10–12 μ. Spores obliquely distichous, oblong, 2-celled, hyaline, 9–12 × 4–5 μ, constricted at the septum. Paraphyses filiform, equalling the asci.

On living leaves of *Osyris compressa*, Cape of Good Hope, MacOwan.

I have not seen this specimen. The above, therefore, is simply a translation of the original description.

*Dimerosporium Acokantherae* P. Henn.

Sydow has determined Wood's Nos. 6450 and 6461 as *D. Acokantherae* P. Henn.; the fungus on the leaves of *Acokanthera spectabilis* under these numbers is not a *Dimerosporium*, it has the shield-shaped perithecia of the *Microthyriaceae*. The spores are immature.

*Species Excludendae.*

*Dimerosporium MacOwanianum* Thuem. = *Dimerium MacOwanianum* (Thuem.).
*Dimerosporium Psilostomatis* Thuem. = *Dimerium Psilostomatis* (Thuem).
*Dimerosporium verrucicolum* Wint. = *Asterodothis solaris* (Wint.) Theiss.

DIMERIELLA.

Mycelium poorly developed. Perithecia sub-globose, astomous, setulose. Asci 8-spored. Spores 2-celled hyaline.

*Dimeriella annulata*, Syd.

Ann. Myc. x (1912), p. 36.

Mycelium amphigenous, very slender and slightly developed, but distinctly developed in concentric rings and forming spots $\frac{3}{4}$–1 cm. diam. Hyphae slender, not much branched, light brown, and bearing sarciniform conidia. Conidia transversely 3-septate and longitudinally 1-septate, light brown. 12–17 × 7–10 μ. Perithecia superficial, globose, astomous, black, under microscope fuliginous, 50–100 μ diam., bearing a few rigid black-brown setae, 50–120 μ long and 4 μ thick. Asci sub-globose or ovate 25–30 × 20–25 μ, 8-spored. Spores ellipsoid, rounded at both ends, 1-septate and constricted, at first hyaline then brown, 17–24 × 8–12 μ, the loculi slightly unequal.

On leaves of *Gymnosporia* sp., Bandolier Kop, Zoutpansberg Dist., 11/8/11, E. M. Doidge (1832).

*Dimeriella claviseta* Doidge n. sp.

Epiphyllous, forming thin, spreading spots of varying size; mycelium much-branched, fuscous, formed of radiating flexuose hyphae 3–3·5 μ thick. Perithecia superficial, scattered or sub-gregarious, sub-hemispherical, black, carbonaceous, with a false ostiole, 90–115 μ diam., bearing near the base 9–15 setae. Setae club-shaped, 15–55 μ long, 3·5–7 μ thick at the base, septate and often constricted at septa, becoming broader above; apex truncated and variously lobed, frequently 2-lobed, lobes also truncated. Asci numerous, paraphysate, 8-spored, sessile, clavate-cylindrical, rounded and not thickened at the apex, 40–50 × 18–20 μ. Paraphyses simple, filiform, longer than the asci. Spores conglobate or distichous, hyaline, 1-septate, slightly constricted, somewhat acute at the ends, oblong-ellipsoid, one cell slightly broader than the other, bi-guttulate when immature, 15–18 × 5–7 μ.

On leaves of *Vernonia angulifolia*, Winkle Spruit, Natal, 6/7/11, E. M. Doidge (2511); Winkle Spruit, 20/5/15, E. M. Doidge (9011).

### Dimerium.

Mycelium abundant (less so in species parasitic on other Perisporiales), black, sub-crustaceous. Perithecia superficial, globose or ovate. Asci 8-spored. Spores 2-celled, fuscous.

*Key to Species.*

A. Spores small, 7–11 × 3–4 μ. — *D. intermedium.*
B. Spores 15–25 μ long.
  *a.* Spores 6–9 μ broad. — *D. Psilostomatis.*
  *b.* Spores 10–13 μ broad.
    1. Spores rounded at both ends. — *D. Gymnosporiae.*
    2. Spores somewhat acute at each end. — *D. MacOwanianum.*

*Dimerium intermedium* Syd.

Ann. Myc. x (1912), p. 37.

Epiphyllous, parasitic on the mycelium of a *Meliola*. Hyphae very poorly developed. Perithecia in groups, ovate or globose, black, narrowed above into a papillum which terminates in a pore, 90–150 μ diam. Asci fasciculate, numerous, clavate-cylindrical, 32–38 × 8–10 μ, sessile, 8-spored. Ascospores distichous, sub-fusiform, 1-septate, not constricted or slightly so, at first hyaline, then yellow-brown, 7–10 × 3–3·5 μ, the upper loculus broader. Paraphyses slightly longer than the asci, filiform, numerous. Pycnidia similar to the perithecia but smaller, spores elliptical, one-celled, hyaline 2-guttulate 5·5–8 × 3–4 μ.

Parasitic on *Meliola* sp. on leaves of *Isoglossa Woodii*, Amanzimtoti, Natal, 10/7/11, E. M. Doidge (1578).

On *Meliola Rhois* on *Harpophyllum caffrum*, Kentani, 17/2/15, A. Pegler (8851). The spores are slightly larger in this specimen, averaging 11 × 4 μ

*Dimerium MacOwanianum* (Thuem.) Doidge.

(*Dimerosporium MacOwanianum* (Thuem.), Sacc. Syll. Fung. i, p. 53.)

Colonies epiphyllous, numerous, often confluent, black, radiating from the centre. Hyphae very sinuous, branched, anastomosing, warm sepia (R. XXIX.) 9–10 μ thick with fairly numerous alternate or unilateral hyphopodia, which are unicellular, globose, about 10–11 μ diam. Perithecia black, carbonaceous, large, up to 120 μ diam. Asci almost pyriform, 8-spored, hyaline, with a thin wall, 75 × 50 μ. Spores clavate, bilocular, strongly constricted at the septum, upper part 10·5 μ thick, lower part 13 μ thick, the whole spore 25 μ ong, somewhat acuteat each end, fuscous.

On leaves of *Celastrus buxifolius*, Somerset East, July, 1876, P. MacOwan (MacOwan 1250).

*Dimerium Psilostomatis* (Thuem.) Sacc.

Sacc. Syll. Fung. xvii, p. 537.

(*Dimerosporium Psilostomatis*, Sacc. Syll. Fung. i, p. 54.)

Hypophyllous, rarely epiphyllous, forming effuse, black, very thin, more or less orbicular spots. Hyphae slender, branching obscurely septate, buffy olive (R. XXX) 4–5 μ thick, with fairly umerous unicellular, alternate or unilateral, ovate hyphopodia about 7 × 3·5 μ. Perithecia small, sub-globose, carbonaceous, 80–85 μ diam., surrounded by numerous radiating hyphae darker in colour than the ordinary hyphae and without hyphopodia. Asci broadly clavate, wall thickened at the apex, narrowed at the base, often slightly curved, 45 × 24–26 μ, 8-spored. Spores in three rows, narrow elliptical, 1-septate, constricted at the septum with equal loculi, rounded at both ends, 16–20 × 6–9 μ, fuscous. Paraphyses none.

On leaves of *Plectronia ciliata*, Somerset East, December, 1876, P. MacOwan (MacOwan 1291).

On leaves of *Plectronia Guenzii*, Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1744); Claridge, Natal, 31/5/15, E. M. Doidge (8991).

*Dimerium Gymnosporiae* (P. Henn.) Syd.

Syd. Ann. Myc. vii (1909), p. 546.

(*Dimerosporium Gymnosporiae* (P. Henn). Sacc. Syll. Fung. xvi, p. 408.)

Mycelium epiphyllous or amphigenous, sub-crustaceous, radiating, effuse, black. Hyphae branched, septate, sinuous, with a few small unicellular hyphopodia, 7–11 μ thick. Perithecia gregarious, membranaceous-subcarbonaceous, globulose, rugulose, about 90–110 μ diam.; asci ovoid, rounded at the apex, subtunicated, attenuated at the base, sometimes substipitate 35–50 × 30–45 μ, 8-spored, paraphysate. Spores conglobate, ovoid 1-septate, constricted, fuscous, 18–24 × 10–13 μ.

On leaves of *Gymnosporia* sp. Umbelusi, Portuguese East Africa. C. W. Howard (523).

### Phaeodimeriella.

Mycelium well developed, black, effuse. Perithecia globose, setulose. Asci 8-spored. Spores 2-celled, fuscous.

*Phaeodimeriella capensis* Doidge n. sp.

Hypophyllous or amphigenous, forming effuse, radiating, carbonaceous colonies 3–5 mm. diam. Hyphae radiating, 6–7 μ thick, with unicellular sub-opposite or alternate hyphopodia 8–12 × 6–7 μ, and opposite branches.

Perithecia numerous, black, globulose, carbonaceous, minutely verrucose, 140–160 μ diam., setulose. Setae 15–25, uncinate, about 55-65 μ long and 5 μ thick at the base, somewhat attenuated towards the blunt apex. Asci numerous, paraphysate, elliptical, 8-spored, thickened at the apex, sessile, 55–70 × 12–14 μ. Spores sub-distichous, fuscous, 1-septate, ellipsoid, very slightly constricted at the septum; one cell slightly broader than the other, 16–18 × 4 x 5 μ; loculi bi-guttulate. Pycnidia similar to perithecia, conidia ellipsoid, fuscous, unicellular, 2-guttulate, about 14 × 3 μ.

On leaves of *Apodytes dimidiata*, Knysna, C.P., 3/6/12. P. J. Pienaar (2426).

## Parodiella.

Aerial mycelium none. Perithecia superficial, globose, astomous, black, adnate at the base to the leaf. Asci cylindraceo-clavate, 8-spored, typically paraphysate. Spores 2-celled, obscurely fuligineous.

*Key to Species.*

| | |
|---|---|
| A. Spores 8–11 × 4–5 μ. | *P. Schimperi.* |
| B. Spores 26–30 μ long. | |
| *a.* Spores 6–7·5 μ broad. | *P. congregata.* |
| *b.* „ 10–11 μ „ | *P. perisporioides.* |

*Parodiella Schimperi* P. Henn.

Sacc. Syll. Fung. xi, p. 260.

Fung. Ethiop. i, p. 119; Bull. Herb. Boiss. i, 1893.

Epiphyllous; perithecia numerous, sub-hemispherical, 100–180 μ diam.; crowded, and forming small round groups 1–5 mm. diam. Asci ovate-cylindrical, 25–33 × 18–25 μ, 4–8-spored. Spores 1-septate, hyalino-flavidulous, 8–11 × 4–5 μ.

On living leaves of *Rhynchosia* sp., near Durban, 25/5/97, J. Medley Wood (356), (Wood No. 6445); Durban, 15/6/15, K. Lansdell (9015).

*arodiella congregata* Syd.

Ann. Myc. x. (1912), p. 37.

Perithecia epiphyllous, globose, very minute, 60–100 μ diam.; closely crowded and forming small round groups 1–4 mm. diam., resembling in habit a *Doassansia*; very slightly immersed at the base, astomous, wall minutely parenchymatous, under the microscope at first dark olive colour and finally more or less brown and sub-opaque. Asci varying in form and size, some ovate or sub-globose, about 30–40 × 20–30 μ, some elongated, saccate, 50–65 × 15–20 μ, sessile, thickened at the apex, 8-spored. Paraphyses indistinct. Spores distichous, tristichous or crowded together, elongated 1-septate, not constricted, olivaceous, 26–30 × 6–7·5 μ, the upper cell usually rather shorter and broader.

On leaves of *Limnanthemum Thunbergianum*, Belfast, Transvaal, 12/11/09, E. M. Doidge (765).

*Parodiella perisporioides* (Berk. & Curt.) Speg.

Sacc. Syll. Fung. i, p. 717.

Epiphyllous; perithecia globose, 150–200 $\mu$ diam., astomous, smooth, black, superficial, adnate at the base, very closely crowded together, entirely covering the whole of the leaf surface; wall of the perithecium membranaceous, parenchymatous, olivaceous-fuliginous. Asci clavate, briefly pedicellate, rounded and thickened at apex which is traversed by a pore, 120 × 20–24 $\mu$, 8-spored.

Paraphyses filiform. Spores distichous, elliptic-bi-conical, 1-septate, constricted, at first each loculus is 1-guttulate, later eguttulate; the upper cell somewhat more swollen and sometimes slightly curved; obtuse at both ends, fuliginous 28–30 × 10–11 $\mu$.

On leaves of *Eriosema* sp., Belfast, Transvaal, 16/2/09, E. M. Doidge (574).

On leaves of *Indigofera* sp., Belfast, Transvaal, 16/2/09, E. M. Doidge (576).

On leaves of *Vigna angustifolia*, Garstfontein, Pretoria Dist., 12/2/10 and 4/12/11, P. J. Pienaar (1201 and 1958); Muckleneuk, Pretoria, 27/4/13, I. B. Pole Evans (6694).

On leaves of *Psoralea decumbens*, Newlands, C.P., 20/11/10, C. P. Lounsbury (1005).

## Zukalia.

Mycelium abundant, effuse; perithecia superficial, globose, sub-astomous, sub-membranaceous, black. Asci 8-spored. Spores ovate-oblong, 2-pluri-septate, hyaline or sub-hyaline.

*Zukalia transvaalensis* Doidge n. sp.

Epiphyllous, effuse forming very thin, spreading, black colonies. Hyphae radiating, branched, anastomosing 7–8 $\mu$ thick, composed of cells about 30–32 $\mu$ long, bearing unicellular hyphopodia. Hyphopodia unilateral, alternate or opposite, globose, flattened, or sub-lobed, usually broader than long, 8–10 × 11–14 $\mu$. Perithecia black, globose, scattered, rather numerous, under microscope sub-pellucid, brown, smooth, with a false ostiole, 130–160 $\mu$ diam. Asci numerous, fasciculate, 8-spored, thin-walled, elliptical, or narrow-ovate, frequently slightly curved, 70–90 × 18–22 $\mu$. Paraphyses none. Spores distichous or tristichous, clavate, hyaline, 5-septate, 45–55 × 5–7 $\mu$, obtuse at both ends.

On leaves of *Eugenia Zeyheri*, Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1759).

## Meliola.

Fungi living on the surface of leaves, more seldom on branches. Perithecigerous mycelium dark brown, thick, always provided with capitate hyphopodia (small 2-celled processes, which Gaillard calls abortive perithecia), and very often with mucronate hyphopodia (abortive mycelial branches), and frequently with setae (sterile, erect branches). Perithecia globose or ovoid, rarely dimidiate, carbonaceous, astomous, or with a false ostiole formed of more delicate, paler cells. Asci spherical or ovoid, rarely cylindrical or claviform, usually evanescent. Spores brown at maturity, large, transversely 2–5 septate. Conidiiferous mycelium slender, paler. Conidia fusiform, transversely septate.

### *Key to the Species.*

I. Spores 3-septate.
- A. Setae none.
  - *a.* Spores 40–50 $\mu$ long.
    - *x.* Capitate hyphopodia 20–30 $\mu$ long. Spores slightly constricted. — *M. manca.*
    - *xx.* Capitate hyphopodia 18–21 $\mu$ long. Spores deeply constricted. — *M. natalensis.*
    - *xxx.* Capitate hyphopodia crowded 14–18 $\mu$ long. Spores slightly constricted. — *M. conferta.*
  - *b.* Spores 50–60 $\mu$ long.
    - *x.* Capitate hyphopodia small, terminal cell globose. — *M. Podocarpi.*
    - *xx.* Capitate hyphopodia large, terminal cell lobed. — *M. speciosa.*
- B. Setae mycelial, simple and straight.
  - *a.* Spores 25–30 $\mu$ long. — *M. torta.*
  - *b.* Spores 45–50 $\mu$ long. — *M. ganglifera.*
  - *c.* Spores 57–68 $\mu$ long. — *M. peltata.*
- C. Setae mycelial, branched. — *M. cladotricha.*

II. Spores 4-septate.
- A. Setae none.
  - *a.* Spores 45–55 $\mu$ long.
    - *x.* Capitate hyphopodia lobed. — *M. ditricha.*
    - *xx.* Capitate hyphopodia not lobed. — *M. Hendeloti.*
  - *b.* Spores not more than 45 $\mu$ long.
    - *x.* Superficial cells of perithecium convex, rounded.
      - . Cells of hyphae 25–30 $\mu$ long. — *M. glabra.*
      - . . Cells of hyphae about 18 $\mu$ long. — *M. Strophanthi.*

*xx.* Superficial cells of perithecium mammillate. — *M. Peglerae.*

*xxx.* Certain superficial cells of perithecium subcylindrical, recurved. — *M. inermis.*

B. Setae perithecial. — *M. Bosciae.*

C. Setae mycelial, simple and straight.

*a.* Setae quite straight or abruptly geniculate at the base.

*x.* Capitate hyphopodia usually opposite.

. Spores 35–40 $\mu$ long. — *M. capensis.*

. . Spores 47–55 $\mu$ long. — *M. Toddaliae.*

*xx.* Capitate hyphopodia usually alternate.

. Spores less than 35 $\mu$ long. — *M. microspora.*

. . Spores 40–50 $\mu$ long.

0 Apex of setae obtuse. — *M. amphitricha.*

00 Apex of setae acute. — *M. Rhois.*

. . . Spores 48–55 $\mu$ long.

0 Setae translucent. — *M. microthecia.*

00 Setae opaque throughout. — *M. sinuosa.*

*b.* Setae more or less flexuose.

*x.* Capitate hyphopodia alternate. — *M. polytricha.*

*xx.* Capitate hyphopodia usually opposite. — *M. rigida.*

D. Setae mycelial, curved.

*a.* Spores 38–48 × 16–20 $\mu$. — *M. falcata.*

*b.* Spores 50–55 × 14–16 $\mu$. — *M. arcuata.*

*c.* Spores 50–54 × 18 $\mu$. — *M. Woodiana.*

E. Setae mycelial, forked.

*a.* Setae only forked at the tip. — *M. furcillata.*

*b.* Setae with more or less spreading branches.

*x.* Ultimate branches usually 3-fid at apex. — *M. varia.*

*xx.* Ultimate branches usually bi-fid.

0 Main branches of setae up to 90 $\mu$ long. — *M. bifida.*

00 Main branches of setae up to 130 $\mu$ long. — *M. leptidea.*

*Meliola manca* Ell. & Mart.

Gaillard, Le Genre Meliola, p. 37.

Amphigenous, but most frequently epiphyllous, forming black, orbicular, or irregular, thinly carbonaceous spots, 2–5 mm. diam.; these are frequently confluent and cover the greater part of the leaf surface. Perithecigerous mycelium, consisting of slender, rather pale hyphae 7–8 $\mu$ diam., articulations distant, cells 18–30 $\mu$ long; branches remote and sometimes anastomosing. Capitate hyphopodia alternate, distant, stipitate, 21·5–29 μ long; upper cell irregular, more or less lobed, 14·5–18 × 14·4 μ; mucronate hyphopodia not very numerous, paler, opposite, ampulliform, rather slender, suddenly narrowed near the apex into a short neck, measuring about 7 × 18 μ. Perithecia scattered or in small groups, black, globular, 150 – 180 μ diam., with a false ostiole formed of paler cells, verrucose; bearing on the surface a number of sub-cylindrical, larviform appendages, terminating in a recurved point, 60–110 × 20–26 μ at the base, unicellular, colour russet-brown, wall rugulose. Asci ovoid, shortly pedicellate, 4-spored. Spores 3-septate, straight or slightly curved, similar in colour to hyphae, tawny olive (R. XXIX), slightly constricted at the septa, rounded at both ends, 40–45 × 13–14 μ.

On leaves of *Rubus rigidus*, Winter's Kloof, Natal, 17/6/11, E. M. Doidge (1574); Woodbush, Zoutpansberg Dist., 5/8/11, E. M. Doidge (1771); Cramond, Natal, 3/6/12, I. B. Pole Evans (2405); Knysna, C.P., 3/6/12, P. J. Pienaar (2425).

On leaves of *Pygeum africanum*, Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1761).

*Meliola natalensis* Doidge n. sp.

Amphigenous, mostly epiphyllous, forming round, irregular, black carbonaceous spots, 2–3 mm. diam. Mycelium radiating, branched; hyphae tawny olive (R. XXIX), somewhat sinuous and frequently constricted at the septa, 6–8 μ thick, composed of cells 14–18 μ long; branches usually opposite. Capitate hyphopodia alternate or unilateral, stipitate, 18–21 μ long; basal cell short, tapering to point of junction with hypha; terminal cell broader than long, lobed usually with 2–3 lobes, which are again bilobulate, 12–14 × 16–20 μ. Mucronate hyphopodia rare, scattered, slender, straight or recurved, ca. 16–18 × 4–5 μ. Mycelial setae none. Perithecia grouped near centre of mycelium, black, globose, carbonaceous, 130–150 μ diam., rugulose, certain of the superficial cells being prolonged into sub-cylindrical vermiform processes 40–55 × 18 μ, sometimes recurved at the tip. Asci 2-spored. Spores 3-septate, cylindrical, deeply constricted at the septa, 40–44 × 14–16 μ, straight or slightly curved, cells subequal.

On leaves of shrub unknown, Umgeni, near Durban, Natal, 27/5/15, E. M. Doidge (8980).

*Meliola conferta* Doidge n. sp.

Amphigenous, forming dull, black, sub-crustaceous colonies 1–3 mm. diam. Hyphae tawny olive (R. XXIX), straight, with numerous opposite branches, 6–8 μ thick, composed of cells 11–18 μ long. Capitate hyphopodia very numerous, crowded together, opposite, occasionally, on the smaller branches, unilateral or alternate, 14–18 μ long; terminal cell variously lobed, usually with 2–3 lobes, each of which is bi-lobulate, 9–14 × 11–14 μ. Mucronate hyphopodia rare, interspersed with the capitate hyphopodia, 18 μ long, pale, with a short, rather thick neck. Mycelial setae none. Perithecia (not quite mature) few, scattered, 100–130 μ diam., black, globose, verrucose, certain of the surface cells being prolonged into sub-cylindrical processes about 18 μ long. Asci not seen. Spores almost black, 3-septate, straight or slightly curved, somewhat constricted at the septa and tapering towards the rounded ends, 40–50 × 18–25 μ.

On leaves of tree unknown, near Durban, 14/5/1897, J. Medley Wood (345), (Wood 6457).

On leaves of *Doryadis rhamnoides*, near Durban, 14/5/97, J. Medley Wood (Wood 6454).

On leaves of tree undetermined, 22/7/15, Mayville, Natal, J. Medley Wood (9065).

This specimen, which is labelled *M. sapindacearum* in Medley Wood's collection, is the one referred to under that name in *Hedwigia*, 1899, p. 132, with the following note: "Hab. in foliis arboris ignotae et *Doryadis rhamnoides*, pr. Durban. Obs. Perithecia obsoleta hinc species dubia. Affinis quoque *M. triloba* Wint." The present specimen has both perithecia and spores, and differs widely from *M. sapindacearum* in the 3-septate spores and the absence of mycelial setae.

Wood's numbers are not quoted in the note in *Hedwigia*, but the numbers are given in a letter containing a list of determinations sent by Sydow to Dr. Medley Wood, now in my possession.

*Meliola Podocarpi* Doidge n. sp.

Amphigenous, but mostly epiphyllous, forming thin, black colonies 2–5 mm. diam.; frequently confluent. Hyphae straight or somewhat sinuous, 6–7 μ thick, sepia or warm sepia (R. XXIX), composed of cells 16–18 μ long; branches opposite. Capitate hyphopodia alternate, briefly stipitate, 14–16 μ long; terminal cell globose, 10–12 × 10–11 μ. Mucronate hyphopodia not seen. Mycelial setae none. Perithecia scattered or in small groups, black, globose, verrucose, 200–250 μ diam.; when immature there are numerous, slender hyphae radiating from the base of the perithecia, some of them bearing hyphopodia; occasionally a few of these are upright, and become differentiated into slender, pointed setae. Asci 2–4-spored. Spores 3-septate, strongly constricted at the septa, slightly curved and tapering towards the rounded ends, 50–56 × 14–16 μ; the two central cells larger than the others, and when the spore is immature, darker in colour.

On leaves of *Podocarpus Thunbergii*, Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1748); Knysna, C.P., P. J. Pienaar (2436).

On leaves of *P. elongata*, Fort Cunningham, Toise River, 20/3/15, Forest Officer (8897).

*Meliola speciosa* Doidge n. sp.

Hypophyllous, forming orbicular-irregular spots 1–5 mm. diam. Hyphae branching, occasionally anastomosing, up to 11 μ thick, Mikado brown (R. XXIX), articulations short, about 18 μ long. Capitate hyphopodia numerous, alternate, stipitate, basal cell 7–11 × 5·5–7 μ, narrower at junction with hypha; terminal wall broader than long, 18–21·5 × 21·5–25 μ, irregular, 2–4-lobed, each lobe being slightly 2-lobed; mucronate hyphopodia very scarce, paler, slender and curved, about 25 × 7 μ. Mycelial setae none. Perithecia grouped in the centre of the colony, black, with a false ostiole, almost smooth, 165–265 μ diam.; bearing a number of sub-cylindrical, larviform appendages, 70–90 μ long, 18 μ thick at the base, apex curving upward. Ascus 2-spored, evanescent. Spores ellipsoid, 3-septate, scarcely constricted at the septa, hazel brown (R. XIV), 52–61 × 21·5–25 μ. Conidiophores dark brown, erect, septate, about 150 μ long; conidia fusoid, 4-septate, pale.

On leaves of *Gymnosporia* sp., Woodbush, Zoutpansberg Dist., 2/8/11, E. M. Doidge (1740).

*Meliola torta* Doidge n. sp.

Amphigenous, forming thin, black colonies 5–10 μ diam. Hyphae slender, 6–7 μ thick, Vandyke brown (R. XXVIII). tortuous, anastomosing, cells 25–36 μ long; branching irregular, usually unilateral. Capitate hyphopodia, distant, slender, tortuous, alternate or unilateral, 32–40 μ long; basal cell irregular in shape and size, rather long and slender; frequently geniculate; terminal cell 14–25 × 14–20 μ, variously lobed and contorted, some flattened at apex, others more or less rounded. Mucronate hyphopodia rather numerous, 1-celled, occasionally 2-celled, unilateral, alternate, or opposite, interspersed with capitate hyphopodia, ampulliform, with a rather long, slender neck, 20–36 μ long. Mycelial setæ not numerous, scattered, simple, straight, abruptly geniculate at the base, 300–600 × 10–11 μ at base, tapering to the acute apex, opaque except near apex. Perithecia few and scattered, black, globular, rugulose, 160–250 μ diam. Asci numerous, 8-spored; spores distichous or conglobate, 3-septate, brown, scarcely constricted at septa, clavate, broader at one end than other, 25–30 × 7–11 μ (at broadest part). The two middle cells are longer than the terminal ones.

On leaves of *Trichocladus crinitus*, Izelini Forest, King William's Town Dist., 8/6/15, Forester Emmett (9064).

There is another *Meliola* associated with this on leaves with 4-septate spores and no setae—but it was badly parasitised and I was unable to etermine it.

*Meliola ganglifera* Kalch.

Grevillea ix, p. 34, pl. 138, fig. 49.

Gaillard, Le Genre Meliola, p. 40.

Amphigenous; colonies orbicular, often confluent, velvety black, up to 8 mm. diam. Perithecigerous mycelium at first vinaceous buff (R. XL), becoming much darker with age (auburn R. II); hyphae 7–8 μ thick, sinuous, cells fairly long, 25–28 μ. Capitate hyphopodia alternate, rather numerous, stipitate, 28–36 μ long, straight or incurved; terminal cell varied in form, usually with 3 or 4 tuberculate protuberances. Mucronate hyphopodia paler, ampulliform, gradually attenuated from the base into a fairly long neck, 18–21 × 8–9 μ; mycelial setae numerous, black, opaque, except near acute apex, bent almost at right angles just above the slightly swollen base, thick-walled, 200–360 × 8 μ, straight or more or less flexuous. Perithecia black, globose, verrucose, 150–220 μ diam. Ascus ovoid, briefly pedicellate, 2–4-spored. Spores cylindrical, 3-septate, auburn (R. II) rounded at the extremities, slightly constricted at the septa, 45–50 × 15–18 μ.

On living leaves of *Curtisia faginea* Ait. (MacOwan 1349), Woodbush, Zoutpansberg Dist., J. Burtt-Davy (134).

On leaves of host undetermined, Kentani, C.P., 7/10/14, A. Pegler (8392), (Pegler No. 1953).

*Meliola peltata* Doidge n. sp.

Amphigenous, forming orbicular, black pilose spots, 3–7 mm. diam., sometimes confluent. Perithecigerous mycelium forming a pseudoparenchymatous disc with a definite margin, antique brown (R. III). Composed of much branched hyphae, branching flabelliform; cells of the hyphae about 5·5–7 × 11 μ. Capitate hyphopodia alternate, closely appressed to the hyphae, sub-clavate, stipitate, 39–50 μ long; terminal cell compressed, usually tuberculate or lobulate, 28–32 μ long. Mucronate hyphopodia not seen. Mycelial setae numerous, simple, straight, 10–11 μ thick and up to 850 μ long, opaque, black, but paler nearer the acute apex. Perithecia not numerous, scattered, black, scabrous but not verrucose. Asci not seen. Spores 3-septate, occasionally 2-septate, constricted at the septa, attenuated towards each of the rounded ends, Vandyke brown (R. XXVIII) 57–68 × 25–32 μ, the majority about 60 × 29 μ.

On leaves of *Podocarpus Thunbergii*, Knysna Forest, C.P., 3/6/12, P. J. Pienaar (2436).

*Meliola cladotricha* Lev.

Ann. des Sc. Nat., v, 1846, p. 266.

Gaillard, Le Genre Meliola, p. 46.

Amphigenous, forming thick, black velvety spots 2–5 mm. diam., frequently confluent, with a fimbriate margin. Perithecigerous mycelium composed of branched hyphae 6–8 μ thick with remote articulations, Isabella colour (R. XXX). Capitate hyphopodia alternate, very rare, stipitate, terminal cell pyriform. Mucronate hyphopodia opposite or unilateral, rarely unicellular, frequently developing 2–3 cells, paler than the mycelium. Mycelial setae opaque at the base, paler at the summit, bifid, each division giving rise to two or three branches with acute apices. There are frequently groups of crystals of calcium oxalate at the tips of the setae. Perithecia globose, black, 300–400 μ diam., with granular surface. Asci ovoid with a very short foot, 2-spored. Spores 3-septate constricted at the septae, attenuated towards the ends, 65–70 × 18–22 μ.

On leaves of *Eugenia Zeyheri*, Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1759).

*Meliola ditricha* (K. & Cke.) Doidge.

(*Asterina ditricha* K. & Cke., Grevillea, 1880, p. 32.)

Hypophyllous, effuse, forming thin black colonies 2–5 mm. diam. Hyphae radiating, Vandyke brown (R. XXXVII), 7–10 μ thick, composed of cells 18–21 μ long; branches usually opposite, anastomosing. Capitate hyphopodia alternate, stipitate 25–30 μ long, terminal cell irregular in shape, variously lobed 18–22 × 14–22 μ. Mucronate hyphopodia fairly numerous, on separate short branches or interspersed with the capitate hyphopodia, opposite or unilateral, slender, lower part not much thicker than the neck, 21–25 × 7–8 μ. Setae none. Perithecia not numerous, grouped in centre of colony, black, globose (not mature). Asci not seen. Spores 4-septate, nearly black, constricted at the septa, rounded at both ends 54 × 25 μ.

Conidiiferous mycelium slender, paler; conidiophores erect, 70–80 μ long, conidia fusoid, 3-septate, 15–18 × 4–8 μ.

On leaves of *Celastrus* sp., Inanda, Natal, May, 1876, Medley Wood (Wood No. 3).

*Meliola Hendeloti* Gaill.

Gaillard, Le Genre Meliola, p. 49.

Amphigenous, but mostly epiphyllous, forming thin, black, orbicular colonies 2–3 mm. in diam. Hyphae straight or sinuous, slightly constricted at the septa, Brussels brown (R. III), 8–10 μ thick, composed of cells 25–40 μ long. Capitate hyphopodia alternate or unilateral, 16–18 μ long, bi-cellular, terminal cell globular or compressed 11–13 × 9–11 μ. Mucronate hyphopodia fairly numerous, opposite, usually on short branches not interspersed with capitate hyphopodia, 15–18 μ long, lageniform. Mycelial setae none. Perithecia scattered, black, globose, 180–220 μ diam., superficial cells developed into mammillate processes, the top of each process being recurved or bent laterally. Asci 2-spored, subglobose, very briefly pedicellate. Spores 45–50 × 18–22 μ, laterally compressed, 4-septate, cylindrical, rounded at both ends, slightly constricted at the septa.

On leaves of *Nuxia floribunda*, 3/8/11, Woodbush, Zoutpansberg Dist., E. M. Doidge (1776).

Differs from Gaillard's description of *M. Hendeloti* only in presence of mammillate cells on perithecium; Gaillard puts this fungus in group "Perithecia smooth or simply granular," but in his description says "Perithecia rugulose."

*Meliola glabra* Berk. & Curt.

Gaillard, Le Genre Meliola, p. 59.

Amphigenous, but most frequently epiphyllous, forming black, crustaceous spots 2–3 mm. diam. Hyphae 7–9 $\mu$ thick, formed of cells 25–30 $\mu$ long, Dresden brown (R. XV). Capitate hyphopodia alternate or unilateral, shortly stipitate, 18–25 $\mu$ long; terminal cell ovoid, globose, or slightly lobed 11–14·5 × 11 $\mu$. Mucronate hyphopodia ampulliform, about 14 $\mu$ long, drawn out at the tip into a short, rather thick neck, not very numerous. Mycelial setae none. Perithecia grouped to the number of 8–10 in the centre of the colony, the superficial cells forming in places conical protrusions, rounded at the top, 150–180 $\mu$ diam., with a false ostiole at the summit. Asci ovoid-oblong, 2–4-spored. Spores 4-septate, constricted at the septa, rounded at the ends, 40–45 × 16–18 $\mu$.

On leaves of *Canthium* sp., Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1780).

This fungus differs slightly from the type described by Gaillard, the perithecia being smaller—he describes them as measuring 200–250 $\mu$. Otherwise the description corresponds with his.

*Meliola Strophanthi* Doidge, n.sp.

Amphigenous, mostly hypophyllous, forming minute, black, sub-crustaceous, orbicular-irregular spots 1–2 mm. diam. Hyphae somewhat sinuous, 6–9 $\mu$ thick, composed of cells about 18 $\mu$ long, Brussels brown (R. III), branching opposite. Capitate hyphopodia alternate, briefly stipitate, 20–25 $\mu$ long; terminal cell cylindrical, straight to slightly curved, convex at the apex 16–18 × 7–9 $\mu$. Mucronate hyphopodia not numerous, ampulliform, about 18 $\mu$ long, with a short neck. Mycelial setae none. Perithecia not numerous, in small groups, globular, black, 215–250 $\mu$ diam.; surface cells convex, rounded, conical. Mature asci not seen. Spores 40–45 × 16–18 $\mu$, 4-septate, very slightly constricted at the septa, cylindrical, broadly rounded at the ends.

Conidiiferous mycelium interwoven with the perithecigerous hyphae, paler, hyphae thinner, with numerous dark brown erect conidiophores 180–200 $\mu$ long. Conidia fusiform, 3-septate, 18–32 × 5–9 $\mu$.

On the leaves of *Strophanthus speciosus*, Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1781).

*Meliola Peglerae* Doidge.

Epiphyllous, sub-crustaceous, black, forming black orbicular colonies 1–3 mm. diam. which form larger spots by becoming confluent. Hyphae frequently septate, formed of cells 8–14 × 7–9 μ, colour Saccardo's umber (R. XXIX). Branches anastomosing. Capitate hyphopodia numerous, alternate, or unilateral, briefly stipitate, appressed towards the hyphae; basal cell 7 × 4–7 μ; terminal cell larger, obovoid, straight or more frequently bent backward at the tip (almost retort-shaped) 14–18 × 7–11 μ. Mucronate hyphopodia few in number, opposite, ampulliform, 14–22 × 7 μ. Mycelial setae none. Perithecia crowded together in the centre of the colony, black, 126–233 μ diam. Superficial cells mammillate. Asci 2–4-spored, evanescent, Spores oblong, rounded at both ends, 4-septate, slightly constricted at the septa, 29–43 × 16–18 μ.

On leaves of *Anastrabe integerrima*, Kentani, 4/6/12, A. Pegler (2363), (Pegler No. 1883).

On leaves of shrub unknown, Umgeni, near Durban, Natal, 16/7/15, J. Medley Wood (9036).

*Meliola inermis* Kalch. & Cke.

Grevillea 1880, p. 34, tab. 38, fig. 51.
Sacc. Syll. Fung. i, p. 64.
Gaillard, Le Genre Meliola, p. 64.
(*M. quinquespora* Thuem., Myc. Univ. n. 657—*M. quinqueseptata* Rehm. Ascom.)

Amphigenous, but mostly epiphyllous; forming small, black, thinly carbonaceous colonies 1–3 mm. in diam., sometimes very numerous and then confluent. Hyphae 7–8 μ thick, composed of cells 18–22 μ long, sinuous, tawny olive (R. XXIX). Capitate hyphopodia alternate, about 25 μ long. stipitate; terminal cell rounded, truncate or somewhat lobed, averaging 14–16 × 10–11 μ. Mucronate hyphopodia not so numerous, opposite, only slightly paler, 14–18 μ long, ampulliform, with a short neck. Setae none. Perithecia scattered, black, globular, 200–250 μ diam., the surface being covered with conical or horn-shaped unicellular processes, 60 × 15 μ. Asci ovoid briefly pedicellate, 2-spored. Spores 4-septate, constricted at the septa, elliptical, rounded at the extremities, similar in colour to the mycelium, 35–38 × 13–15 μ.

On leaves of *Buddleia auriculata*, Boschberg nr. Somerset East, C.P., July, 1876, MacOwan (MacOwan 1251), (de Thüm Myc. Univ. 657) Bulwer, Natal, April, 1914, W. Haygarth (7790).

On leaves of *Buddleia salvifolia*, Woodbush, Zoutpansberg, 2/8/11, E. M. Doidge (1742).

On leaves of *Buddleia pulchella*, Amanzimtoti, Natal, 10/7/11, E. M. Doidge (1571).

*Meliola Bosciae* Doidge n. sp.

Epiphyllous, rarely hypophyllous; forming a thin, black, sub-orbicular pellicle 2–3 mm. wide on the leaf surface. Hyphae radiating, frequently anastomosing in the neighbourhood of the perithecia, tawny olive (R. XXIX), septa at times curved, vermiculate, 5·5–9 $\mu$ thick; branches opposite or unilateral. Capitate hyphopodia alternate or unilateral, rarely opposite, shortly stipitate, 14–20 $\mu$ long; terminal cell 10·5–16 $\mu$ long, scabrous, convex, truncate or slightly lobed. Mucronate hyphopodia most numerous in the neighbourhood of the perithecia, on separate branches or scattered amongst the capitate hyphopodia, opposite or unilateral 14–18 $\mu$ long and about 7 $\mu$ thick at the base, ampulliform, with a long neck which is frequently incurved. Mycelial setae none. Perithecia globose, black, verrucose, 160–180 $\mu$ diam., with 6–12 setæ scattered on the surface. Setae simple, 70–90 $\mu$ long, opaque, and about 6 $\mu$ thick at the slightly bulbous base, and tapering to the obtuse pellucid apex, straight, or abruptly bent just behind the apex. Ascus 2–3-spored, ovate, shortly pedicellate, evanescent. Spores sepia colour (R. XXIX) 4-septate, constricted at the septa, rounded at both ends, 39–47 × 10·5–14·5 $\mu$.

On leaves of *Boscia caffra*, Winkle Spruit, Natal, 6/7/12, E. M. Doidge (2510); Stella Bush, Durban, 7/6/15, K. Lansdell (9016).

On leaves of *Maerua pedunculosa*, Umgeni, Natal, 16/7/15, J. Medley Wood (9024).

*Meliola capensis* (K. & Cke.) Theiss.
Ann. Mycologici x (1912), p. 19.
(*Asterina capensis* Kalch. & Cke., Grevillea ix, p. 32.)

Epiphyllous, sometimes hypophyllous, forming round black colonies about 2–4 mm. broad, often confluent. Hyphae straight, radiating, branched, up to 8 $\mu$ thick, frequently septate, colour Saccardo's umber (R. XXIX). Branches widely divaricating. Capitate hyphopodia opposite, numerous, 10·5–15 $\mu$ long, widely divaricating, regular; terminal cell 9–10 × 7–8 $\mu$, basal cell about 3·5 × 6–7 $\mu$. Mucronate hyphopodia opposite, numerous, 14–18 $\mu$ long. Mycelial setae straight, simple, opaque, 300–400 × 5–10 $\mu$, pellucid near the acute apex. Perithecia gregarious, black, globose, verrucose, 100–200 $\mu$ diam. Asci 2-spored, evanescent. Spores oblong, rounded at both ends, 4-septate, slightly constricted at the septa, 35–40 × 14–16 $\mu$.

On leaves of *Hippobromus alatus*, Inanda, Natal, J. Medley Wood (Wood No. 57); Somerset East (MacOwan No. 1328); Winkle Spruit, 6/7/12, E. M. Doidge (2499); Verulam, 3/7/13, I. B. Pole Evans (6805); Umgeni, Natal, 16/7/15, J. Medley Wood (9034).

On leaves of *Hippobromus* sp., Kentani, 7/10/14, A. Pegler (8391). (Pegler No. 1956).

*Meliola Toddaliae* Doidge n. sp.

Amphigenous, forming black, circular, velvety spots 2–3 mm. diam., very easily detached from the leaf. Hyphae fuscous (R. XLVI), much branched, 7–10 μ thick, composed of cells 10–18 μ long; branches usually opposite, less frequently unilateral, anastomosing, very pale near the tips. Capitate hyphopodia numerous, opposite, 18–20 μ long, stipitate; terminal cell usually sub-ovate and slightly in- or recurved, but often becoming flattened in various directions by compression, 14–16 × 8–10 μ. Mucronate hyphopodia not numerous, opposite, ampulliform, with a straight or curved neck, 18–20 × 8–10 μ. Mycelial setae numerous, simple, straight, erect, at first translucent then becoming opaque almost to the acuminate apex, more or less torulose, 300–350 × 8–10 μ. Perithecia rather numerous, scattered, hidden among the setae, black, globose, verrucose, 200–250 μ diam. Asci 3–4-spored. Spores 4-septate, slightly constricted, cylindrical, rounded at both ends, thick-walled, laterally compressed, 47–55 × 18–21 × 14 μ.

On leaves of *Toddalia lanceolata*, Kentani, 16/12/14, A. Pegler (8788), (Pegler No. 1960 A.); Henley, near Pietermaritzburg, Natal, 24/5/15, E. M. Doidge (8999).

*Meliola microspora* Pat. et Gaill.

Bull. Soc. Myc. 1888, p. 104.
Sacc. Syll. Supplem. Univ. i, p. 426.
Gaillard, Le Genre Meliola, p. 75.
var. *Africana* var. nov.

Amphigenous, forming very minute black colonies ½–1 mm. in diam. Hyphae slender, radiating, Isabella colour (R. XXX) 5–8 μ thick, composed of cells 20–35 μ long. Capitate hyphopodia distant, alternate or unilateral, stipitate, widening gradually from the base to just below the convex or rather pointed apex, 20–21·5 × 7–8 μ, terminal cell ovate, 14–16 μ long. Mucronate hyphopodia opposite, interspersed with the capitate hyphopodia, ampulliform, with a neck 5–7 μ long. Mycelial setae not numerous, more numerous in the neighbourhood of the perithecia, simple, somewhat abruptly geniculate near the base or incurved, 230–320 μ × 6–7 μ, very dark at the base, rather paler near the apex. Perithecia few, black, verrucose or rugulose, globular, 150–180 μ diam. Asci ovate, briefly pedicellate, 3–4 spored, Spores 4-septate, cylindrical, broadly rounded at both ends, slightly constricted at the septa, 26–32·5 × 10·5–14 μ, frequently wider at one end than the other.

On leaves of *Galopina circaeoides,* Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1760).

On leaves of *Labiatae,* undetermined, Woodbush, Zoutpansberg Dist., 4/8/11, E. M. Doidge (1766).

On leaves of *Barleria* sp., Amanzimtoti, Natal, 20/5/13, E. M. Doidge (6623).

On leaves of *Isoglossa Woodii,* Amanzimtoti, Natal, 10/7/11, E. M. Doidge (1578).

Differs from type in size of spores and hyphopodia. Gaillard gives capitate hyphopodia 12–15 × 6–8 $\mu$. Spores 25–28 × 8–10 $\mu$. Asci 2-spored.

*Meliola amphitricha,* Fr.

Bull. Soc. Myc. 1888, p. 104.

Gaillard, Le Genre Meliola, p. 76.

Amphigenous, spots at first orbicular then confluent and irregular, velvety. Hyphae Dresden brown (R. XV), 8–10 $\mu$ thick, formed of rather short cells. Capitate hyphopodia usually alternate, 20–30 $\mu$ long, stipitate, terminal cell sub-cylindrical, or increasing in thickness from the base upwards, the apex truncate or convex, up to 15–20 $\mu$ long. Mucronate hyphopodia pale, opposite or unilateral, drawn out at the apex into a neck. Mycelial setae numerous, remotely septate, distributed over the surface of the spot, 300–400 × 10-15 $\mu$, of an opaque, violaceous black at the base, somewhat obtuse at the summit which is paler and translucid. Perithecia globular, black, verrucose, each exterior cell being strongly convex, usually scattered, no false ostiole present, 120–200 $\mu$ diam. Asci ovoid, very briefly pedicellate, 2-spored. Spores 4-septate, constricted at the septa, elliptical, rounded at the ends, 40–50 × 18–22 $\mu$.

On leaves of *Sapindus oblongifolius,* Stella Bush, Durban, 11/7/11 and 2/7/12, E. M. Doidge (1572 and 2520); M. Franks, 2/7/12 (8404).

On leaves of *Psychotria capensis,* Amanzimtoti, Natal, 10/7/11, E. M. Doidge (1272); Stella Bush, Durban, E. M. Doidge (2521).

On leaves of *Gardenia globosa,* Kentani, 1/4/12, A. Pegler (2214), (Pegler No. 1858); Winkle Spruit, Natal, 28/5/15, E. M. Doidge (9014).

On leaves of *Grumilea globosa,* Kentani, 29/5/12, A. Pegler (2366), (Pegler No. 1875).

On leaves of *Olea laurifolia,* Woodbush, Zoutpansberg Dist., 4/8/11, E. M. Doidge (1835).

On leaves of *Olea Pegleri,* Kentani, 29/8/14, A. Pegler (8382), (Pegler No. 1948).

On leaves of shrub unknown, Krantzkloof, Natal, 14/8/14, P. van der Bijl (8377).

On leaves of *Mitriostigma axillaris,* Winkle Spruit, Natal, 28/5/15, E. M. Doidge (9013).

*Meliola Rhois* P. Henn.

Fungi Brasilienses, Engl. Jahrb. xvii, p. 523.

Amphigenous, forming small, black, velvety spots 1–3 mm. diam.; these are frequently confluent and cover a great part of leaf surface. Hyphae radiating, frequently septate, 7–11 $\mu$ thick, usually constricted at the septa, buffy citrine (R. XVI); branching alternate; cells of the hyphae 17–27 $\mu$ long. Capitate hyphopodia alternate, stipitate, 18–25 $\mu$ long, terminal cell varied in form, straight or bent and usually sub-lobed (or with rounded protrusions) 14–18 × 10–11 $\mu$. Mucronate hyphopodia fairly numerous, on separate branches, opposite, ampulliform, with a thin neck, 18–22 × 8–10 $\mu$. Mycelial setae rather numerous, scattered, erect, rigid, simple, straight, opaque at the base, more pellucid near the acute apex 280–400 × 7–9 $\mu$. Perithecia scattered or in groups, black, globose, granular or slightly verrucose, 180–230 $\mu$ diam. Ascus elliptical-ovate with a very short foot, 2–4-spored. Spores 4-septate; cylindrical, slightly constricted at the septae, rounded at both ends, laterally compressed 35–47 × 15–20 × 14 $\mu$.

On leaves of *Rhus longispina*, Despatch, near Uitenhage, 24/3/11, E. M. Doidge (1239).

On leaves of *Rhus crenata,* Verulam, 3/7/13, I. B. Pole Evans (6804).

On leaves of *Rhus* sp., Mayville, near Durban, Natal, 22/7/15, J. Medley Wood (9032).

On leaves of *Harpophyllum caffrum*, Kentani, 17/2/15, A. Pegler (8851), (Pegler No. 1986).

Var. *tenuis*.—Hyphae more slender with distant articulations, capitate hyphopodia more frequently smooth.

On leaves of *Rhus* sp., Stella Bush, Durban, 2/7/12, E. M. Doidge (2519).

In his description Hennings does not mention the presence of mycelial setae; but as the remainder of the description agrees exactly with the South African specimens I have assigned them to this species.

*Meliola microthecia* Thum.

Flora, 1876, p. 569.

Sacc. Syll. Fung. i, p. 68.

Gaillard, Le Genre Meliola, p. 73.

Amphigenous, forming very small, thin, black colonies $\frac{1}{2}$–$1\frac{1}{2}$ mm. diam., these frequently becoming confluent and forming larger spots. Hyphae radiating, sinuous 7–8 $\mu$ thick, branching freely, frequently constricted at the septa, snuff-brown (R. XXIX) formed of cells 18–25 $\mu$ long; branches usually alternate, frequently anastomosing. Capitate hyphopodia numerous, alternate, stipitate, 21–32 $\mu$ long; terminal cell 14–21 × 10–18 $\mu$, at first ovoid then lobed, frequently becoming triangular with truncated angles. Mucronate hyphopodia opposite or unilateral, on separate branches, inflated in the middle and drawn out into a short neck 12-18 × 10$\mu$. Mycelial setae very few in number (4–6 to each colony), in the neighbourhood of the perithecia, straight, cylindrical, 200–350 × 8–10 $\mu$, translucent throughout and frequently septate, Vandyke brown (R. XXVIII) at the base, paler towards the apex, which is rounded or ends in a broad angle. Perithecia very few in the centre of the spot, sometimes only one, black, globose, verrucose, 200–230 μ diam. Asci 3–4 spored, ovate, shortly pedicellate. Spores 4-septate, Vandyke brown, slightly constricted at the septa, oblong, broadly rounded at both ends, 48–54 × 18–22 μ.

On leaves of *Barosma scoparia*, Grahamstown, July, 1876, P. MacOwan (MacOwan 1260, de Thüm. Myc. Univers. 851).

On leaves of shrub undetermined, Paddock, Natal, 23/12/13, P. van der Bijl (8376).

*Meliola sinuosa* Doidge n. sp.

Amphigenous, mostly hypophyllous, forming black velvety colonies 1–5 mm. diam. Hyphae very sinuous, with opposite or unilateral branches which frequently anastomose, very variable in thickness and sometimes constricted at the septa, 5–11 μ thick, composed of cells 18–44 μ long Isabella colour (R. XXX). Capitate hyphopodia alternate or unilateral, 18–25 × 12–15 μ, stipitate; terminal cell 14–15 μ long, of various form, subcylindrical, curved or slightly lobed, apex truncate or convex; basal cell varying in length, usually short. Mucronate hyphopodia rare, 14–15 × 10–16 μ, the basal part almost hemispherical, narrowing suddenly into a slender neck which may be straight or curved, 7–8 × 2–2·5 μ. Mycelial setae numerous, scattered over the colony, simple, straight, 250–350 × 8–10 μ, opaque right up to the acute apex. Perithecia scattered, black, globose, 160–220 μ diam. Ascus elliptical-ovate, briefly pedicellate, 2-spored. Spores 4-septate, the middle cell being larger than the rest, cylindrical, rounded at both ends, slightly constricted at the septa, 50–55 × 15–18 μ.

On leaves of *Trichilia emetica*, Lemana, Spelonken, Zoutpansberg Dist., 14/8/11, E. M. Doidge (1783).

On leaves of *Trichilia* sp., Kentani, 16/12/14, A. Pegler (8786), (Pegler No. 1971).

On leaves of shrub undetermined, Springfield, Natal, 16/7/15, J. Medley Wood (9035).

*M. deciduae* affinis.

*Meliola polytricha* K. & Cke.

Grevillea, 1880, p. 72.
Sacc. Syll. Fung. i, p. 67.
Gaillard, Le Genre Meliola, p. 92.

Hypophyllous or amphigenous, forming black colonies 2–3 mm. diam. Hyphae radiating, much-branched, chestnut brown (R. XIV), 8–10 μ thick, composed of cells 18–22 μ long; branches opposite or alternate, numerous. Capitate hyphopodia alternate, stipitate, 20–25 μ long; terminal cell broadly ovate, globulose or compressed, 14–16 × 12–14 μ. Mucronate hyphopodia fairly numerous usually on special short branches, opposite, ampulliform, tapering rather gradually to the neck, about 18 × 7 μ. Mycelial setae numerous, simple, more or less flexuose, opaque right to the acute tip, 250–300 × 9–10 μ. Perithecia numerous, scattered, 160–200 μ diam., black, globose, very minutely verrucose. Asci not seen. Spores 4-septate, cylindrical, rounded at both ends, 45–55 × 16-18 μ. Conidiiferous mycelium paler and more slender, conidia borne on upright flexuose conidiophores, clavate, 3–5-septate, 50–70 × 6–10 μ.

On leaves of shrub unknown, Inanda, J. Medley Wood (Wood 222).

On leaves of *Osyris compressa* near Grahamstown, 1876, P. MacOwan (MacOwan, No. 1256).

On leaves of *Pittosporum viridiflorum*, Claridge, Natal, 31/5/15, E. M. Doidge (8996).

This description, taken from Wood's duplicate of the type specimen, differs in many essentials from that given by Gaillard (*Le Genre Meliola*, p. 92).

MacOwan (No. 1262) on leaves of *Cunonia capensis* approximates this species, but the specimens examined are parasitised by *Dimerium intermedium* Syd., and no *Meliola perithecia* were seen.

*Meliola rigida* Doidge n. sp.

Amphigenous, forming rusty black colonies of varying size, sometimes, especially in the conidial stage, up to 1 cm. diam. Hyphae rigid, 7–8 μ thick, sepia-warm sepia (R. XXIX), composed of cells 18–25 μ long, branches usually opposite, hyphopodia very briefly stipitate, 14–18 μ long, terminal cell globose or broadly ovate, sometimes slightly curved, 10–12 × 8–10 μ. Mucronate hyphopodia not very numerous, paler, opposite, narrowed above into a short neck, about 18 μ long. Mycelial setae not very numerous, black, opaque almost to the acute apex, more or less flexuose, 250–600 μ long by 10–11 μ. Perithecia scattered, black, globose, verrucose, 180–220 μ diam. Ascus ovate, briefly stipitate, 3-spored. Spores 4-septate, slightly constricted, oblong, compressed, rounded at both ends, 40–45 × 16–20 μ.

On leaves of *Xymalos monospora*, Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1775). Tabankulu, Transkei, 15/3/15, G. Fraser (8890). Buccleuch, Natal, 18/3/15, I. B. Pole Evans (8894).

*Meliola falcata* Syd.

Annales Mycologici, vol. x, no. 1, 1912.

Amphigenous, but most frequently epiphyllous, forming velvety black orbicular colonies 2–4 mm. broad, often confluent, and then irregular in outline. Hyphae snuff-brown (R. XXIX), anastomosing, 6–7 μ thick; capitate hyphopodia alternate, 22–25 μ long, apical cell up to 10 μ broad; mucronate hyphopodia opposite, 15–18 μ long. Mycelial setae very numerous, simple, curved, often falcate, opaque, 175–250 × 6–9 μ, apex acute. Perithecia hidden among the numerous mycelial setae, globose, verrucose, black, 200–230 μ diam., asci 2–4-spored; spores oblong, rounded at both ends, 4-septate, constricted, similar in colour to the hyphae, 38–48 × 16–20 μ.

On leaves of *Plectronia ventosa*, Amanzimtoti, Natal, 10/7/11, E. M. Doidge (1577); Durban Beach, 2/7/11, I. B. Pole Evans (1591).

On leaves of *Pavetta* sp., Tongaat, Natal, 12/9/13, P. van der Bijl (6952).

On leaves of *Plectronia* sp. (?), Winkle Spruit, Natal, 28/5/15, E. M. Doidge (9005); Springfield, Natal, 14/7/15, J. Medley Wood (9017).

On leaves of shrub undetermined, Mayville, Natal, 22/7/15, J. Medley Wood (9030).

*Meliola arcuata* Doidge.

Forms small, velvety, irregular-orbicular colonies 1–2 mm. diam. Hyphae branched, sinuate, frequently septate, Vandyke brown (R. XXVIII), about 10·5–11 μ thick, finally anastomosing. Capitate hyphopodia alternate, shortly stipitate, 20–29 × 10·5–11 μ; terminal cell irregularly ovoid, dentate or lobulate. Mucronate hyphopodia scarce, opposite, 14–18 × 7–9·5 μ. Mycelial setae numerous, simple, arcuate or sometimes almost straight, black, opaque, apex acute, of uneven thickness, 7–11 μ thick, 295–330 μ long. Perithecia hidden among the mycelial setae, black, granular, 115–150 μ diam. Asci 2-spored, evanescent. Spores ellipsoid-oblong, rounded at both ends, 4-septate, slightly constricted at the septa, 50–54 × 14–16 μ.

On stems of *Viscum* sp., Kentani, 1/6/12 (2364), 4/8/14 (8389), (Pegler No. 1949).

*Meliola Woodiana* Sacc. & Syd.
Hedwigia, 1899, p. 132.
Sacc. Syll. Fung. ix, p. 415.

Hypophyllous, forming black, velvety sub-orbicular spots up to 4 mm. diam., frequently confluent. Perithecigerous mycelium radiating, branched, composed of hyphae, 8–9 μ thick, Natal brown (R. XL), septate; cells 18–25 μ long; branches not numerous, opposite. Capitate hyphopodia alternate, stipitate, 25–35 μ long, terminal cell ovate or slightly angular 18–25 × 7–11 μ. Mucronate hyphopodia on separate short branches, not numerous, opposite, paler, with a short, rather thick neck, 11–18 μ long. mycelial setae most numerous near perithecia, simple, black, rigid, arcuate, tapering slightly to blunt, translucent apex, 300–400 × 9–11 μ. Perithecia black, globose, granulose, ca. 200 μ diam. Asci 2–3-spored. Spores oblong, obtuse at both ends, 4-septate, constricted 47–54 × 18 μ. Conidiiferous mycelium filiform, conidiophores sub-simple, ascending, black-fuliginous, above paler and nodulose, 300–350 × 7–8 μ. Conidia obclavate, 4-septate, 52–55 × 9–11 μ, pale fuliginous.

On sub-coriaceous leaves of an unknown tree, Durban, Natal, J. Medley Wood (Wood 5467).

*Meliola furcillata* Doidge n. sp.

Amphigenous, forming thin black spots 2–3 mm. diam. Hyphae straight or sinuous, tawny olive (R. XXIV), 6–8 μ thick, with opposite or unilateral branches, cells mostly about 18–21 μ long. Capitate hyphopodia alternate or unilateral, briefly stipitate 18–21·5 μ long; terminal cell ovoid, straight, incurved or recurved 10·5–12·5 × 7–9 μ. Mucronate hyphopodia numerous, interspersed among the capitate hyphopodia, not on separate branches, 14–18 μ long, ampulliform, with a rather long neck which is frequently curved. Mycelial setae more numerous in the neighbourhood of the perithecia, 330–400 × 7 μ, once or twice abruptly geniculate near the base, otherwise straight, more or less torulose, opaque at the base, more translucent and with a slight constriction below the apex, which terminates in a single mucronate point or is bi- or tridentate. Perithecia scattered or in small groups, black, globose, verrucose, 160–180 μ diam. Asci 2-spored. Spores 4-septate, cylindrical, broadly rounded at both ends, constricted at the septa, 43–45 × 16–18 μ.

On leaves of *Maesa rufescens*, Amanzimtoti, Natal, 10/7/11, E. M. Doidge (1573).

*Meliola varia* Doidge n. sp.

Amphigenous, forming small, black colonies 1–2 mm. diam. Hyphae sinuate, and irregular in thickness, 7–9 μ, argus brown (R. III) cells 18–25 μ long, branching irregular, usually alternate or unilateral. Capitate hyphopodia remote, not numerous, alternate or unilateral 21–25 μ long, terminal cell globular-ovoid, 14–16·5 × 10·5–12 μ. Mucronate hyphopodia very rare, paler, slender, tapering about 11 × 5–6 μ. Mycelial setae very numerous, 180–220 μ long, lower part opaque 160–190 × 10 μ, above more translucent and branching in various ways, some dividing at once into 3 short branches about 18 μ long, others producing 2 thick, spreading branches 18–30 × 8 μ, each of these dividing into 2–3 smaller branches. Ultimate branches all bi- to trifid. Perithecia scattered, black, globose, collapsing slightly after drying, verrucose, 160–180 μ diam. Asci not seen. Spores 4-septate, scarcely constricted at the septa, cylindrical, rounded at the ends 45–50 × 16–18 μ, middle cell sometimes larger than the rest.

On leaves of *Cissus rhomboidea*, Winter's Kloof, Natal, 26/6/11, E. M. Doidge (1639).

*Meliola bifida* Cke.

Grevillea 1880, p. 15.
Sacc. Syll. Fung. i, p. 62.
Gaillard, Le Genre Meliola, p. 99.

Forms conspicuous, black, velvety spots, chiefly on stems. Mycelium snuff-brown (R. XXX), much branched. Hyphae 7–8 μ thick, frequently septate, cells 15–18 μ long, branches opposite. Capitate hyphopodia very numerous, crowded, mostly opposite, 15–18 μ long; terminal cell subcylindrical to ovate, convex, frequently compressed, 11–14 × 7–8 μ. Mucronate hyphopodia not seen. Mycelial setae very numerous, erect, 250–325 μ long, 10 μ thick at the base; bifid near apex, branches 10–90 μ long, 6–7·5 μ thick, simple or bifid, apices acute; in many cases ultimate branches also bifid or trifid. Perithecia numerous, completely concealed among the setae, black, globose, verrucose, 250–300 μ diam. Asci 2-3-spored. Spores brown, 4-septate, cylindrical, rounded at both ends, slightly constricted at the septa, 42–50 × 14–16 μ.

On stems and leaves of *Osyridicarpus natalensis*, Inanda, Natal, J. Medley Wood; Springfield, Natal, 14/7/15, J. Medley Wood (9020).

*Meliola leptidea* Syd.

Annales Mycologici, vol. x, no. 1, 1912.

Epiphyllous, forming velvety black colonies 2–4 mm. diam., frequently confluent. Hyphae branched, chestnut brown (R. XIV) 8–11 μ thick; capitate hyphopodia very numerous, closely crowded, opposite or alternate, 18–28 μ long, terminal cell ovate or globular, obtuse, 10–15 μ thick; mucronate hyphopodia not so numerous, up to 25 μ long. Perithecia congregated in the centre of the colony, but not crowded together, black, globose, collapsing somewhat when dry, asperulous, 250–300 μ diam. Mycelial setae very numerous, 200–300 μ long, 8–11 μ thick, opaque at the base, dividing above into two long (up to 130 μ) spreading, slightly incurved branches, these branches being again divided into two branches of various length (30–80 μ), bifurcate at the apex. Asci ovate 50–60 × 28–40 μ, 2–3-spored; spores oblong, broadly rounded at both ends, 4-septate, constricted at the septa, chestnut brown, 45–55 × 15–20 μ.

On leaves of *Cussonia* sp., Woodbush, Zoutpansberg Dist., 27/7/07, C. E. Legat (405).

On leaves of *Cussonia umbellifera*, Woodbush, Zoutpansberg Dist., 3/8/11, E. M. Doidge (1774).

*Species Excludendae.*

| | | |
|---|---|---|
| *Meliola capnodioides* Thuem. | = | *Meliola amphitricha*, Fr. |
| *Meliola Psilostomae* Thuem. | = | *Dimerium Psilostomatis* (Thuem.) Sac. |
| *Meliola quinquespora* Thuem. | = | *Meliola inermis* K. & Cke. |
| *Meliola MacOwaniana* Thuem. | = | *Dimerium MacOwanianum* (Thuem.). |
| *Meliola Sclerochitonis* Kalch. | = | *Asterina fimbriata* K. & Cke. |

Capnodium.

Mycelium superficial, crustaceous, formed of short, thick-walled cells.

Perithecia superficial, globose to pyriform, membranaceous or carbonaceous. Asci ovate to clavate, 8-spored. Spores brown, muriform. Conidia very various, and produced in great numbers.

A large number of fungi have been collected in South Africa on various hosts probably belonging to this genus, but as no perithecia have yet been found on any of these it is impossible to diagnose them accurately. A list of the hosts is appended:

*Capnodium* spp.

On leaves and stems of *Citrus* spp. Lemana, Zoutpansberg Dist., 20/8/08 (504), 14/8/11, E. M. Doidge (1790).

On leaves of *Pyrus malus*, March, 1906, C.P. (39).

On *Asparagus plumosus*, Table Mt., Natal, 18/5/11, C. Fuller (1676); Kentani, C.P., 4/3/12, A. Pegler (8886).

On leaves of *Grewia occidentalis*, Kentani, 1/6/12, A. Pegler (2365).

On leaves of *Celastrus* sp., Butterworth, 19/3/12, A. Pegler (2188).

On leaves of *Royena* sp., Kentani, 4/3/12, A. Pegler (2192).

Host Index.

| *Host.* | *Fungus.* |
|---|---|
| Anastrabe integerrima | Meliola Peglerae. |
| Apodytes dimidiata | Phaeodimeriella capensis. |
| Barleria sp. | Meliola microspora, var. africana. |
| Barosma scoparia | Meliola microthecia. |
| Boscia caffra | Meliola Bosciae. |
| Buddleia auriculata | Meliola inermis. |
| Buddleia pulchella | Meliola inermis. |
| Buddleia salvifolia | Meliola inermis. |
| Canthium sp. | Meliola glabra. |
| Celastrus buxifolius | Dimerium MacOwanianum. |
| Celastrus sp. | Meliola ditricha. |
| Cissus rhomboidea | Meliola varia. |
| Curtisea faginea | Meliola ganglifera. |
| Cussonia umbellifera | Meliola leptidea. |
| Cussonia sp. | Meliola leptidea. |
| Dovyalis rhamnoides | Meliola conferta. |
| Eriosema sp. | Parodiella perisporioides. |
| Eugenia Zeyheri | Meliola cladotricha.<br>Zukalia transvaalensis. |
| Galopina circaeoides | Meliola microspora, var. africana. |
| Gardenia globosa | Meliola amphitricha. |
| Grumilea globosa | Meliola amphitricha. |
| Gymnosporia spp. | Dimeriella annulata.<br>Dimerium Gymnosporiae.<br>Meliola speciosa. |

| *Host.* | *Fungus.* |
|---|---|
| Hippobromus alatus | Meliola capensis. |
| Indigofera sp. | Parodiella perisporioides. |
| Isoglossa Woodii | Meliola microspora, var. africana. |
| Limnanthemum Thunbergianum | Parodiella congregata. |
| Maerua pedunculosa | Meliola Bosciae. |
| Maesa rufescens | Meliola furcillata. |
| Meliola Rhois | Dimerium intermedium. |
| Meliola sp. | Dimerium intermedium. |
| Mitriostigma axillaris | Meliola amphitricha. |
| Nuxia floribunda | Meliola Hendeloti. |
| Nuxia tomentosa | Meliola Hendeloti. |
| Olea laurifolia | Meliola amphitricha. |
| Olea Pegleri | Meliola amphitricha. |
| Osyridicarpus natalensis | Meliola bifida. |
| Osyris compressa | Meliola polytricha.<br>Dimerosporium osyridis. |
| Pavetta Bowkeri | Balladyna velutina. |
| Pavetta natalensis | Balladyna velutina. |
| Pavetta obovata | Balladyna velutina.<br>Meliola falcata. |
| Pittosporum viridiflorum | Meliola polytricha. |
| Plectronia ciliata | Dimerium Psilostomatis. |
| Plectronia Guenzii | Dimerium Psilostomatis. |
| Plectronia ventosa | Meliola falcata. |
| Podocarpus elongata | Meliola Podocarpi. |
| Podocarpus Thunbergii | Meliola peltata.<br>Meliola Podocarpi. |
| Psoralea decumbens | Parodiella perisporoides. |
| Psychotria capensis | Meliola amphitricha. |
| Pygeum africanum | Meliola manca. |
| Rubus rigidus | Meliola manca. |
| Rhus crenata | Meliola Rhois. |
| Rhus longispina | Meliola Rhois. |
| Rhynchosia sp. | Parodiella Schimperi. |
| Sapindus oblongifolius | Meliola amphitricha. |
| Strophanthus speciosus | Meliola Strophanthi. |
| Toddalia lanceolata | Meliola Toddaliæ. |
| Tricalysia floribunda | Balladyna velutina. |
| Tricalysia lanceolata | Balladyna velutina. |
| Trichilia emetica | Meliola sinuosa. |
| Trichocladus crinitus | Meliola torta. |
| Vernonia angulifolia | Dimeriella claviseta. |

| *Host.* | *Fungus.* |
|---|---|
| Vigna angustifolia | Parodiella perisporioides. |
| Viscum, sp. | Meliola arcuata. |
| Xymalos monospora | Meliola rigida. |

## Descriptions of New Species.

*Dimeriella claviseta* Doidge n. sp.

Epiphylla, maculas effusas efformans; mycelio ex hyphis flexuosis, septatis, fuscidulis, 3–3·5 μ crassis composito; peritheciis superficialibus, sparsis v. laxe gregariis, sub-hemisphaericis, atris, carbonaceis, 90–115 μ diam., praecipue basi v. in parte inferiore 9–15 setulis obsitis; setulis septatis clavatis, 15-55 μ long, basi 3·5–7 μ crassis, ad apicem incrassatis, truncatis, diverse lobatis; ascis numerosis, paraphysatis, 8-sporis, sessilibus, cylindraceo-clavatis, apice rotundatis, 40–50 × 18–20 μ; paraphysibus filiformibus, simplicis, hyalinis; sporidiis conglobatis v. distichis, hyalinis, 1-septatis, sub-constrictis 15–18 × 5–7 μ.

Hab. in foliis *Vernoniae angulifoliae*, Winkle Spruit, Natal, 6/7/11, leg. E. M. Doidge (2511).

*Phaeodimeriella Capensis* Doidge n. sp.

Hypophyllis vel amphigenis, maculis effusis radiantibus, atris, 3–5 mm. diam., efficiens; hyphis radiantibus, 6–7 μ crassis; hyphopodiis continuis, alternis vel sub-oppositis; ramis oppositis; peritheciis numerosis, atris, globulosis, carbonaceis, verruculosis, 140–160 μ diam., setulosis; setis 15–25, uncinatis, circ. 55–65 μ long., basi 5 μ crassis, ad apicem obtusum leniter attenuatis; ascis numerosis, paraphysatis, ellipticis, octosporis, apice incrassatis, sessilibus, 55–70 × 12–14 μ; sporidiis sub-distichis, fuscis, 1-septatis, ellipsoidis, ad septum leniter constrictis, 16–18 × 4–5 μ; pycnidiis peritheciis similis, conidiis ellipsoidis, continuis, circ. 14 × 3 μ.

In foliis *Apodytis dimidiatæ*, Knysna, C.B.S., 3/6/12, leg. P. J. Pienaar (2426).

*Zukalia Transvaalensis*, Doidge n. sp.

Epiphylla, maculas tenues effusas efficiens; hyphis radiatis, ramosis, anastomosantibus, 7–8 μ crassis, e cellulis 30–32 μ longis compositis; hyphopodiis unilateralibus, plerumque laterioribus quam longis 8–10 × 11–14 μ, peritheciis sparsis, numerosis, globosis, atris, 130–160 μ diam.; ascis octosporis, ellipticis v. ovatis, plerumque leniter curvatis, 70–90 × 18–22 μ; paraphysibus nullis; sporidiis distichis v. trifariis, clavatis, hyalinis, 5-septatis, utrinque obtusis, 45–55 × 5–7 μ.

Hab. in foliis *Eugeniae Zeyheri*, Woodbush, Zoutpansberg Dist., 3/8/11, leg. E. M. Doidge (1759).

*Meliola Natalensis* Doidge n. sp.

Amphigena, plerumque epiphylla, maculas atras carbonaceas, rotundatas, 2–3 mm. diam. efficiens; mycelio radiante ramoso; hyphis fuscis, subsinuosis et saepe ad septa constrictis, 6–8 μ crassis, e cellulis 14–18 μ long compositis; ramis oppositis; hyphopodiis capitatis alternis v. unilateralibus, stipitatis, 18–21 μ long, cellula basali breve, prope hyphas angustiore; capitulo latiore quam longo 2–3 lobato, quoque lobo bi-lobulato, 12–14 × 16–20 μ; hyphopodiis mucronatis raris, sparsis, tenuibus, rectis v. recurvatis, ca. 16–18 × 4–5 μ; setis mycelicis nullis; peritheciis aggregatis, atris, globosis, carbonaceis 130–150 μ diam., rugulosis, appendiculis numerosis, subcylindraceis, larviformibus, acclivis, 40–45 × 18 μ, apice interdum recurvatis; ascis bisporis; sporidiis 3-septatis, rectis v. leniter curvatis, ad septa valde constrictis, 40–44 × 14–16 μ.

Hab. in foliis arboris ignotae, Umgeni prope Durban, Natal, 27/5/15, leg. E. M. Doidge (8980).

*Meliola conferta* Doidge n. sp.

Amphigena, maculas atras, subcrustaceas 1–3 mm. diam. efficiens; hyphis fuscis, rectis, ramosis; 6–8 μ crassis, ex cellulis 11–18 μ longis compositis; ramis numerosis, oppositis; hyphopodiis capitatis numerosissimis, confertis, oppositis, interdum unilateralibus vel alternis 14–18 μ long; cellula superiore diverse lobata, plerumque bi-triloba, quoque lobo bilobulato, 9–14 × 11–14 μ; hyphopodiis mucronatis pallidis, 18 μ long.; setis mycelicis nullis; peritheciis (vix maturis) paucis, sparsis, 100–130 μ diam., atris, verrucosis, quibusdam cellulis externis usque 18 μ productis; ascis non visis; sporidiis atro-brunneis, 3-septatis, ad septa vix constrictis, utrinque attenuatis et rotundatis, rectis vel leniter curvatis, 43–50 × 18–25 μ.

Hab. in foliis arboris ignotae, prope Durban, 14/5/1897, leg. J. Medley Wood (345), (Wood 6467).

*Meliola Podocarpi* Doidge n. sp.

Amphigena, plerumque epiphylla, maculas atras tenues, 2–5 mm. diam. efficiens; hyphis rectis v. sub-sinuosis, 6–7 μ crassis, fuscis; hyphopodiis capitatis alternis, breviter stipitatis, 14–15 μ long, cellula superiore globosa, 10–12 × 10–11 μ; hyphopodiis mucronatis non visis; setis mycelicis nullis; peritheciis sparsis v. sub-aggregatis, atris, globosis, verrucosis, 200–250 μ diam.; ascis 2–4 sporis; sporidiis 3-septatis, ad septa valde constrictis, leniter curvatis, utrinque attenuatis et rotundatis, 50–56 × 14–16 μ.

Hab. in foliis *Podocarpi Thunbergii*, Woodbush, Zoutpansberg Dist., 3/8/11, leg. E. M. Doidge (1748); Knysna, C.B.S., leg. P. J. Pienaar (2436).

In foliis *Podocarpi elongatae*, Fort Cunningham, Toise River, 20/3/15, (8897).

*Meliola speciosa* Doidge n. sp.

Maculis hypophyllis, rotundatis, atris 1–5 mm. diam., hyphis ramosis, demum anastomosantibus, usque ad 11 $\mu$ crassis, brunnosis, cellulis ca. 18 $\mu$ longis compositis; hyphopodiis capitatis numerosis, speciosis, alternis, stipitatis; cellula basali 7–11 × 5·5–7 $\mu$, prope hyphae angustiora, capitulo latiore quam longiore, 18–21·5 × 21·5–25 $\mu$, irregulari, 2–4 lobo, quoque lobo leviter bilobato; hyphopodiis mucronatis raris, pallidioribus, tenuibus, arcuatis, ca. 25 × 7 $\mu$; setis nullis; peritheciis aggregatis, atris, 125–265 $\mu$ diam., basi appendiculis numerosis, subcylindraceis, basi 18 $\mu$ crassis; ascis 2-sporis, evanescentibus; sporidiis ellipsoideis, 3-septatis, leniter constrictis, brunneis 52–61 × 21·5–25 $\mu$; conidiophoris erectis, atrofuscis, septatis, ca. 150 $\mu$ longis; conidiis fusoidibus, 4-septatis, fuscis.

*M. mancae* affinis.

Hab. in foliis *Gymnosporiae* sp., Woodbush, Zoutpansberg Dist., 2/8/11, leg. E. M. Doidge (1740).

*Meliola torta* Doidge n. sp.

Amphigena, maculas atras tenues, 5–10 mm. diam. efficiens; hyphis tenuibus, 6–7 $\mu$ crassis, tortuosis, anastomosantibus, cellulis 25–36 $\mu$ long; ramis irregularibus plerumque unilateralibus; hyphopodiis capitatis tenuibus, cellula superiore 14–25 × 14–20 $\mu$, diverse lobata, torta, apice obtusa v. convexa; hyphopodiis mucronatis, ampullaceis, 20–36 $\mu$ long.; setis mycelicis non numerosis, sparsis, rectis, simplicibus, basi 10–11 $\mu$ cr., apice acutis; peritheciis paucis, sparsis, atris, globulosis, rugulosis, 160–250 $\mu$ diam.; ascis numerosis, 8-sporis; sporidiis distichis v. conglobatis, 3-septatis ad septa vix constrictis, clavatis, 25–30 × 7–11 $\mu$.

Hab. in foliis *Trichocladi criniti*, Izeleni, Kingwilliamstown Dist., 8/6/15, (9064).

*Meliola peltata* Doidge n. sp.

Amphigena; maculas atras, rotundatas, pilosas, 3–7 mm. latas, interdum confluentes efficiens; mycelio peritheciigero pseudoparenchymatico, peltiformi v. flabelliformi, composito ex hyphis fuscis, ramossissimis, crebre septatis, cellulis ca. 5·5–7 × 11 $\mu$; hyphopodiis capitatis alternis, ad ramos appressis, subclavatis, stipitatis, 39–50 $\mu$ longis, cellula superiore compressa, plerumque tuberculata v. sublobata, 28–32 $\mu$ long.; hyphopodiis mucronatis non visis; setis mycelicis numerosis, simplicibus, rectis, 10–11 $\mu$ crassis, usque ad 850 $\mu$ longis, nigris, opacis, apice acuto pallidiore; peritheciis paucis, in plagulis sparsis, atris, scabris sed non verrucosis; ascis non visis; sporidiis 3-septatis, nonnunquam 2-septatis, ad septa constrictis, utrinque ca. 50 × 29 $\mu$; mycelio conidiifero inter mycelio peritheciigero intertextis, tenuiore, pallidiore; conidiophoris brunneis, torulosis, flexuosis, usque ad 500 $\mu$ longis; conidiis fusiformibus, non septatis, 16–18 × 10–11 $\mu$.

Hab. in foliis *Podocarpi Thunbergii*, Knysna, C.B.S., 3/6/12, P. J. Pienaar (2436).

*Meliola ditricha* (K. & Cke.) Doidge.

*Asterina ditricha* K. & Cke. Grevillea, 1880, p. 3.

Hypophylla, effusa, maculas, tenues, atras, 2–5 mm. diam. efficiens; hyphis radiantibus, brunneis, 7–10 μ crassis, ex cellulis 18–21 μ long. compositis; ramis plerumque oppositis, anastomosantibus; hyphopodiis capitatis alternis, stipitatis, 25–30 μ long., cellula superiore irregulare, diverse lobata, 18–23 × 14–22 μ; hyphopodiis mucronatis numerosis, oppositis v. unilateralibus, tenuibus 21–25 × 7–8 μ; setis nullis; peritheciis non numerosis, atris, globosis (immaturis) ascis non visis, sporidiis 4-septatis, atro-brunneis, ad septa constrictis, utrinque rotundatis, 54 × 25 μ; mycelio conidiophoro tenui; conidiophoris erectis, ca. 70–80 μ long., conidiis fusoidibus, 3-septatis, 15–18 × 4–8 μ.

Hab. in foliis *Celastri* sp., Inanda, Natal, J. Medley Wood (Wood No. 3).

*Meliola Strophanthi* Doidge n. sp.

Amphigena, plerumque, hyphophylla, sub-crustacea; maculas minutas, atras, orbiculares, 1–2 mm. diam., efficiens: mycelio peritheciigero ex hyphis flexuosis, 6–9μ crassis, e cellulis ca. 18μ longis compositis, brunneis, ramis oppositis; hyphopodiis capitatis alternis, breviter stipitatis, 20–25 μ long., cellula superiore cylindrica, recta v. leniter curvata, convexa, 16–18 × 7–9 μ; hyphopodiis mucronatis paucis, ampullaceis, ca. 18 μ long.; setis mycelicis nullis, peritheciis paucis, congregatis, atris, globosis 215–250 μ diam., verrucosis; ascis maturis non visis; sporidiis 4-septatis, cylindricis, ad septa vix constrictis, utrinque rotundatis 40–45 × 16–18 μ; mycelio conidiifero inter mycelio peritheciigero intertextis, pallidiore, tenuiore; conidiophoris numerosis, erectis, septatis, brunneis 180–200 μ long.; conidiis fusiformibus, 3-septatis, 18–32 × 5–9 μ.

Hab. in foliis *Strophanthi speciosi*, Woodbush, Zoutpansberg Dist., 3/8/11, leg. E. M. Doidge (1781).

*Meliola Bosciae* Doidge n. sp.

Epiphylla, rarius hypophylla; pelliculas tenues, suborbiculares, nigras, 2–3 mm. latas formans; hyphis radiantibus, circa perithecia crebre anastomosantibus, fuscis, septatis, plerumque curvatis, vermiculatis, 5·5–9 μ crassis; ramis oppositis, v. unilateralibus; hyphopodiis capitatis alternis v. unilateralibus, rarius oppositis, breviter stipitatis, 14–20 μ long., cellula superiore 10·5–16 μ long., scabra, convexa, truncata v. sub-lobata; hyphopodiis mucronatis plerumque prope perithecia, in ramis separatis v. inter hyphopodia capitata sparsis, oppositis v. unilateralibus, ampullaceis, apice interdum uncinatis, 14–18 μ long., basi ca. 7 μ crassis; setis mycelicis nullis;

peritheciis globosis, atris, verrucosis, 160–180 μ diam., appendiculis 6–12 sparsis, simplicis, 70–90 μ long., basi sub-bulbosis, ca. 6 μ crassis, ad apicem obtusum pellucidum attenuatis, rectis v. infra apicem abrupte curvatis; ascis 2–3 sporis, ovatis, breviter pedicellatis, mox evanescentibus; sporidiis atro-brunneis, 4-septatis constrictis, utrinque rotundatis, 39–47 × 10·5–17·5 μ.

Hab. in foliis *Bosciae Caffrae*, Winkle Spruit, Natal, 6/7/12, leg. E. M. Doidge (2510).

*Meliola microspora* Pat. et Gaill.

Var. *africana* Doidge, var. nov.

Hyphopodiis capitatis 20–21·5 × 7·8 μ, cellula superiore ovata 14–16 μ long.; sporidiis 26–32·5 × 10·5–14 μ.

A typo differt hyphopodiis capitatis majoribus et sporidiis crassioribus.

*Meliola Toddaliae* Doidge n. sp.

Amphigena, maculas atras velutinas 2–3 mm. diam. efficiens; hyphis fuscis, ramosis, 7–10 μ crassis, cellulis 18–25 μ longis, ramis plerumque oppositis, anastomosantibus, hyphopodiis capitatis numerosis, oppositis, 18–20 μ long., stipitatis, cellula superiore sub-ovata et leniter curvata, saepe compressa, 14–16 × 8–11 μ; hyphopodiis mucronatis non numerosis, ampullaceis, 18–20 × 8–10 μ; setis mycelicis numerosis, simplicibus, rectis, demum opacis, plus minusve torulosis, 300–350 × 8–10 μ; peritheciis sparsis, in setis mycelicis absconditis, atris, globulosis, verrucosis, 200–250 μ diam.; ascis 3–4 sporis; sporidiis 4-septatis, leniter constrictis, cylindricis, utrinque rotundatis, compressis, 47–55 × 18–21 × 14 μ.

Hab. in foliis *Toddaliae lanceolatae*, Kentani, 16/12/14, leg. A. Pegler, (8788).

*Meliola sinuosa* Doidge n. sp.

Amphigena, plerumque hypophylla, maculas atras, velutinas, 1–5 mm. diam. efficiens; hyphis sinuosis, 5–11 μ crassis, interdum ad septa constrictis, cellulis 18–44 μ longis, ramis oppositis v. unilateralibus, saepe anastomosantibus; hyphopodiis capitatis alternis v. unilateralibus, 18–25 × 12–15 μ stipitatis, cellula superiore 14–15 μ long. forma varia, subcylindrica, curvata v. sub-lobata, apice truncata v. convexa; hyphopodiis mucronatis raris, 14–15 × 10–16 μ; setis mycelicis numerosis, sparsis, erectis, simplicibus, 250–350 × 8–10 μ, opacis; peritheciis sparcis, atris, globulosis, 160–220 μ diam.; ascis ellipticis-ovatis, breviter pedicellatis, bisporis, sporidiis 4-septatis, cellula media majore, cylindricis, utrinque rotundatis, ad septa leniter constrictis, 50–55 × 15–18 μ.

Hab. in foliis *Trichiliae emeticae*, Lemana, Spelonken, Zoutpansberg Dist., 14/8/11, leg. E. M. Doidge (1783).

*Meliola rigida* Doidge n. sp.

Amphigena, maculas atras usque ad 1 cm. diam. efficiens; hyphis rigidis, 7–8 μ crassis, brunneis, cellulis 18–25 μ longis, ramis plerumque oppositis; hyphopodiis capitatis numerosis, oppositis breviter stipitatis 14–18 μ long., cellula superiore ovata-globulosa 10–12 × 8–10 μ; hyphopodiis mucronatis non numerosis, pallidioribus, oppositis circ. 18 μ long.; setis mycelicis erectis, simplicis, plus minusve sinuosis, atris, opacis, 250–600 × 10–11 μ; peritheciis sparsis, atris, globulosis, verrucosis, 180–220 μ diam.; ascis ovatis, breviter stipitatis, 3-sporis; sporidiis 4-septatis, leniter constrictis, oblongis, compressis, utrinque rotundatis, 40–45 × 18–20 μ.

In foliis *Xymalos monosporae*, Woodbush, Zoutpansberg Dist., 3/8/11, leg, E. M. Doidge (1775).

*Meliola furcillata* Doidge n. sp.

Amphigena, maculas tenues, atras, 2–3 mm. diam. efficiens; hyphis rectis v. sinuosis, fuscis, 6–8 μ crassis, cellulis 18–21 μ long., compositis, ramis oppositis v. alternis v. unilateralibus, breviterstipitatis 18–21·5 μ long., cellula superiore ovata, recta, incurvata v. recurvata, 10·5–12·5 × 7–9 μ; hyphopodiis mucronatis inter hyphopodia capitata intersparsis, 14–18 μ long., ampullaceis, collo longiore plerumque curvata; setis mycelicis prope perithecia congregatis, 330–400 × 7 μ, basi opacis semel v. bis abrupte geniculatis, superne rectis, rigidis, pellucidis, plus minusve torulosis, prope apicem leniter constrictis, apice mucronatis v. 2–3 dentatis; peritheciis sparsis v. sub-aggregatis, atris, globosis, verrucosis, 160–180 μ diam.; ascis 2-sporis; sporidiis 4-septatis, cylindricis, utrinque, rotundatis, ad septa constrictis, 43–45 × 16–18 μ.

Hab. in foliis *Maesae rufescentis*, Amanzimtoti, Natal, 10/7/11, E. M. Doidge (Pole Evans 1573).

*M. bidentatae* affinis.

*Meliola varia* Doidge n. sp.

Amphigena, plagulas minutas, atras, 1–2 mm. diam., efficiens; hyphis sinuatis irregulariter 7–9 μ crassis; brunneis, cellulis 18–25 μ long., compositis; ramis plerumque alternis v. unilateralibus; hyphopodiis capitatis remotis, non numerosis, alternis v. unilateralibus, 21–35 μ long., cellula superiore ovata-globosa, 14–15 × 10·5–12 μ; hyphopodiis mucronatis rarissimis, pallidioribus tenuibus ca. 11 × 5–6 μ; setis mycelis numerosis, 180–220 μ longis erectis, rigidis, stipite opaco, simplice, 160–190 × 10 μ; superne ramosis, pellucidis, variis, aliis in ramos ternos breves (ca. 18 μ) apice bifurcatos divisis, aliis in ramos duos (18–30 × 8 μ) patentes divisis, ramis iterum in ramulos duos v. ternos brevissimos ad apicem bi v. trifurcatos divisis; peritheciis sparsis atris, globosis, in sicco leniter collapsis, verrucosis, 160–180 μ diam., ascis non visis; sporidiis 4-septatis, ad septa vix constrictis, cylindricis, utrinque rotundatis, 45–50 × 16–18 μ.

Hab. in foliis *Cissi rhomboideae,* Winter's Kloof, Natal, 26/6/11, E. M. Doidge (1639).

*Meliola bifida* Cke. Char. emend.

Caulicola et amphigena, maculas atras velutinas efficiens; mycelio ramosissimo ex hyphis 7–8 μ cr. septatis composito, cellulis 15–18 μ long.; ramis oppositis; hyphopodiis capitatis numerosissimis, confertis, oppositis, 15–18 μ long.; cellula superiore cylindrica-ovata, convexa, 11–14 × 7–8 μ; hyphopodiis mucronatis non visis; setis mycelicis numerosissimis, rigidis, 250–325 μ long.; basi 10 μ cr., apice bifidis, ramis 10–90 μ long., saepe bifidis, ramis ultimis quoque apice bi- v. trifidis; peritheciis inter setis absconditis, atris, verrucosis, 250–300 μ diam.; ascis 2–3-sporis, sporidiis brunneis, 4-septatis, cylindraceis, utrinque rotundatis, ad septa leniter constrictis, 42–50 × 14-16 μ.

Hab. in foliis *Osyridicarpi natalensis,* Natal, 14/7/15, leg. J. Medley Wood (9020).

## Summary.

An account is given of the Perisporiaceæ in the Union Mycological Herbarium; this is a group of fungi well represented in South Africa, but up to the present only a few species have been described or recorded. Descriptions are given of forty-five fungi belonging to the Perisporiaceæ, of which thirty-two are *Meliolas* and seventeen are species hitherto undescribed. Each species is illustrated by drawings made to scale with the aid of the camera lucida.

Botanical Laboratories of the Union
of South Africa, Pretoria.

---

## EXPLANATION OF PLATES LVII—LXVI.

### PLATE LVII.

FIG.

1. *Balladyna velutina* (B. & C.) v. Höhn. (*a*) Mycelium; (*b*) setae; (*c*) asci; (*d*) ascospores.
2. *Dimeriella annulata* Syd. (*a*) Fungus on leaf; (*b*) perithecia; (*c*) ascus and spores; (*d*) mycelium and sarciniform conidia.
3. *Dimeriella claviseta* Doidge n. sp. (*a*) Perithecia; (*b*) asci; (*c*) spores.
4. *Dimerium intermedium* Syd. (*a*) Pycnidium; (*b*) perithecia; (*c*) asci with paraphyses and spores.
5. *Dimerium MacOwanianum* (Thuem.) Doidge. (*a*) Mycelium; (*b*) perithecium; (*c*) spores.

## PLATE LVIII.

FIG.

6. *Dimerium Psilostomatis* (Thuem.) Sacc. (*a*) Mycelium and perithecia; (*b*) spores.
7. *Dimerium Gymnosporiae* (P. Henn.) Syd. (*a*) Mycelium; (*b*) spores.
8. *Phaeodimeriella capensis* Doidge n. sp. (*a*) Mycelium; (*b*) perithecium; (*c*) setae; (*d*) asci; (*e*) spores; (*f*) conidia.
9. *Parodiella Schimperi* P. Henn. (*e*) Perithecia on leaf; (*f*) ascus and spores.
9. *Parodiella congregata* Syd. (*a*) Perithecia on leaf (nat. size); (*b*) spores; (*c*) asci.
9. *Parodiella perisporioides* (Berk. & Curt.) Speg. (*d*) Asci and spores.
10. *Zukalia transvaalensis* Doidge n. sp. (*a*) Mycelium; (*b*) asci; (*c*) spores.

## PLATE LIX.

11. *Meliola manca* Ell. & Mart. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) appendages of perithecia; (*d*) spores.
12. *Meliola natalensis* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) appendages of perithecium; (*d*) spores.
13. *Meliola conferta* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) cells of perithecium; (*d*) spores.
14. *Meliola Podocarpi* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) spores.

## PLATE LX.

15. *Meliola speciosa* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) appendages of perithecium; (*d*) spores.
16. *Meliola torta* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial seta; (*d*) spores.
19. *Meliola cladotricha* Lev. (*a*) Mycelial seta; (*b*) spores.
20. *Meliola ditricha* (K. & Cke.) Doidge. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) spores.

## PLATE LXI.

17. *Meliola ganglifera* Kalch. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial setae; (*d*) spores.
18. *Meliola peltata* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) tip of seta; (*c*) spores; (*d*) spore germinating.
25. *Meliola inermis* Kalch. & Cke. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) cells of perithecium; (*d*) spores.
26. *Meliola Bosciae* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) perithecial setae; (*d*) spores.

## PLATE LXII.

21. *Meliola Hendeloti* Gaill. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) cells of perithecium; (*d*) spores.
22. *Meliola glabra* Berk. & Curt. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) cells of perithecium; (*d*) spores.
23. *Meliola Strophanthi* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) conidiophores; (*c*) cells of perithecium; (*d*) spores.
27. *Meliola capensis* (K. & Cke.) Theiss. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial seta; (*d*) spores.

## PLATE LXIII.

FIG.

24. *Meliola Peglerae* Doidge. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) cells of perithecium; (*d*) spores.
28. *Meliola Toddaliae* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial setae; (*d*) spores.
29. *Meliola microspora* Pat. et Gaill. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial setae; (*d*) spores.
31. *Meliola Rhois* P. Henn. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial seta; (*d*) spores.

## PLATE LXIV.

32. *Meliola microthecia* Thum. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*e*) mycelial setae; (*d*) spores.
33. *Meliola sinuosa* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial seta; (*d*) spores.
35. *Meliola rigida* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial setae; (*d*) spores.
38. *Meliola Woodiana* Sacc. & Syd. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial setae; (*d*) spores.

## PLATE LXV.

30. *Meliola amphitricha* Fr. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial seta; (*d*) spores.
34. *Meliola polytricha* K. & Cke. (*a*) Mycelium with capitate hyphopodia; (*b*) mycelial seta; (*c*) spores.
39. *Meliola furcillata* Doidge n. sp. (*a*) Mycelium with capitate and mucronate hyphopodia; (*b*) mycelial setae; (*c*) cells of perithecium; (*d*) spores.
40. *Meliola varia* Doidge n. sp. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial setae; (*d*) spores.

## PLATE LXVI.

36. *Meliola falcata* Syd. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial setae; (*d*) spores.
37. *Meliola arcuata* Doidge. (*a*) Mycelium with capitate hyphopodia; (*b*) mucronate hyphopodia; (*c*) mycelial setae; (*d*) spores.
41. *Meliola bifida* Cke. (*a*) Mycelium with capitate hyphopodia; (*b*) mycelial setae; (*c*) spores.
42. *Meliola leptidea* Syd. (*a*) Mycelium with capitate hyphopodia; (*b*) mycelial setae; (*c*) spores.

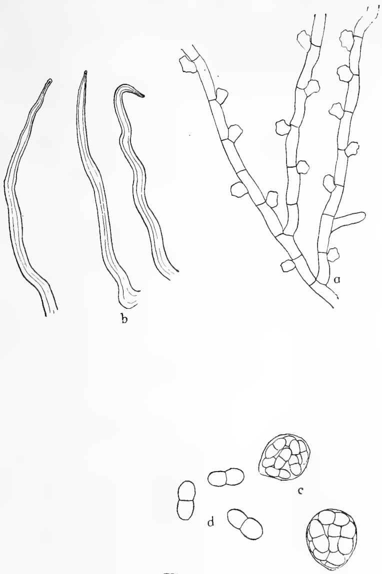



Fig 1.

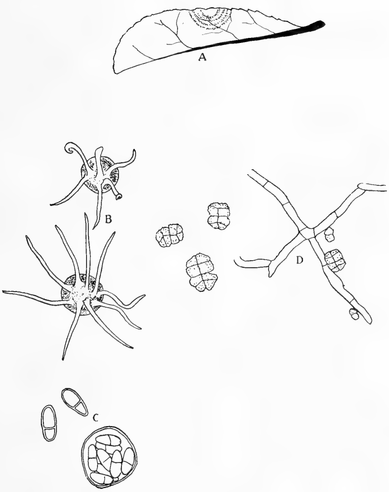



Fig. 2.

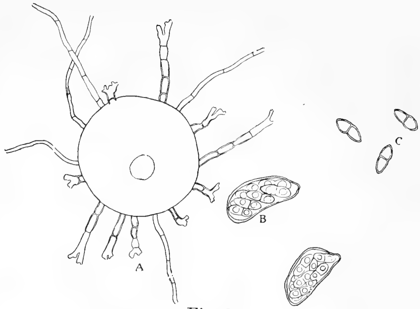



Fig. 3.

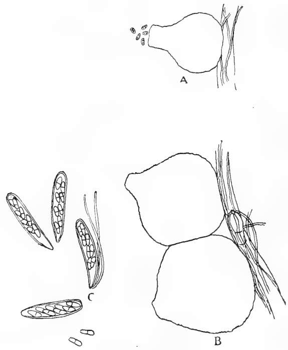



Fig. 4.

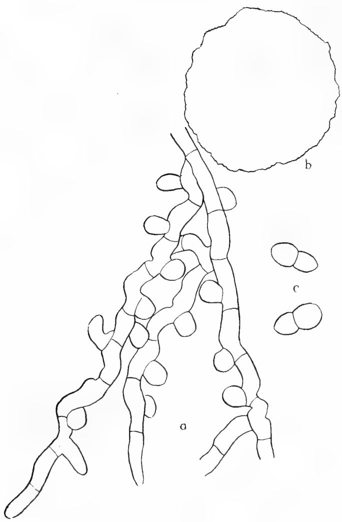



Fig. 5.

*Adlard & West Newman.*

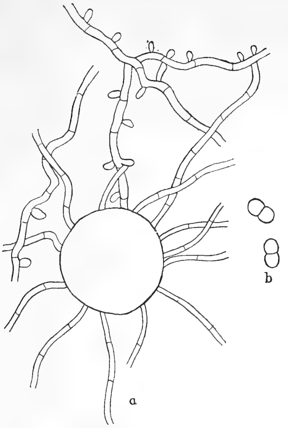



Fig. 6.

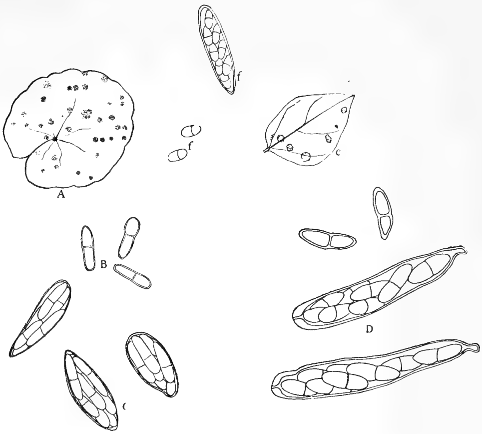



Fig. 9.

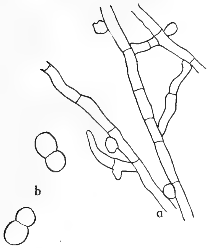



Fig. 7.

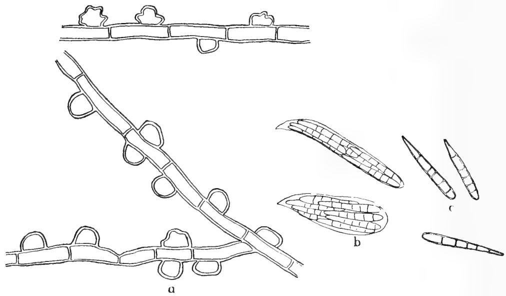



Fig. 10.

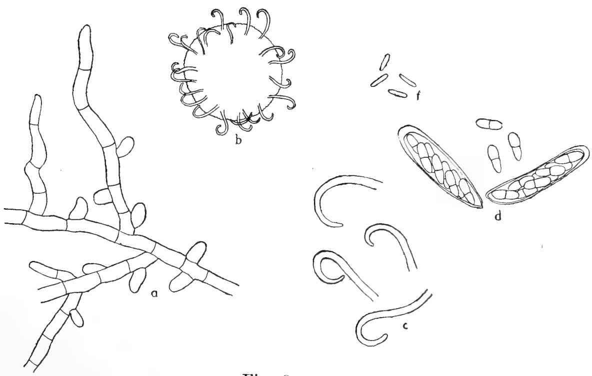



Fig. 8.

*Adlard & West Newman.*

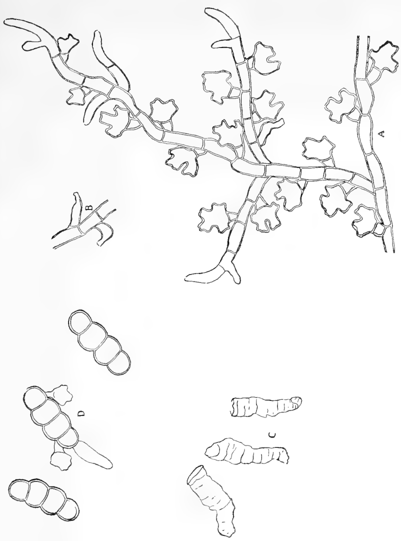



Fig. 12.

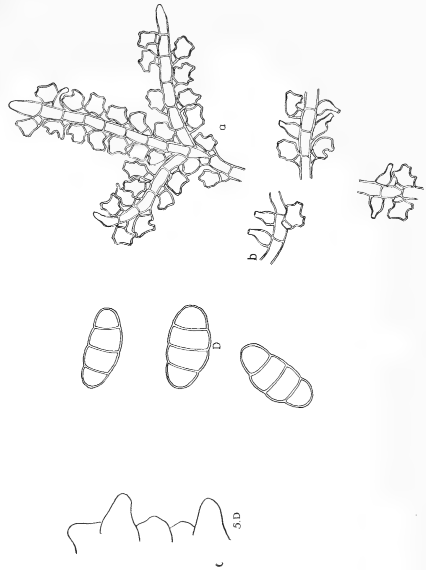



Fig. 13.

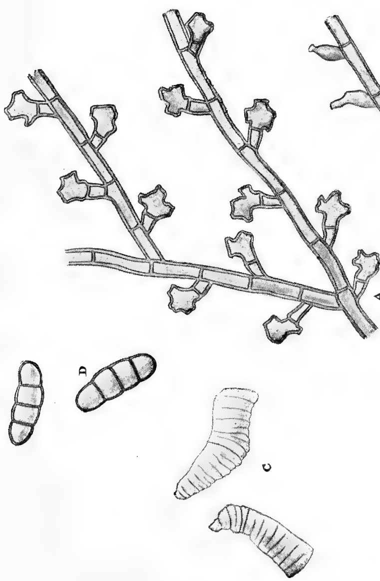



Fig. 11.

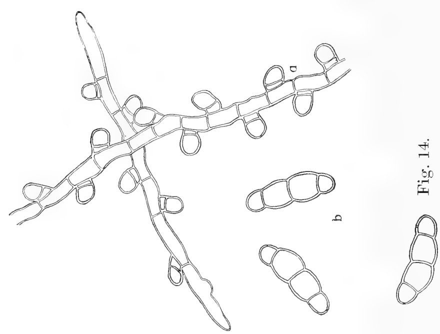



Fig. 14.

*Adlard & West Newman.*

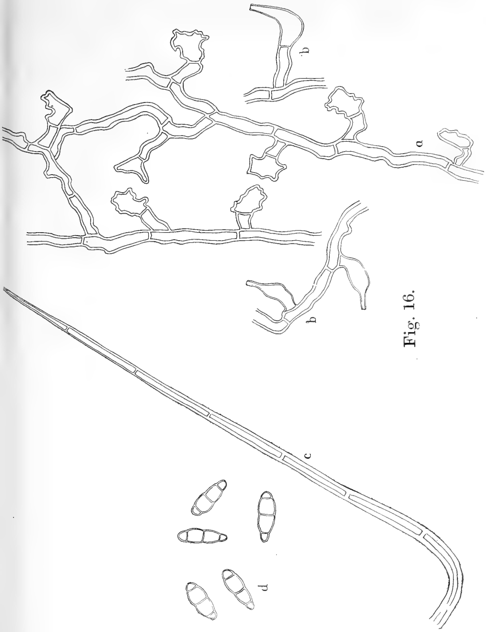


Fig. 16.

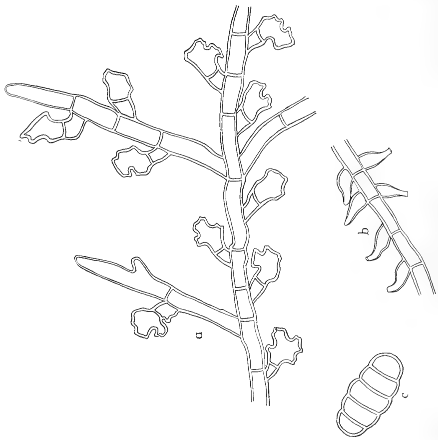


Fig. 20.

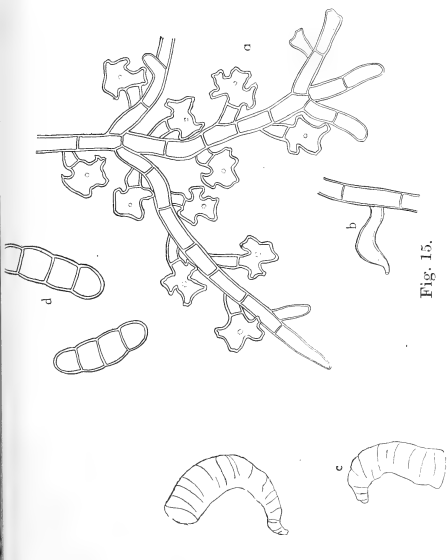


Fig. 15.

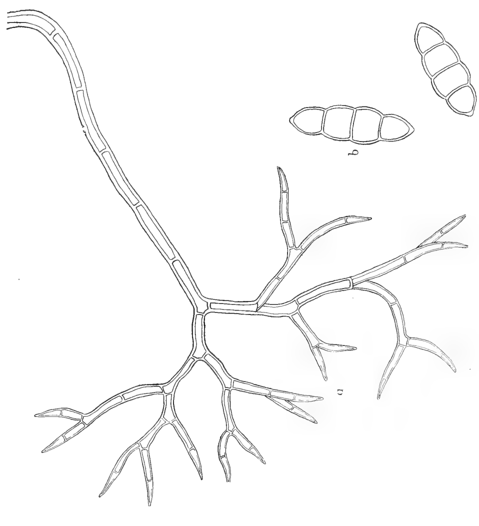


Fig. 19.

Adlard & West Newman.

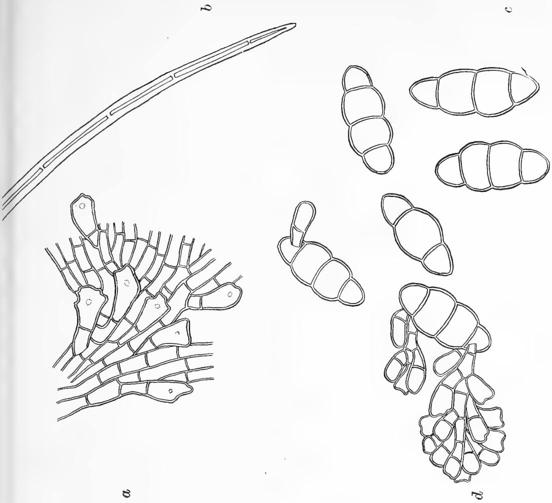



Fig. 18.


Fig. 25.


Fig. 17.

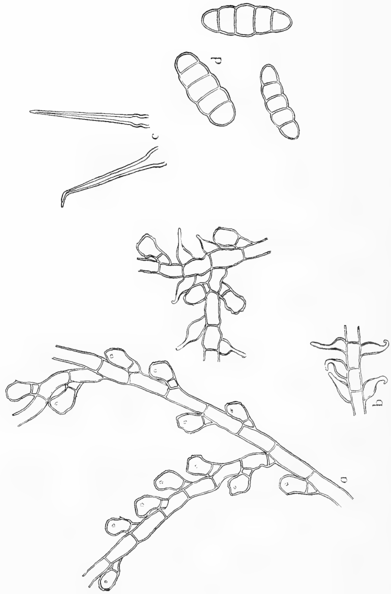



Fig. 26.

*Adlard & West Newman.*

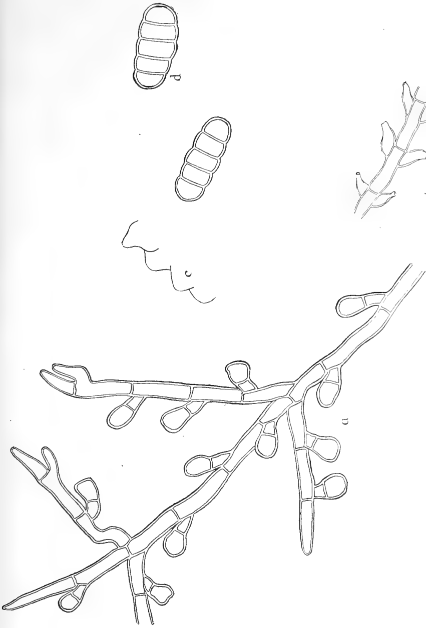


Fig. 22.

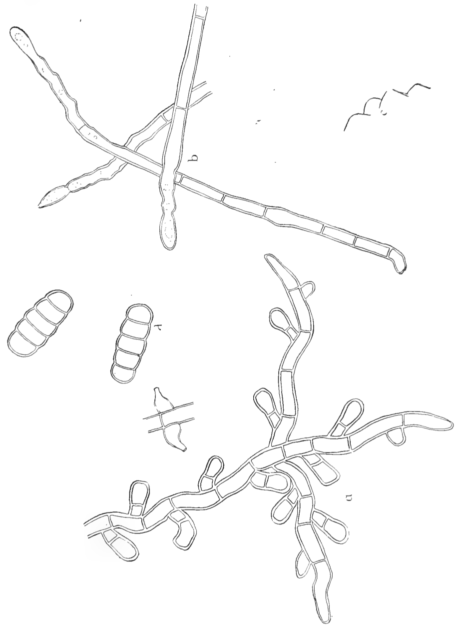


Fig. 23

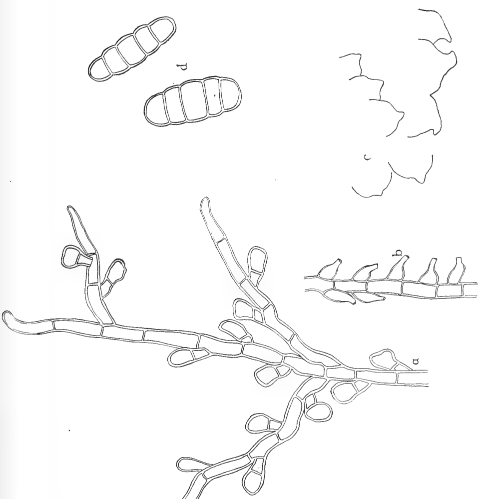


Fig. 21.

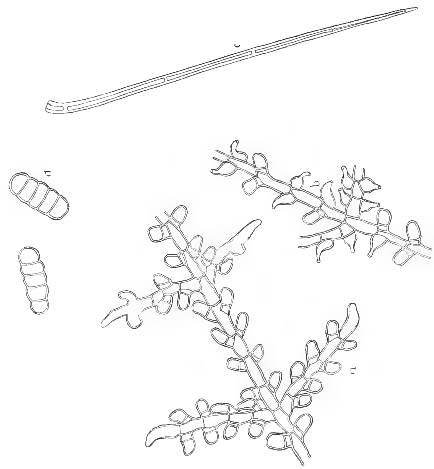


Fig. 27.

*Adlard & West Newman.*

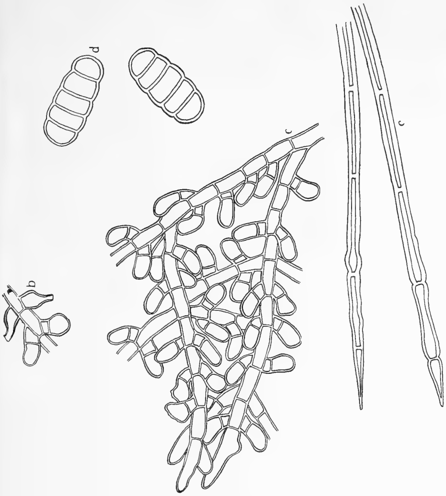



Fig. 28.

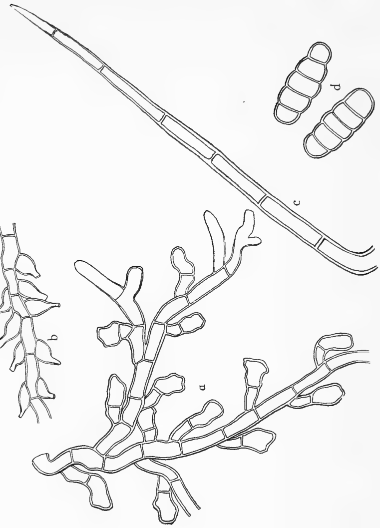



Fig. 31.

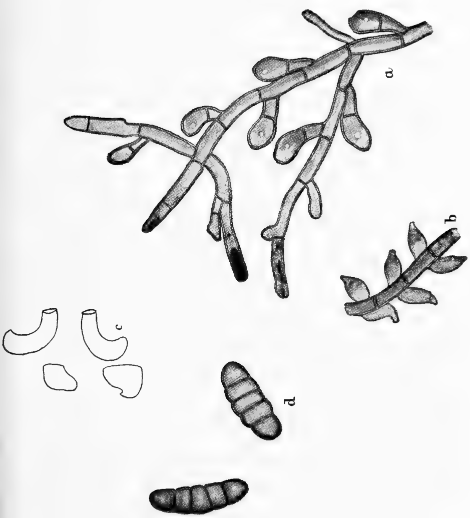



Fig. 24.

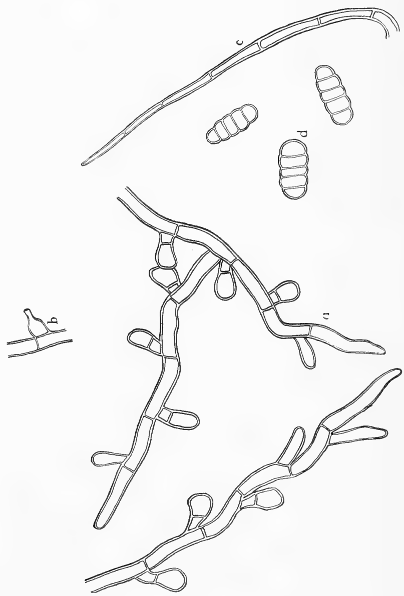



Fig. 29.


*Adlard & West Newman.*

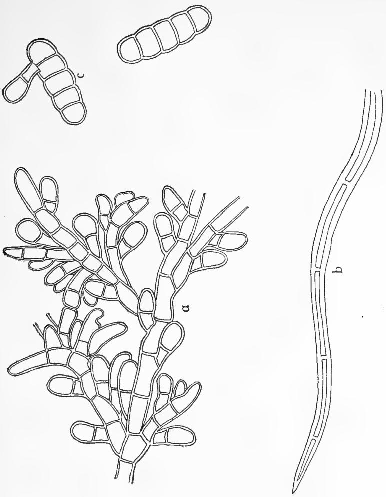



Fig. 34.

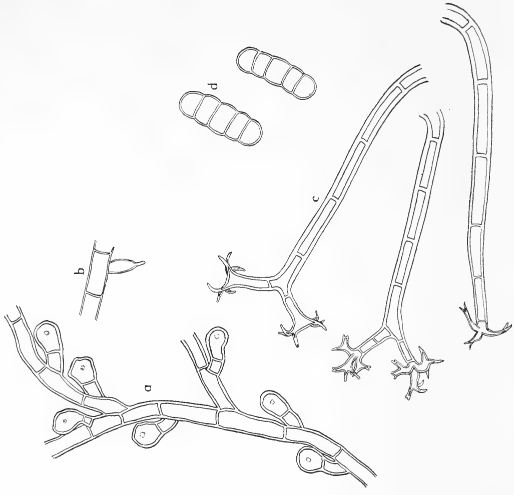



Fig. 40.


Fig. 30.

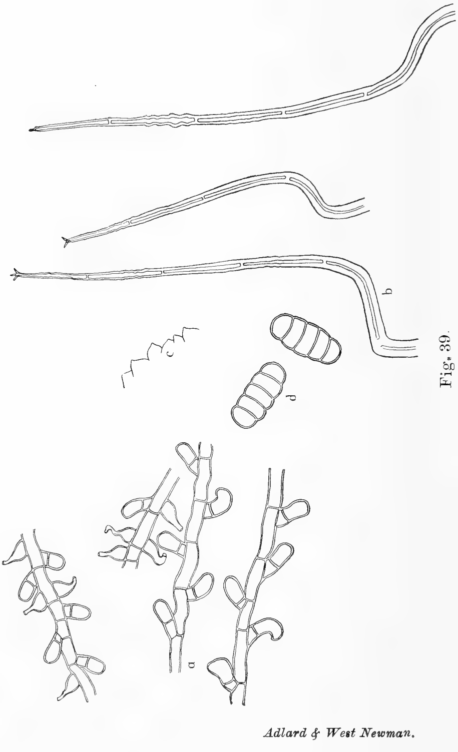



Fig. 39.

*Adlard & West Newman.*

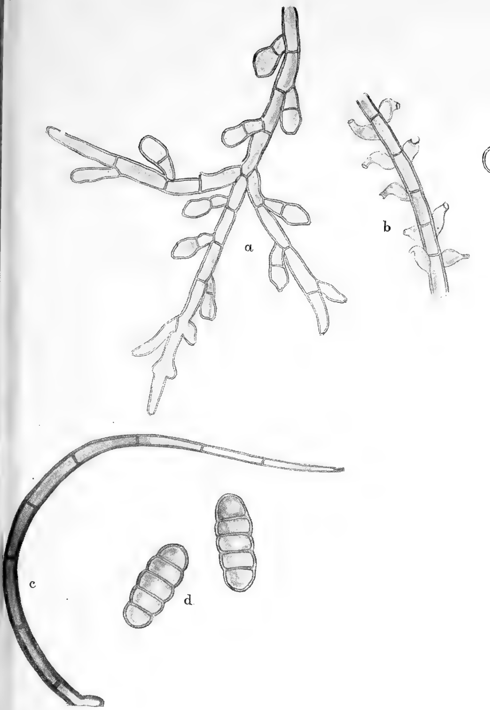



Fig. 36.

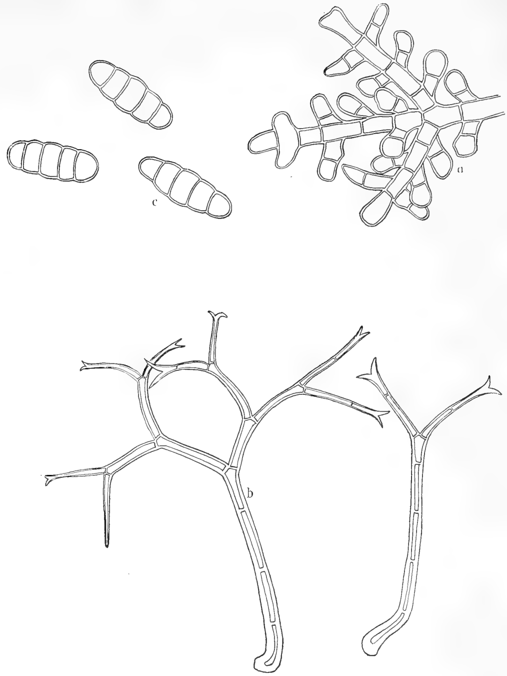



Fig. 42.


Fig. 37.

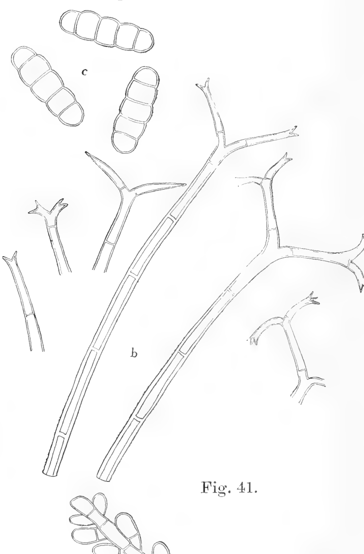



Fig. 41.

# TRANSACTIONS

OF THE

# South African Philosophical Society.

The following volumes have been published:—

| VOL. | | PUB. | s. | d. |
|---|---|---|---|---|
| I.— | Part 1 ...... | 1878 | | |
| | Part 2 ...... | 1879 | 2 | 6 |
| | Part 3 ...... | 1880 | 2 | 6 |
| II.— | Part 1 ...... | 1881 | 5 | 0 |
| | Part 2 ...... | 1881 | 2 | 6 |
| | Part 3 ...... | 1882 | 2 | 6 |
| III.— | Part 1 ...... | 1884 | 2 | 6 |
| | Part 2 ...... | 1885 | 10 | 0 |
| IV.— | Part 1 ...... | 1887 | 2 | 6 |
| | Part 2 ...... | 1888 | | |
| V.— | Part 1 ...... | 1888 | | |
| | Part 2 ...... | 1893 | 2 | 6 |
| VI.— | Part 1 ...... | 1890 | 2 | 6 |
| | Part 2 ...... | 1892 | 2 | 6 |
| VII.— | Part 1 ...... | 1893 | 10 | 0 |
| | Part 2 ...... | 1896 | 20 | 0 |
| VIII.— | Part 1 ...... | 1893 | 2 | 6 |
| | Part 2 ...... | 1896 | 5 | 0 |
| IX.— | Part 1 ...... | 1897 | 5 | 0 |
| | Part 2 ...... | 1898 | 7 | 6 |
| X.— | Part 1 ...... | 1897 | 15 | 0 |
| | Part 2 ...... | 1898 | 7 | 6 |
| | Part 3 ...... | 1899 | 7 | 6 |
| XI.— | Part 1 ...... | 1900 | 12 | 6 |
| | Part 2 ...... | 1900 | 12 | 6 |
| | Part 3 ...... | 1901 | 7 | 6 |
| | Part 4 ...... | 1902 | 12 | 6 |
| XII.— | (Pp. 1–560) | 1901 | 25 | 0 |
| | (Pp. 561–896) | 1902 | 14 | 0 |
| | (Pp. 897–920) | 1903 | 2 | 0 |
| XIII.— | (Pp. 1–298) | 1904 | 12 | 6 |
| | (Pp. 289–546) | 1907 | 8 | 6 |
| | (Pp. 547–752) | 1908 | 10 | 0 |
| XIV.— | Part 1 ...... | 1903 | 5 | 6 |
| | Part 2 ...... | 1903 | 8 | 6 |
| | Part 3 ...... | 1903 | 11 | 0 |
| | Part 4 ...... | 1903 | 5 | 0 |
| | Part 5 ...... | 1904 | 8 | 0 |
| XV.— | Part 1 ...... | 1904 | 8 | 6 |
| | Part 2 ...... | 1904 | 3 | 6 |
| | Part 3 ...... | 1904 | 17 | 0 |
| | Part 4 ...... | 1905 | 7 | 6 |
| | Part 5 ...... | 1905 | 12 | 6 |
| XVI.— | Part 1 ...... | 1905 | 10 | 0 |
| | Part 2 ...... | 1905 | 10 | 0 |
| | Part 3 ...... | 1906 | 5 | 0 |
| | Part 4 ...... | 1906 | 15 | 0 |
| | Part 5 ...... | 1907 | 3 | 6 |
| XVII.— | Part 1 ...... | 1907 | | |
| | Part 2 ...... | 1908 | | |
| XVIII.— | Part 1 ...... | 1907 | 9 | 0 |
| | Part 2 ...... | 1908 | 12 | 6 |
| | Part 3 ...... | 1907 | 4 | 6 |
| | Part 4 ...... | 1909 | 7 | 0 |

Copies may be obtained from the Honorary Secretary of the Royal Society of South Africa; or from Messrs. WM. WESLEY & SON, 28, Essex Street, Strand, London.

*Members of the Society may obtain the publications, from the Secretary only, at half of the above prices.*

Part 1 of vol. I., Part 2 of vol. IV., Part 1 of vol. V., and vol. XVII. Parts 1 and 2, are out of print.

# TRANSACTIONS

OF THE

# ROYAL SOCIETY OF SOUTH AFRI[...]

| | | | | £ | s. | d. |
|---|---|---|---|---|---|---|
| Vol. I. Part 1 | 1909 | Price | | 1 | 5 | 0 |
| „ I. Part 2 | 1910 | Price | | 0 | 10 | 0 |
| „ II. Part 1 | 1910 | Price | | 0 | 10 | 0 |
| „ II. Part 2 | 1911 | Price | | 0 | 16 | 0 |
| „ II. Part 3 | 1912 | Price | | 0 | [illegible] | [illegible] |
| „ II. Part 4 | 1912 | Price | | 0 | 12 | 6 |
| „ II. Part 5 | 1912 | Price | | 0 | 5 | [illegible] |
| „ III. Part 1 | 1913 | Price | | 0 | 17 | 0 |
| „ III. Part 2 | 1913 | Price | | 0 | 17 | [illegible] |
| „ III. Part 3 | 1913 | Price | | 0 | 10 | [illegible] |
| „ IV. Part 1 | 1914 | Price | | 0 | 10 | [illegible] |
| „ IV. Part 2 | 1914 | Price | | 0 | 5 | 6 |
| „ IV. Part 3 | 1915 | Price | | 0 | 12 | [illegible] |
| „ V. Part 1 | 1915 | Price | | 0 | 12 | [illegible] |
| „ V. Part 2 | 1915 | Price | | 0 | 16 | 0 |
| „ V. Part 3 | 1915 | Price | | 0 | 10 | 6 |
| „ V. Part 4 | 1916 | Price | | 0 | 12 | 6 |
| „ V. Part 5 | 1916 | Price | | 1 | 7 | [illegible] |
| „ V. Part 6 | 1917 | Price | | 1 | [illegible] | 6 |

Copies may be obtained from the Honorary Secretary ; or [...]

Messrs. Wm. Wesley & Son, 28, Essex Street, Strand, Lond[...]

*Members of the Society may obtain the publications from the [...]*
*Secretary only, at half of the above prices.*