Publications of the Royal Society of Victoria, and of the Societies amalgamated with it.

VICTORIAN INSTITUTE FOR THE ADVANCEMENT OF SCIENCE.
Transactions. Vol. 1. 1855.

PHILOSOPHICAL SOCIETY OF VICTORIA.
Transactions. Vol. 1. 1855.

These two Societies then amalgamated and became:—

PHILOSOPHICAL INSTITUTE OF VICTORIA.
Transactions. Vols. 1-4.

The Society then became:—

ROYAL SOCIETY OF VICTORIA.

Transactions and Proceedings (Vol. 5, *entitled* Transactions). (8vo). Vols. 5-24.

Transactions. (4to). Vols. 1, 2, 3 (Pt. 1 only was published), 4, 5, 6——1888——.

Proceedings (New Series). (8vo). Vols. 1——1888——.

MICROSCOPICAL SOCIETY OF VICTORIA.

Journal (Vol. 1, Pt. 1, *entitled* Quarterly Journal). Vol. 1 (Pts. 1 to 4), 2 (Pt. 1), title page and index [*all published*]. 1879-82.

[*The Society then combined with the* ROYAL SOCIETY OF VICTORIA].

NOTE.—*Most of the volumes published before 1890 are out of print.*

PROCEEDINGS

OF THE

Royal Society of Victoria.

VOL. XXXV. (New Series).

PARTS I. and II.

Edited under the Authority of the Council.

ISSUED 7th DECEMBER, 1922 and 31st MAY, 1923.

(*Containing Papers read before the Society during 1922*).

THE AUTHORS OF THE SEVERAL PAPERS ARE INDIVIDUALLY RESPONSIBLE FOR THE SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE STATEMENTS MADE THEREIN.

MELBOURNE

FORD & SON, PRINTERS, DRUMMOND STREET, CARLTON.

1923.

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[Proc. Roy. Soc. Victoria 35 (N.S.), Pt. I., 1922].

Art. I.—*New or Little-known Fossils in the National Museum.*

XXVI.—Some Tertiary Mollusca.

By FREDK. CHAPMAN, A.L.S.

(Palaeontologist to the National Museum: Lecturer in Palaeontology, Melbourne University).

(With Plates I-III.)

[Read 20th April, 1922.]

Introductory Note.

The following paper deals with fourteen new species, and also discusses points of distribution in regard to eight other forms.

A large portion of this collection has been donated to the National Museum of late years by several indefatigable collectors, to whom the authorities are much indebted. Groups other than mollusca have been equally augmented, and they will be worked out as opportunity permits.

It will be seen by the present work that even as far back as Oligocene and Miocene times there existed many species of mollusca which are so closely related to living forms as to leave no doubt that they were the direct ancestors of our present molluscan types. Others have migrated from the Bassian area, and are now only found as varietal offshoots in warmer Australian waters.

List of Species Described:—

Pelecypoda.

Pteria (Meleagrina) crassicardia, Tate sp.
Ostrea ingens, Zittel.
Neotrigonia bednalli, Verco var.
Hinnites mulderi, sp. nov.
Plicatula youngi, sp. nov.
„ dennanti, sp. nov.
„ brevispina, sp. nov.
Spondylus baileyana, sp. nov.
Modiolus mooraboolensis, sp. nov.
Lucina (Codakia) planatella, Tate.
Diplodonta harrisi, sp. nov.

Gasteropoda.

Astralium (Imperator) hudsonianum, Johnston
Turbo grangensis, Pritchard.

Xenophora (Tugarium) tatei, Harris.
Cypraea siphonata, sp. nov.
Erato obesula, sp. nov.
Murex (Muricidea) gatliffi, sp. nov.
Fusinus youngi, sp. nov.
Solutofusus curlewisensis, sp. nov.
Lyria acuticostata, Chapman.
Voluta sexuaplicata, sp. nov.
Cancellaria torquayensis, sp. nov.

Description of the Species.

Phylum MOLLUSCA.

Class PELECYPODA.

Order PRIONODESMACEA (Schizodonta).

Fam. PTERIIDAE.

Genus **Pteria,** Scopoli.

Subgenus Meleagrina, Lamarck.

Pteria (Meleagrina) crassicardia, Tate sp.

Meleagrina crassicardia, Tate, 1886. Trans. R. Soc. S. Austr., vol. viii., p. 14, pl. ix., figs. 9, 10.

Observations.—In Dennant and Kitson's List we find the following localities mentioned for this species: Muddy Creek (lower); Lower Moorabool; and Murray River Cliffs, Oyster bed. These localities indicate respectively, Oligocene (Balcombian), Miocene (Janjukian), and Lower Pliocene (Kalimnan). The present record, from the Beaumaris Cliffs, is new for the locality, and so links on to that of the oyster beds of the Murray River Cliffs, South Australia, in point of age. This species, therefore, has a remarkably extended range. The Beaumaris specimens are the umbonal parts of very heavy shells, whilst the Balcombian examples are generally much thinner and lighter.

In the Dennant collection there is also a juvenile shell of the same species from the Muddy Creek beds (upper or Kalimnan).

Additional Occurrence.—Beaumaris Cliffs, Port Phillip. Also upper beds at Muddy Creek. Age.—Kalimnan (L. Pliocene).

Fam. OSTREIDAE.

Genus **Ostrea,** Linné.

Ostrea ingens, Zittel. (Plate I., Figs. 1, 2.)

Ostrea ingens, Zittel, 1864, Novara Exped., Geol. Theil, vol. i., p. 54, pl. xiii., fig. 3.
Ostrea nelsoniana, Zittel, 1864. Ibid., p. 55, pl. xi., fig. 7.

Ostrea hatcheri, Ortmann, 1897. Amer. Journ. Sci., vol. iv., p. 355, pl. xi., fig. 1.

Ostrea philippi, Ortmann, 1897. Ibid., p. 356, pl. xi., fig. 2.

Ostrea patagonica, von Ihering (non d'Orbigny), 1897. Rev. Mus. Paul., vol. ii., p. 221, pl. ix., fig. 2.

Ostrea hatcheri, von Ihering, 1899. Neues Jahrb., für Min., vol. v., p. 8.

Ostrea ingens, Zittel, Ortmann, 1900. Amer. Journ. Sci., vol. x., p. 379. Ortmann, 1902, Rep. Princetown Exped., Patagonia, 1896-99, vol. iv., pt. 2, p. 99, pl. xv., xvi., xvii., xviii., xix., figs *a-c*.

Observations.—The fauna of the Miocene or Middle Tertiary beds of Victoria and South Australia contains a large form of oyster which has never been assigned to a definite species. Many examples of these large bivalves are represented in the National Museum fossil collection, but have not been specified up to the present. I am now satisfied, however, that they are identical with the New Zealand and Patagonian species, *Ostrea ingens*.

Professor Tate's useful "Census of the Older Tertiary Fauna of Australia"[1] mentions on page 249 five species of *Ostrea* from the older Tertiary (that is, Balcombian to Kalimnan), as understood by Tate. But only four are listed in Dennant and Kitson's "Catalogue of the Cainozoic Fauna," etc.,[2] so that in all probability the fifth in Tate's estimate is that now referred to *O. ingens*, Zittel.

Characters of *O. ingens*.—The chief specific distinctions given by Ortmann, and now by the writer, are:—

1. Large size and extremely thick shell.
2. Situation of muscular scar. Muscle impression large, generally situated a little below the middle of the shell, and a little posteriorly.
3. Smooth margins of the inner side of the valves, except close to the area.
4. Slight development of the radial folds. In some there is a tendency for the lamellae to develop undulae or frills, but with no marked radial disposition.

This species of *Ostrea* has been referred by H. Suter to the subgenus *Anodontostrea* (Suter),[3] the distinctive characters being the smooth inner margin. It seems, however, to belong to *Eostrea* (Ihering), for the dorsal region of the shell is often distinctly crenate.

Measurements.—Ortmann gives the length of the largest specimen as 255 mm. and the width as 162 mm.

The largest specimen in the National Museum collection appears to be an example from the Janjukian of Bairnsdale, having a length of 218 mm., and a width of 157 mm. Another specimen, from Cape Otway, also from Janjukian beds, measures 180 mm., by 135 mm.; this approaches *O. sturtiana*, Tate,[4] in its oblong shape, but is very much

1. Journ. and Proc. Roy. Soc., N.S. Wales, vol. xxii., pt. ii., 1888, p. 240.
2. Rec. Geol. Surv. Vict., vol. i., pt. 2, 1903.
3. Descriptions of New Tertiary Mollusca, Part I. New Zealand Geol. Surv. Palaeontological Bulletin, No. 5, 1917, p. 86.
4. Trans. Roy. Soc. S. Austr., vol. viii., p. 97.

larger and heavier, and is no doubt referable to *O. ingens.* Ortmann has already drawn attention to *O. sturtiana* as being closely allied to *O. ingens.*[5] The specimen here figured is from Waurn Ponds (Janjukian), and measures 137 mm. by 112 mm.

A smaller but still heavy shell of great thickness is found in the Bailey collection from Beaumaris. It measures 120 mm. by 83 mm., and the principal lamellae number about 34. This is of Lower Pliocene age.

Distribution.—Victoria and South Australia: The Janjukian or Miocene of Bairnsdale, Cape Otway, Murray River Cliffs. Also in the Kalimnan or Lower Pliocene of Beaumaris, Port Phillip.

Elsewhere.—New Zealand: Oamaru and Pareora beds (Oligocene to Upper Miocene).

Patagonia: Upper part of Patagonian Formation and Suprapatagonian, Miocene.

Chile: Coquimbo Beds. Pliocene.

Fam. TRIGONIIDAE.

Genus **Neotrigonia**, Cossman.

NEOTRIGONIA BEDNALLI, Verco var. (Plate I., Fig. 3.)

> *Trigonia margaritacea,* Lam., var. *bednalli.* Verco, 1907, Trans. Roy. Soc., S. Australia, vol. xxxi., p. 224, pl. xxviii., figs. 1-3.

Observations.—Dr. Verco regarded this form as a variety of the living *N. margaritacea.* From its occurrence in fossiliferous beds of Lower Pliocene age it can no longer be logically regarded as a variety of a recent type, and therefore it appears to be more consistent to give it specific rank.

This form has been taken in some abundance in the living state by Dr. Verco, who dredged it from St. Vincent's Gulf. A solitary specimen was previously found by Mr. W. T. Bednall in 1865, between the Semaphore and Glenelg.

This appears to be its first occurrence in the fossil state, and adds to the increasing list of species from the Kalimnan whose descriptions were originally based on living examples found round the Australian coast. *N. bednalli* has been dredged from 10 down to 200 fathoms. Dr. Verco's description runs as follows:—

"This variety is characterised by its very compressed shape, its narrow ribs, its large, oblong, plate-like spines, broader at their free than at their attached ends, features which are exceedingly constant in the very large series obtained."

Occurrence.—In shelly sand of Kalimnan age (Lower Pliocene), MacDonald's, Muddy Creek, near Hamilton, Victoria. Discovered and presented by Mr. James Hay Young.[6]

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5. Princetown Univ. Exped., vol. iv., pt. ii., 1902, p. 105.
6. Mr. Young died on Feb. 10th, 1922. The Museum has been enriched on many occasions by his valuable discoveries.

Order PRIONODESMACEA (Isodonta).

Fam. PECTINIDAE.

Genus **Hinnites,** Defrance.

HINNITES MULDERI, sp. nov. (Plate II., Figs. 9, 10.)

Description.—Valves very inaequilateral, oblique, depressed. Anterior margin gently rounded near the umbo, truncately rounded towards the ventral, the posterior region is well-rounded, the margin sweeping forward and upward in an almost straight line to the umbonal angle made with the anterior. The neanic part of the shell is pectinoid, and feebly radiately striate, there being about sixteen fine costae. The ephebic and possibly gerontic stages show the characteristic irregularly undulose surface caused by the alternately concave and convex condition of the ventral edge; shell surface of later stages with a similarly striate and radiate ornament. Muscle impression large. Resilium small, acutely triangular.

Dimensions.—Left valve, length, 57 mm.; height, 59 mm. Height of pectinoid stage, 16.5 mm.

Observations.—The following characters distinguish this species from the allied *Hinnites corioensis*, McCoy[7]:—

1. Shell narrower or higher and more oblique.
2. Radial striae of pectinoid stage more numerous and finer.
3. Radial striae on ostreiform area not so strongly frilled by the crossing of the growth lines, the surface being sinuously striate, and not verriculate.

Occurrence.—In the white polyzoal limestone of Batesford, near Geelong. Janjukian (Miocene).

Two valves presented by the late J. F. Mulder, Esq. The species is named after its discoverer in recognition of his assiduous and successful work in bringing to light many interesting Cainozoic forms.

Fam. SPONDYLIDAE.

Genus **Plicatula,** Lamarck.

PLICATULA YOUNGI, sp. nov. (Plate I., Figs. 4, 5.)

Description.—Shell moderately thin, subtrigonal, high, oblique; left valve strongly arched. With about 20 low, rounded plaits, only conspicuous towards the ventral margin, and apparently once divided from their base near the medium area. Umbonal area rugose with irregular folds. Growth-lines more strongly marked towards the ventral border and imbricated. The pair of strong teeth in the right valve are fused to a fairly large triangular area, which is transversely striate.

Dimensions.—Height of shell (right valve), 26 mm.; length, 17 mm.; depth of valve, 7 mm.

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7. Prodomus Palaeont., Dec., vi., 1879, p. 31, pl. lviii.

Observations.—The long, triangular shape of the shell reminds one of *P. australis*, Lamarck,[8] of the Philippines, but does not show the dominant sharp median ribs of that species, which extend from umbo to margin.

Occurrence.—In the Lower beds at Muddy Creek, near Hamilton, Victoria. Of Balcombian (Oligocene) age. Found by the late Mr. J. H. Young.

Plicatula dennanti, sp. nov. (Plate I., Figs. 6, 7.)

Description.—Shell roundly trigonal, distinctly oblique. Right valve depressed, with more or less inflated umbo and marginal area; left valve depressed. Plicae few, about 7, bifurcating and rather acutely ridged. Teeth situated on a small, triangular hinge-plate.

Dimensions.—Right valve (cotype); height, 22 mm.; length, 18.5 mm. Left valve (cotype); height, 19 mm.; length, 15.5 mm.

Observations.—There are three examples of this species in the Dennant collection at the National Museum—two right valves and one left. A note by the late Mr. Dennant which accompanies this form says, "allied to *P. essingtonensis*." That species, however, differs from *P. dennanti* in the more numerous plicae, which are quite sharp; and in the nearly equilateral form of the shell. *P. essingtonensis*, Sowerby,[9] is a Northern Australian shell.

Occurrence.—Lower beds at Muddy Creek, near Hamilton. Dennant collection. Of Balcombian (Oligocene) age.

Plicatula brevispina, sp. nov. (Plate I., Fig. 8.)

Description.—Shell subtriangular, moderately stout, slightly oblique. With about eighteen plicae, rarely bifurcated, slightly ridged and crossed by undulating growth-lines, which develop into nodose spines at their intersection near the ventral margin. The attached umbonal area flat, from which the shell slopes away at a steep angle. Teeth attached to a short dental plate, which is obliquely striated.

Dimensions.—Height of right valve, 25 mm. Length, 22.5 mm. Depth of valve, 7 mm.

Observations.—This species differs from *P. youngi* in the rounder outline, the sharp nodose ribs, and the smaller dental plate.

It is a very ornate form compared with other species, and the fossil example is well preserved. In the style of ornament it is not unlike *P. novae-zelandiae*,[10] but that species is more depressed.

Occurrence.—Lower beds Muddy Creek, near Hamilton. Of Balcombian (Oligocene) age. Dennant Collection.

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8. Anim. sans Vert., vol. vi., p. 85. Reeve, Conch. Icon., vol. xix., 1873, pl. iii., figs. 10*a, c, d*.

Reeve, Conch. Icon., vol. xix., 1873, pl. iii., fig. 8.

10. Sowerby in Reeve, Conch. Icon., vol. xix., 1873, pl. i, fig. 1.

Fam. SPONDYLIDAE.

Genus **Spondylus**, Linné.

SPONDYLUS BAILEYANA, sp. nov. (Plate II., Fig. 11.)

Description.—Valves roundly to obliquely ovate; left valve depressed, right valve moderately convex. Shell thinner than in *S. gaederopoides*, McCoy. Hinge-line moderately long for the genus. Anterior margin of the shell widely rounded, curving obliquely to the ventral margin, and broadly rounded at the posterior angle. Surface of shell ornamented with about 6 principal radii, which are more than usually adpressed to the shell, but at intervals projecting into sharp spines, more strongly developed towards the posterior extremity. Smaller and almost obsolete radii between the stronger ones. Growth-lines faint except towards the ventral margin of full-grown specimens; never developing further than as a series of depressed lamellae. Inner surface with the margin finely toothed. Muscle impression large, situated close to the umbo.

Dimensions.—Type specimen, left valve. Length, 74 mm.; height, 82 mm.

Observations.—This species is clearly the ancestral form of the living *S. tenellus*, Reeve,[11] which is found off New South Wales and Victoria (Western Port, Phillip Island and Portland). The fossil specimen is fully twice the height, with more widely spaced radii and stronger and more adpressed spines. The Kalimnan *Spondylus spondylioloides* (or *arenicola*), Tate sp.,[12] from the Upper beds at the Murray Cliffs is distinguished by the more triangular shape and more spinous character, with obliteration of the concentric lamellae.

Occurrence.—In calcareous shelly marl, Beaumaris, Port Phillip. Collected by the late J. A. Bailey, after whom the species is named. Also in the Dennant collection, from Rose Hill, near Bairnsdale, and from McDonald's, Muddy Creek (F.C.).

Age.—Kalimnan (Lower Pliocene).

Order PRIONODESMACEA (Dysodonta).

Fam. MYTILIDAE.

Genus **Modiolus**, Lamarck.

MODIOLUS MOORABOOLENSIS, sp., nov. (Plate III., Fig. 17.)

Description.—Shell ovate, oblique, very tumid. Umbo small, incurved; a comparatively sharp umbonal ridge extending from beak to near the ventral margin, where it forms a broadly convex arch at the posterior

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11. Reeve, Conch. Icon., vol. ix., pl. xviii., fig 67.
12. Trans Roy. Soc., S. Australia, vol. viii., 1886, p. 19, pl. iv., fig. 6, as *Pecten spondylioides*. Renamed by Tate, 1896, in Rep. Australasian Association for the Advancement of Science, vol. vi., p. 318 as *Spondylus arenicola*. Although inappropriate, this earlier trivial name must stand, according to the rules of nomenclature.

angle. Ventral flexure or sinus well-marked, thus distinguishing it from *M. adelaidensis*, Tate, to which it bears some resemblance. The posteror margin is widely rounded, and meets the ventral margin at an obtuse angle. Surface finely wrinkled with growth striae.

Dimensions.—Height (circ.), 35 mm.; width (circ.), 29 mm.; depth of valve, 12 mm.

Observations.—This specimen from the Moorabool Valley was at first thought to be a mere variety of *M. pueblensis*, Pritchard,[13] but finding other examples in the Dennant collection from Brown's Creek, Otway, showing the same strong umbonal angulation, there is no doubt that it is distinct. *M. adelaidensis*, Tate,[14] also resembles this form in some particulars, but differs in having no conspicuous sinus on the ventral border. All the species here mentioned are confined to the Janjukian (Miocene).

Occurrence.—Type; in hard, yellow limestone, from the Moorabool River, near Maude. Geod. Surv. coll., W.T.M.4. Other specimens occur at Brown's Creek, Cape Otway (Dennant coll.).

Order TELEODESMACEA (Diogenodonta).

Fam. LUCINIDAE.

Geuus **Lucina**, Bruguière.

Subgenus Codakia, Scopoli.

Lucina (Codakia) planatella, Tate.

Lucina planatella, Tate, 1886, Trans. R.S., South Australia, vol. viii., pl. xii., fig. 11 (fig. only). Iden., 1887, ibid., vol. ix., p. 146 (description).

Observations.—This species has hitherto been recorded only from Table Cape. Its occurrence in the hard, yellow limestone of the Moorabool Valley at Maude is additional evidence in favour of the correlation of these two beds. The shell is preserved in places, showing the typical ornament.

Dimensions of the present specimen.—Height, 50 mm.; width (circ.), 48 mm. The Table Cape specimen is much smaller, measuring 33 mm. by 31 mm.

Occurrence.—Moorabool River at Maude (Geol. Surv. Vict. coll. W.T.M.4).

Age.—Janjukian (Miocene).

Fam. DIPLODONTIDAE.

Genus **Diplodonta**, Bronn.

Diplodonta harrisi, sp. nov. (Plate II., Fig. 12.)

Description.—Shell moderately large, subquadrate, tumid, with well-rounded beaks, and a well-marked umbonal ridge. Anterior margin

13. Proc. R. Soc. Vict., vol. xiv., pt. i., 1901, p. 26, pl. iii., fig. 1.
14. Trans. R.S. South Australia, vol. viii., 1886, p. 123, pl. xi., fig. 3.

incurved beneath the beaks and transversely rounded to meet the nearly straight ventral margin. Posterior margin subangular, meeting the hinge-line in a straight upward slope. Surface with concentric grooves and finer striae between.

Dimensions.—Height, 28 mm.; width, 28 mm.; thickness of the two valves, 16.5 mm.

Observations.—To some extent this species resembles the commoner and more widely distributed *Diplodonta balcombensis*,[15] but the large umbones and the strong umbonal ridge, the squarer contour and the greater convexity all separate it from the other species.

I have much pleasure in naming this species after Mr. W. J. Harris, B.A., who discovered the shell.

Occurrence.—Bird Rock Cliffs, Torquay.

Age.—Janjukian (Miocene).

Class GASTEROPODA.

Order ASPIDOBRANCHIA.

Sub-order RHIPIDOGLOSSA.

Fam. TURBINIDAE.

Genus **Astralium**, Link.

Sub-genus Imperator, Montfort.

Astralium (Imperator) hudsonianum, Johnston. (Plate II., Fig. 15.)

Imperator (*Astralium*) *imperiale* (?) Johnston, 1876. Proc. Roy. Soc., Tasmania, p. 90*c*.

Imperator hudsoniana, Johnston, 1888. Geol. Tasmania, pl. xxix., figs. 12, 12*a*.

(?)*Imperator tasmanica*, Johnston, 1888. Ibid., p. 239.

Astralium (*Imperator*), *johnstoni*, Pritchard, 1896. Proc. Roy. Soc. Vict., vol. viii. (N.S.), pp. 116-118.

Astralium (*I.*) *hudsonianum*, Johnston, sp., Chapman, 1912. Proc. Roy. Soc., Vict. vol. xxv. (N.S.), pt. i., p. 188 and footnote 2.

Observations.—The figure given by Johnston in his Geology of Tasmania, although unaccompanied by any description, renders this form a valid species. In re-naming this form as *Astralium* (*Imperator*) *johnstoni*, Dr. Pritchard gives a very full description, and adds further Victorian localities.

The specimen before us, which we have taken the opportunity to figure, is from Rose Hill, Bairnsdale. It is a large and fairly well-preserved shell, having a maximum diameter of 72 mm., with a height of 35 mm. The characters agree almost exactly with those mentioned by Pritchard. The spiral threads are often coarse and broken

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15. *Diplodonta subquadrata*, Tate. Trans. R. Soc., S. Australia, vol. ix., 1887, p. 147, pl. xiv., figs. 10*a*, *b*. *D. balcombensis* (nom. mut.), Pritchard, Victorian Naturalist, 1906, vol. xxiii., p. 117.

up, becoming erect and bluntly spinose. These spiral threads on the outer, peripheral side are radiately curved, and pass into the calcarate portion of the shell.

An example from Table Cape, in the Dennant Collection, measuring 24 mm. in diameter, shows a very coarse spiral ornament on the earlier whorls of the shell.

Occurrence.—Here noted for the first time from Rose Hill, near Bairnsdale (donated by F. A. Cudmore to the National Museum). Other localities, mentioned by Dr. Pritchard are Keilor, Flemington, and the Moorabool Valley. Also found at Table Cape (Johnston, Dennant and Pritchard).

Age.—Janjukian (Miocene).

Genus **Turbo,** Linné.

TURBO GRANGENSIS, Pritchard. Plate II., Figs. 13, 14.

Turbo paucigranosa, Tate, MS. in Dennant, 1888. Trans. Roy. Soc. South Australia, vol. xi., p. 48.

Turbo hamiltonensis, Pritchard (non Harris, 1897), 1904. Proc. Roy. Soc. Vict., vol. xvii. (N.S.), pt. i., p. 329, pl. xix., fig. 4.

Turbo grangensis, Pritchard (nom, mut.), 1906. Victorian Naturalist, vol. xxiii., No. 6, p. 117.

Observations.—As the nomenclature of this species is rather involved, it may help future workers by recording the synonymy as above. In the Dennant Collection this particular species was labelled with Tate's MS. name. The most typical form there found is rather more depressed than Dr. Pritchard's type, probably owing to its being a more youthful shell. The measurements of this specimen are:—Height, 24.5 mm.; greatest diameter, 30 mm. Height of mouth, 15.5 mm. Diameter of umbilicus, 4 mm.

From the living perforated Turbos, *T. undulatus*, *Martyn* sp.,[16] and *T. stamineus*, Martyn sp.,[17] it differs both in ornament and contour, although distantly related. *T. undulatus* bears spiral ridges but they are not so pronounced, and the growth striae are not so conspicuously developed, whilst the beaded ornament is wanting. *T. stamineus* has the spiral ridges more pronounced, and the concentric growth-lines are developed as strong threads.

Occurrence.—Upper Beds at Muddy Creek and Grange Burn. Holotype from the Dennant Collection (Upper Beds, Muddy Creek). Another specimen, presented by Mr. F. P. Spry, from the Grange Burn, near Hamilton.

Kalimnan, Lower Pliocene.

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16. *Limax undulatus*, Martyn, Univ. Conch, 1784, vol. i., fig. 29.
17. *Limax stamineus*, Martyn, ibid., 1784, vol. ii., fig. 71.

Order CTENOBRANCHIATA.

Sub-order PLATYPODA.

Genus **Xenophora,** Fischer.

Fam. XENOPHORIDAE.

Sub-genus TUGURIUM, Fischer.

XENOPHORA (TUGURIUM) TATEI, Harris.

Xenophora (*Tugurium*) *tatei*, Harris, 1897. Cat. Tert. Mollusca. Brit. Mus., pt. i., Australasian Tertiary Mollusca, p. 254, pl. vii. figs. 7*a*, *b*.

Xenophora tatei, Harris, Hedley, 1903. Mem. Aust. Mus., Mem. iv., pt. 6, p. 357.

Observations.—This species is very remarkable for its great persistence in time. It first appears in the Oligocene of Muddy Creek, where it is of moderate dimensions. In the Janjukian, of the Murray River Cliffs and elsewhere, it attains an enormous size. It has not been found in the Kalimnan or Werrikooian to my knowledge, but reappears in recent dredgings, as recorded by Hedley.

The Oligocene Specimens.—In the Dennant Collection at the National Museum is a fair series of specimens from the lower beds at Muddy Creek. The smallest example has a diameter of 15 mm., whilst the largest measures 45 mm. The attached fragments on the surface of the shell are chiefly polyzoa and *Siliquariae*, but the latter may be idioparasitic; that is, growing upon the adventitious fragments. Newport, Altona and Mornington are also mentioned as localities by Dennant and Kitson.[18] In the National Museum collection there are also examples from Grice's Creek, which have *Limopsis* and *Dimya* shells attached.

Janjukian Examples.—Dennant and Kitson's List[19] includes the following localities: Camperdown, Shelford, Lower Moorabool.

A fine example of *X. tatei* in the National Museum from Bird Rock Cliffs, presented by Mr. F. A. Cudmore, is almost entirely covered by fragments of bivalves. The same donor presented an enormous specimen from the Murray River Cliffs, a quarter of a mile above Morgan (lowest bed).—See wall-case, Australian Fossil Gallery, Nat. Mus. This megalomorph shows that the Janjukian fauna was at its acme of development at this phase, and dwindled down in size to the present day to the same extent as when it existed in Oligocene times. The Murray River specimen, which is a cast and mould with fragmental covering, measures 115 mm. in diameter between the extreme surfaces of the mould. The internal cast is 98 mm. in diameter. The height of the shell was approximately 70 mm. The entire shell with encrusting fragments (small oysters) measures 22 cm.

18. Rec. Geol. Surv. Vict., vol. i., pt. ii., 1903, p. 113.
19. Op. cit., p. 113.

Recent Example.—The recent record of dredged specimens from New South Wales by Hedley[20] is of great interest to the student of persistent types. The localities given are: 63-75 fathoms off Port Kembla; 54-59 fathoms off Wata Mooli; 100 fathoms, 16 miles E. of Wollongong.

Hedley states that it "corresponds with actual fossil shells from Muddy Creek, with which I have compared it." One example was 30 mm. in diameter, and apparently half-grown.

Fam. CYPRAEIDAE.

Genus **Cypraea**, Linné.

CYPRAEA SIPHONATA, sp. nov. (Plate III., Fig. 16.)

Description.—Based on cast of shell. Body whorl inflated, sub-globular pyriform; spire not exsert, rather depressed. Anterior prolongation of aperture very extended, nearly as long as the body whorl, produced in a straight line in the plane of the shell base (apertural surface); posterior canal produced as in *Cypraea sphaerodoma*, Tate.

Dimensions.—Length of body whorl without prolongations, 61 mm.; width of body whorl, 61 mm.; height, 50 mm.; length of anterior prolongation, 56 mm.

Observations.—This shell, here represented by a well-preserved and complete cast, is of the type of Tate's *C. sphaerodoma*.[21] The remarkable and extensive anterior channel merits specific distinction. The longest anterior extension in *C. sphaerodoma* is, so far as I have seen, never more than one-fourth the length of the body whorl, and is always obtorted, never in a plane with the base.

Occurrence.—Tertiary (Janjukian). Below Overland Corner (left bank), and second cliff showing strata, below Waikerie, Murray River, South Australia. From the upper part of the cliff below the Kalimnan beds. Pres. and collected by Mr. F. A. Cudmore.

Genus **Erato**, Risso.

ERATO OBESULA, sp. nov. (Plate III., Fig. 18.)

Description.—Shell rather small, subrotund, spire small and depressed. Body whorl inflated. Outer lip thick, smooth, inner lip with one strong, curved plait. Aperture subcrescentic, moderately wide, canaliculate anteriorly. Surface polished, with faint folds in the line of growth.

Dimensions.—Length, 4.8 mm. Width, 4.25 mm.

Observations.—This species is by far the broadest shelled *Erato* from the Victorian Tertiaries. Its striking shape and smooth outer lip separate it from all previously described Eratos from this part

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20. Mem. Austr. Mus., Mem. iv., pt. 6, 1903, p. 357.

21. Trans. R. Soc. S. Australia, vol. xiii., 1890, p. 209. Also vol. xiii., supplement, 1892, pl. viii., fig 5.

of the world. From *E. morningtonensis*, Tate,[22] it differs in its greater width and depressed spire, whilst the outer lip is smooth, unlike that of *E. morningtonensis*, which is crenulated, and with the inner lip plaited. In its tumid form, *E. pyrulata*, Tate, approaches the present species, but differs in having a crenulated lip, and more exsert spire.

Occurrence.—In the blue clay of Balcombe Bay, Mornington. Found and presented by Mr. J. H. Gatliff. Balcombian (Oligocene).

Fam. MURICIDAE.

Genus **Murex**, Linné.

Sub-genus Muricidea, Swainson.

Murex (Muricidea) gatliffi, sp. nov. (Plate III., Fig. 19.)

Description.—Shell of medium size, turrited, and with a short canal. Spire elevated, apical angle 36°, longer than the body whorl, consisting of six turns besides the protoconch. Suture deeply impressed, whorls rounded, subangulate below the middle, with costate varices often becoming lamellose or scaly, about 10 on body whorl. Costae crossed by fine rounded spiral threads, about 10 on the penultimate whorl, and 26 on the body whorl with even finer intermediate ones; one on the angulation much thicker and prominent. The entire surface crossed with fine varicial lines passing over the spiral and coarser threads. Aperture roundly pyriform, with a nearly straight canal. Inner lip having a thin callus and a single columellar fold about midway in the aperture; outer lip thin, smooth. Protoconch small, consisting of one and a half turns, the initial portion obtuse.

Dimensions.—Height, 26 mm.; length of body whorl, to end of canal, 16 mm.; width of body whorl, 14 mm.; greatest width of aperture from inner lip, 7 mm.

Observations.—The above species is not unlike some living Trophons in general outline,[24] but the tendency to form lamellose varices and its decided affinity both to *Murex asperulus*, Tate,[25] and *M. camplytropis*, Tate,[26] makes its generic position clear. From both the forms mentioned, *M. gatliffi* differs in the greater number of costae and in the shape of the protoconch; whilst *M. asperulus* has a larger and more twisted canal and less extended spire. *M. camplytropis* differs in having a heavier shell, denticulate outer lip and pseudo-umbilicus.

Occurrence.—In the blue clay of Balcombe Bay, Mornington. Bal-

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22. Ibid., vol xiii., 1890, p. 217.
23. Ibid., vol. xiii., p. 216, pl. xiii., fig. 12.
24. In making comparisons with living genera and species, I have been materially assisted by Mr. C. J. Gabriel, to whom by best thanks are due.
25. Trans. R. Soc. S. Australia, vol. x., 1888, p. 106, pl. iii., fig. 1.
26. Ibid., p. 105, pl.iii., fig. 2.

combian (Oligocene). Collected and presented by Mr. J. H. Gatliff; named in recognition of his valuable work in Victorian conchology.

Fam. FUSIDAE.

Genus **Fusinus**, Rafinesque.

FUSINUS YOUNGI, sp. nov. (Plate III., Fig. 20.)

Description.—Shell long, fusiform. Spire turrited; apical angle 17°. Protoconch smooth, globular at apex, of two turns. Whorls angulate, upper and lower faces flat or slightly concave; shoulders carinate, with about 10 sharp almost spinose and flattened tubercles on each whorl. Ornamented with numerous, closely set, spiral lirae, interrupted on the siphonate part of the body whorl. Lirae crossed by numerous fine vertical threads, forming a delicate mesh-ornament. Aperture narrowly ovate. Canal long, inner lip smooth, outer thin.

Dimensions.—Length, 27 mm; greatest width of body whorl, 7 mm.; length of spire, above body whorl, 12.5 mm.; width of aperture, 2 mm.

Observations.—The original specimen (holotype) was found at Curlewis, and in the Dennant Collection there is a specimen from the same locality, and also others from Shelford and Belmont not quite so elevated in the spire, but clearly referable to the same species. There is no other form quite related to this in the Victorian Tertiaries. From the New Zealand Tertiary, Suter has described[27] a *Fusinus* (*F. climacotus*) from the Oamaru Series of Enfield, which approaches the above species, but differs in the more numerous shoulder tubercles and coarser vertical growth-lines.

Occurrence.—Janjukian (Miocene), Curlewis. Collected and presented by the late Mr. J. Hay Young of Meredith. Also found at Belmont, Curlewis and Shelford by J. Dennant (Dennant coll.).

Genus **Solutofusus**, Pritchard.

SOLUTOFUSUS CURLEWISENSIS, sp. nov. (Plate III., Fig. 21.)

Description.—Shell turrited, very attenuate. Whorls convex, slightly fluted vertically. Sutures deeply incised or canaliculate, partially separating the whorls. Aperture elongate, pyriform, with a long, slightly twisted canal, rather less than one third the length of the shell; inner lip thinly callused, outer lip fairly thick and transversely costate on the inside. Ornament of sharp lirae, with grooved interspaces, and a median thread; crossed by numerous vertical threads. Protoconch finely scaly, cylindrical, apically flattened of two and a half whorls. Neanic stage of shell with nearly obsolete costae, later whorls becoming evenly convex.

Dimensions.—Length, 56 mm.; width of body whorl, 13 mm.; height of protoconch, 2.5 mm.

27. Palaeontological Bulletin, No. 5, New Zealand Geological Survey, 1917, p. 21, pl. iii., fig. 12.

Observations.—The separation of the whorls in this species is not so pronounced as in the genotype, *Solutofusus carinatus*, Pritchard,[28] but this character is too decided in the present form for its inclusion in *Fusinus* (formerly *Fusus*, pars). The slightly tuberculate costae of the earlier stage of the shell is suggestive of Tate's *Fusus hexagonalis*,[29] but the rounded later whorls and their canaliculation easily separates the two forms. It is worth noting that *Solutofusus carinatus* and *Fusus* (*Fusinus*) *hexagonalis*, Tate, agree in having an exsert protoconch, whilst the present species has the apex flattened; so that that feature does not seem to be constant in *Solutofusus*.

Occurrence.—Janjukian (Miocene). Curlewis, near Geelong. Collected and presented by the late Mr. J. H. Young. There is a related specimen with ornament closer to *Fusinus hexagonalis*, but with canaliculate sutures, in the Dennant collection, from Shelford.

Fam. VOLUTIDAE.

Genus **Lyria**, Gray.

Lyria acuticostata, Chapman. (Plate III., Figs. 22, 23.)

Lyria acuticostata, Chapman, 1920. Proc. Roy. Soc. Vict., vol. xxxii. (N.S.), pt. ii., p. 241.

Observations.—Since the above-mentioned description was written, I have been able to identify some smaller and rather rare shells of the genus from the Balcombian, with the larger and better developed Miocene forms. These smaller forms have all the essential characters of the Ooldea and Torquay fossils, but are thinner in build, though otherwise typical; they are therefore included here under the same trivial name, and may be regarded as ancestral and deep water forms (of Balcombian age), of the Ooldea shells (of the Janjukian).

Dimensions.—Length of a full-grown Balcombian shell (from Balcombe Bay), 23 mm. Length of a shell from Torquay, 42 mm. Length of a Janjukian shell from Ooldea, circ. 60 mm.

Occurrence.—Balcombian (Oligocene). Balcombe Bay and Grice's Creek, Port Phillip. Janjukian (Miocene), Bird Rock Cliffs, Torquay, Victoria; and Ooldea, South Austrilia.

Genus **Voluta**, Linné.

Sub-genus AULICA, Gray.

Voluta (Aulica) sexuaplicata, sp. nov. (Plate III., Fig. 24.)

Description.—Shell long-ovate with hemispherical protoconch of two and a half turns, moderately large and turbinoid. Apical angle of shell 33°; consisting of four depressed convex whorls, with im-

28. Proc. Roy. Soc. Vict., vol. xi., pt. i., 1898, p. 102, pl. vii. figs. 1, 1*a*, 2.
29. Trans. Roy. Soc. S. Australia. vol. x., 1888, p. 139, pl. iii., figs. 15*a*, *b*.

pressed sutures. Outer lip not so extensive as in *V. ellipsoidea*, with a straight margin rather than convex; inner lip with a thin callus and six plaits, of which the anterior is oblique, and just within the entrance to the canal, the second, third and fourth slightly oblique and evenly spaced, the fifth and sixth smaller and close together beyond the second third of the inner lip margin. Surface nearly smooth, covered with fine indistinct striae, both spiral and vertical.

Dimensions.—Length, 72 mm. (body whorl, 46 mm.; spire, 26 mm.). Width of body whorl, 23.5 mm. Height of protoconch, 4 mm.

Relationships.—The nearest species to which the above form is related is *V. ellipsoidea*, Tate.[30] It differs, however, in the depressed convexity of the whorls, the compression of the outer lip, the narrower protoconch, the more oblique sutures, and the absence of lirae. Besides these differences, *V. sexuaplicata* has the two extra plicae on the inner columellar lip.

Occurence.—*Voluta (Aulica) sexuaplicata* is represented by a well-preserved example from the Balcombian (Oligocene) of Clifton Bank, Muddy Creek, presented by Mr. G. P. Tait.

Fam. CANCELLARIIDAE.

Genus **Cancellaria**, Lamarck.

CANCELLARIA TORQUAYENSIS, sp. nov. (Plate III., Fig. 25.)

Description.—Shell bucciniform, stout, with a small rounded protoconch of two turns, and five moderately convex whorls. The ephebic and neanic stages have rather flattened whorls, ornamented with well marked spiral striae, vertically lineated. Penultimate and body whorl inflated, with about 15 rounded costae; both these and the interspaces transversely grooved with deeply incised lines.

Dimensions.—Height, 23 mm.; width of body whorl, 15 mm.; height of body whorl, 14.5 mm.

Observations.—This shell is of the type of *Cancellaria australis*[31] in the costate and spirally grooved ornament. The spire in *C. torquayensis* is more elongated and the costation is not seen until the fourth whorl.

Occurrence.—Janjukian (Miocene). Bird Rock Cliffs, Torquay. Collected and presented by Mr. F. A. Cudmore.

CORRIGENDA.

New or Little-known Victorian Fossils, part xxv., Proc. Roy. Soc. Vict., vol. xxiii. (N.S.), 1921.

P. 224, eighth line from the bottom—for "*Aveolites*" read "*Alveolites.*"

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30. Trans. Roy. Soc. S. Australia, vol. x., 1888, p. 176, pl. xiii., fig. 4; and vol. xi., 1889, p. 127.

31. *Cancellaria australis*, Sowerby. Conch. Illustr., 1841, fig. 23. Thesaurus Conch., vol. ii., p. 442, pl. xcv., figs. 72, 73.

Also plate ix. title—for "Michelina" read "Michelinia."

Plate x. title—for "Michelina," read "Michelinia," and for "Romingera," read "Romingeria."

EXPLANATION OF PLATES.

PLATE I.

Fig. 1.—*Ostrea ingens*, Zittel. Interior of left or lower valve. Miocene (Janjukian), Waurn Ponds, Geelong, Mulder coll., circ. two-thirds natural size.

„ 2.—*O. ingens*, Zittel. Exterior of same specimen. Circ. two-thirds natural size.

„ 3.—*Neotrigonia bednalli*, Verco var. Left valve. Lower Pliocene (Kalimnan). Macdonald's, Muddy Creek, Pres. J. H. Young. Slightly enlarged.

„ 4.—*Plicatula youngi*, sp. nov. Exterior of right valve. Oligocene (Balcombian). Clifton Bank, Muddy Creek. Coll. J. H. Young. Slightly enlarged.

„ 5.—*P. youngi*, sp. nov. Interior of right valve of same specimen. Slightly enlarged.

„ 6.—*Plicatula dennanti*, sp. nov. Exterior of right valve. Oligocene (Balcombian), Lower Beds, Muddy Creek. Coll. by J. Dennant. Slightly enlarged.

„ 7.—*P. dennanti*, sp. nov. Interior of a left valve. Oligocene (Balcombian), Lower Beds, Muddy Creek. Coll. J. Dennant. Slightly enlarged.

„ 8.—*Plicatula brevispina*, sp. nov. Exterior of right valve, Oligocene (Balcombian), Lower Beds, Muddy Creek. Coll. J. Dennant. Slightly enlarged.

PLATE II.

Fig. 9.—*Hinnites mulderi*, sp. nov. Left valve. Miocene (Janjukian). Batesford, near Geelong. Pres. J. F. Mulder. Nat. size.

„ 10.—*H. mulderi*, sp. nov. Interior of left valve of same specimen. Nat. size.

„ 11.—*Spondylus baileyana*, sp. nov. Left valve. Lower Pliocene (Kalimnan), Beaumaris, Port Phillip. J. F. Bailley coll. Nine-elevenths nat. size.

„ 12.—*Diplodonta harrisi*, sp. nov. Left valve. Miocene (Janjukian), Torquay, near Geelong. Pres. by W. J. Harris. Nat. size.

„ 13.—*Turbo grangensis*, Pritchard. Umbilical aspect. Lower Pliocene (Kalimnan). Grange Burn, near Hamilton. Dennant coll. Slightly enlarged.

„ 14.—*T. grangensis*, Pritchard. Same specimen, lateral view. Dennant coll. Slightly enlarged.

„ 15.—*Astralium (Imperator) hudsonianum*, Johnston. Miocene (Janjukian). Rose Hill, near Bairnsdale. Pres. F. A. Cudmore. Slightly enlarged.

PLATE III.

Fig. 16.—*Cypraea siphonata*, sp. nov. Cast of shell in matrix. Miocene (Janjukian). Murray River Cliffs, South Australia. Presented by F. A. Cudmore. Circ. nine-tenths nat. size.

„ 17.—*Modiolus mooraboolensis*, sp. nov. Right valve. Miocene (Janjukian), Moorabool River, near Maude. Coll. Geol. Surv. Vict. Five-eighths nat. size.

„ 18.—*Erato ovesula*, sp. nov. Oligocene (Balcombian). Balcombe Bay, Port Phillip. Pres. by J. H. Gatliff. Enlarged slightly more than four-thirds.

„ 19.—*Murex* (*Muricidea*) *gatliffi*, sp. nov. Oligocene (Balcombian), Balcombe Bay. Pres. J. H. Gatliff. Slightly enlarged.

„ 20.—*Fusinus youngi*, sp. nov. Miocene (Janjukian). Curlewis, near Geelong. Pres. J. H. Young. Enlarged nearly twice nat. size.

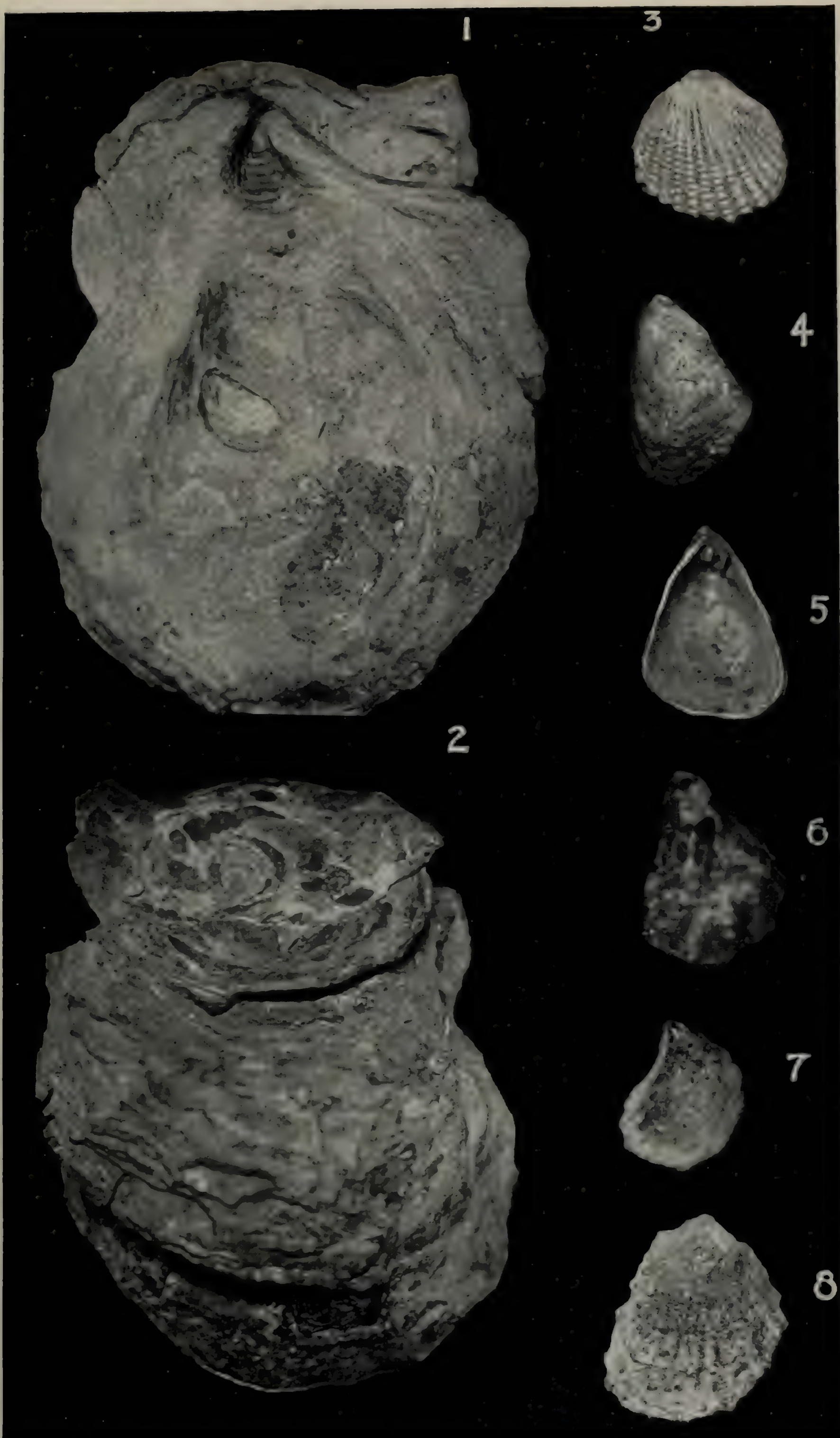
„ 21.—*Solutofusus curlewisensis*, sp. nov. Miocene (Janjukian). Curlewis. Pres. J. H. Young. Enlarged seven-sixths nat. size.

„ 22.—*Lyria acuticostata*, Chapman. Megamorphic example. Miocene (Janjukian). Torquay, near Geelong. Dennant coll. Nat. size.

„ 23.—*L. acuticostata*, Chapman. Micromorphic example. Oligocene (Balcombian). Balcombe Bay. Nat. size.

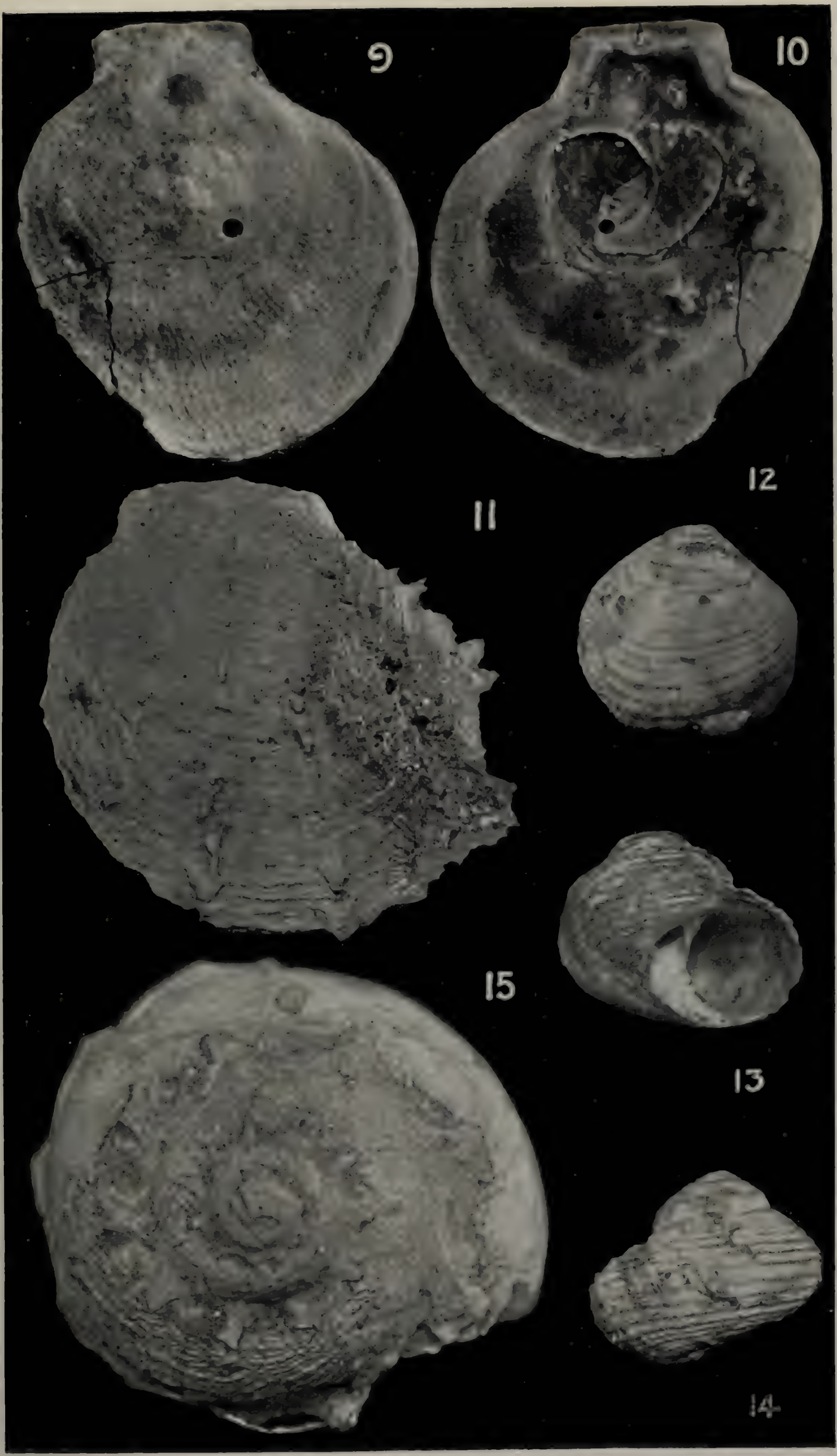
„ 24.—*Voluta sexuaplicata*, sp. nov. Oligocene (Balcombian). Clifton Bank, Muddy Creek. Pres. G. P. Tait. Nat. size.

„ 25.—*Cancellaria torquayensis*, sp. nov. Miocene (Janjukian). Bird Rock Cliffs, Torquay. Pres. F. A. Cudmore. Slightly enlarged.



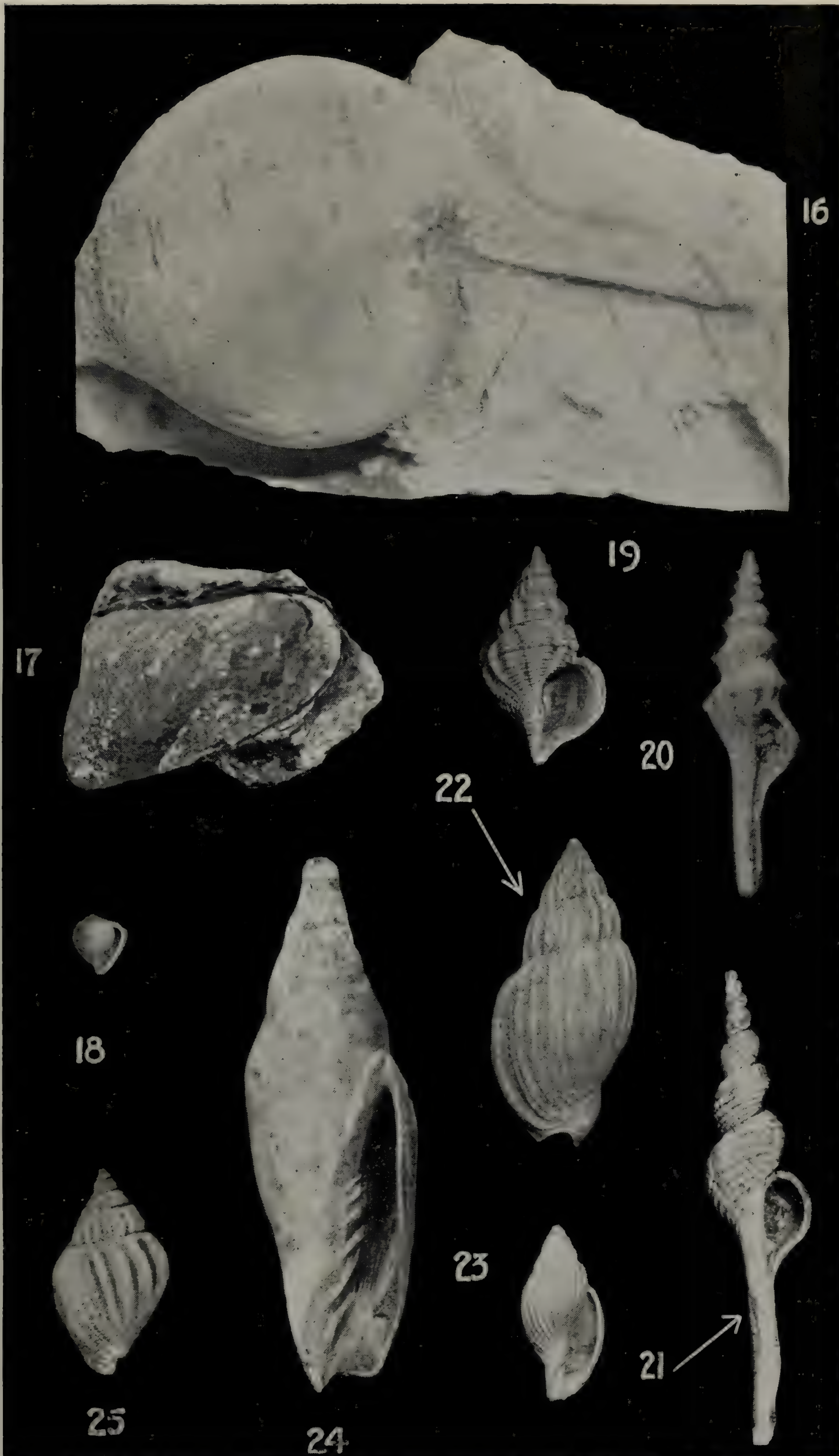
F.C. ad nat. del.

Ostrea, Neotrigonia, Plicatula: Tertiary.



F.C. ad nat. del.

Hinnites, Spondylus, Diplodonta, Astralium, Turbo: Tertiary.



F.C. ad nat. del.

Cypræa, Modiolus, Erato, Murex, Fusinus, Solutofusus, Lyria, Voluta, Cancellaria: Tertiary.

PROC. ROY. SOC. VICTORIA 35 (N.S.), PT. I., 1922.]

ART. II.—*On Coprosma Baueri, Endlicher.*

By JOHN SHIRLEY, D.Sc., and C. A. LAMBERT.

(With Plate IV.)

[*Read 20th April, 1922.*]

1. The Genus.

Coprosma is a genus of Rubiaceæ, comprising some 60 species, whose headquarters are in New Zealand. The Dominion and its dependencies possess 39 of these species(1), Australia five(2), and the remaining units extend northward to New Guinea and Borneo, and westward to the Sandwich Islands and Juan Fernandez, near the Pacific coast of South America. The New Zealand species form dense thickets, both in lowland forests and in woods to heights of 6000 feet. They vary very much in mode of growth and foliage at different periods of their life history. Many Coprosmas have the aspect of desert plants, as have also New Zealand species of *Pennantia*, *Hoheria* and *Plagianthus*, and are consequently termed xerophytes. These show great range of variability in their leaves; the seedling and mature stages possessing larger leaves than the intermediate one. This xerophytic habit, so strongly represented in the flora of a temperate, well watered group of islands, has been a fertile source of discussion by biologists and geologists. Hutton(3) asserts that during the Pliocene period the Southern Alps were much higher than now, and that such groups as the Chatham and Auckland Islands were part of the New Zealand mainland. The plains east of the main ridge were arid and wind-swept, with warm summers, and very cold winters. Dr. L. Cockayne(4) explains that the seedling stage of these plants of xerophytic aspect, and with an alternation of leaf forms, represents the ancestral plant before the Pliocene desiccation; the intermediate foliage represents the plant of Pliocene New Zealand; and the larger leaves of the mature form are the response to present conditions. Two erect species with large coriaceous shining leaves are commonly cultivated in public and private gardens throughout Australia—*C. Baueri*, Endl., and *C. lucida*, Forst.

2. Previous workers.

Cheeseman(5), in an article on "New Zealand Species of Coprosma," refers to the curious little pits that exist on the under surface of the leaves of these plants, states that they are often inhabited by a tiny yellow acarid, but confesses that he is unable to guess as to their function.

Dr. A. N. Lundström (6) applied to the pits the name domatia, and decided that they were of use to the plant as the home of commensals, living in symbiosis with it. Mr. Alexander Hamilton(7)

1 The numbers refer to works consulted, shown in the Bibliography at the end of the paper

gave a general review of these curious leaf organs, dealing especially with the histology of the leaf of *Pennantia Cunninghamii*, Miers, and figuring a hair from the pit of *Coprosma lucida*, Forst. Both of these writers(6, 7) lay much stress on the use of the pits as a habitation for Acarina, though Hamilton acknowledges that as often as not the pits were found without guests. Where mites were numerous he found the walls of the cavities damaged, showing brownish patches and bright crimson cells. It is remarkable that the kaikomako or New Zealand Pennantia is in its young state a shrub, whose flexuous interlacing branches and small distant sessile leaves give it the aspect of a xerophyte; while in its mature stage it is a tree, 20 to 30 feet high, with stalked glossy leaves two inches in length. A very important paper on the Coprosma leaf pits is that by Miss N. A. R. Greensill(8), dealing with the minute structure of the leaves of ten New Zealand species, and reviewing all work on the subject to date. Miss Greensill utterly failed to find insect guests in the so-called *domatia*, either in species cultivated in gardens and public parks, or in those growing under natural conditions; she found some pits in an unhealthy state with brown patches and crimson-coloured cells, but traced these changes to attacks of fungi. Miss Greensill favours the view that the pits absorb moisture. Mr. Nathan Banks(9) figures three structures in leaves caused by Acarina, which he terms dimple gall, capsule gall, and pouch gall respectively, caused by mites *Eriophyes pyri*. The pear-leaf blister mite is found in Australia.

3. Histology.

I. Leaf Structure of C. Baueri.

The pits lie on each side of the midvein, at junctions with primary veins, and vary in number from four to nine; those in the lower part of the leaf are often immature and closed, when the upper ones are mature and open. Very rarely are they found on the primary veins; and in each case noted this abnormal position was limited to a single pit. In transverse section, (fig. 1), the leaf shows an upper epidermis of three layers. The first is constructed of small ovate cells, with their longitudinal axis parallel to the surface, irregular in size, the longest about 31μ. This layer is clothed externally by cutin measuring one-half to one-third the transverse diameter of a cell. The units of the second layer show no cell contents, and are polygonal in outline; their greatest diameter is 65μ. The third layer is composed of cells (fig. 2) showing transition forms between those of the second layer and palisade cells, the shape is rhomboidal or rhombo-polygonal, and the long axis is at right angles to the surface, the greatest length is 33μ. Palisade cells proper are in three rows, slender in outline, 54 long, three or four abutting on each pair of third rank epidermal cells. The spongy parenchyma (fig. 1), shows cells of various outlines—oval, globular, dumb-bell shaped, etc., seldom exceeding 35μ in diameter. The intercellular spaces between them are very small; with the exception of those near a pit they communicate by numerous small stomata.

with the outer air. Stomata are of usual type, surrounded by the ordinary epidermal cells, which have not the wavy outline common to their class. The lower epidermis is of a single layer of minute rounded-oval cells, raised into short bluntly conical points on their free surfaces (fig. 3). Numerous unicellular hairs coat this lower leaf surface, most of which spring from an inflated base (fig. 3), and sometimes from a pear-shaped cell, larger than the epidermal cells among which it is inserted.

II The Leaf Pits. (Fig. 1).

In transverse section the pits present various irregular shapes, and widen rapidly from their openings. In common with other portions of the lower epidermis, these pits are beset with numerous unicellular nucleated and non-nucleated hairs. Each pit is lined with epidermal cells, clothed outwardly with cutin, and set with the longitudinal axis at right angles to the surface. Though the spaces in the spongy parenchyma may only be separated from the outer air by two layers of cells, no stomata have been found in these depressions.

III. The Veins. (Fig. 1.)

In transverse section the midrib presents an upper epidermis of a single layer of cells, resembling those of the outer layer in the blade. Beneath this is a mass of cortical cells, most thickly developed on the lower surface, and enclosing a vascular bundle, of which the xylem elements form the upper, and the phloem elements the lower, portion of the bundle, as is usual in dicotyledonous leaves. A well marked pericycle surrounds the whole, its cells blending into the mass of cortical cells on the upper margin. In smaller veins the bundle sheath is formed of large cells, whose outer walls are considerably thickened, and when the vein is cut at right angles the sheath resembles a minute necklace. The vessels of the xylem are mainly spirally strengthened, and those of the protoxylem are exceedingly slender and delicate.

IV. The Stem. (Figs. 5 and 6.)

In transverse section, fig. 5, the stem is peculiar for the depth of the bast layer, and for the way in which it gradually merges into the phelloderm of the cortex. The only difference in transverse section between phloem and phelloderm is the direction of the longitudinal axis in their cells, in the former running radially, in the latter circumferentially. The phellogen shows clearly, and there is a layer of empty cells below the dead cork.

In longitudinal section, (fig. 6), the elements of bast and wood are particularly interesting, especially in reference to the xylem and phloem parenchyma, which are very well represented. The wood parenchyma is exactly of the type illustrated by Strasburger (11), as are also the tracheides, with narrow oblique bordered pits, figured by that author under the term *fibre tracheides.* In tangential section the medullary rays are three to four cells thick, the elements unequal in size, and arranged in oblique series. The cells are evidently of two types, the outer ones showing circular bordered pits, which in the inner cells are absent.

4. The Functions of the Pits.

My colleague, C.A.L., examined a large number of leaves in Melbourne gardens, and in no case found insect guests inhabiting the pits; an examination of plants in the Sydney Botanic Gardens in January, 1921, and in the Brisbane Botanic Gardens in October, 1921, also gave negative results. Miss Greensill reports similarly of her experience of New Zealand species of Coprosma. This seems to dispose of Lundström's theory that the pits are the homes of commensals. To test whether these pores are sources of a supply of moisture to the leaf, similar to those figured by Kerner and Oliver(12) the pits on healthy leaves, still attached to the plant, were filled by C.A.L. with a quickly drying varnish, and flourished as well as ever, proving that absorption through the pores is no necessary function. It has already been stated that the pits do not contain stomata, and that these organs are minute in size, and numerously spread over the surface of the lower epidermis. After exhausting the aids of the microscope and of experiment, our conclusion is that the pores were formerly of assistance to the plant when under xerophytic conditions, and that in the Miocene age of continental New Zealand, the stomata were confined to them, as in the leaves of many of our Hakeas, but that with modern and more humid conditions, the leaves have developed stomata on their lower epidermis, and the pits are now useless to the plant, having only an interest to the teleologist.

EXPLANATION OF PLATE IV.

Fig. 1—Transverse section of leaf.
 e. Pit.
 f. Midrib.
Fig. 2—a. Epidermis and cutin.
 b. Epidermal cells of second layer.
 c. Palisade cells.
Fig. 3—Epidermis, underside of leaf.
Fig. 4—Upper epidermis, surface.
Fig. 5—Transverse section of young twig.
Fig. 6—Tangential section.
 a. Medullary rays.
 b. Fibre tracheids.
 c. Trachea.
Fig. 7—Basal membrane of pit.
Fig. 8—Nucleated hair from base of pit.

BIBLIOGRAPHY.

1. Cheeseman, T. F.—Manual of the New Zealand Flora, 1906, p. 243.
2. Bentham—Flora Australiensis, Vol. III., pp. 429–30.

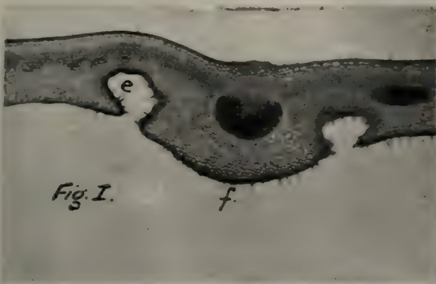


Fig. I.

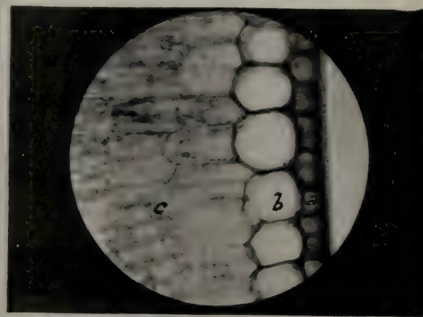


FIG. 2

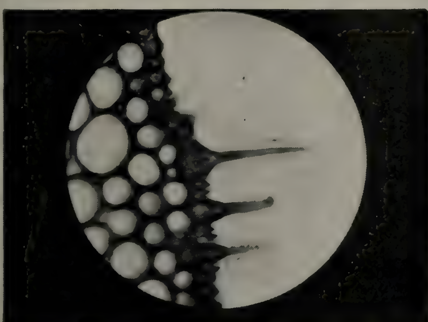


FIG. 3

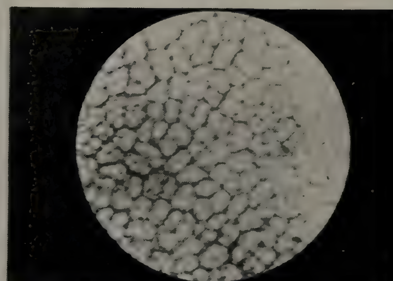


FIG. 4

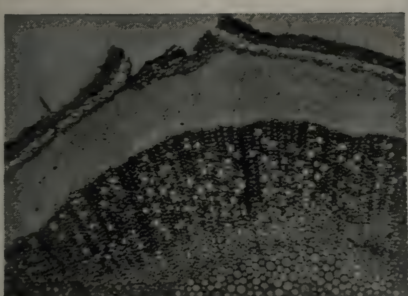


FIG. 5

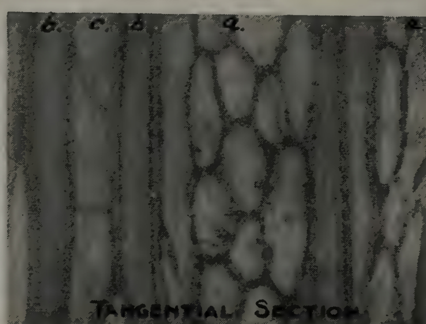


FIG. 6

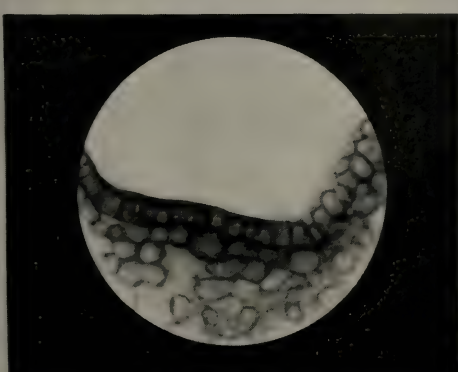


FIG.7

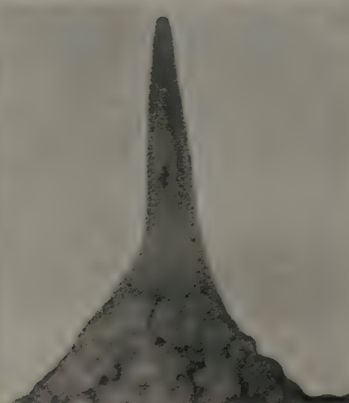


FIG. 8

3. Hutton, Captain—Transactions of the New Zealand Institute, Vol. XXXII., p. 182.
4. Cockayne, Dr. L.—Transactions of the New Zealand Institute, Vol. XXXIII., p. 277.
5. Cheeseman, T. F.—Loc. cit., Vol., XIX., 1886, p. 221.
6. Lundström, Dr. A. N.—On Domatia, Nov. Arch. R. Soc. Scient. Upsala., XIII., 1887, pp. 1–72, 4 plates.
7. Hamilton, Alexander—On Domatia in certain Australian and other plants, Proc. Lin. Soc. N.S.W., Vol. 21, 1896, pp. 758–792, Pl. LVII.
8. Greensill, Miss N. A. R.—Trans. N.Z. Inst., XXXV., 1902, pp. 342–355. Plates 41–44.
9. Banks, Nathan—Report No. 108, United States Department of Agriculture, p. 135.
10. Trimen, H.—Handbook of the Flora of Ceylon, pp. 328, 336, 354, 357, 359, 360, 362 and 369.
11. Strasburger, Ed.—Handbook of Botany, 1908, p. 137.
12. Kerner and Oliver—Natural History of Plants, Vol. I., p. 231.

[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. I., 1922.]

Art. III.—*Description of a New Victorian Helichrysum.*

By H. B. WILLIAMSON, F.L.S.

(With Plate V.)

[Read 20th April, 1922.]

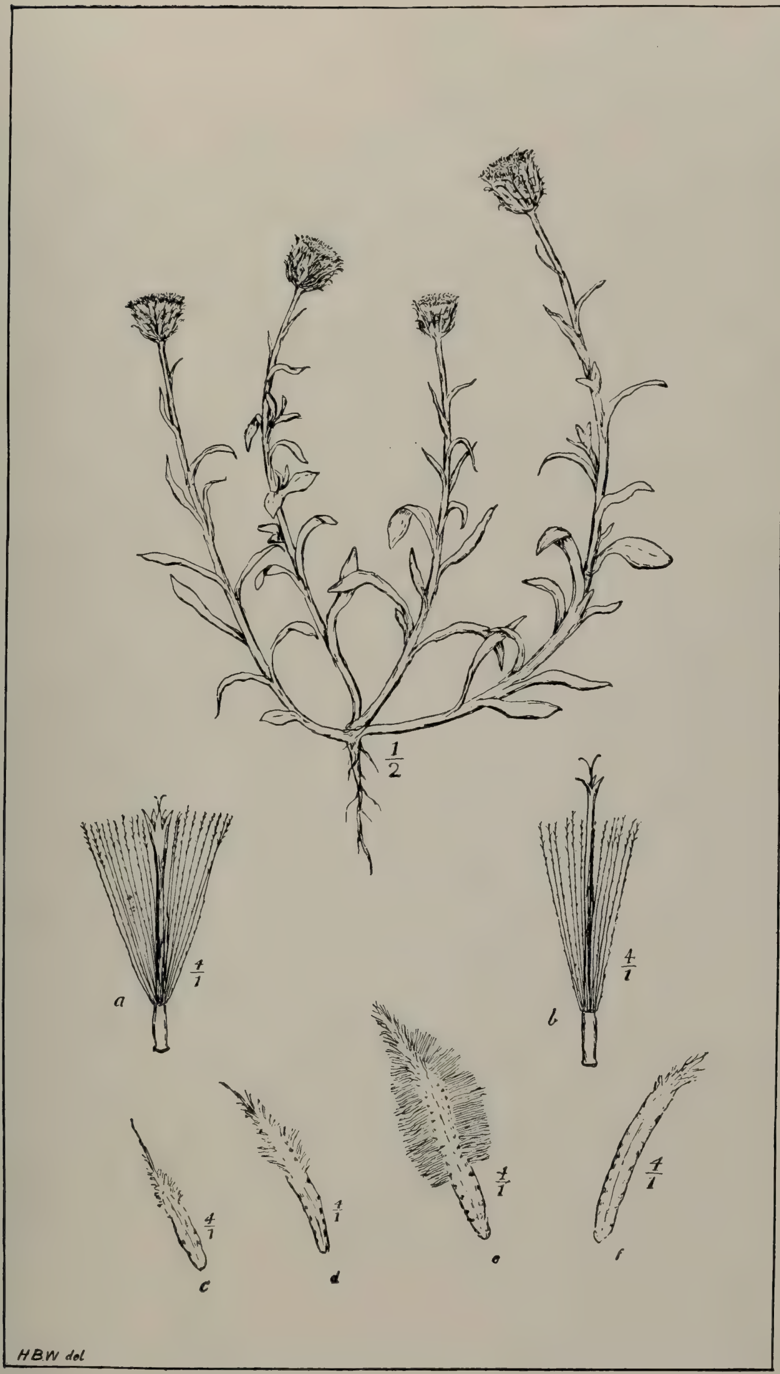
Helichrysum Gatesii, n.sp.

Fruticulus humilis circiter 15 cm. altus, caulibus saepe occumbentibus rarius ramosis adpresse albo-lanatis, foliis alternis, subamplexicaulibus oblanceolatis vel linearibus subtus dense supra sparse albo-lanatis margine paulo recurvatis undulatisque 2-4 cm. longis 0.5-1 cm. latis, capitulis solitariis caules superne dissite foliatos terminantibus campanulatis circiter 1 cm. longis latisque, involucri bracteis numerosis plerumque longo-linearibus scariosis stramineis rugulosis ad apicem tenuibus ciliolatis aureis ruginosis subpatentibus, exterioribus brevioribus omnibus praeter intimas longe lanatis involucram vix superantibus, pappi setis circiter 20 inferne sparse barbellatis superne breviter plumosis, floribus foemineis paucis periphericis circiter 12 pappi setis instructis, acheniis glabris erostribus 1.5 mm. longis, pappi setis 6 mm. longis.

On hard dry ground on hillsides, Lorne, Vic. Rev. A. C. F. Gates, Dec. 7th, 1921. Flowering December to April.

A plant about 15 cm. high, with the habit and general aspect of *Leptorrhynchus Waitzia* or *L. pulchellus*, with alternate leaves, and with stems and the under side of the leaves woolly white. Flower heads solitary on rather long stems, with distant leafy bracts towards the flower heads. Involucral bracts not expanding into a ray, the outer ones shorter, and all embedded in cottony wool growing from their edges, wrinkled, and with light golden ciliate tips. Florets scarcely exceeding the involucre, with about 20 pappus bristlets excepting the few female florets which have about 12. All pappus bristlets sparsely barbellate below, shortly plumose at the summit. Achenes glabrous, not beaked.

Reference to page 612, vol. iii., Fl. Aust., will indicate the difficulty encountered in assigning a place to this plant. The bracts, consisting of woolly-edged linear claws point to *Ixiolaena*, but the numerous pappus bristlets plumose at the summit keep it out of that genus. It is here placed out of *Leptorrhynchus* on account of the shortness of the florets, and the absence of distinct upward narrowing of the achenes. It approaches near to *Helichrysum ambiguum*, Turcz. (*Leptorrhynchus*, Bth.), but that species has female florets with few or no pappus bristlets, and a very different involucre. From *H. rutidolepis* it is distinguished by having all flowers provided with at least 12 pappus bristlets, and by the short ciliate wrinkled laminae of the bracts.


1/2
4/1
a
4/1
b
4/1
c
4/1
d
4/1
e
4/1
f
HBW del

It may be considered as forming a link between sections Oxylepis and Chrysocephalum, and is placed next to *H. podolepideum*, its nearest affinity. That species (from Central Australia), has rather larger flower heads, with longer, and almost entire scarious tips to the bracts, stouter, shorter and almost bractless peduncles, leaves obovate and thick, which are densely clothed on both sides with a cottony wool, and resemble one of the forms of *H. apiculatum*.

It is rather strange that this plant has apparently never been sent to the National Herbarium, for it is not rare in the locality from which it is received. I am indebted to the Government Botanist, and to the officers of the Herbarium for the privilege of searching for and comparing material.

EXPLANATION OF PLATE V.

Fig. *a*=Bisexual floret.
,, *b*=Female floret flower.
,, *c*, *d*, *e*, *f*=Bracts.

[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. I., 1922.]

Art. IV.—*Studies in Australian Lepidoptera.*

By A. JEFFERIS TURNER, M.D., F.E.S.

[Read 20th April, 1922.]

In this paper I have described a number of species from three localities, omitting the *Geometrites*, which are included in another publication.

(1) From a collection made by Mr. J. A. Kershaw on the Claudie River, in the Cape York Peninsula. This river, which is not marked in most maps, flows into Lloyd Bay to the north of Cape Direction, at about latitude 13°S. The area chiefly collected over was situated from seven to ten miles inland, and consisted of both open forest and dense tropical rainforest.

(2) A collection made in Tasmania by Mr. G. H. Hardy.

(3) Species captured by myself in the luxuriant rainforest and ferntree gullies of the Queensland National Park in the MacIntyre Range, at an altitude of 2000 to 4000 feet.

I have also taken this opportunity of completing and correcting my former revisions of five of the smaller families, the *Syntomidae*, *Uraniadae*, *Epiplemidae*, *Thyrididae*, and *Aegeriadae*, and have added a revision of the *Tineodidae*. A few new forms, of which it appears desirable to publish the descriptions, belonging to other groups, have been also included.

Fam. SYNTOMIDAE.

Since the publication of my revision (Proc. Lin. Soc., 1904, N.S.W., p. 834), I have described one new species (*Syntomis phaeochyta*, ib. 1906, p. 678), and I have now several more.

Ceryx affinis.

Ceryx affinis, Roths., Nov. Zool., 1910, p. 429, and 1911, pl. iii., fig. 15. Hmps., Cat. Lep. Phal. Suppl. i., p. 4.

I have not seen this species. It should be recognisable by the orange abdominal rings being interrupted on dorsum except on penultimate segment.

N.Q., Kuranda, near Cairns (Dodd). Also from New Guinea.

Ceryx rhysoptila, n. sp.

♂ 25-30 mm. Head blackish; face and back of crown orange-yellow. Palpi yellow. Antennae blackish; in ♂ simple, minutely ciliated. Thorax black; tegulae and patagia orange-yellow. Abdomen black with six orange-yellow rings; tuft black. Legs blackish; femora and tibiae suffused with yellowish on inner surface; anterior tibiae and tarsi thickened with rough scales, yellow on inner surface. Forewings narrow; black with hyaline colourless spots; an elongate-triangular spot in cell; a larger spot between this and dorsum, extended towards base and tornus; an elongate-oval, undivided subapical spot; a circular supratornal spot, nearly equally divided; cilia black. Hindwings small, somewhat shrivelled, termen indented above tornus; black, an irregular orange-yellow basal spot, with a rounded median projection, cilia black.

N.Q., Evelyn Scrub, near Herberton, in November and December; two specimens received from Mr. F. P. Dodd.

Syntomis xanthosoma.

Amata tunneyi, Roths., Nov. Zool., 1910, p. 431, and 1911, Pl. iii., fig. 44. Hmps., Cat. Lep. Phal. Suppl. i., p. 14, is a synonym.

N.W.A., Derby; two examples taken by Mr. W. D. Dodd received from the South Australian Museum.

Syntomis pactolina.

Q., Brisbane, in October; one specimen differing from the type in the distal spot of the hindwing being smaller and separated for the most part from proximal spot, confluent only beneath costa.

Syntomis amoenaria.

Syntomis amoenaria, Swin., Ann. Mag. Nat. Hist. (7), ix., p. 418 (1902). Hmps., l.c., p. 20.

I have not seen this species.

N.W.A., Roeburne.

Syntomis pyrocoma.

Hampson records this as *cingulata*, Butl., but that name is preoccupied in the genus (Weber, 1801). I am not sure that *melitospila*, Turn., is more than a local race of this species.

Syntomis microspila, n. sp.

♂ ♀ 29-30 mm. Head orange, with some fuscous scales between antennae. Palpi dark fuscous. Antennae dark fuscous; apices white; in ♂ slightly serrate. Thorax dark fuscous, tegulae orange; sometimes with a few orange scales at posterior apex. Abdomen dark fuscous, with 7 orange rings in ♂, 6 in ♀ ; tuft dark fuscous, in ♀ whitish at apex. Legs dark fuscous; anterior tibiae with an orange tuft on under-side. Forewings elongate; dark fuscous, with small dull orange spots tending towards obsolescence; basal and sub-dorsal spots more or less quadrangular; spot in cell subtriangular; subapical spot nearly or wholly obsolete; supratornal very small, nearly equally divided; cilia dark fuscous. Hindwings dark fuscous; a moderate or small basal spot, nearly or quite obsolete on costal side of median; a very small undivided distal spot sometimes nearly obsolete; cilia dark fuscous.

Allied to *S. insularis*, but differing in the great reduction or obsolescence of the distal spots in both wings, and with intermediate spot wholly absent.

N.Q., Cooktown, in December; Kuranda, near Cairns, in January; three specimens.

Syntomis ochrospila, n.sp.

♂ ♀ 25-30 mm. Head dark fuscous; face, back of crown, and behind eyes yellow. Palpi dark fuscous. Antennae dark fuscous; in ♂ shortly bipectinate.(1) Thorax dark fuscous; tegulae and a posterior spot yellow. Abdomen dark fuscous with 7 orange-yellow rings in ♂, 6 in ♀; tuft dark fuscous, with an orange-yellow spot on dorsum, larger in ♀. Legs dark fuscous. Forewings moderately broad; dark fuscous; spots moderate, whitish-ochreous; basal spot small; dorsal spot elongate, oblique, often with a small spot or dot above it; spot in cell subtriangular; subapical spot elongate, rarely with a dot above it at apex; supratornal spot moderate, equally divided; cilia dark fuscous. Hindwings dark fuscous; basal spot moderate or rather small; distal spot moderate, unequally divided, the upper segment very small; cilia dark fuscous.

Easily distinguished by the pale-spotted wings, dark fuscous patagia, and abdominal tuft, and pectinate ♂ antennae.

N.Q., Ingham, in April and May; four specimens received from Mr. G. N. Goldfinch.

Eressa megalospilia, nom. nov.

Eressa strepsimeris, Hmps., Cat. Lep. Phal. Suppl. i., p. 47, pl. iii., fig. 13, *nec*. Meyr.

This is the North Australian representative of the North Queensland *strepsimeris*, Meyr. (*xanthostacta*, Hmps.). It is larger than that species, the spots are much larger and more transparent, and the basal spots of hindwings are largely developed. Meyrick's type was from Bowen, and his description is of the small-spotted species.

N.A., Darwin, Daly River.

Eressa paurospila, n. sp.

♂ 26-30 mm. Head blackish; face and an anterior spot on crown ochreous. Palpi blackish. Antennae blackish; in ♂ shortly bipectinate.(1) Thorax blackish with a posterior orange spot. Abdomen blackish, with six ochreous rings; first ring interrupted on both sides on dorsum; tuft blackish, at apex ochreous. Legs blackish. Forewings blackish, with five pale-ochreous, semi-translucent spots; first between basal part of cell and dorsum; second in cell; third very small beneath ¾ costa; fourth and fifth small, separated by vein 4, before middle of termen. Hindwings blackish; two ochreous spots; first basal, moderate, bisected by a blackish line on cubital vein; second minute, subapical.

Nearest *E. geographica*. but with fewer and smaller spots on wings, and only one spot on thorax.

N.S.W., Bulli, in March; three specimens received from Mr. G. H. Hardy, who has presented the type to the Queensland Museum.

Euchromia polymena.

N.W.A., Wyndham; two specimens received from Mr. L. J. Newman. Previously the only Australian record for this wide-ranging species was a single specimen in the Macleay Museum, said to be from North Australia.

Fam. ARCTIADAE.

Hestiarcha atala, n. sp.

♂ 30 mm. Head ochreous. Palpi short (about 1), porrect or somewhat drooping; ochreous, slightly fuscous-tinged. Antennae (broken short) ochreous; in ♂ simple, shortly ciliated (1). Thorax brownish-ochreous. Abdomen with apical half densely hairy on dorsum and sides; brownish-ochreous; beneath ochreous. Legs ochreous; anterior pair suffused with fuscous. Forewings elongate, posteriorly dilated, costa very slightly arched, apex rounded, termen scarcely oblique, rounded towards tornus; brownish-ochreous; cilia brownish-ochreous. Hindwings twice as broad as forewings, termen rounded; pale-ochreous; cilia pale-ochreous.

♀ Wings small, aborted, forewings when closed reaching nearly or quite as far as apex of abdomen.

In the ♂ the tongue is present but weakly developed. It differs from *Hestiarcha pyrrhopa*, Meyr., in the antennae not being pectinate, and vein 6 of forewings arising separately, not stalked with 7, 8; for I agree with Hampson that vein 9 is absent, not 6 as in Meyrick's diagnosis. Otherwise the peculiar neuration of both species is identical, except that in *atala*, the discocellulars of the hindwing, though weak are traceable, the cell being very short (about ¼). As these two forms agree in so many features, and must be allied, it would be unwise to separate them into two genera. The ♀ of *pyrrhopa* is unknown.

T., Mt. Wellington, in January and February; four examples (1, ♂ 3 ♀), all found at rest under stones by Mr. G. H. Hardy. One ♀ had emerged from a slight cocoon of silk and hairs. The types have been presented to the Queensland Museum.

Heliosia aedumena, n. sp.

♂ 16-20 mm. Head brown-whitish; face and palpi ochreous-whitish. Antennae brown-whitish; in ♂ serrate, shortly ciliated (1/3), with longer bristles (1). Thorax and abdomen brown-whitish. Legs ochreous-whitish. Forewings elongate, costa rather strongly arched, apex round-pointed, termen obliquely rounded; brown-whitish; markings fuscous; median discal dots at 1/3 and 2/3; sometimes a suffused dorsal spot at 1/3; a faint outwardly-curved line from ¾ costa to 2/3 dorsum; some suffusion on tornus and before mid-termen; cilia ochreous-whitish. Hindwings with termen sinuate; ochreous-whitish; at apex sometimes fuscous-tinged.

N.Q., Kuranda, near Cairns, in July, August and October; four specimens received from Mr. F. P. Dodd.

Gen. **Panachranta**, nov.

Tongue present. Palpi slender, porrect, short, not reaching beyond frons. Antennae of ♂ shortly ciliated, with longer bristles. Tibial spurs moderate. Forewings with 2 from middle of cell, 3 from shortly before angle, 5 from slightly above angle, 6, 7, 8 stalked, 9 absent, 10 and 11 free, oblique. Hindwing with 2 from 2/3, 3, 4 from angle of cell stalked nearly to termen, 5 from well above angle, 6, 7 stalked, 8 from middle of cell; cell about 2/3.

Allied to *Brachiosia*, Hmps.

Panachranta lirioleuca, n. sp.

♂ ♀ 22-25. Head white; face sometimes ochreous-tinged. Palpi pale-fuscous. Antennae white; in ♂ ochreous-tinged except towards base, ciliations ½, bristles 1. Thorax white; patagia ochreous-tinged. Abdomen white. Legs white; anterior pair more or less suffused with pale-fuscous; middle pair ochreous-tinged in ♂. Forewings moderately elongate, costa gently arched, apex round-pointed; termen slightly bowed, slightly oblique; white; costal edge sometimes ochreous; cilia white. Hindwings with termen rounded; white; cilia white.

N.Q., Cairns and Karanda, in September and October; four specimens.

Macaduma strongyla, n. sp.

♂ ♀ 16-19 mm. Head, palpi, and thorax in ♂ grey, in ♂ ochreous-tinged. Antennae grey; in ♂ ochreous-grey, shortly ciliated (½). Abdomen grey; in ♂ ochreous-grey with ochreous tuft. Legs grey; in ♂ whitish-ochreous. Forewings short and broad, costa angled beyond middle, with a slight tuft at angle, slightly arched before angle, thence straight, apex and termen obtusely rounded; grey, in ♂ darker towards base and costa; costal edge ochreous in ♂, sometimes in ♀; a whitish discal dot at 3/5, absent in ♀; two finely dentate fuscous transverse lines; first at 2/5, very faint towards costa, in ♂ thickened towards dorsum; second from costal angle obliquely outwards, bent inwards in disc, and continued to dorsum at 4/5; cilia grey, on costa ochreous. Hindwings with termen rounded; grey; cilia grey.

N.Q., Kurunda, near Cairns, in September, October, March, April and May; six specimens received from Mr. F. P. Dodd.

Gen. **Eurypepla**, nov.

Palpi moderate, upturned, appressed to frons; second joint slender; terminal joint short, acute. Antennae in ♂ moderately ciliated. Tibial spurs long. Forewings rather broad; 2 from 2/3, 3 from well before angle, 4 from angle, 5 from well above angle, 7, 8, 9 stalked, 7 arising after 9, 11 free. Hindwings broad, nearly circular, 2 from 3/4, 3 and 4 coincident, 5 from middle of cell, 6 and 7 long-stalked, 8 anastomosing with cell to 1/3.

Eurypepla pteridaula, n. sp.

♂ 15-20 mm. Head ochreous-whitish. Palpi about 1; fuscous. Antennae fuscous; ciliatious in ♂ 1. Thorax fuscous. Abdomen grey. Legs pale-ochreous; anterior pair fuscous anteriorly; middle pair with some fuscous suffusion. Forewings broadly triangular, costa moderately arched, apex round-pointed, termen slightly bowed, oblique; fuscous; a pale-ochreous transverse fascia near base, constricted or interrupted in middle; a large whitish spot on 2/3 costa, giving rise to a slender dentate line, bent outwards in middle, and again inwards to end on 2/3 dorsum; sometimes a whitish dot on costa before apex, and several similar dots on termen; cilia pale-ochreous. Hindwings nearly circular, termen strongly rounded; a dense patch of audroconia in cell on upper surface; pale-ochreous, with some grey suffusion towards costa and termen; cilia ochreous-whitish.

Q., National Park (2000 to 4000 ft.) in December and January; nine specimens beaten from dead fronds of tree-ferns.

Philenora pteridopola, n. sp.

♂ ♀ 17-18 mm. Head pale-yellow, lower edge of face fuscous. Palpi 1, obliquely porrect; dark-fuscous. Antennae fuscous; ciliatious in ♂ very short ($\frac{1}{4}$). Thorax fuscous. Abdomen pale-ochreous. Legs pale-ochreous; anterior and middle pairs suffused with fuscous. Forewings elongate-triangular, costa slightly arched, apex round-pointed, termen nearly straight, oblique; fuscous; markings pale-yellow; a basal patch on dorsum to 1/3, reaching about half across disc; a suffused inwardly oblique line from mid costa to end of dorsal basal patch; a triangular patch on dorsum beyond middle, extending nearly to tornus, joined by a fine dentate line from $\frac{3}{4}$ costa, at first parallel to termen, then bent inwards; two dark-fuscous discal dots beyond 1/3 and before 2/3; a subterminal suffusion; cilia pale-ochreous, bases broadly barred with fuscous. Hindwings with termen gently rounded; pale-ochreous; apical and costal area pale fuscous, joined by a suffused transverse median line from dorsum; cilia fuscous, on veins, tornus, and dorsum pale-ochreous.

N.Q., Evelyn Scrub, near Herberton (F. P. Dodd), in January and February; three specimens, which appear to belong to a local race, the forewings being yellower, and the basal patch larger, and extending nearly to costa.

Q., National Park (2500 to 4000 ft.), in December and January; ten specimens beaten from dead fronds of three-ferns.

Thallaracha epileuca, n. sp.

♂ ♀ 15-16 mm. Head white; face and palpi pale-grey. Antennae fuscous; in ♂ with short pectinations, each terminating in a tuft of cilia and a longer bristle. Thorax white; bases of patagia sometimes fuscous. Abdomen grey; tuft ochreous-whitish. Legs grey; posterior pair paler. Forewings subtriangular, costa gently arched; apex tolerably pointed, termen obliquely rounded; fuscous; a broad white streak on dorsum from base to middle, its outline wavy; a large white circular spot on ¾ costa, nearly or quite confluent with a small subapical spot, the former with lower margin sometimes irregularly invaded by fuscous; sometimes a short white erect streak from tornus towards costal spot; cilia fuscous, on subapical spot white. Hindwings with termen rounded; pale-grey; cilia pale-grey.

N.Q., Herberton; two ♀ in January and February (F. P. Dodd). Q., Mt. Tambourine, ♂ type in October. There are slight differences which may be sexual or varietal.

THALLARCHA EPICELA, n. sp.

♀ 18-19 mm. Head white; face grey. Palpi fuscous or grey. Antennae pale-grey; bases white. Thorax white, with a fuscous spot before middle. Abdomen whitish-ochreous; bases of segments grey towards middle. Legs whitish-ochreous; anterior pair grey in front. Forewings subtriangular, costa gently arched, apex tolerably pointed, termen slightly bowed, oblique; fuscous with indications of pale waved transverse lines; a white spot on base of dorsum, reaching to ¼ dorsal edge, but forming a rounded or pointed process above dorsum beyond this; a large circular whitish spot on 2/3 costa, and a fine sinuate whitish transverse line beyond this, more or less distinct; a variably developed apical white spot; sometimes confluent white terminal spots above tornus; cilia fuscous, on apical spot whitish. Hindwings with termen rounded; ochreous-whitish; a grey discal spot on end of cell; a slight greyish apical suffusion; cilia ochreous-whitish.

Variable, and nearly allied to the preceding species; best distinguished by the differently shaped white dorsal mark, and the discal dot on hindwings.

Q., National Park (3000 ft.) in December and January; two specimens.

TERMESSA ORTHOCROSSA, n. sp.

♂ ♀ 30-32 mm. Head, palpi, thorax and abdomen yellow. Thorax with a blackish dot on anterior margin of each patagium. Antennae fuscous; in ♂ slightly laminate, ciliatious 1½. Legs yellow; tarsi dorsally barred with fuscous. Forewings broadly triangular, costa straight almost to apex, apex subrectangular, termen straight to near tornus, scarcely oblique; rather pale yellow; a slender blackish costal streak from base to 4/5, thickened into spots at base, 2/5, and 4/5; cilia blackish, interrupted by very narrow yellow bars opposite veins, on costa and tornus yellow. Hindwings with termen rounded, slightly bowed on vein 3; pale-yellow; a circular blackish submarginal spot below middle; cilia pale-yellow.

Q., Toowoomba, in October; four specimens received from Mr. W. B. Barnard.

Fam. NOCTUIDAE.

Subfam. AGARISTINAE.

Gen. **Prostheta,** nov.

Frons with a truncate conical prominence, at its apex a large circular depression with raised edge. Antennae dilated before apex. Palpi moderate, porrect; second joint covered with long, rough hairs; terminal joint short, hairy. Thorax and abdomen(?) not crested. Posterior tibiae with long rough hairs on dorsum. Neuration normal.

Intermediate in structure between *Periscepta*, Turn., and *Phalaenoides*, Lew., agreeing with the former in the palpi, with the latter in the antennae. I will not be sure of the absence of abdominal crests, as the type is not in the best condition. Specifically it is very different from species of both these genera.

Prostheta acrypta, n. sp.

♂ 22 mm. Head blackish with lateral whitish streaks. Palpi blackish, towards base whitish; apex of second joint whitish. Thorax [abraded] blackish with whitish spots. Abdomen blackish with some whitish scales; a basal dorsal spot and tuft pale-ochreous. Legs blackish; tibiae and tarsi with whitish annulations; hairs on posterior tibiae ochreous. Forewings triangular, costa gently arched, apex round-pointed, termen bowed, slightly oblique; blackish with some whitish irroration and whitish-ochreous spots; a minute subcostal basal spot; a subcostal spot near base with another obliquely beyond it in disc; a spot beneath 1/3 costa, with another obliquely beyond it in disc; a spot beneath 2/3 costa, with another close beneath it; a series of subterminal spots, those in middle smaller; cilia blackish, on tornus white. Hindwings with termen rounded; orange-ochreous; a blackish discal spot on costal side of middle; a broad blackish terminal band containing a series of subterminal whitish spots; cilia blackish, mixed with whitish.

Type in South Australian Museum.

S.A., Tumby ; one specimen.

Subfam. AGROTINAE.

Agrotis poliotis, Hmps.

Agrotis bromeana, Auriv., Arkiv. f. Zool., Stockholm. Band xiii., p. 16, T. i, f. 6. N.W.A., Broome.

A ♀ example admirably figured.

Subfam. MELANCHRINAE.

Dasygaster pammacha, n. sp.

♀ 23-24 mm. Head brownish with a few blackish scales; face paler with a pair of blackish spots above middle. Palpi slightly over 1; brownish with some dark-fuscous irroration. Thorax brownish-grey with a few blackish scales. Abdomen grey-brownish; densely hairy on dorsum. Legs grey-brownish. Forewings elongate-triangular, costa almost straight, apex rectangular, termen straight, rounded beneath; whitish with a few scattered reddish-brown scales; a broad, somewhat irregular, dark-fuscous and reddish-brown median band from base to termen, irregularly expanded in middle, constricted before termen, triangularly expanded on termen; two similar terminal spots between this and tornus, the lower larger; similar dots on costa near base, at ¼, and middle; cilia reddish-brown mixed with fuscous and a few whitish scales. Hindwings with termen wavy, more deeply so beneath apex; fuscous; cilia pinkish-tinged, with median fuscous line and whitish apices. Underside fuscous with blackish discal mark at end of cell on hindwings.

T., Cradle Mountain, in December and January; two specimens from Mr. G. H. Hardy, the type presented to the Queensland Museum.

Subfam. ACRONYCTINAE.

Euplexia pamprepta, n. sp.

♂ 40 mm. Head white; centre of crown and lateral spots on face blackish. Palpi blackish; apices of three joints and inner surface of basal joint white. Antennae blackish; in ♂ minutely and evenly ciliated. Thorax blackish; tegulae brownish; posterior crest and bases of patagia white. Abdomen dark-fuscous, with dense whitish irroration except on penultimate segment. Legs blackish; tibiae and tarsi with white annulations; dorsum of posterior tibiae and tarsi with white annulations; dorsum of posterior tibiae whitish. Forewings elongate-triangular, costa slightly arched, apex round-pointed, termen bowed, moderately oblique, wavy; marked with white, blackish, and grey, with a few ochreous points; base white; a sub-basal blackish line angled outwards; triangular costal blotches at 1/5, 2/5, and 4/5, partly blackish, partly grey, and a smaller similar spot at 3/5; a sub-basal grey dorsal blotch; a dentate blackish line from ¼ costa to 1/3 dorsum; an irregular, central, partly grey, partly blackish, discal blotch beyond this line, surmounted by an ochreous dot on its posterior costal angle; followed by an angular white fascia; reniform broadly oval, outlined first with blackish, then with white, its centre grey above, ochreous beneath; a fine grey line traversing a white area from reniform to mid-dorsum; a grey postmedian fascia containing one or two ochreous dots, traversed by a dentate, blackish line, posteriorly edged with white, from ¾ costa, at first bent outwards, then strongly sinuate inwards to 2/3 dorsum; a strong white subterminal line, angled outwards, and touching termen in middle, angled inwards above dorsum; triangular blackish blotches on termen above middle and above tornus; cilia white, barred with blackish. Hindwings with termen gently rounded, wavy; grey-whitish with fuscous discal dot, postmedian line, and broad terminal fascia; cilia fuscous with white bars.

Q., National Park (3000 ft.), in December; one example in perfect condition at light.

Gen. **Syntheta.**

Syntheta Turn., P.L.S., N.S.W., 1902, p. 85.
Phaeopyra Hmps., Cat. Lep. Phal. vii., p. 19 (1908).
Phaeomorpha Turn., Tr. R.S., S.A., 1920, p. 149.

There is quite a tangle to be unravelled in the history of this genus. In describing it I made *xylitis* the type, but remarked that I referred *nigerrima* Gn. to the same genus, which I placed in Hampson's sub-family *Acronyctinae.* Hampson has adopted my genus for both species, but referred it to his *Noctuinae*, evidently on account of the origin of vein 5 of hindwings from near the lower angle of the cell. But this vein is only weakly developed, and in some *Acronyctinae*, for instance, *Euplexia dolorosa*, Wlk., vein 5 is quite as nearly approximated to 4 at its origin; and I now refer *nigerrima*, which has a well-developed series of abdominal crests to the genus *Euplexia.* It is a common species, and I venture to predict that the larvae, which should not remain long undiscovered, will prove to have all the prolegs fully developed.

Phaeopyra Hmps. is a synonym of *Syntheta*, and so is *Phaeomorpha Turn.* I distinguished the latter by the absence of a basal abdominal crest, but I find the crest is really present though small and often concealed by hairs. It will be as well to give a fresh diagnosis of the genus.

Frons not projecting. Palpi moderately long, ascending, appressed to frons; second joint thickened with loosely appressed scales; terminal joint moderate. Thorax with rounded anterior, and rather small, rough posterior crests. Abdomen with a small crest on dorsum of basal segment. Posterior tibiae hairy on dorsum. Forewings with neuration normal. Hindwings with 5 weakly developed, from much below middle of discocellulars ($\frac{1}{4}$ to $\frac{1}{3}$).

Antennae of ♂ in *xylitis* serrate, with tufts of cilia, and longer bristles; in *smaragditis* simple, evenly ciliated.

Syntheta xylitis.

Syntheta xylitis Turn., P.L.S., N.S.W., 1902, p. 85.
Euplexia chloeropis Turn., Tr. R.S., S.A., 1904, p. 213.
Phaeomorpha acineta Turn., Tr. R.S., S.A., 1920, p. 149.

The three forms I have described differ in coloration, but after careful comparison I have come to the conclusion that these differences are varietal only.

N.Q., Cairns, Townsville; Q., Biggenden, Nambour.

Syntheta smaragdistis.

Euplexia smaragdina B. Bak., Nov. Zool., 1906, p. 195, *praeocc.*
Trachea smaragdistis Hmps., Cat. Lep. Phal. vii., p. 137.

N.Q., Cairns, Innisfail; Q., National Park (3000 ft.); N.S.W., Richmond River. Also from New Guinea.

EUPLEXIA NIGERRIMA.

Mamestra nigerrima Gn., Noct. i., 200.

Q., Gympie, Brisbane, Mt. Tambourine, National Park (2000 ft.), Toowoomba, Killarney; N.S.W., Ebor, Sydney, Brewarrina; V., Melbourne, Moe, Gisborne, Birchip. T., Launceston. Hobart, W.A., Albany, Perth, Bridgetown, Narrogin.

Gen. Thalatha.

I find that the distinction given in my key (Tr. R.S., S.A., 1920, p. 140), between this genus and *Molvena* is untenable; I propose, therefore, to merge these two genera.

THALATHA MELANOPHRICA, n. sp.

♀ 34 mm. Head white, with a few blackish scales; face with central and lateral blackish dots. Palpi white; second joint blackish, except at base and apex. Antennae ochreous-grey, towards base whitish. Thorax ochreous-white, with some fuscous scales posteriorly. Abdomen ochreous-white, with some fuscous scales; apical segment except tuft mostly dark-fuscous. Legs whitish; tibiae and tarsi annulated with blackish. Forewings triangular, costa slightly arched, apex rounded-rectangular, termen bowed, slightly oblique; white, slightly ochreous-tinged; markings blackish; a basal spot; two costal dots near base; sub-basal dots in disc and on dorsum, two fine, parallel, interrupted, crenulate lines from costa before $\frac{1}{4}$ to dorsum beyond $\frac{1}{4}$; a dentate line from costa before middle to dorsum beyond middle, followed by some blackish suffusion; reniform indistinct, partly outlined by blackish marks, broadly oval; a longitudinal streak above dorsum towards tornus, crossed by a short transverse streak; four dots on apical third of costa; a fine, interrupted, irregularly dentate line from $\frac{5}{6}$ costa twice bent outwards and crossing subdorsal streak; beyond this some blackish suffusion; a terminal series of dots, that above middle and that above tornus enlarged; cilia white barred with blackish. Hindwings with termen rounded, slightly wavy; white; towards termen suffused with grey; an interrupted fuscous terminal line; cilia white with some obscure fuscous dots.

Q., Clermont, in November; one specimen received from Mr. E. J. Dumigan.

Subfam. EUTELIANAE.

PHLEGETONIA PANTARCHA, n. sp.

♂ 38-40 mm. Head, brownish-grey. Palpi, 2, terminal joint $\frac{1}{2}$; fuscous with whitish irroration, basal half of second joint fuscous externally. Antennae fuscous. Thorax grey, with a few fuscous scales. Abdomen grey, sometimes suffused with fuscous on dorsum. Legs fuscous, mixed with whitish. Forewings with costa straight, apex obtuse, termen crenulate, obtusely angled on vein 4; basal area dark-grey, with fuscous irroration, sharply defined by a nearly straight line from mid-costa to mid-dorsum; beyond this pale-grey, but suffusedly darker towards termen; costa fuscous interrupted by whitish dots; reniform long, narrow, obliquely curved, upper end pointed; lower end broader, rectangular, the whole being shaped like an inverted comma, whitish, centre brownish narrowly outlined with fuscous; a triangular fuscous patch outside reniform, sharply produced to a point posteriorly, not always well defined; a fine fuscous line from upper end of reniform, describing a roughly circular line as far as vein 5, and then produced towards dorsum; a triangular fuscous costal patch before apex traversed by three or four pale streaks parallel to veins; two short parallel dark-fuscous streaks from $\frac{2}{3}$ dorsum, separated by a pale streak; a fine fuscous terminal line thickened on indentations; cilia dark-grey, apices reddish. Hindwings with termen rounded, crenulate; fuscous tinged with reddish, dorsal edge whitish with three dark-reddish dots before tornus; a dark-fuscous streak on vein 2, interrupted by two whitish dots; an ill-defined whitish tornal mark giving rise to a short whitish terminal line; terminal line and cilia as forewings, but bases of cilia whitish. Underside whitish, with numerous fuscous transverse lines and suffusion, and antemedian discal dot on hindwings.

Near *P. delatrix*, but larger, more distinctly marked, reniform differently shaped, not constricted, streak from $\frac{2}{3}$ dorsum double, posterior fuscous patch sharply pointed posteriorly, etc.

N.Q., Kuranda, near Cairns, in April; Q., National Park (3000 ft.), in March; two specimens.

Subfam. CATOCALINAE.

Parallelia arctotaenia.

Ophinsa arctotaenia, Gn., Noct., iii. p. 272.
Parallelia arctotaenia, Hmps., Cat. Lep., Phal. xii., p. 594, 594, Pl. 221, f. 7.

N.Q., Claudie River, in February; one specimen taken by Mr. J. A. Kershaw. Also from China, Japan, Ceylon, and India. Not previously recorded from Australia.

Subfam. NOCTUINAE.

Raparna lugubris, n. sp.

♂ ♀ 24-28 mm. Head fuscous or grey. Palpi moderate; terminal joint $\frac{1}{4}$ of second, rather stout, acute; fuscous. Antennae fuscous; in ♂ with moderate ciliations (1) and longer bristles, (2) Thorax grey. Abdomen grey, irrorated with dark-fuscous. Legs dark-fuscous. Forewings triangular, costa slightly sinuate, apex rounded-rectangular, termen bowed, scarcely oblique; fuscous; four blackish costal dots at $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{5}{8}$, of these all but the first give rise to extremely fine dentate blackish transverse lines to dorsum; postmedian line with minute whitish dots at apices of external dentations; subterminal represented by some whitish dots, with a larger costal dot before apex; cilia fuscous, apices partly whitish. Hindwings like forewings, but without costal markings and subterminal line; post-median line ochreous. Underside with bases of wings more or less suffused with ochreous in ♂

Near *R. horcialis* (*horcinsalis*), Wlk.

N.A., Port Darwin, in January; four specimens received from Mr. G. F. Hill and Mr. F. P. Dodd.

Raparna crocophara, n. sp.

♀ 18 mm. Head yellow. Palpi long, recurved; second joint stout, smooth-scaled; terminal joint as long as second, slender, acute; yellow with a few purplish scales. Antennae fuscous, towards base ochreous-tinged. Thorax yellow. Abdomen and legs ochreous-grey. Forewings triangular, costa nearly straight, apex round-pointed, termen very slightly bowed, scarcely oblique, crenulate; orange-yellow, with reddish or purplish markings; a broad transverse line, its centre leaden-fuscous, at $\frac{1}{5}$, with a slight outward tooth below middle; a similar costal line from base to first line; a sub-basal spot; a leaden-fuscous dot surrounded by reddish scales on mid-costa; a minute, fuscous median discal dot; second line at $\frac{4}{5}$, similar to first, wavy; some reddish irroration between second line and termen; cilia purple-grey, at apex yellow. Hindwings like forewings, but without first line; second line not reaching costa.

Near *R. transversa*, Moore.

N.A., Port Darwin, in January. N.Q., Chillagoe, in March. Two specimens received from Mr. F. P. Dodd.

Anomis definata.

Anomis definata, Luc., P.L.S., N.S.W., 1893, p. 146.
Cosmophila psamathodes, Turn., P.L.S., N.S.W., 1902, p. 108.

N.Q., Cairns, Innisfail, Q., Nambour, Stradbroke I.

Fam. SPHINGIDAE.

Hopliocneme marmorata.

Sphinx marmorata, Luc., "Queenslander," May, 1891, and P.L.S., N.S,W., 1891, p. 278.

♀ 50-60 mm. Head and palpi fuscous, mixed with whitish, appearing grey. Antennae whitish. Thorax fuscous, mixed with whitish, appearing grey; apices of tegulae sometimes whitish-ochreous. Abdomen blackish on dorsum, with lateral series of large oblong whitish-ochreous spots, and a central series of narrow whitish marks on apices of segments; two apical segments fuscous irrorated with whitish; underside mostly whitish. Legs fuscous, with whitish irroation. Forewings narrowly triangular, costa straight to $\frac{4}{5}$, thence arched, apex pointed, termen slightly bowed, oblique; fuscous densely irrorated, with whitish, appearing grey; an ill-defined, dark-fuscous mark on costa at $\frac{1}{3}$; an ill-defined, oblique, whitish shade from apex towards mid-dorsum, but lost in disc; beyond this a series of dark-fuscous, longitudinal, interneural streaks; veins towards termen narrowly fuscous; cilia whitish, interrupted with fuscous on veins.

Hindwings with termen slightly rounded; grey, towards base whitish, peripheral veins outlined with fuscous; cilia as forewings.

Agrees in structure with *H. brachycera*, Low, which I took at the same time and place, but that species has the forewings darker, with discal spot and transverse lines, and the abdomen has not a central series of whitish marks.

Q., Duaringa, Emerald, in March; one ♂ from Mr. W. B. Barnard, Clermont, in April; one ♀ from Mr. E. Q. J. Donnigan, Charleville, in September; six specimens at light, all of the same ♀ sex. N.S.W., Brewarrina, one specimen received from Mr. W. W. Froggatt.

♂ 54 mm. Differs from ♀ in lateral and posterior margins of thorax being suffused with whitish; a whitish suffusion from base of forewing along dorsum, meeting a broadly suffused whitish post-median fascia, acutely angled in middle posteriorly, containing a fuscous discal dot near its anterior margin; terminal areas, with some whitish suffusion.

Fam. URANIADAE.

A few additions and corrections have to be made in my former revision of this and the following families (Ann. Queensland Mus., 1911, p. 70).

Alcidis zodiaca.

Alcidis zodiaca, Butl., Ent. Mo. Mag., 1869, p. 273.

Also from New Guinea.

Gen. Strophidia.

Strophidia, Hb., Verz., p. 290, Hmps., Moths, Ind. iii. p. 113.

Palpi moderately long, smooth, slender; terminal joint longer than second. Antennae slender; in ♂ minutely ciliated. Forewings with cell about $\frac{1}{3}$; 3 and 4 connate, 6 and 7 stalked, 8 and 9 stalked, 10 and 11 separate from cell. Hindwings with a short acute projection on vein 4; cell about $\frac{1}{3}$; middle, 6 and 3 and 4 connate, 5 from above middle, 6 and 7 separate.

Type, *S. fasciata*, Cram.

Strophidia fasciata.

Geometra fasciata Cram., Pap. Exot. ii., p. 12, pl. 104, f. D.
Phalaena candata, Fab., Ent. Syst. iii. (2), p. 163.
Micronia obtusata, Gn, Lep. x., p. 25, Pl. v. f.6.
Strophidia fasciata, Hmps., Moths, Ind., iii. p. 114.

♂ 60 mm., Head and thorax white. Palpi blackish above, white beneath. Antennae grey, becoming white towards base; in ♂ filiform, minutely ciliated. Abdomen grey-whitish. Legs whitish; internal surface of anterior pair grey. Forewings broadly triangular, costa strongly arched, apex acutely rectangular, termen straight, slightly oblique; white; numerous black costal strigulae; nine straight fasciae, consisting of two or more series of fine grey strigulae, except the ninth, which is single; first four fasciae outwardly oblique, fifth transverse, sixth and seventh convergent and fused before dorsum; eighth and ninth convergent; a pronounced blackish terminal line; cilia white, apices grey. Hindwings with termen straight, angled and with a strong acute projection on vein 4; with 5 fasciae similar to those on forewing, outwardly oblique, not reaching termen; a subterminal, angled fascia of grey strigulae; terminal line as forewing, but widely interrupted at base of projection; projection with three blackish dots, one on each side of base, the third on inner margin before apex.

N.Q., Claudie River, in December; one specimen taken by Mr. J. A. Kershaw. Also from the Archipelago, Ceylon, and India.

Fam. EPIPLEMIDAE.

An examination of the types in the British Museum shows that I was mistaken in some of my identifications.

Balantiucha leucocephala.

Erosia leucocephala, Wlk., Cat. Brit. Mus., xxvi., p. 1758.
Dirades platyphylla, Turn., Tr. R.S., S.A., 1903, p. 21.

Balantiucha leucocera.

Dirades leucocera, Hmps., Ill. Het., viii., p. 102, pl. 150, fig. 13, Moths Ind. iii. p. 133.

Balantiucha mutans.

Erosia mutans, Butl., A.M.N.H. (5), xix., p. 434 (1887).
Dirades seminigra, Warr., Nov. Zool., 1896, p. 346.

Dirades lugens.

Epiplema lugens, Warr., Nov. Zool., 1897, p. 202.

Chaetopyga horrida.

There is a doubt as to the true locality for this species. In the British Museum there are specimens labelled as from British Guiana. Should this be correct the species must be removed from the Australian fauna.

Epiplema conflictaria.

Epiplema lacteata, Warr., Nov. Zool., 1896, p. 276.
Epiplema perpolita, Warr., ib. 1896, p. 349.

Epiplema angulata.

Epiplema angulata, Warr., Nov. Zool., 1896, p. 275.
Epiplema schematica, Turn., Ann, Q. Mus., 1911, p. 83.

Also from New Guinea and Amboyna.

Fam. THYRIDIDAE.

Some additions and corrections to my revision were published in the Proc. Roy. Soc., Q., 1915, p. 26, and to these I shall not further refer.

OXYCOPHINA THEORINA.

Siculodes fenestrata, Pagen., Nass., Jahr, f. Nat., 1888, p. 183.

Also from Amboyna.

Gen. **Trophoessa**.

I based this genus on the stalking of veins 9 and 10 in the forewings, but examination of a series shows that this is inconstant; 9 and 10 may arise separately. The genus must therefore be dropped, and probably the type species must be merged with the following.

STRIGLINA MYRTAEA.

Phalaena (Noctua), myrtaea Drury Ins. Exot. ii., p. 4, pl. ii., f. 3 (1773).
Thermesia fenestrina, Feld, Reise, Nov., pl. 117, f. 2.
Striglina clathrula, Gn., Ann. Soc., Ent., Fr., 1877, p. 285.
Durdara fenestrata, Moore, P.Z.S., 1883, p. 27, pl. vi., f. 6.
Microsca plagifera, Butl., Tr. E.S., 1886, p. 420.
Durdara ovifera, Butl., P.Z.S., 1892, p. 129, pl. vi., f. 7.
Letchena satelles, Warr., Nov., Zool., 1906, p. 64.
Trophoessa daphoena, Turn., Ann., Q. Mus., 1911, p. 99.

N.Q., Cairns. Also from the Archipelago, India, and Mauritius.

STRIGLINA CITRODES, n. sp.

♂ 24 mm. Head, palpi, and antennae pale-brownish. Thorax pale-yellow; tegulae pale-brownish. Abdomen pale-brownish; basal and apical segments pale-yellow. Legs brownish; posterior pair and apical half of middle tibiae pale-yellow. Forewings triangular, costa nearly straight, apex acute, termen slighly bowed, slightly oblique; 7 and 8 short-stalked; very pale yellow, with faintly darker strigulae forming indistinct transverse lines; costal edge and strigulae brown, with four elongate brown spots beyond middle, the last apical; a fine brown line from second costal spot, at $\frac{3}{4}$ to $\frac{3}{5}$ dorsum; cilia pale-yellow. Hindwings with termen very slightly rounded; colour, irregular lines of strigulae and cilia as forewings. Underside similar, but strigulae brown and more distinct, post-median line of forewings broadened into an irregular fascia.

The stalking of 7 and 8 of forewings would put this in Hampson's genus, *Plagiosella*, but the stalking is very short on one side, and may not be constant. Taking the neurational variation of the preceding species into consideration, it appears safer to regard this as a *Striglina*.

Q., Mount Tambourine, in November; one specimen.

STRIGLINA MYRSALIS.

Pyralis myrsusalis, Wlk., Cat. Brit. Mus., xix. p. 892.
Letchena elaralis, Wlk., ib. xix., p. 901.
Pyralis idalialis, Wlk., ib. xix., p. 903.
Siculodes cinereola, Feld., Reise, Nov., pl. 134, fig. 8.

Striglina scallula, Gn., Ann. Soc., Ent., Fr., 1877, p. 287.
Durdara pyraliata, Moore, Lep., Atk., p. 177.
Durdara lobata, Moore, Lep. Atk., p. 177.
Durdara zonula, Swin., P.Z.S., 1885, p. 469, Pl. 28, f. 12.
Striglina radiata, Pagent., Iris, v., p. 41.

STRIGLINA LOCEALIS.

Pyralis loceusalis, Wlk., Cat. Brit. Mus., xix., p. 903.
Pyralis thyralis, Wlk., ib., xxxiv., p. 1234.

N.Q., Kuranda, near Cairns, in October; one specimen received from Mr. F. P. Dodd. Also from Ceylon.

STRIGLINA CENTIGINOSA.

Morova ? innotata, Warr., Nov. Zool., 1904, p. 483.

STRIGLINA SCITARIA.

Drepanodes scitaria, Wlk., Cat. Brit. Mus., xxvi., p. 1488.
Anisodes pyriniata, Wlk., ib. xxvi., p. 1582.
Thermesia reticulata, Wlk., ib. xxxiii., p. 1062.
Laginia reticulata, Wlk., ib. xxxv., p. 1560.
Striglina lineola, Gn., Ann. Soc., Ent., Fr. 1877, p. 284.
Homodes thermesioides, Suel., Tijd. v. Ent., 1877, p. 28.
Sonagara strigosa, Moore, Lep. Atk., p. 180.
Sonagara strigipennis, Moore, Lep. Atk., p. 180.
Azazia navigatorum, Feld., Reise, Nov., pl. 117, fig. 4.
Sonagara superior, Butl., A.M.N.H. (5), xx., 433.
Sonagara vialis, Moore, P.Z.S., 1883, p. 27, Pl. vi. f. 9.
Timandra cancellata, Christ., Neue Lep., Amur., p 23.
Striglina curvilinea, Warr., Nov., Zool., 1905, p. 411.

RHODONEURA ALBIFERALIS.

Pyralis albiferalis, Wlk., Cat. Brit. Mus., xxxiv., p. 1524.
Banisia elongata, Warr., Nov., Zool., 1896, p. 340.

Also from New Guinea and Moluccas.

RHODONEURA ATRIPUNCTALIS.

Pyralis atripunctalis, Wlk., Cat. Brit. Mus., xxxiv., p. 1523.
Brixa australiae, Warr., Nov. Zool., 1908, p. 329.

Also from Java and India.

RHODONEURA DISSIMULANS.

This occurs in Borneo and India, but appears to be distinct from *tetragonata*, Warr., to which I referred it. The latter is not known from Australia, but *ordinaria*, Warr., is a synonym of *dissimulans*.

RHODONEURA BASTIALIS.

Rhodoneura melilialis, Swin., A.M.N.H. (7), vi., p. 312, (1900).

Also from N.Q., Cooktown; Q., Duaringa.

RHODONEURA POLYGRAPHALIS.

Rhodoneura marmorealis, Moore, P.Z.S., 1877, p. 617.
Rhodoneura denticulosa, Moore, Lep. Ceyl., iii., p. 267.

Also from N Q., Cooktown.

ADDAEA PUSILLA.

Microsca pusilla, Butl., A.M.N.H. (5), xx. p. 116.

This is the species I cited as *polyphoralis*, Wlk., in my former paper, but that name rightly belongs to the following species. The two have been mixed in the British Museum, and during my first examination of the series in that collection I must have made some mistake as to the type.

ADDAEA POLYPHORALIS.

This I identified by the description as *castaneata*, Warr., but wrongly. That species is not known from Australia.

ADDAEA FRAGILIS.

Addaea fragilis, Warr., Nov. Zool., 1899, p. 314.

N.Q., Cooktown. Also from Dammer Island.

Fam. PHYCITIDAE.

CEROPREPES MNIAROPIS.

Ceroprepes mniaropis, Turn., P.R.S.Q., 1903, p. 151.

♂ ♀ 22-26 mm. Antennae of ♂ unipectinate, pectinations 5, apical ¼ simple; basal joint large, with a short process directly backwards over vertex. Thorax with two pairs of long hair tufts on under surface, near anterior and posterior extremities. Posterior tibiae with a short dorsal tuft of hair scales from base.

The discovery of the ♂ confirms the position of this species in the genus *Ceroprepes*, though the cell of the hindwings is about ½; vein 7 of hindwings, though closely applied to 8, does not actually anastomose.

N.Q., Kuranda, near Cairns, in October; Q., Mt. Tambourine, in February; National Park (3000 ft.), in March. Three specimens.

Gen. **Ammatucha**, nov.

Frons flat. Tongue strong. Palpi moderately long (1½), curved upwards, slightly rough anteriorly; terminal joint ⅓, stout. Antennae of ♂ shortly serrate, towards apex simple, with minute ciliations; above basal joint flattened and elongated anteroposteriorly, with an excavation on inner side containing a tuft of dense hairs. Thorax with anterior and posterior tufts of hair in ♂ on undersurface. Forewings, with a transverse ridge of raised scales before middle; 2, 3, 4, 5 approximated at origin, 8 and 9 stalked, 10 closely approximated to 8, 9, for some distance. Hindwings with cell less than $\frac{1}{2}$, 2 from $\frac{3}{4}$, 3 from angle nearly connate with 4, 5, which are closely approximated for some distance, 6 and 7 connate, 7 closely applied to 8 for some distance, not actually anastomosing.

Nearly allied to *Ceroprepes*, but with very different ♂ antennae.

Ammatucha lathria, n. sp.

♂ 20 mm. Head, palpi, antennae, and thorax fuscous-grey. Abdomen fuscous-grey; apices of segments and under surface whitish-ochreous; tuft fuscous-grey. Legs fuscous irrorated, and tarsi annulated, with ochreous-whitish. Forewings narrow, posteriorly dilated, apex rounded-rectangular; fuscous-grey, suffused with whitish, the absence of which leaves dark markings; a dark straight ridge of raised scales from $\frac{2}{5}$ dorsum transversely nearly to costa; a suffused line from $\frac{1}{3}$ costa, opposite this ridge, to about mid-dorsum; a pair of dots in disc at $\frac{2}{3}$, arranged transversely; a suffused line from apex, inwardly oblique, soon diverging, anterior limb to mid-dorsum, posterior to near end of dorsum; a suffused subterminal line; cilia grey. Hindwings dark-grey; cilia grey; with a darker sub-basal line.

Q., National Park (3000 ft.), in March; one specimen.

Fam. GALLERIADAE.

Lamoria idiolepida

♂ ♀ 28 mm. Head, palpi, antennae, thorax and abdomen grey-whitish, antennal ciliations in ♂ imperceptible. Legs grey-whitish, finely irrorated, except posterior pair, with fuscous. Forewings elongate, posteriorly moderately dilated, apex rounded, termen obliquely rounded; grey-whitish, costal margin and terminal area suffused with pale-fuscous; dark-fuscous dots in disc beneath costa shortly before and after middle; dark-fuscous points sparsely scattered, more numerous in terminal area, where they are arranged longitudinally between veins; cilia pale-fuscous. Hindwings with termen sinuate; whitish, suffused with greyish towards apex; cilia greyish, on tornus and dorsum whitish.

The dark points on forewings depend on large scales, which, viewed at one angle, appear whitish, with dark bases, at another angle the apices are dark and bases pale.

Q., Brisbane, in December; National Park (2500-3000 ft.), in January; two specimens.

Lamoria peridiota, n. sp.

♂ 30-31 mm. Head and palpi ochreous-grey-whitish. Antennae ochreous-whitish, annulated with dark-fuscous; ciliations in ♂ 1/3 Thorax grey-whitish, tinged with green; bases of patagia brownish-fuscous. Abdomen grey-whitish. Legs ochreous-whitish; middle tarsi annulated with fuscous; anterior pair mostly fuscous. Forewings with basal $_{5}$ of costa folded on lower surface to form a pouch, including a large tuft of scent-scales; costa bisinuate, apex acute, termen sinuate, scarcely oblique; pale-green; a brownish-fuscous patch on base of costa; a suffused, bisinuate, fuscous line from $\frac{1}{4}$ costa to $\frac{2}{5}$ dorsum, preceded by some fuscous irroration above dorsum; an outwardly-oblique, oval, discal spot beneath mid-costa, brownish outlined with fuscous, a short dark-fuscous longitudinal mark beneath this, and a broad bar of brownish-fuscous suffusion extending to termen immediately beneath apex; a finely dentate, fuscous line from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum, curved outwards in middle; an interrupted dark-fuscous terminal line, enlarged to form elongate marks beneath apex; cilia greenish, apices grey. Hindwings with termen sinuate; ochreous-grey-whitish; cilia concolorous.

Q., National Park (2500 to 3000 ft.), in December and January; two specimens.

Fam. CRAMBIDAE.

Crambus ammoploceus, n. sp.

"A spinner of sand."

♂ 24-27 mm. Head ochreous-whitish. Palpi 2; pale-grey; basal joint ochreous-whitish. Antennae grey, towards apex darker, towards base whitish. Thorax pale-grey. Abdomen ochreous-grey. Legs whitish grey. Forewings somewhat dilated posteriorly, costa straight, slightly arched before apex, apex rounded-rectangular, termen slightly bowed, scarcely oblique; whitish-grey more or less irrorated with darker-grey; an ill-defined whitish streak on basal half of fold; some fuscous terminal dots; cilia whitish with a pale-grey ante-median line. Hindwings whitish-grey, cilia whitish.

N.Q., Dunk Island; two specimens received from Mr. E. J. Banfield, who has also sent larval galleries and cocoons with pupae, which unfortunately did not survive. From these and from information received from Mr. Banfield, I gather that the larvae inhabit galleries several inches in length in the sand under *Casuarina* trees. The gallery is lined with grains in the sand fastened together with silk; the larva emerges from the gallery, seizes the end of a piece of casuarina stem that lies on the surface, and, biting off a convenient length, backs down to the bottom of the gallery, carrying the fragment with it. In captivity the pupae are found in egg-shaped cocoons of sand and silk.

Gen. **Notocrambus**, nov.

Frons flat. Tongue present. Labial palpi moderately long, broadly dilated with rough scales, not hairy; terminal joint moderate; antennae short (about $\frac{1}{2}$); ciliations in ♂ imperceptible. Thorax and abdomen stoutly built; thorax hairy beneath. Posterior tibiae, with two pairs of spurs. Forewings with 2 from $\frac{3}{4}$, 3 from before angle, 7 from upper angle, 8 and 9 stalked. Hindwings with 2 from $\frac{3}{4}$, 3, 4, 5 approximated at base from lower angle, 6 and 7 connate from upper angle, 7 approximated to or anastomosing with 12 for a short distance.

Allied to *Crambus*, differing in the comparatively short, broadly dilated, rough-scaled palpi, and hairy underside of thorax. Related also to the New Zealand *Orocrambus*, Meyr., but has not the hairy palpi and coxae of that genus.

Notocrambus holomelas, n. sp.

♂ ♀ 20 mm. Head, antennae, thorax, abdomen, and legs blackish, Palpi, 2¼; blackish mixed with a few white scales. Forewings moderately broad, posteriorly dilated, costa straight, apex obtusely pointed, termen bowed, moderately oblique; blackish, sometimes with a few whitish scales in disc towards tornus; cilia fuscous. Hindwings with termen rounded; dark-fuscous, cilia fuscous.

T., Cradle Mountain (3000 to 3500 ft.), in January; three specimens received from Dr. R. J. Tillyard. Type in Coll. Lyell; two examples in poor condition in my own collection.

Ubida holomochla.

Ubida holomochla, Turn., P.R.S.Q., 1904, p. 165.

I have received an example from Pt. Darwin (F. P. Dodd), very like type, and four from Claudie River (J. A. Kershaw), which show considerable variation. Three of the latter differ from type by having a dark streak along dorsum of forewing, and some fuscous suffusion on apex of hindwing, while in the fourth the dark markings are reduced to a minimum, being represented only by a slender median streak, and a fine post-median subcostal streak with two short streaks before termen between it and apex.

Ubida hetaerica.

Ubida hetaerica, Turn., Ann. Q. Mus., 1911, p. 112.

A ♂ example from Claudie River (J. A. Kershaw) is probably referable to this species. The costal edge of forewings, median streak, and a short streak running into termen above it, are white; there is also a white posterior spot on thorax.

Ubida amochla, n. sp.

♂ 26 mm. ♀ 40 mm. Head and thorax whitish. Palpi in ♂ 2½, in ♀ 4; whitish. Antennae whitish; pectinations in ♂ 1. Abdomen whitish; bases of segments on dorsum grey. Legs whitish; anterior pair grey. Forewings elongate-oblong, costa gently arched, apex rounded-rectangular, termen rounded, slightly oblique; whitish; in ♂ a very faint pale-grey subcostal streak from base to termen, and a short longitudinal streak in disc beneath cell; in ♀ a terminal series of blackish dots; cilia whitish. Hindwings with termen very slightly sinuate; whitish; in ♂ some grey suffusion towards apex; cilia whitish.

Type in National Museum, Melbourne.

N.Q., Claudie River and Lloyd Island, in January; two specimens taken by Mr. J. A. Kershaw.

Fam. SCHOENOBIADAE.

SCHOENOBIUS MELANOSTIGMUS, n. sp.

♂ 20-23 mm. Head and thorax white. Palpi extremely long (7); second joint with long rough hairs; terminal joint long, smooth; ochreous-whitish; antennae whitish. Abdomen whitish; tuft whitish. Legs whitish; anterior and middle pairs suffused with pale-fuscous. Forewings elongate, costa gently arched, apex round-pointed, termen slightly bowed, slightly oblique; 11 running into 12; white, sometimes faintly ochreous-tinged; a rather irregular black median spot at $\frac{2}{3}$ over lower angle of cell; cilia whitish or ochreous-white. Hindwings and cilia white. Underside whitish.

Type in National Museum, Melbourne.

N.Q., Claudie River in January and February; three specimens taken by Mr. J. A. Kershaw.

SCHOENOBIUS CROSSOSTICHUS, n. sp.

♂ ♀ 22-24 mm. Head and thorax ochreous-whitish. Palpi very long (6); second joint with a few long hairs; whitish with a few grey scales. Antennae whitish. Abdomen ochreous-whitish. Legs ochreous-whitish, tarsi tinged with grey. Forewings elongate, apex acute, terman straight, oblique, 11 running into 12, the latter separating close to costal edge; ochreous-whitish sparely irrorated with fuscous in dorsal half; a terminal series of blackish dots between veins; cilia ochreous-whitish. Hindwings and cilia white; underside whitish.

Type in National Museum, Melbourne.

N.Q., Claudie River in February; two specimens take by Mr. J. A. Kershaw.

Gen. Styphlolepis.

Styphlolepis, Hmps., P.Z.S., 1895, p. 912.

An Australian genus allied to *Cirrhochrista*, from which it may be distinguished by vein 7 of the hindwings being approximated to 12, or anastomosing at a point only, whereas in *Cirrhochrista* these veins anastomose for a considerable distance. The stalking of 6 and 7 of the forewings is an exceptional character in the genus, and is not constant in those species in which it occurs. The larvae are internal feeders, occurring often in dry districts. The perfect insects attain a large size, and, owing to their retired habits, are very seldom seen. The largest species hitherto discovered was bred from larvae found in a Brisbane suburban garden, in which the owner, a zealous entomologist, had worked and collected for thirty years, but had never previously seen the moth. Five species are at present known, of which two are here described; the other three are:—

squamosalis, Hmps., P.Z.S., 1895, p. 912, from N.Q., Townsville.

agenor, Turn., P.R.S.Q., 1915, p. 31, from Western N.S.W., Brewarrina, Gunnedah.

leucosticta, Hmps., Ann. Mag. Nat. Hist., (9), iv., p. 318, (1919), from N.W.A., Sherlock River.

Styphlolepis raaua, Swin., Ann. Mag. Nat. Hist. (7), vi. p. 313 (1900), from N.Q., Townsville; Q., Bundaberg, Brisbane; N.S.W., Lismore, does not belong to the genus. It is a true *Cirrhochrista.*

Styphlolepis peribarys, n. sp.

♂ 48 mm., ♀ 55 mm. Head and thorax reddish-brown, mixed with white. Palpi and antennae reddish-brown. Abdomen white. Legs white; anterior pair reddish-brown. Forewings triangular, costa straight, arched towards apex, apex pointed, termen doubly sinuate, oblique; white copiously irrorated with reddish-brown, which tends to form transverse strigulae; two, slender, transverse, reddish-brown lines; first from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, beneath costa outwardly-curved, thence straight; second similar from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum; cilia reddish-brown, with a whitish subapical line and apices pale-fuscous. Hindwings with termen gently rounded, slightly wavy; white; a reddish-brown terminal line not reaching tornus; cilia white, bases tinged with reddish-brown.

Veins 6 and 7 of forewings are connate, or closely approximated at origin in both sexes.

Q., Emerald, in May; two specimens received from Mr. W. B. Barnard.

Styphlolepis hypermegas, n. sp.

♂ 46 mm., ♀ 66 mm. Head pale red. Palpi 3; fuscous brown; lower edge white nearly to apex. Antennae grey; in ♂ thickened, simple. Thorax ochreous-brown, with a central pale red spot. Abdomen brown; sides and under-surface whitish. Legs white; anterior tarsi and inner surface of anterior femora and tibiae fuscous-brown. Forewings triangular, costa, strongly arched, apex rounded, termen sinuate towards apex and tornus, strongly bowed in middle, brown inclining towards grey in costal area, with sparsely scattered, large, dark-fuscous scales; a large subdorsal suffusion from near base, where it is broadest, nearly to termen, whitish mostly suffused with pale-red and containing also some dark-fuscous scales; a fuscous line from $\frac{2}{3}$ costa to $\frac{1}{3}$ dorsum; a suffused discal fuscous mark beyond middle; a second fuscous line from $\frac{4}{5}$ costa, bent slightly outwards beneath costa, thence nearly straight to $\frac{2}{3}$ dorsum; cilia dark-fuscous with a white spot in sinuation above tornus. Hindwings with termen rounded; brownish-ochreous becoming paler towards base; a narrow-grey terminal suffusion produced inwards on veins; a wavy curved transverse line at about $\frac{2}{3}$. becoming obsolete towards dorsum; cilia fuscous more or less mixed with white, wholly white on tornus and dorsum.

Q., Brisbane in October; two specimens received from Mr. R. Illidge, bred from larvae.

Fam. PYRALIDAE.

Gen. Larodryas, nov.

Frons flat. Tongue well-developed, thickly scaled towards base. Labial palpi moderate, straight, drooping, smooth-scaled; terminal joint obtuse with some rough scales at apex. Maxillary palpi obtuse and rough-scaled at apex. Antennae of ♂ slightly laminate, with moderately long ciliations. Forewings with 2 from ¾, 3 from well before angle, 4 and 5 connate from angle, which is acutely produced, diverging, 7, 8, 9 stalked, 10 and 11 from cell, free. Hindwings with 2 from ⅔, 3 from well before angle, 4 and 5 connate from angle, 6 and 7 connate, 7 anastomosing strongly with 8.

Nearest *Oenogenes*, Meyr., but the palpi are very different.

Larodryas haplocala, n. sp.

♂ 18 mm. Head ochreous-whitish; face fuscous. Palpi dark-fuscous. Antennae grey, towards base ochreous-whitish; ciliations in ♂ 1½. Thorax ochreous-whitish, mixed with fuscous-green. Abdomen dark-fuscous, beneath whitish-ochreous. Legs dark-fuscous; tibiae and tarsi annulated with ochreous-whitish. Forewings elongate-triangular, costa sinuate, apex rounded, termen bowed, oblique; purple-grey; base fuscous-green, continuous with a broad fuscous-green costal streak to apex; a whitish transverse line from ⅓ costa to mid-dorsum, strongly curved outwards in middle, edged anteriorly by a fuscous-green fascia containing some dark-fuscous scales, posteriorly by a dark-fuscous line; a second whitish line from ¾ costa to tornus, bent outwards above middle, thence strongly inwards, edged anteriorly by a dark-fuscous line, posteriorly by a fuscous-green and dark-fuscous fascia; four whitish costal dots between lines; a dark-fuscous discal spot beneath mid-costa; a terminal series of dark-fuscous dots edge with fuscous-green; cilia purple-grey, with four large whitish bars. Hindwings with termen gently rounded; grey, towards base, and tornus suffused with whitish; two fine grey transverse lines, first from mid-dorsum strongly curved towards base of costa; second from above tornus to costa beyond middle, wavy; a terminal series of fuscous dots; cilia grey with basal and median whitish lines.

Q., National Park (3000 ft.), in March; one specimen.

Fam. PYRAUSTIDAE.

Musotima callidryas, n. sp.

♂ ♀ 11-12 mm. Head, thorax, and abdomen fuscous. Palpi whitish; second joint with apical, third joint with subapical dark-fuscous ring. Antennae with joints dilated at apices; grey-whitish, on dorsum barred with dark-fuscous. Legs fuscous; tarsi broadly annulated with whitish. Forewings strongly dilated posteriorly, costa gently arched, apex rounded, termen deeply incised beneath apex, and above tornus, oblique; whitish densely suffused with fuscous; a small darker basal patch outlined with whitish; an outwardly-curved fuscous line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, edged anteriorly with whitish; median area in ♂ broadly whitish; a second, less distinct line from $\frac{2}{3}$ costa, at first curved strongly outwards, then sinuate and inwardly-oblique to $\frac{2}{3}$ dorsum; a short, white, outwardly-oblique, subapical streak, a similar streak parallel to termen between incisions, and a third streak below lower incision; a brownish terminal line interrupted by incisions, cilia fuscous with a dark-fuscous basal line, on apex and incisions whitish. Hindwings with termen nearly straight and deeply incised beneath apex; fuscous; basal part of costal area whitish; a fine, dentate, whitish, transverse line at about $\frac{1}{4}$; a large, median, subdorsal, white spot, suffusedly connected with costal area; replaced in ♂ by a broad whitish fascia; a second whitish line at about $\frac{3}{4}$; bent inwards beneath middle; four blackish terminal spots preceded by fine whitish lunules; cilia fuscous, apices whitish.

Q., National Park (2500-3500 ft.), in December and January; four specimens.

SYLEPTA PHAEOPLEURA, n. sp.

♂ 20 mm. Head ochreous-whitish; face dark-fuscous. Palpi dark-fuscous, with a sharply defined, oblique, whitish, basal patch. Antennae and thorax ochreous-whitish. Abdomen ochreous-whitish; dorsum with two dark-fuscous dots on third segment, and median fuscous spots on three last segments. Legs ochreous-whitish; anterior tarsi white broadly annulated, with dark-fuscous. Forewings triangular, costa straight to $\frac{3}{4}$, thence arched, apex round-pointed, termen slightly bowed, oblique; brown-whitish; markings dark-fuscous; a costal streak throughout, interrupted by four pale dots in terminal $\frac{1}{4}$, with a slight discal projection at $\frac{1}{5}$, and a larger acute blackish projection in middle; an incomplete fine curved line at $\frac{1}{3}$; a finely dentate line from $\frac{4}{5}$ costa, bent inwards between veins 2 and 3, and again at right angles to end on $\frac{2}{3}$ dorsum; a terminal series of blackish dots on veins; cilia brown-whitish. Hindwings as forewings, but without costal streak and first line; second line not dentate, and succeeded by some fuscous suffusion.

Type in National Museum, Melbourne.

N.Q., Claudie River, in January; one specimen taken by Mr. J. A. Kershaw.

MARGARONIA APIOSPILA, n. sp.

♂ ♀ 21-25 mm. Head ochreous-whitish, centre of crown and face fuscous. Palpi, $1\frac{1}{2}$; ochreous-whitish; a narrow median bar, apex of second joint, and terminal joint blackish. Antennae whitish-ochreous. Thorax white, with a broad median fuscous line. Abdomen white; a median dorsal fuscous line on first four segments; a blackish dot on dorsum of terminal segment. Legs ochreous-whitish; anterior pair fuscous. Forewings rather narrowly triangular, costa straight to $\frac{3}{4}$, thence arched, apex pointed, termen sinuate oblique; fuscous; markings white; a line from beneath $\frac{1}{5}$ costa to $\frac{1}{4}$ dorsum; a large subquadrate spot shortly beyond this extending from nearly beneath costa $\frac{2}{3}$ across disc; a large subovate (pear-shaped) spot with larger end dorsal at $\frac{2}{3}$; a curved subterminal line, expanded on margins; cilia whitish with an interrupted fuscous sub-basal line. Hindwings with apex pointed, termen sinuate; white; a transverse oval discal spot before middle, and a moderate terminal band; fuscous; cilia white, bases fuscous.

Near *microta*, Meyr., and *flavizonalis*, Hmps.; distinguished from the first by the white thorax and abdomen; from the second by the fuscous colouring without yellowish tinge, differently shaped posterior spot, and terminal band on hindwings.

N.Q., Cooktown in April; Cairns in October; Q., Coolangatta (and Cudgen, N.S.W.), in January and May; seven specimens.

PYRAUSTA HYALISTIS.

Pyrausta hyalistis, Low., P.L.S., N.S.W., 1901, p. 669.
Pyrausta diplosticta, Turn., Tr. R.S.S., S.A., 1908, p. 100.

V., Melbourne, Sale, Lorne, Upper Macedon, near Gisborne.

ECLIPSIODES SEMIGILVA, n. sp.

Semigilvus, half-yellowish.

♂ 22 mm. Head pale-ochreous mixed with fuscous. Palpi $2\frac{1}{2}$; dark-fuscous; base and internal surface, except apex, whitish. Antennae grey annulated with dark-fuscous, in ♂ slightly dentate with very short ciliations ($\frac{1}{4}$). Thorax whitish, mixed with dark-fuscous; a posterior spot whitish. Abdomen pale-ochreous. Legs fuscous; tibiae and tarsi annulated with whitish; posterior pair, pale-ochreous, with fuscous annulations on tarsi. Forewings moderately narrow, costa slightly arched, apex tolerably pointed, termen nearly straight, moderately oblique; white, with fairly uniform dark-fuscous irroration; markings dark-fuscous; a suffused basal patch; a line from $\frac{1}{5}$ costa to $\frac{1}{3}$ dorsum; orbicular minutely outlined; reniform 8-shaped, outlined in fuscous, connected by a line with $\frac{2}{3}$ dorsum, and by a large suffused spot with tornus; a finely dentate line from $\frac{4}{5}$ costa to tornal spot; a subapical costal spot; cilia whitish mixed with grey, bases barred with dark-fuscous. Hindwings with termen slightly sinuate; pale-ochreous; a rather narrow fuscous terminal band not reaching tornus; cilia whitish, bases pale fuscous.

Type in Coll. Lyell.

V., Daytrap, in October; one specimen.

SCOPARIA ISCHNOPTERA, n. sp.

♂ 20 mm. Head grey. Palpi 4; fuscous; extreme base white. Antennae fuscous. Thorax fuscous-grey; pectus white. Abdomen pale-grey; base of dorsum ochreous-tinged. Legs grey. Forewings very narrow, slightly dilated posteriorly, apex round-pointed, termen bowed, oblique; dark-grey, inclining to fuscous; a blackish streak from base to middle along fold; a similar streak in cell from middle to $\frac{4}{5}$; some blackish subapical and subtornal suffusion; cilia whitish with two grey lines, basal line darker. Hindwings three times as broad as forewings, termen gently rounded; whitish; slight grey-whitish suffusion towards apex; cilia whitish.

This species and the following are remarkable for their long palpi and narrow forewings. Type in Coll. Lyell.

V., Ringwood in April, one specimen.

SCOPARIA ITHYNTIS, n. sp.

♂ ♀ 14-16 mm. Head whitish. Palpi 4; fuscous, upper edge, and base of lower edge whitish. Antennae grey; ciliations in ♂ ½. Thorax fuscous. Abdomen pale-grey. Legs fuscous; posterior pair whitish. Forewings narrow, posteriorly dilated, apex acute, termen sinuate, oblique; whitish, irrorated with fuscous, more densely in ♀ ; an indistinct fuscous line from ¼ costa to ⅓ dorsum, inner edge suffusedly whitish, orbicular and claviform obsolete; reniform represented by a brownish-ferruginous spot; a whitish transverse line from ¾ costa to ¾ dorsum, angled outwardly, better defined in ♀ ; a whitish streak from apex towards or meeting second line at angle; cilia whitish, an interrupted sub-basal fuscous line, apices partly greyish. Hindwings 2½ times as broad as forewings, termen slightly sinuate; whitish, towards termen greyish-tinged; cilia whitish, usually with a fuscous sub-basal line

Type in Coll. Lyell.

N.S.W., Adaminaby, in October; V., Gisborne, in September and October; fifteen specimens.

SCOPARIA MELANOXANTHA, n. sp.

♀ 18-19 mm. Head yellow, with a few blackish scales. Palpi 2; yellowish, with a few blackish scales. Antennae pale-ochreous, on dorsum barred with blackish. Thorax yellow; bases of patagia, a pair of posterior dots, and some scattered scales blackish. Abdomen pale-grey. Legs yellowish, tibiae and tarsi with obscure fuscous annulations. Forewings narrowly triangular, costa nearly straight, apex pointed, termen nearly straight, moderately oblique; yellow; markings blackish; a dot on costa near base; a short basal dorsal streak; a broad incomplete fascia from costa near base, outwardly-oblique, not reaching dorsum; a dot on fold beyond this; a second similar mark from costa reaching half across disc, and connected with a narrow suffusion on central half of costa; reniform 8 shaped, its upper half very thickly outlined, its lower very slenderly and incompletely; some blackish dorsal irroration; a triangular costal subapical spot; a large tornal spot, acutely produced halfway across disc, containing a yellow dot near tornus; a triangular spot on mid-termen; cilia yellowish with an interrupted fuscous basal line, and a grey subapical line. Hindwings with termen sinuate; ochreous-whitish, suffused with grey towards termen; cilia ochreous-whitish with a grey sub-basal line.

This and the following species are specifically very unlike anything else found in Australia.

Q., National Park (3000 ft.), in December; two specimens taken at light.

SCOPARIA GETHOSYNA, n. sp.

♀ 20 mm. Head brownish-orange. Palpi 3; ochreous-whitish with two broad oblique fuscous bars on external surface. Antennae grey. Thorax grey; patagia whitish-ochreous, bases orange. Abdomen pale ocheous-grey. Legs ochreous-whitish; tibiae and tarsi annulated, with fuscous. Forewings narrowly triangular, costa slightly arched, apex obtusely pointed, termen nearly straight, slightly oblique; brownish-orange; a large basal dark-fuscous spot, angled outwards, not reaching dorsum; an obscure, whitish, slightly outwardly curved line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; a squarish dark-fuscous blotch extending on costa from $\frac{1}{4}$ to middle, sharply limited beneath by fold; a whitish fascia beyond this, broad on costa and in disc, narrow near dorsum, containing some fuscous scales, and a dark fuscous line near, and parallel to its posterior edge; a large subapical, a supratornal, and a series of small terminal spots, dark-fuscous; cilia whitish, with a central grey line. Hindwings with termen slightly sinuate. ochreous-whitish; cilia ochreous-whitish.

Q., National Park (3000 ft.), in December; one specimen at light.

SCOPARIA CROCOSPILA, n. sp.

♀ 18 mm. Head blackish; face mixed with whitish. Palpi $2\frac{1}{2}$; blackish; lower edge whitish towards base. Antennae whitish, finely barred with blackish. Thorax blackish, with a few whitish scales; apices of patagia whitish; a large posterior spot whitish suffused with orange. Abdomen fuscous; apices of segments narrowly whitish; underside whitish. Legs whitish with some blackish scales; tibiae and tarsi broadly annulated with blackish. Forewings moderate, costa gently arched, apex round-pointed, termen slightly rounded, slightly oblique; blackish; markings whitish; a suffused transverse sub-basal line; a more distinct slightly outwardly-curved line at $\frac{1}{3}$; orbicular and claviform obsolete; reniform represented by two blackish spots separated by a whitish spot, and situated in a post-median whitish suffusion; a fine doubly-sinuate line from $\frac{5}{6}$ costa to $\frac{3}{4}$ dorsum; a broader, irregularly crenated subterminal line; cilia ochreous-whitish, with sub-basal and apical series of dark-fuscous dots, the latter incompletely developed. Hindwings with termen slightly sinuate; grey; cilia ochreous whitish, with an incomplete series of grey median dots.

Type in Coll. Lyell. The orange thoracic spot, if constant, should make this species easily recognised.

V., Gisborne, in November; one specimen.

SCOPARIA AXIOLECTA, n. sp.

♀ 18 mm. Head white, between antennae blackish. Palpi 3; white mixed with fuscous. Antennae white, with blackish annulations. Thorax white, mixed with blackish and fuscous. Abdomen pale-grey. Legs whitish; anterior and middle tibiae irrorated with blackish; tarsi with blackish annulations, those on posterior pair only slightly developed. Forewings elongate-triangular, costa gently arched, apex round-pointed, termen nearly straight, moderately oblique; white with well-defined blackish markings, and slight blackish irroration; a sub-basal fascia, expanded on dorsum, and containing a whitish dot; a line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; an irregular discal mark beyond this, representing orbicular and claviform; reniform strongly marked, X shaped; indications of a curved line from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum; rather large angular spots on costa before apex, on termen above middle, and on dorsum before tornus; an interrupted submaginal line; cilia white, bases obscurely barred with blackish. Hindwings with termen sinuate; whitish-grey; cilia whitish.

T., Cradle Mountain, in January; one specimen received from Dr. R. J. Tillyard. A second ♀ example from Mt. Macedon, Victoria (Coll. Lyell), appears to be the same species.

Scoparia tristicta, n. sp.

♂ 21 mm. Head grey. Palpi $2\frac{1}{2}$; grey. Antennae grey; ciliations in ♂ minute. Thorax grey. Abdomen grey-whitish. Legs whitish; anterior and middle tibiae and tarsi annulated with dark-fuscous. Forewings elongate-triangular, costa gently arched, apex rounded-rectangular, termen slightly bowed, scarcely oblique; grey with slight dark-fuscous irroration; markings dark-fuscous; a small suffused spot on base of costa; a moderately broad line, slightly dentate in middle, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, followed by some dark-fuscous suffusion; orbicular and claviform distinct, edged with dark-fuscous, pale in centre, well separated from each other, and first line; reniform broadly oval, indented posteriorly, outline and centre dark-fuscous, connected with a suffused spot on mid costa; second line from $\frac{4}{5}$ costa to $\frac{4}{5}$ dorsum, indented beneath costa, outwardly bowed in middle, thence inwardly oblique and wavy, edged posteriorly by a pale line; suffused spots in terminal area, first subapical, second on mid-termen, third supratornal; a subterminal dot above second spot; cilia whitish with a subapical series of fuscous dots. Hindwings with termen sinuate; whitish; cilia whitish.

N.S.W., Ebor (4000 ft.), in January; one specimen.

Fam. TINEODIDAE.

A small family of the group *Pyralites* characterised by the wide separation of vein 5 of the hindwings from 4; only in the new genus *Tanycnema* are these two veins somewhat approximate, but separate at origin. From it have arisen probably the two small families *Oxychirotidae* and *Coenolobidae*, each consisting of a single genus. More remotely related are the *Pterophoridae*, which may be distinguished from all genera of these three families, except *Tanycnema*, by the absence of maxillary palpi. As at present known the family consists of a few small Australian genera and the Indian genus *Simaethistis* (which, however, I have not seen). The family, as Meyrick has pointed out, is a primitive one, which was probably formerly much more largely developed. I imagine that it arose in

Southern Asia, and that in the remote past a few genera reached the Eastern Cordillera of this continent, when that consisted of a chain of islands surrounded by the ocean, and the old Australia lay many hundred miles to the west. Almost destroyed in its original habitat after the appearance of the dominant family *Pyraustidae*, a few genera have survived in these mountain-tops, or in the rain-forests at their bases, one genus, *Tineodes*, having become adapted to life on the coastal plains. I should expect that further representatives of the family will be found in the mountains of New Guinea.

The family may be divided into two groups; a more primitive, in which 6 of the hindwings is widely separate from 7; and a less primitive, in which these veins are connate from the upper angle of the cell. The latter group includes the exotic genus *Simaethistis*. It happens that the latter group also exhibits some primitive features; for instance, in *Simaethistis* and *Palaeodes*, all veins in the forewings are separate; and in the new genus *Anomima* 7 of the hindwings does not anastomose with 12, a structure which is shared only by the genus *Tanycnema*.

1.	Hindwings with 6 and 7 connate	2
	Hindwings with 6 remote	3
2.	Hindwings with 7 not anastomosing	Anomima
	Hindwings with 7 anastomosing	Palaeodes
3.	Hindwings with 4 and 5 somewhat approximate at origin	Tanycnema
	Hindwings with 4 and 5 widely separate	4
4.	Hindwings with a strong costal tuft	Euthesaura
	Hindwings without costal tuft	5
5.	Labial palpi extremely long (8), maxiliary palpi strongly dilated	Tineodes
	Labial palpi moderately long (4), maxillary palpi filiform	Euthrausta

Gen. Anomima, nov.

Palpi long (about 4), porrect; terminal joint short, acute. Maxillary palpi moderately long. Antennae in ♂ serrate and shortly ciliated. Thorax and abdomen moderately stout. Legs moderately long; tibial spurs nearly equal. Forewings with 2 and 3 long-stalked from angle, 4, 5 separate, 6 widely separate, 7 connate with 8, 9, 10, which are stalked, 8 arising shortly before 10, 11 from $\frac{3}{4}$. Hindwings with 2, 3, 4, 5 remote, equidistant, parallel, 2 arising from before angle, 6 and 7 connate from upper angle, 7 approximated to 8 for a short distance, but not anastomosing.

The solitary example on which this genus is based was captured some thirty years ago, and is in bad condition, the head somewhat mutilated, so that I am not able to give the characters fully, but sufficiently so to indicate that it is a very distinct genus. The absence of any anastomosis of 7 of the hindwings and the generally stout build are primitive characters, but the neuration of the forewings is specialised, and the origin of 6 of hindwings is a later character than its separate origin. It is probably derived from the Indian genus *Simaethistis*.

ANOMIMA PHAEOCHROA, n.sp.

♂ 18 mm. Head, thorax, and abdomen fuscous. Palpi 4, fuscous. Antennae fuscous. Legs pale-fuscous with darker irroration. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen concave, slightly oblique; pale-fuscous irrorated throughout with darker scales; a small, round, dark-fuscous, discal spot at end of cell beneath midcosta; a subterminal series of dark-fuscous dots; cilia fuscous. Hindwings narrow, subtriangular, apex round-pointed, termen sinuate; as forewings, but without markings.

The type is in poor condition, but amply distinguished by the generic characters. At best this must be a dull-coloured inconspicuous insect.

Q., Brisbane; one specimen.

Gen. **Palaeodes**.

Palaeodes, Hmps., A.M.N.H. (8), xii., p. 318 (1913).

Frons flat. Tongue present. Palpi long (4), porrect; second joint thickened with short rough hairs above and beneath, with a slight apical inferior tuft; terminal joint short, slender, acute. Maxillary palpi rather large, rough-scaled, strongly dilated. Antennae simple except towards apex, where apices of joints are slightly dilated by whorls of scales; in ♂ shortly ciliated throughout. Thorax and abdomen rather slender, smooth. Posterior tibiae with spurs nearly equal. Forewings with 2 from shortly before angle, 3, 4, 5 approximated from about angle, 6 separate, 7, 8, 9, 10 approximated, 11 from $\frac{4}{5}$. Hindwings with 2 from $\frac{3}{4}$, 3, 4 connate from angle, 5 widely separate from middle of cell, 6, 7 connate, 7 anastomosing with 8. Retinaculum in ♂ not bar-shaped.

The absence of stalking of 8 and 9 of forewings distinguishes this genus.

PALAEODES SAMEALIS.

Palaeodes samealis, Hmps., A.M.N.H. (8), xii., p. 318 (1913).

N.Q., Herberton, Townsville. Q., Coolangatta, Toowoomba.

Gen. **Tanycnema**, nov.

Frons with a strong anterior tuft of hairs. Tongue present. Palpi rather long, porrect. Maxillary palpi obsolete. Antennae short. Legs long, slender; outer tibial spurs about $\frac{3}{4}$ length of inner spurs. Forewings narrow, elongate; 2 from well before angle, 3 from angle, 4 and 5 somewhat approximate at origin, 6 from upper angle, 7, 8, 9, 10 stalked, 7 arising slightly before 10, 11 free. Hindwings twice as broad as forewings; 2 from $\frac{3}{4}$, 3 from angle, 4 and 5 somewhat approximate at origin, 6 well separated at origin from 5, still more widely from 7, 7 from upper angle, closely approximated to 12 for some distance, but not anastomosing.

A peculiar, isolated, and primitive genus. The wide separation of 6 from 7 of the hindwings, and the absence of any anastomosis of 7 with 12 are primitive characters; on the other hand the relative approximation of 5 to 4 in the hindwings, and the stalking of 7 and 10 of the forewings are specialised characters, the former being unique in this family, to which the genus must, I think, be referred, though the absence of maxillary palpi (if confirmed), suggests some relationship to the *Pterophoridae*, but this may be more apparent than real.

Tanycnema anomala, n. sp.

♂ 34 mm. Head and thorax brownish-grey. Palpi 3½; brownish. Antennae about ½; fuscous. Abdomen grey; dorsum of basal segment whitish-grey. Legs brownish-grey. Forewings narrow, elongate, gradually dilating posteriorly, but only to a moderate extent, costa straight to middle, thence sinuate, apex pointed, termen slightly sinuate, slightly oblique; brownish-grey; costa broadly suffused with ochreous-whitish throughout; an ochreous-whitish dot at ⅔ on end of cell; a suffused inwardly-oblique, fuscous streak from before apex, cutting across pale costal area, then slightly dentate to about half-way across disc; a whitish subterminal line from apical pale area to vein 3; a similar line precedes terminal edge, which is fuscous, and is itself preceded by an obscure series of fuscous dots; cilia whitish-brown. Hindwings with apex tolerably pointed, termen gently rounded, wavy; grey; cilia grey.

Q., National Park (3000 ft.), in December; one specimen.

Gen. Euthesaura, nov.

Frons flat. Tongue present. Palpi moderate (not exceeding 2), porrect; second joint thickened with rough hairs; terminal joint very short. Maxillary palpi short, filiform. Antennae over 1, slender, joints dilated by whorls of short scales at apices; in ♂ without ciliations. Thorax and abdomen slender; inner tibial spurs twice as long as outer. Forewings with 2 from well before angle, 3 from angle, 4 from shortly above, 5 and 6 widely separate, 7 approximated to 8, 9, which are stalked from angle, 10 approximated to them at origin, 11 from middle of cell. Hindwings with a strong tuft of scales on costa beyond middle; 2 from ⅔, 3 and 4 approximated from angle, 5 parallel from middle of cell, 6 widely separate, 7 from angle anastomosing shortly with 8. Retinaculum in ♂ bar-shaped.

Distinguished by the comparatively short labial palpi, and short filiform maxillary palpi, costal tuft of hindwings, and very unequal tibial spurs. Type *E. glycina*.

Euthesaura glycina, n. sp.

♂ 18-20 mm. Head and thorax fuscous. Palpi about 2; fuscous, lower edge ochreous. Antennae grey. Abdomen whitish; two basal segments and some median dorsal dots dark-fuscous. Legs ochreous-whitish; anterior pair mostly fuscous. Forewings elongate-triangular; costa bisinuate, apex acute, termen nearly straight, oblique;

white with patchy dark-fuscous suffusion in parts; a large basal patch prolonged along costa to beyond middle; a spot on mid-dorsum tending to be connected with costa by scattered dark scales; another dorsal spot at $\frac{3}{4}$; a large tornal spot suffusedly connected with another before termen above middle, and this with costa; a large, transversely-elongate, ochreous, fuscous-edged mark in disc beneath $\frac{2}{3}$ costa; an interrupted, dark-fuscous line on upper half of termen; cilia whitish. Hindwings with costa slightly concave, with strong tufts of scales before and after excavation, apex rounded-rectangular, termen sinuate; white, an elongate blackish spot on base of dorsum; a broadly suffused ante-median, transverse, fuscous fascia, broader towards costa, where it contains an ochreous black-edged spot; a second fuscous fascia from tuft on $\frac{2}{3}$ costa to tornus; terminal dots and cilia as forewings.

Q., National Park (3000 ft.), in December and January; twelve specimens, all of the same sex.

Euthesaura carbonaria, n. sp.

♂ ♀ 19-21 mm. Head blackish. Palpi 1; blackish. Antennae about 1; grey, towards base blackish. Thorax and abdomen blackish. Legs dark fuscous; tarsi barred with whitish on upper surface, wholly whitish beneath. Forewings narrow to beyond middle, very strongly dilated towards termen, costa bisinuate, apex pointed, termen scarcely bowed, oblique, dark-fuscous; markings blackish; an outwardly bent, sub-basal, transverse line; a broad line from $\frac{1}{3}$ costa, strongly angled outwards, not reaching dorsum; a suffused whitish subcostal streak, broadening posteriorly, from second line to discal spot; discal spot at $\frac{2}{3}$ narrowly oval, transverse brownish-tinged in centre, posteriorly narrowly edged with whitish; connected by a sinuate line with $\frac{2}{3}$ dorsum; four, minute, whitish, nearly equidistant dots on apical third of costa; from beneath the first of these is a third transverse line to dorsum before tornus; from the second a fourth curved subterminal line to tornus; cilia dark-fuscous, with a narrow whitish basal line from apex to midtermen. Hindwings very strongly dilated beyond middle, with a strong tuft of scales on $\frac{2}{3}$ costa, apex rounded, termen sinuate; as forewings but without discal spot; one or two variable whitish dots on or near second line.

Q., National Park (3000 ft.), in December and January; seven specimens, 5 ♂ 2 ♀.

Gen. Tineodes.

Tineodes Gn., Lep. viii., p. 236, Meyr., Tr. E.S., 1884, p. 291. Hmps., P.Z.S., 1899, p. 284.

Frons flat. Tongue present. Palpi extremely elongate (about 8), porrect; second joint thickened with short rough hairs above and beneath; with a slight apical inferior tuft; terminal joint short, smooth, pointed. Maxillary palpi rather large, rough-scaled, strongly dilated. Antennae 1, slender, joints dilated by whorls of raised scales at apices. Thorax and abdomen slender, smooth. Legs very long and slender, inner spurs slightly longer than outer. Forewings with 2 from well before angle, 3 from angle, 4 from shortly above, 5 and 6 widely separate, 7 closely approximated at origin to 8, 9, which are stalked, 10 closely approximated, 11 from $\frac{4}{5}$. Hindwings with 2 to 7 equidistant and parallel, 2 arising from before angle, 7 anastomosing shortly with 8 soon after origin.

Specially characterised by the extremely long palpi. Sir George Hampson (*loc. cit.*) has incorrectly described the neuration of the hindwings.

TINEODES ADACTYLALIS.

Tineodes adactylalis Gn., Lep. viii., p. 237, Pl. 9, f. 7., Meyr. Tr. E.S., 1884, p. 291.

Carcantia pterophoralis, Wlk., Cat. Brit. Mus., xvii., 425.

Q., Coolangatta; N.S.W., Sydney; V., Gisborne; W.A., Waroona.

Gen. **Euthrausta**, nov.

Frons with anterior tuft of hairs. Tongue present. Palpi moderately long (3 to 4), porrect or slightly depressed; second joint dilated with rough scales above and beneath; terminal joint minute, almost concealed. Maxillary palpi moderate, filiform. Antennae over 1, slender, joints dilated by whorls of raised scales at apices; in ♂ with long ciliations on basal part, apical part not ciliated. Thorax and abdomen slender, not crested. Legs very long and slender, inner spurs slightly longer than outer. Forewings with 2 from $\frac{2}{3}$, 3 from before angle, 3, 4, 5, 6 equidistant and parallel, 7 approximated at origin to 8, 9, which are stalked, 10 approximated, 11 from middle. Hindwings with 2 from middle, 3 from before angle, 3, 4, 5, 6, 7 equidistant and parallel, 7 anastomosing with 8. Rectinaculum of ♂ short, bar-shaped. Type, *E. oxyprora*.

EUTHRAUSTA PHOENICEA.

Tineodes phoenicea Turn., Tr. R.S., S.A., 1908, p. 107.

N.Q., Herberton; Q., Brisbane.

EUTHRAUSTA OXYPRORA.

Tineodes oxyprora Turn., Tr. R.S., S.A. 1908, p. 108.

N.Q., Cairns; Q., Brisbane.

EUTHRAUSTA HOLOPHAEA.

Tineodes holophaea Turn., Tr. R.S., S.A., 1908, p. 108.

That this is not an aberration of the preceding is shown by the much shorter antennae ciliations of the ♂.

N.Q., Cairns.

Fam. AEGERIADAE.

In the Proc. Roy. Soc. Q., 1917, p. 78, I attempted a revision of the few known Australian species of this family, not knowing that Le Cerf was publishing at the same time an important paper on this family in Oberthur's Etudes de Lepidopterologie Comparee, xiv., p. 127. Since then Sir Geo. Hampson has completed a revision of the

Oriental species in the Novitates Zool., 1919, p. 46, which contains several species not known to me. It seems advisable, therefore, to give a fresh synopsis of the known Australian species,* of which there are now fifteen, all (except one introduced form) from Queensland and North Australia, and to give a tabulation of the genera.

1.	Antennae dilated towards apex and ending in a minute tuft of hairs	2
	Antennae not so formed	5
2.	Hindwings with 3 from angle of cell connate or stalked with 4, 5	3
	Hindwings with 3 separate from before angle	4
3.	Posterior tarsi with first joint fringed with scales above	Lepidopoda
	Posterior tarsi without fringe of scales above	Trochilium
4.	Hindwings with 3 arising from as near or nearer 2 than 5	Melittia
	Hindwings with 3 arising from nearer 5 than 2 . . .	Paranthrene
5.	Hindwings with 3 and 5 stalked	6
	Hindwings with 3 arising remote from 5	Tinthia
6.	♂ without tongue, and with dense tufts of hair on middle and posterior tibiae	Lophocnema
	♂ with tongue, and without tibial tufts	Diapyra

Gen. Lepidopoda.

Lepidopoda, Hmps., J. Bomb. Nat. Hist. Soc., 1900, p. 43, Type, *L. heterogyna* Hmps., from India.

Lepidopoda xanthogyna.

Lepidopoda xanthogyna, Hmps., Nov. Zool., 1919, p. 54.
N.Q., Cairns.

Gen. Trochilium.

Trochilium, Scop., Int. Nat. Hist., p. 414 (1777).

Trochilium chrysophanes.

Sesia chrysophanes, Meyr., P.L.S., N.S.W., 1886, p. 689.
♂ *Aegeria panyasis*, Druce, A.M.N.H., (7), p. 201 (1899).
♀ *Aegeria caieta*, Druce, *ibid*, p. 202.

The latter is the southern form; it differs only in the orange markings of the ♀ being replaced by yellow; the ♂ differs much less. I cannot regard it as more than a local race. Mr. Dodd has bred the species from *Alphitonia excelsa*.

N.Q., Townsville, Bowen; Q., Brisbane, Mt. Tambourine, Toowoomba.

Trochilium melanocerum.

Conopia melanocera, Hmps., Nov. Zool., 1919, p. 71.
N.Q., Cairns, Innisfail.

Trochilium tipuliforme.

Sesia tipuliformis, Clerck, Icones, Pl. 4, f. 1 (1759).

Tasmania; two specimens received from Mr. G. H. Hardy. This is an introduced species feeding on the currant (especially *Ribes* *nigrum*), which has been introduced from Europe to America, New Zealand and Australia.

TROCHILIUM CORACODES, n. sp.

♂♀ 28–30 mm. Head black; sides of face white. Palpi 3, upturned, second joint rough-scaled, terminal joint ½, smooth; black, in second joint mixed with white scales anteriorly. Antennae black; basal joint, with an anterior white spot; in ♂ slightly serrate with tufts of cilia, cilia ⅔. Thorax, abdomen and tuft black, with bluish reflections, abdomen with a few whitish scales. Forewings spathulate; black with lustrous bluish scales in disc; a narrow hyaline streak in cell, and another beneath cell towards base; cilia blackish. Hindwings with termen gently rounded; 3 and 5 connate; hyaline; all veins, a spot on end of cell, and a narrow marginal line on termen and dorsum, black; cilia blackish. Underside similar.

Q., Toowoomba, in February; two specimens taken together by Mr. W. B. Barnard, who has kindly given me the type.

Gen. **Melittia.**

Melittia, Hb., Verz., p. 128.

Type, *M. bombyliformis*, Cram., from India.

MELITTIA AMBOINENSIS.

Melittia amboinensis, Feld., Sitz. Akad. Wiess. Wien, 1861, p. 28.

Melittia amboinensis, var. *doddi*, Le Cerf, Obert. Et. Lep. Comp. xii. i., Pl. 373, f. 3119-3120 (1916), ibid. xiv., p. 1916.

Melittia thaumasia, Turn., P.R.S.Q., 1917, p. 81.

N.Q., Claudie River, Cairns. Also from the Archipelago and India.

MELITTIA CHALYBESCENS.

Melittia chalybescens, Misk., P.R.S., Q., 1892, p. 59.

N.Q.,

MELITTIA PROSERPINA.

Melittia proserpina, Hmps., Nov. Zool., 1919, p. 92.

N.Q., Claudie River, Cairns.

Gen. **Paranthrene.**

Paranthrene, Hb., Verz., p. 128.

Type, *P. tabaniformis*, Rott., from Europe.

PARANTHRENE OBERTHURI.

Phlogothauma oberthuri, Le Cerf, Oberth. Et. Lep. Comp. xii. i. Pl. 376, f. 3141-3142 (1916), *ibid.* xiv. p. 251.

Sciapteron terribile, Turn., P.R.S., Q., 1917, p. 81.

N.A., Port Darwin, Melville Island.

**Balataea homotona*, Swin., Cat. Oxf. Mus., p. 36, belongs to the genus Miscera (Glyphipterygidae).

PARANTHRENE ISOZONA.

Sesia isozona, Meyr., P.L.S., N.S.W., 1886, p. 689.

Q., Maryborough.

PARANTHRENE CAERULIFERA.

Paranthrene carulifera (misprint), Hmps., Nov. Zool., 1919, p. 108.

N.Q., Cairns.

PARANTHRENE ZONIOTA, n. sp.

♂ 24 mm. Head with crown blackish; face whitish. Palpi whitish; extreme base and terminal joint dark-fuscous. Antennae fuscous, towards base brownish; in ♂ simple. Thorax blackish; patagia dark-grey. Abdomen blackish; a white ring on apex of fifth segment; apices of following segments whitish on under-surface; tuft blackish. Legs fuscous; anterior coxae whitish. Forewings narrow, posteriorly dilated, costa straight to near apex, apex round-pointed, termen obliquely rounded; hyaline; veins, a broad transverse bar at end of cell, and a terminal band dark-fuscous with purple reflections; cilia dark-fuscous. Hindwings over 2; hyaline; veins, a broad transverse bar at end of cell, and a narrow terminal band lessening towards tornus dark-fuscous.

Type in National Museum, Melbourne.

N.Q., Claudie River, in January; one specimen taken by Mr. J. A. Kershaw.

Gen. **Lophocnema.**

Lophocnema, Turn., P.R.S., Q., 1917, p. 78.

Type, *L. eusphyra*, Turn.

LOPHOCNEMA EUSPHYRA.

Lophocnema eusphyra, Turn., P.R.S., Q., 1917, p. 79.

N.Q., Cairns.

Gen. **Diapyra.**

Diapyra, Turn., P.R.S., Q., 1917, p. 79.

Glossecia, Hmps., Nov. Zool., 1919, p. 113.

Type, *D. igniflua*, Luc.

DIAPYRA IGNIFLUA.

Sesia igniflua Luc., P.L.S., N.S.W., 1893, p. 133.

Diapyra igniflua, Turn., P.R.S., Q., 1917, p. 79.

Q., Brisbane.

Gen. **Tinthia.**

Tinthia, Wlk., Cat. Brit. Mus., xxxi., p. 23.

Type, *T. varipes*, Wlk., from Celebes.

TINTHIA XANTHOSPILA.

Tinthia xanthospila, Hmps., Nov. Zool., 1919, p. 115.

N.Q., Cooktown.

[PROC. ROY. SOC. VICTORIA, 35 (N.S.), PT. I., 1922].

ART. V.—*On the Drying of Timber.*

By REUBEN T. PATTON, B.Sc., M.F.

(With 9 Text Figures.)

[Read 8th June, 1922.]

The drying of timber is governed by six factors, namely, Moisture Content, Diffusion of Moisture, Evaporating Surface, Thickness, Humidity and Temperature. The first two may be conveniently referred to as the biological factors since they are due to the plant's activity, and are quite beyond our control. The last two may be referred to as the mechanical factors, since we can vary them at will. The two intermediate factors, Evaporating Surface and Thickness, belong partly to both. We may cut a piece of timber to any thickness, or so as to expose more or less of one face than another, but having so cut it, its drying will be governed by the organization of the wood substance.

The work contained herein was commenced at Melbourne (Victoria) and was subsequently carried on at London. The work had its origin in the difference of opinion which exists as to the relative merits of air and kiln-drying of timber. The research had for its object a study of all the factors influencing the drying of timber, in order to ascertain what is involved in the phenomenon of seasoning. It may be here remarked that the term kiln seasoning involves widely different ideas and practices. In some kilns, wholly artificial conditions are used, the temperatures used, for instance, being far in excess of any found in nature. On the other hand, some kiln drying is carried on at about the maximum atmospheric temperatures. In this latter case, it is the continuance of the temperature, not the temperature itself, that is artificial. Timber in our State may be subject to a temperature of 123.5F, and at Melbourne itself to a temperature of 111°F.

There is no doubt in the mind of the wood worker as to the value of air-seasoned timber. Up to the present generation, all the finest wood work of the world has been carried out with air-seasoned timber. That is, in itself, quite a sufficient answer to the statements sometimes made that air-dried timber is inferior to kiln dried. However, modern civilisation demands a greater supply of seasoned timber than can be met by the old practice of air drying. The first aim, therefore, was a study of drying under conditions which have produced such satisfactory results in the past. The work, therefore, was carried on at such temperatures and humidities which, with slight exceptions, are found in nature.

Moisture Content.—In the seasoning of timber we are concerned not only with how much moisture there may be in the wood of a tree when it is felled, but also how that moisture is distributed in the tree, and also whether the moisture content is a constant all through the year. In other words, we are concerned with the quantity of moisture and its distribution both in space and time.

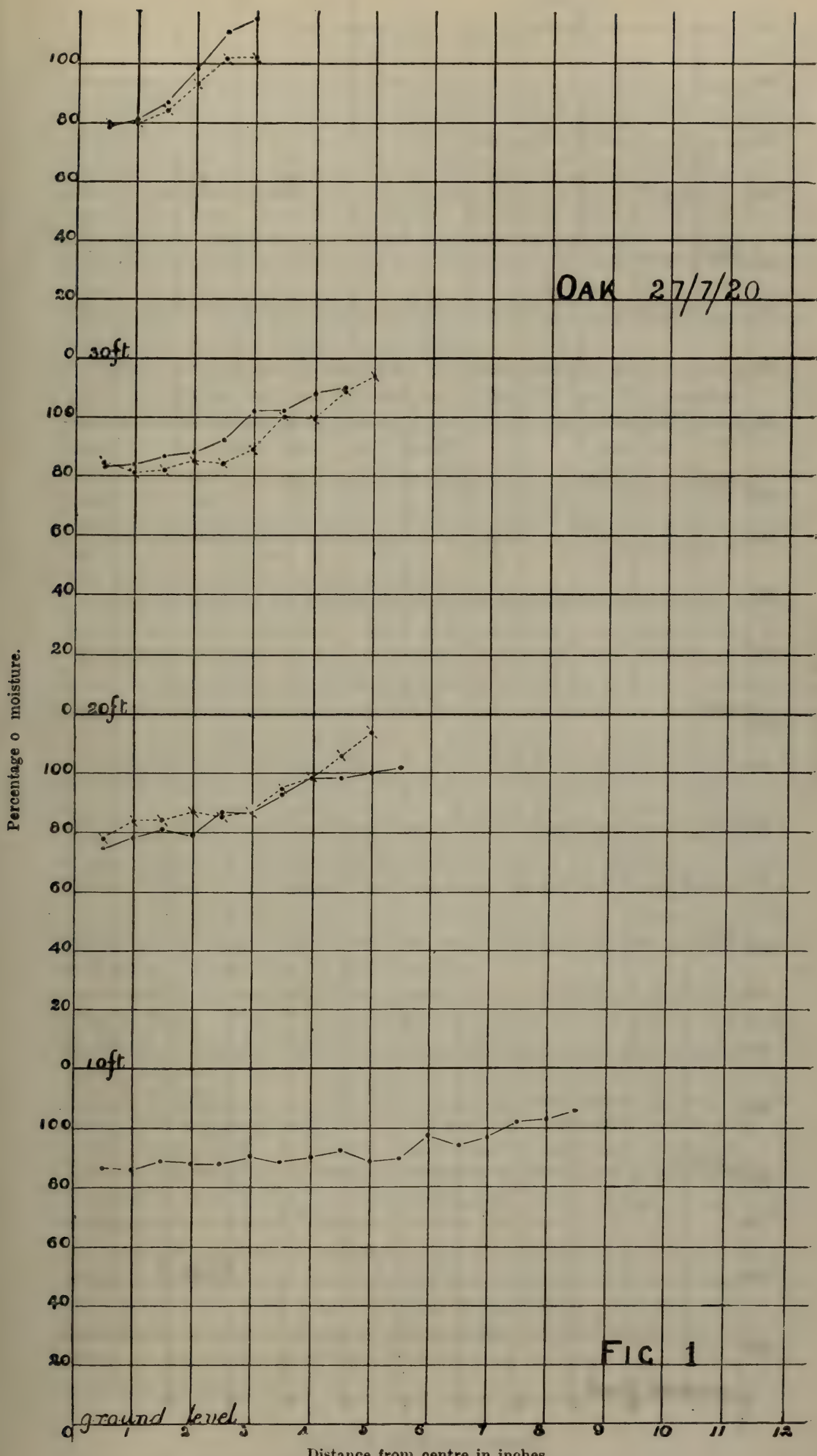
If the sapwood be the means by which water is transported in a living tree, then it should not matter at what time of the year a tree is felled, and if the heartwood be inactive, then we should expect the heartwood content to be a constant. It is obvious, however, that if the heartwood content does undergo a seasonal change, then there is a favourable period for felling. Ordinarily, however, when we speak of the sap as rising, we are considering only the sapwood, and not the heartwood.

It has recently been suggested(1) that the heartwood may play an important part in the moisture needs of the plant. It is suggested that the heartwood acts as a reservoir for the sapwood. This may be true for some trees, but it cannot hold for all. The giant eucalypt of Victoria, *E. regnans*, may have practically no heartwood at all, as it may have all rotted away, yet the tree may live for centuries. The trunk is a mere shell, yet the needs of the tree are met. It was quite a well-known belief among the tree-fellers in the Victorian forests that the central portion of the heartwood of our big trees contained more moisture than the outer portion of the heartwood. In many cases it was found that this central portion contained more moisture than the sapwood. This central portion is very prone to decay, and is rejected in timber milling. An examination of it microscopically shows that the fibres have comparatively thin walls. The percentages of moisture for one tree were as follow:—

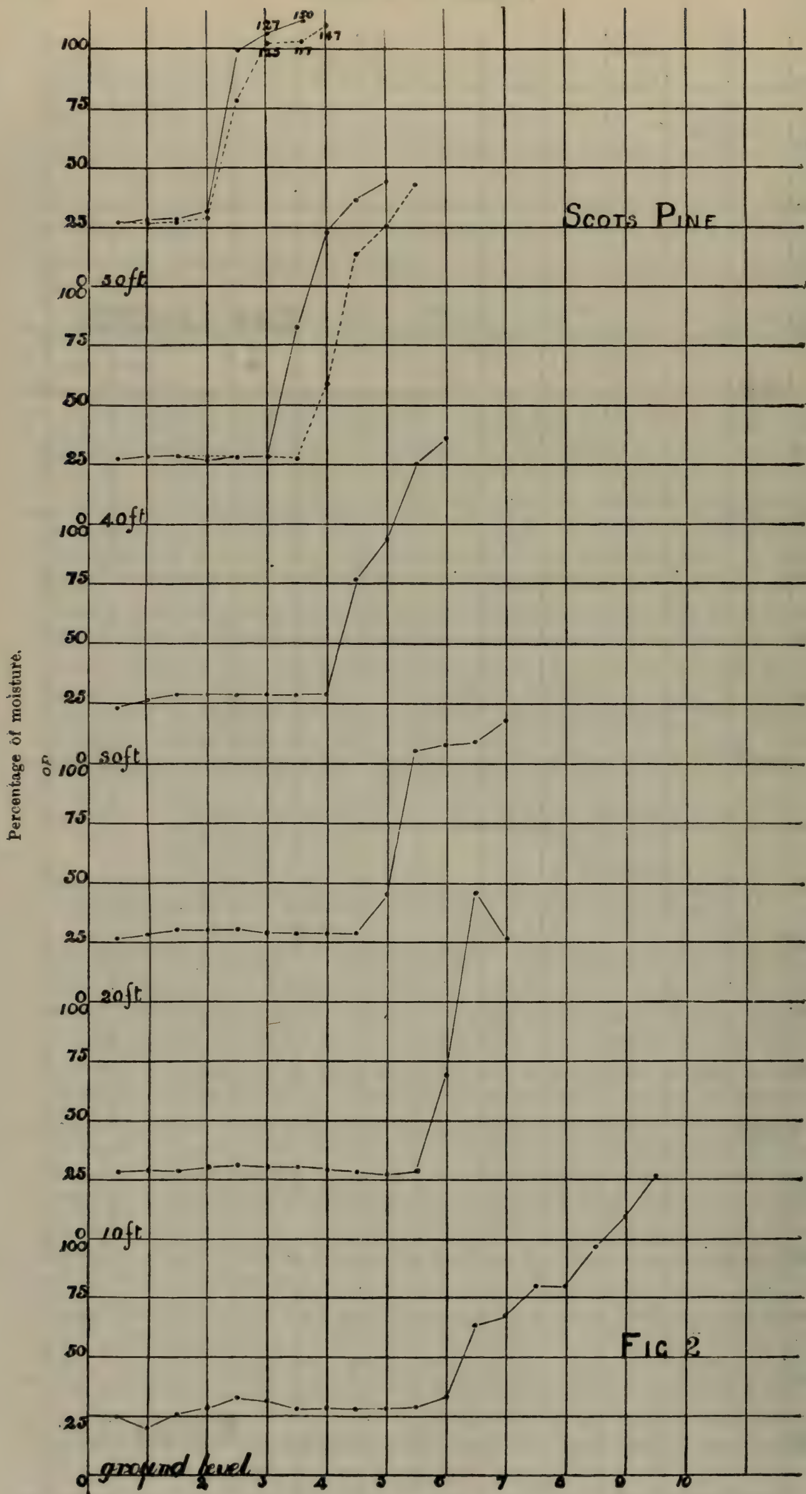
Central portion	150 per cent.
Outer heartwood	77 per cent.
Sapwood	110 per cent.

The percentages are calculated to the dry weight of the wood.

The differential distribution of moisture in *Acer pseudoplatanus* was fully investigated at Edinburgh(1). The investigation was carried on during the dormant period of the tree, i.e., from October to March. The matter was further studied at London during 1920, and the results are given herein. The period of investigation was from February to September, that is, from the end of the winter to the beginning of the autumn. The trees selected for the main investigation were oaks (*Quercus robur*). In every case they were felled in the morning and cross sections, two inches thick, were taken every 10 feet. These sections were at once wrapped in grease paper and taken to the laboratory, where a strip one and a-half inches wide was cut from the centre to the bark. These strips were then split into half-inch pieces, commencing at the centre. If there was an odd width left at the sapwood end, this was considered as a half-inch, and is graphed accordingly. The small pieces were at once weighed and then dried. The percentage of moisture is calculated to the dry weight of wood. In some cases two strips were taken from the section, and these are given on the graphs. In Fig. 1 is given a typical moisture distribution in oak. The first tree was felled on March 2nd, 1920, and the last tree on September 1st. All the trees were taken from the same area and soil which was heavy clay.



DISTRIBUTION OF MOISTURE IN THE TRUNK OF OAK.



Distance from centre in inches.

Owing to financial considerations, it has been found impossible to publish all the graphs, but Fig. 1 is typical of the series. In the graphs for the first trees felled there was a tendency for the curves to sink downwards in the sapwood area, but there was nothing definite, however. When the first tree was felled, there was no sign of the bursting of the buds. On the 23rd March, when the second tree was felled some of the buds appeared as if they were commencing to swell, but there was no further indication of bursting when the third tree was felled on April 22nd. In the graphs for these three trees, the curves rise steadily from the centre of the tree to the outer portion of the heartwood, just as is the case in Fig. 1.

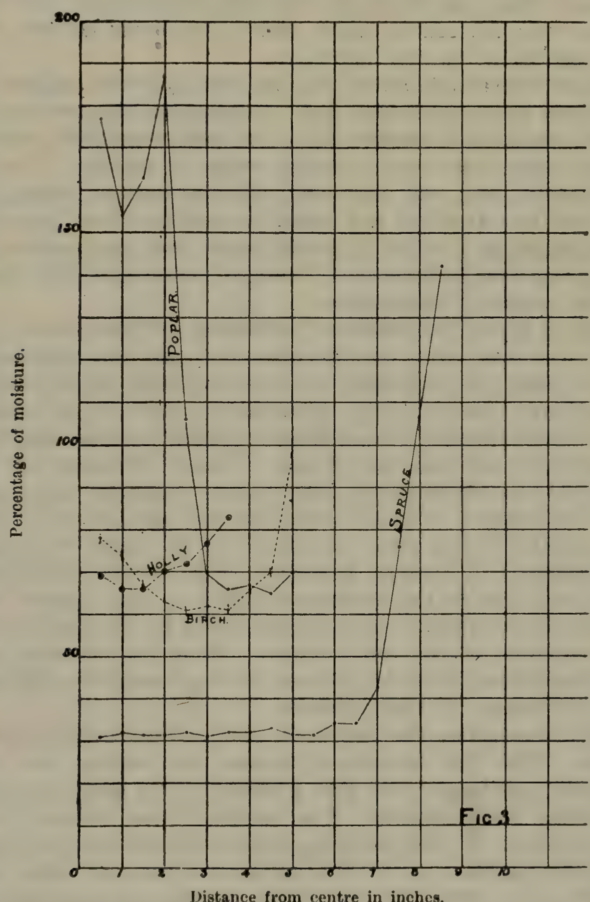
The fourth tree was felled on June 2nd and the fifth on July 27th. Both these trees were in full leaf, and transpiration was greatest. The last tree was felled on September 1st. The oaks were still green, but some of the other trees were showing signs of autumn. The lime (*Tilia Europoea*) was well advanced with its autumn tints. The graph for the last tree did not differ materially from that given. Taking the graphs as a whole, it would appear that the moisture content of the heartwood is constant. There is, however, a well marked rise from the centre to the sapwood.

In Fig. 2 is given the moisture distribution of Scots Pine (*Pinus sylvestris*). The tree was a very fine specimen, and was growing in a pure stand of pine. It was felled on February 25th. It will be seen that the moisture content of the heartwood is very low as compared with that of the sapwood. The difference between the moisture content of heartwood and sapwood of oak is small. In pine, the moisture content of the heartwood is very low as compared with that of oak, while the content of the sapwood of the pine is much higher than that of oak. A low moisture content of the heartwood appears to be characteristic of conifers generally. The moisture distribution is not only very low in the heartwood, but it is very evenly distributed. There is no steady rise from the centre to the sapwood. The vertical distribution is also very uniform. From the practical standpoint, the heartwood of pine is easy to dry owing to the small and even distribution of the moisture.

In Fig. 3 are given the graphs of the moisture distribution of several trees. With the exception of spruce, the sections were taken at breast high. All these trees were growing in the same forest from which the oaks were obtained. The spruce (*Picea excelsa*) was a very fine specimen. It was felled on April 22nd, and the section was taken just above ground level. The graph conforms to those of the pine. There is the same low heartwood content and extremely high sapwood content. The poplar (*Populus nigra*) was a fine tree, and was felled on April 22nd. The distribution of the moisture was extraordinary.

The birch (*Betula alba*) was felled on March 25th. It also has a peculiar moisture distribution. The holly (*Ilex aquifolium*) was felled on August 5th. The graphs in Fig. 3 show that the lateral moisture distributon in trees requires investigation. Such varying distributions of moisture may very seriously affect the drying of lumber, especially if the drying is uneven, due to circulation of the air being bad.

So far as the graphs for oak and pine are concerned, it would appear that it does not matter when the trees are felled. There does not appear to be any movement of the moisture in the heartwood of oak, and it is inconceivable that the heartwood of pine can ever contain a great amount of moisture to meet the needs of the tree.



LATERAL DISTRIBUTION OF MOISTURE IN VARIOUS TREES.

As already mentioned, the big trees of Victoria frequently have very little heartwood, as it has rotted away.

Diffusion.—The second biological factor is that of the power of any particular timber to lose its moisture. When it is said that a wood is difficult to season, all that is meant is that the wood loses its moisture either too slowly or too quickly. If it loses the moisture too rapidly, then the wood is very apt to warp, especially if the drying be at all uneven. This appears to be the case with elm (*Ulmus campestris*). On the other hand, if the moisture be lost very slowly, any attempt to hurry up the drying will lead either to warping or cracking, as in the case of oak, where the medullary rays tend to open out. Wood that contains a low percentage of moisture is not difficult to season.

We have already seen that different species contain different amounts of moisture. Hence we cannot compare their rates of drying. However, moisture is lost by diffusion, and we know from the laws of diffusion that the amount of moisture lost is proportional to the gradient of the concentration, and the area of the evaporating surface. It is expressed mathematically as—

$$dx/dt = \mathrm{D}d\,\mathrm{C.A}/dl.$$

Where for timber x is amount of moisture lost in grams, t is time in days, c is concentration of the moisture, l is length in inches, A is area of diffusing surface in sq. inches, and D is the diffusion constant.

The amount of moisture diffused will also be affected by Temperature and Humidity, but these may be omitted if the conditions are kept constant.

If this formula can be applied to the drying of wood, then the value of D will give us a measure of the ease or difficulty with which any particular timber parts with its moisture. Owing to the many difficulties in applying such a formula to timber drying, it was not expected to obtain any very accurate results. In fact, accuracy is impossible. But what might be expected is that values would be obtained which would give an indication of the relative powers of diffusion of the various timbers. For the experimental work, blocks of straight grained, freshly felled timber were cut into sizes approximately 2 x 2 x 3 inches. The 2 x 2 face was tangential and the length, 3 inches, was in a radial direction. The four 2″ x 3″ sides were coated with the mixture recommended by Tiemann(2). The blocks were placed in an oven at 40°C. and at a 50 per cent. humidity. They were weighed at the same time every day, and the loss of weight plotted so that any irregularity of loss might be noticed. While the blocks were still actively drying, the sides were cut off and the blocks split up into one quarter of an inch sections. These sections were at once weighed and then dried, and the moisture percentage calculated to the dry weight. These percentages were plotted as in fig. 4, and the moisture gradient was obtained by drawing a tangent at the extremity of the curve. The value of the gradient was substituted in the equation for $d\mathrm{C}/dl$. Half of the amount lost in the previous 24 hours was taken as the value of dx/dt.

The value of D obtained from the formula is by no means accurate, as the values obtained are somewhat wide. This was expected for various reasons. The width of ring varies greatly, even in the same specimen, and may even vary widely in two adjacent rings. In a pile of Red Oak (*Quercus rubra*) which was ready to go into a kiln the width of ring varied from one-half to one-tenth of an inch.

The material was inch timber, and quite a number of the boards had only two rings of growth. It may reasonably be expected that there would be, in such timber, a great variation in the rate of diffusion. No material could be obtained, however, to investigate this matter.

In Table I. are given the results of the calculations for D. for various timbers at 40°C. and 50 per cent. humidity.

TABLE I

Timber	Botanical Name	Values of D						Average
Oak	*Quercus robur*	.0012	.0026	.0032	.0048	.0056	.0057	.0038
Birch	*Betula alba*	.0049	.0067	—	—	—	—	.0058
Beech	*Fagus sylvatica*	.0061	.0072	.0092	.0113	.0142	.0169	.0108
Elm	*Ulmus campestris*	.0084	.0102	.0169	—	—	—	.0118
Scots Pine	*Pinus sylvestris*	.0051	.0115	.0195	.0240	.0266	—	.0173

The average values of Oak, Beech and Pine generally indicate the positions of these timbers as regards drying in practice. Both Elm and Beech are said to be difficult to dry, as they warp badly while drying. Both Beech and Elm have a high moisture content, and as we have found a high diffusion constant. These timbers lose moisture rapidly, and unless the drying be uniform warping will result. The cause of the warping of Elm is said to be due to its twisted grain, but an examination of a large amount of elm lumber does not bear this out. It is true that twisted grain will produce warping, and this is freely borne out by such a timber as River Red Gum (*Eucalyptus rostrata*). It is doubtful if any other timber even approaches this for irregularity of grain. A twisted grain, however, does not appear to be a character of the elms. The warping of elm is most likely to be due to uneven drying.

In Victoria our timbers warp a great amount due to bad stacking. The green sawn timber is frequently stacked in a mass, and no provision is made for circulation of air through the pile. The stack is exposed to the fierce rays of the summer sun, and the top timber warps badly in consequence. The pieces of timber in the interior of the stack can only dry by their exposed ends, and these crack badly. All kinds of timber are stacked out in the open in Eastern U.S.A., but the stack is properly ventilated. There is a space between each board laterally and vertically. The top of the stack is roofed with off cuts from the logs. The timber comes out of these stacks in perfect condition.

Oak is difficult to dry because it has a high moisture content and a low power of diffusion. Pine, on the other hand, has a low moisture content, but a high power of diffusion, hence drying is rapid.

If we knew the moisture content of a species of timber and its diffusion constant, we might then be able to predict the time necessary for drying, and we could, if kiln drying, prescribe the necessary treatment. Until we know more about the diffusion of moisture in wood, formulas for drying are more or less guesswork.

In general the diffusion constant will vary with the specific gravity of timber. Dense heavy timbers are generally slow in drying, and therefore we may expect a low diffusion constant. The cell walls in conifers are on the whole much thinner than the walls of the fibres of hardwoods. The walls of the tracheides are comparable to the walls of the vessels.

Tissues, engaged in water conduction, must have relatively thin walls. Water conducting elements have their walls freely pitted, while strength elements such as the libriform fibres are sparsely pitted. Coniferous timber has a higher power of diffusion than most dicotyledonous timbers, because the elements concerned in drying, the tracheides, are the water conducting elements, while in the hardwoods the elements concerned in drying are the fibres or strength elements. The movement of water in a tree is, in some intimate way, closely associated with the cell walls, and if a hardwood consisted of vessels only, we should find this timber drying as quickly as coniferous.

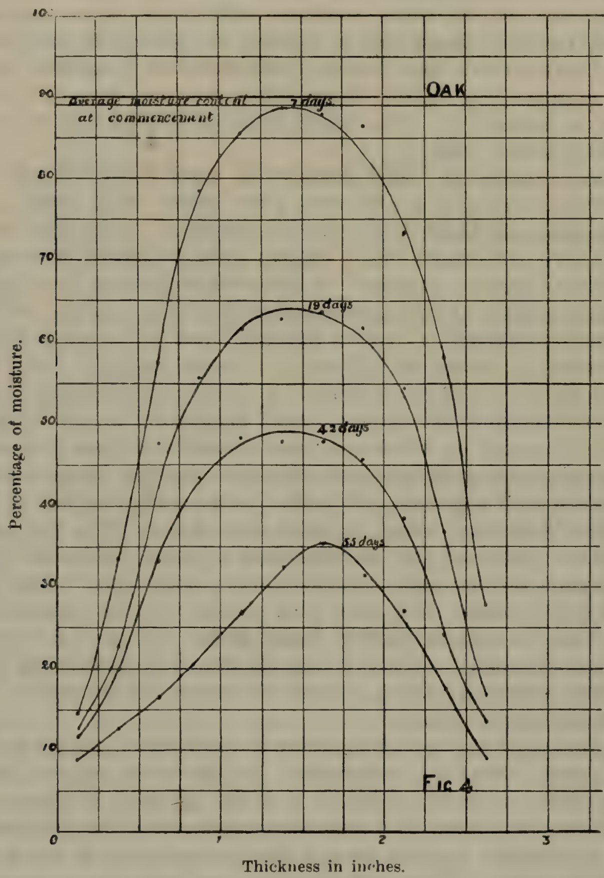
It is of interest to know how the moisture diffuses through the wood. Moisture in wood has been classified into free water and water of saturation. All water in the timber over or above what is known as the fibre saturation point, is called free water. The fibre saturation point is defined as the concentration of water necessary to saturate the walls of the cells without there being any water in the cavities of the cells. The term free water is used because it is assumed that this so-called free water passes out of the wood first when timber is drying. When it has all been lost the timber is then at the fibre saturation point. When the water of saturation begins to be lost, shrinkage begins.

This theory of the loss of moisture from wood is against the facts.

The word "free" is unfortunate, as the term implies that the water is free to move. Now if a block of wood containing this so-called water be placed in a saturated atmosphere, the block remains constant in weight. In soils we get free water, which is the water in excess of saturation. The water is truly free, because it moves under the force of gravity. The water in the cells of the wood is not free to move under the force of gravity. Instead of calling this cell water free, we may call it *Contained Water*. There is, however, actual free water in a tree. When a giant eucalypt is felled, water pours from the cut end of the bole. This may be observed even in mid-summer. This water is truly free, for we cannot prevent its loss by merely altering the humidity of the atmosphere.

Free water occurs in birch, and the phenomenon of weeping is well known. This free water has all been lost by the time the logs get to the mill. We may define Free Water as the water which escapes from the lumber not as vapor, but as a liquid. The loss is due to the force of gravity. Free water, as here defined, must readily escape from the cut ends of the vessels, when full, of such timbers as Eucalptus, for in these the vessels are very large.

As will be seen from Fig 4, as soon as drying commences a gradient is established. It does not matter at what temperature or at what humidity the wood be dried, a gradient is established. Gradients



GRAPHS ILLUSTRATING THE PROGRESSIVE DRYING OF 3 IN. TIMBER AT 40°C AND 50% HUMIDITY.

have been found in all timbers examined. A series of birch blocks were dried at room temperature, and room humidity, and after 55 days they gave the following gradient from the evaporating surface to the centre of the block:—

Percentage of moisture in each ¼ inch.

16	23	29	34	37	39

Drying was very slow, nevertheless a graidient was formed.

If a graident be formed, then there can be no such condition as fibre saturation. It is believed that no shrinkage takes place until this so-called fibre saturation point is reached. As a matter of fact, in all timbers examined shrinkage follows the gradient. This can be readily seen if blocks of timber be coated on four sides so that the moisture can only escape in one direction, preferably the radial. Shrinkage can be measured under such conditions. A block of beech 2″ x 2″ x 3″, drying at 40°C., gave the following amounts of shrinkage at the times and positions given. The 2 x 2 face was tangential, and the shrinkage occurred in the tangential direction.

TABLE II.

	Shrinkage at each distance from end.				
Days	¼ in.	½ in.	¾ in.	1 in.	1½ in.
2	.02 cms.	.02 cms.	.01 cms.	—	—
5	.05	.03	.01	—	—
7	.08	.06	.02	.01	—
11	.11	.08	.05	.04	.03
19	13	.11	.10	.10	.10

Amount of shrinkage in a beech block when drying.

In Fig. 4 are given the results of drying a series of similar oak blocks under the same conditions—40°C. and 50 per cent. humidity. The blocks were approximately 2″ x 2″ x 3″, and the longest side was in the radial direction. The four long faces were sealed, and the two 2″ x 2″ faces were exposed. Blocks were cut up at the times shown on the graphs. The distribution of the moisture was obtained as before. It will be seen that the gradient was steep at the commencement. It may be argued that such a condition indicates case hardening, but as a matter of fact no such condition existed. It will be shown later that the conditions of drying were very favourable, and that these same conditions permit of a greater amount of shrinkage than lower temperatures and higher humidities. The graphs indicate that drying is accompanied by a moisture gradient, and that no such condition as fibre saturation is reached.

Instead of a piece of timber losing its contained water until fibre saturation is reached, we may say that as soon as a surface of green timber is exposed to the air, it immediately tries to come into equilibrium with the air moisture. The vapour tension of the moisture in the wood is greater than the vapour pressure of the air, and moisture is lost. This loss is made good from the contained water of the cells immediately next to the surface. This water passes out through the outer cell wall. As soon as this water is lost a gradient begins to be established. The walls begin then to lose moisture, and as wood is hygroscopic the cell walls draw moisture from the next layer of cells. The contained water in the cells passes to the outside by means of the cell walls, not through the cavities of the empty cells. This process goes on from cell to cell. The steepness of the gradient depends partly on the rate at which the moisture is being lost, and partly on the rate at which moisture can move through the wood to the evaporating face.

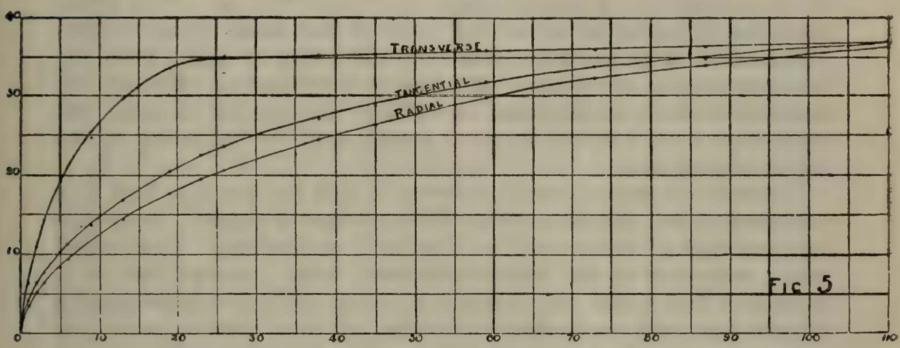
If the contained water passed from cell to cell as is necessitated by the fibre saturation theory, then there would have to be osmotic substances present in the cavities of the cells, and these do not exist. There is only one path for the moisture to reach the exterior, and that path is along the cell walls. This loss continues until the vapour pressure on the outside of the face is equal to the vapour tension of the face.

In other words, when the moisture in the wood and the moisture of the air are in equilibrium, the wood is seasoned. When exposed to the air, the weight of a piece of seasoned timber is not a constant, however, as it varies with the humidity of the atmosphere.

Evaporating Surface.—The third factor influencing the drying of timber is the face or surface exposed. There are three faces in timber—the transverse, the tangential, and the radial; and it is well known that these have different rates of drying. Wagner(3) says: "A very moist piece of pine or oak will, during one hour, lose more than four times as much water per square inch from the cross section, but only one half as much from the tangential as from the radial section." Tiemann(2) says: "The transfusion endwise of the grain is very much greater, probably ten or twenty times as rapid as it is across the grain." Again, Tiemann says: "Quarter sawed lumber will generally require 25 to 50 per cent longer to dry than plain sawed." These two authors differ widely in their opinions.

In order to ascertain what were the actual rates of loss from each face, cubes were used, and for these freshly felled timber was obtained. The timber was cut square, usually 2″ x 2″, two faces being parallel to the annual rings, and two parallel to the medullary rays. This can be done if timber from large trees be used. The length was cut transversely into cubes. Thus each cube had the same annual rings. Each cube had four faces sealed, and two corresponding faces exposed. For sealing, paraffin is undoubtedly the best material to use. The paraffin was heated to a temperature just above the boiling point of water, and the face of the cube brought into contact with it for a moment. The surface layer of moisture was evaporated, and the paraffin then came into intimate contact with the wood. All four faces of the cube were sealed in this way. After the paraffin set, the cubes were given a second coating. By this means a perfect seal was secured. For higher temperatures, the seal recommended by Tiemann(2) was used. This mixture is unsatisfactory for the first few days, when high humidities are used, as it sticks to the supports. It has this advantage, however, in that it readily indicates the shrinkage of wood, for as the wood shrinks the seal forms very fine wrinkles. When the cubes were coated they were placed in a saturated atmosphere for 24 hours at the temperature at which they were to dry subsequently. When the cubes were dried it was found in all cases that the transverse face lost the most moisture in a given unit of time. A large number of timbers, both European and Australian, have been tried, and they all give the same type of drying curves as shown in Fig. 5. A study of these curves of loss shows that the curve of loss for the transverse face always rises very sharply, and turns over rather abruptly into a straight line. The curve for the radial face is always the lowest, but the tangential curve of loss is always close to it. The tangential curve is above the radial, not below, as indicated by the statement of Wagner. The general equation to the curves is

OAK.



Time in days

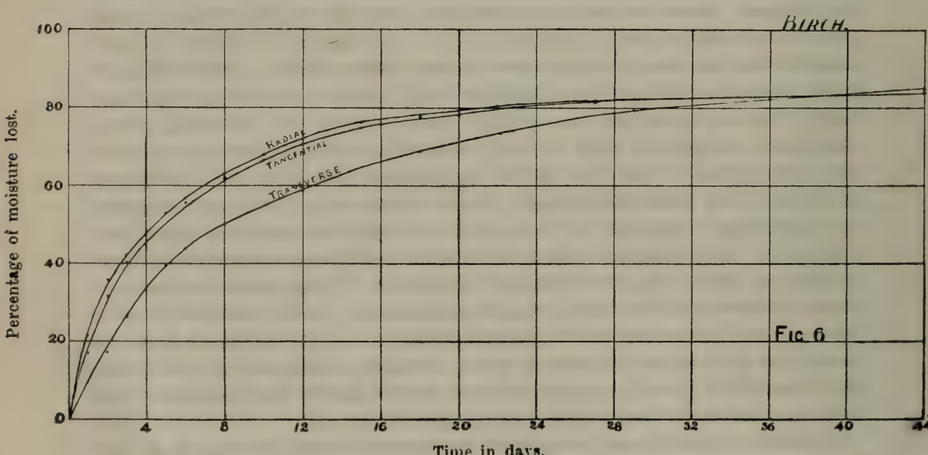
CURVES OF LOSS OF MOISTURE FROM THE TRANSVERSE TANGENTIAL AND RADIAL FACES OF CUBES OF WOOD.

$l = at^b$ where l is the loss in weight in grams in time, "t," "a" is the loss for the first day, "t" the time in days, and "b" the index varies in value from unity to ·5, but is constant for any one curve, provided the conditions of drying are kept constant. The transverse curve has the greatest "a" value, and the greatest value for "b." When "b" is unity, the curve is a straight line, and when ·5 it is a parabola. The radial curve approaches a parabola, while the transverse curve approaches a straight line. The curves of loss for both softwood and hardwood cubes are similar. The transverse face of pine, as stated by Wagner, loses moisture, relatively just as readily, when compared with the radial, as does that of a hardwood. Hence, we are compelled to assume that the cause of this differential loss from the three faces is due to the structure of the wood itself. Water is lost most readily in the direction in which water moves in the living tree. Again the tangential face loses more moisture in a given time than the radial face. Abutting on the tangential face are the transverse sections of the medullary rays. Hence a tangential face is a complex of longitudinal sections of fibres and of transverse sections of medullary rays. If an isolated fibre of wood be examined in polarised light it will be found to give straight extinction. Transverse sections of fibres, however, do not give straight extinction. If an isolated medullary ray cell be examined in polarised light, it will be found that its length in the radial direction gives straight extinction. This leads us to conclude that the micellae of the fibres and of the medullary ray cells are arranged parallel to the length of the cell.

Now moisture finds its readiest movement, when the tree is living, along the cell walls in the direction in which the micellae are arranged. Were it not for the medullary rays, the tangential face would lose moisture at the same rate as, or even less than, the radial. The micellae of the walls of the medullary rays are arranged in a radial direction, and it is in this direction that the water moves in them when the tree is alive. The movement of water in the plant is in some way closely associated with the structure of the cell wall, and we find in the drying of timber that the greatest losses in unit time are in the direction of greatest water movement in the living plant. Since the organisation of the cell walls of the woods of all timbers is the same, it is not surprising that the ratios of losses from the three faces are approximately the same for all timbers. While these ratios of loss may be the same, the rates of loss are not the same. All three faces have different rates of drying, and the equations to the curves are different.

As will be shown later, the curve of loss for any one face is a composite curve, and is made up of two types of curves. It is only the first type of curve that we are here considering. This curve varies, according to the drying conditions, from a straight line to a parabola. The slower the drying the nearer the curve approaches a straight line, and the faster the drying, up to a certain point, the nearer the curve approaches a parabola.

Not only does each face lose moisture at a different rate, but each rate of loss decreases differently. The face with the greatest initial loss, the transverse, has also the slowest rate of decrease. Hence we cannot cut a piece of timber so that all three faces will have the same rate of loss. Of course they could be cut so that all faces would have the same initial loss, but the losses on the subsequent days would be different. However, it is possible so to cut a piece of timber that all the curves of loss shall meet, or just cross each other, towards the end of the drying period. The curves of loss for White Birch were studied, and it was considered that if a piece of this wood was cut so that the dimensions in the tangential radial and vertical directions were as 5 : 6 : 30, the curves of loss would meet towards the end



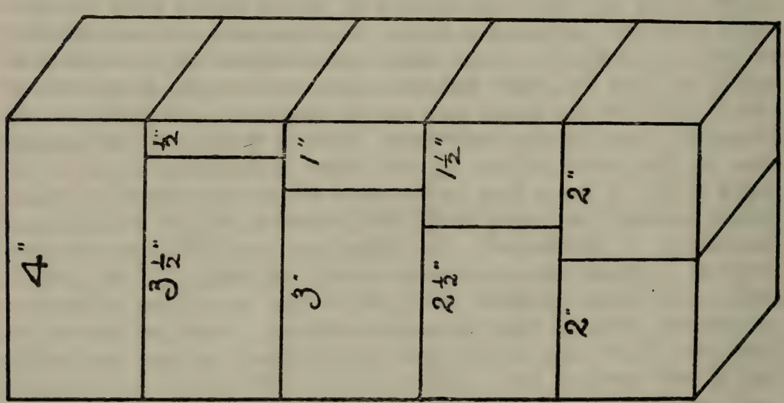
CURVES OF LOSS FOR BLOCKS OF BIRCH $1\frac{3}{8}'' \times 1'' \times 5''$

of the drying period. A length of straight grained, freshly-felled birch was cut 1⅜″ thick radially and 1″ tangentially. This was then cut into three 5 inch pieces. One length had the two transverse faces exposed, and the sides sealed, in the second the tangential faces were exposed, and in the third the radial faces were exposed. The blocks were dried at 25°C. Fig. 6 gives the result of the experiment. The percentage of moisture lost is calculated to the total amount of moisture present at the commencement of drying. The moisture percentages of the three blocks at the conclusion of the experiment were as follow:—Radial, 10.7 per cent.; Tangential, 11.4 per cent.; Transverse, 11.1 per cent. These percentages are calculated to the dry weight of the wood.

From a study of the curves of loss for oak, it was calculated that if it were cut so that the dimensions in the tangential radial and vertical directions were as 4: 5: 20, the curves of loss would meet towards the end of the drying period. Two sets of blocks were cut, one to a size 1″ x 1¼″ x 4″, and the other 1″ x 1¼″ x 6″. The calculated length lay between the limits, 4″ and 6″. The blocks were dried at 25°C. The radial curve of loss was above the tangential until the 50th day, when they met. The differences thereafter were very small. The curve for the transverse face, in the case of the 4″ set, crossed the other curves on the 92nd day. In the 6″ set the curve for the transverse loss was still below the other curves on the 104th day, when the experiment finished. In the 4″ set, at the close of the experiment, the percentages of moisture, calculated to the dry weight of wood, of the radial, tangential and transverse specimens, were respectively 11·8 per cent., 11·5 per cent., and 11·4 per cent. In the case of oak it appears that the ratio of the radial dimension to that of length should have been only about 1:4. In the case of birch the ratio could have been increased a little. The true ratio for inch material probably is about 1·5. This ratio of dimensions for inch material would not hold for larger material, since the decrease in the rate of loss is faster for the radial than for the tangential, and faster for the tangential than for the transverse. This is because in the expression for the curve of loss for the radial surface, the value of the index of "*t*" is lower than in the curve for the transverse. As thicknesses increase the ratios would also increase, but by what amount remains to be determined. We cannot say that the transverse face dries at a definite rate as compared with the radial, for the rate of loss is constantly changing. If a rate of loss be specified, it must be in relation either to time or moisture content. While we cannot say how much faster one surface dries than another, we may say that as far as inch material goes, quarter sawn boards, one inch in thickness, will take as long to season as tangentially cut boards about 1¼″ in thickness. Normally, most timber seasons by lateral drying, but at times end drying is important, as for instance, when large dimension material is to be used in short lengths. As an example, a kiln was being charged with long lengths of 9″ x 9″ lumber. This was to be used subsequently in 3½ ft. lengths. In this case if the timber had been cut into short lengths first, time would have been saved, as the manufacturing length was less than five times the width.

End drying is important in this state owing to the loss which is caused, both in stacks of sawn timber, and in logs, through the large cracks occurring in the ends. Much of our tall, straight-grained timber is very fissile, and, therefore, splits much more easily than most timbers. The cause of the cracks at the ends of both logs and stacked timber is mainly the prevention of lateral drying. In the log, lateral drying is prevented either by the bark or by the thickness of the log, or by both. In stacked timber lateral drying is prevented, if no ventilation is provided for. Only the outside pieces can dry laterally, and then only from one side. As we have already seen, shrinkage commences as soon as a gradient is formed. Shrinkage, however, is prevented from taking place where only end drying is occuring, owing to the rigidity of the adjacent portions of the timber. End drying affects only a few inches, and the timber in this short length is held in position by the remainder of the length. As the wood is drying, it tends to occupy a smaller volume, but if it cannot do so as a whole it must do in parts, and it therefore splits. That some of our timber will split even when correctly stacked is true, and this can only be overcome by sealing the ends with paint, or with Tiemann's mixture. In usual commercial sizes this does not affect time taken in drying, as the length is generally very many times greater than the thickness. In commercial sizes lateral drying is almost always the means by which timber is dried.

Thickness.—The fourth factor concerned in seasoning is that of thickness. For the study of the effect of thickness on time taken in drying, lengths of straight grained, freshly felled timber were used. Thicknesses up to five inches have been used. The timber was cut as in the diagram:—



The sides were coated as in the previous experiments. Where possible, three of each thickness were used, and the average loss of the three taken as the loss for that thickness. Each thickness had the same evaporating surface, and the various blocks differed only in thickness.

In Table III. are given the results of the first experiment. The timber was messmate (*Eucalyptus obliqua*), and the evaporating faces were four inches square. The thicknesses ranged from half an inch by half inches to three and a-half inches. The blocks were left to dry on the laboratory table. The experiment commenced in the middle of summer, and the effect of winter is seen by the decrease in

TABLE III.

Time in Days	Total losses of each thickness.						
	3½ in.	3 in.	2½ in.	2 in.	1½ in.	1 in.	½ in.
	gms.	gms.	gms.	gms.	gms.	gms.	gms.
1	9	12	11	11	11	10	11
2	15	19	17	17	18	16	17
3	22	25	23	21	23	21	20
5	29	33	31	31	30	28	24
7	35	39	38	37	36	34	26
11	45	47	47	47	45	42	26
18	61	62	61	63	60	53	28
25	72	73	72	74	69	59	27
32	81	82	81	83	77	62	27
39	87	89	87	89	81	61	26
46	93	94	92	94	84	61	26
53	99	100	98	99	89	—	—
69	112	113	112	111	96	—	—
87	123	124	122	120	98	—	—
115	142	142	139	134	102	—	—
141	148	149	145	137	101	—	—
195	168	168	161	145	102	—	—

Each thickness loses approximately the same amount of moisture in a given time.

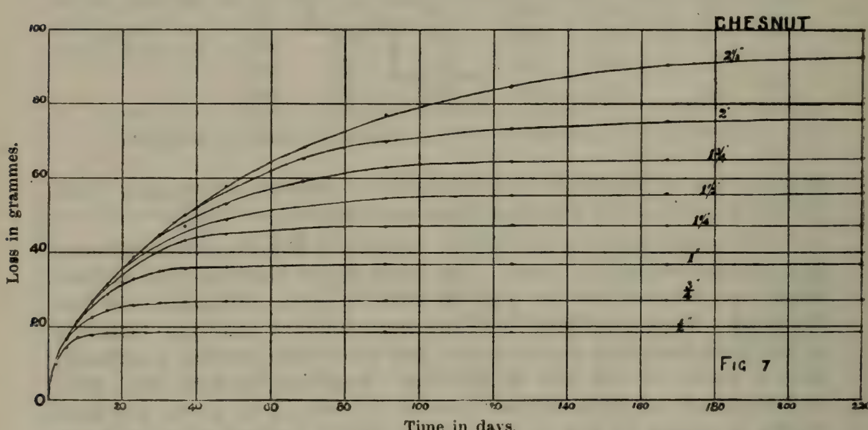
loss of some of the blocks and a subsequent increase in weight. This occurred in the inch and half inch specimens..

The total losses on the left of the heavy line for any particular day are approximately equal. The table shows that up to a certain point, the amount lost in a given time is quite independent of the thickness. Each thickness loses the same amount until the reservoir of moisture begins to be exhausted, and after that there is a different type of curve for the loss of moisture. Experiments with Oak, Elm, and Chestnut all gave similar results. In Fig. 7 is given a typical family of curves of loss for a series of blocks, having 2″ x 2″ faces, and ranging from half an inch by half inches to two and a-half inches. The outer curve or envelope is the curve of loss for the thickest specimen. The equation to this curve is approximately, $l = 6 \cdot 75 t^{\prime 554}$, where l is the total loss of weight in grams in time "t," 6·75 is loss in weight in grams for the first day, and "t" is time in days. The irregularities of the secondary curves at the point of junction with the main curve have been smoothed out. In this series only one specimen was used for each thickness. The differences between the values of the calculated losses and those actually obtained by weighing are given in the following table:—

TABLE IV.

Time in Days.	Calculated Loss $l=6.75t^{.554}$	Actual Loss.	Difference.
5	16.46 gms.	16.35 gms.	+.11 gms.
8	21.35	21.45	—.10
16	31.35	31.40	—.05
23	38.34	38.65	—.31
37	49.87	50.10	—.23
48	57.62	57.80	—.18
69	70.52	69.20	+1.32

From an examination of Fig. 7 it will be seen that drying commences and continues for a while as if the supply of moisture was inexhaustible. However, in a given thickness the amount of moisture is limited, and therefore the curve of loss leaves the initial curve, and finally becomes a straight line. Where the one curve leaves the other it is difficult to say. In the small thicknesses the change is somewhat abrupt, but as thicknesses increase the change becomes less and less abrupt. This is because the secondary curve does not leave the main curve at the same moisture content in each case. In the small



SERIES OF CURVES ILLUSTRATING LOSS OF MOISTURE FOR VARIOUS THICKNESSES OF TIMBER.

sizes the moisture has only a small distance to diffuse, in order to reach the surface, and hence the curve of loss for thin sections coincides with the envelope for a relatively longer period than do the curves of loss for thicker sizes. The rate of loss is greater on the main curve than on the secondary, and hence these sizes dry rapidly. This was observed by Tiemann (2), for he says: "For one half inch or less the time should be decreased as the square of the fractional part of an inch." Again, he says, for thickness above an inch, "The time ordinate should be increased in proportion to the thickness up to three inches, and about one and a-half times the thickness for thicknesses over three inches."

Humidity and Temperature.—The fifth factor with which drying is concerned is that of humidity, and with this we may conveniently consider the sixth factor, temperature. Humidity is not a satisfactory variable to use, since it is only a relative quantity. When we speak of a humidity we must always specify a temperature. The same humidity at different temperatures gives very different drying conditions. Drying depends on the difference between the vapor pressure of the air surrounding the wood and the vapor pressure at saturation. At a temperature of 50°C. and a relative humidity of 90 per cent., there is a difference in pressure between that actually existing and that at saturation point of 9.25 mm. of mercury. At a temperature of 20°C. and the same humidity, namely, 90 per cent., there is only a difference of 1·75 mm. Hence there is a very great difference in the rate of drying of timber, when placed under these two sets of conditions. A high humidity at a high temperature may cause timber to dry at a much faster rate than a low humidity at a low temperature. Thus blocks drying at 80 per cent. humidity at 50°C. were losing moisture faster than those at 10 per cent. humidity at 20°C. This point is frequently lost sight of in kiln drying, when it is recommended to commence the seasoning at a high temperature and a high humidity.

Experiments were carried out at different humidities, at the temperatures 20°, 30°, 40° and 50°C. For the experimental work blocks approximately 2″ x 2″ x 1″ were used. For any one experiment the blocks were cut from the same length of timber. Only straight grained, freshly felled material was used. The sides of the specimens were sealed, leaving the 2″ x 2″ faces exposed. The exposed faces were always radial surfaces. To obtain the various humidities, solutions of sulphuric acid were used. After each weighing, the solution in each desiccator was brought up to strength by adding the amount of acid corresponding to the loss of weight of the specimen. For desiccators, tall gas cylinders were used, and the specimens were supported on glass rods. The humidities used ranged from 95 per cent. down to 2 per cent. There were two humidities below 10 per cent., namely 7 per cent. and 2 per cent.

In the experiment at 20°C. losses increased with decreasing humidity. The greatest loss occurred at the lowest humidity, that is at 2 per cent. At the other temperatures, however, the maximum loss occurred at 7 per cent., and the curve of loss bent downwards from the 7 per cent. to the 2 per cent. humidity. This is shown in Fig. 8, which gives a typical series of losses. Similar graphs were obtained with beech, elm, and chestnut. A duplicate experiment with oak at 50°C. gave precisely the same type of graph. Owing to limitations of space and material, only single specimens could be used at each humidity, but the greatest care was taken in the selection and cutting of the material. In the case of Fig. 8 the heaviest specimen was 64:5 gms., and the lightest 64:12 gms., so that the differences in the weight of the specimens were negligible.

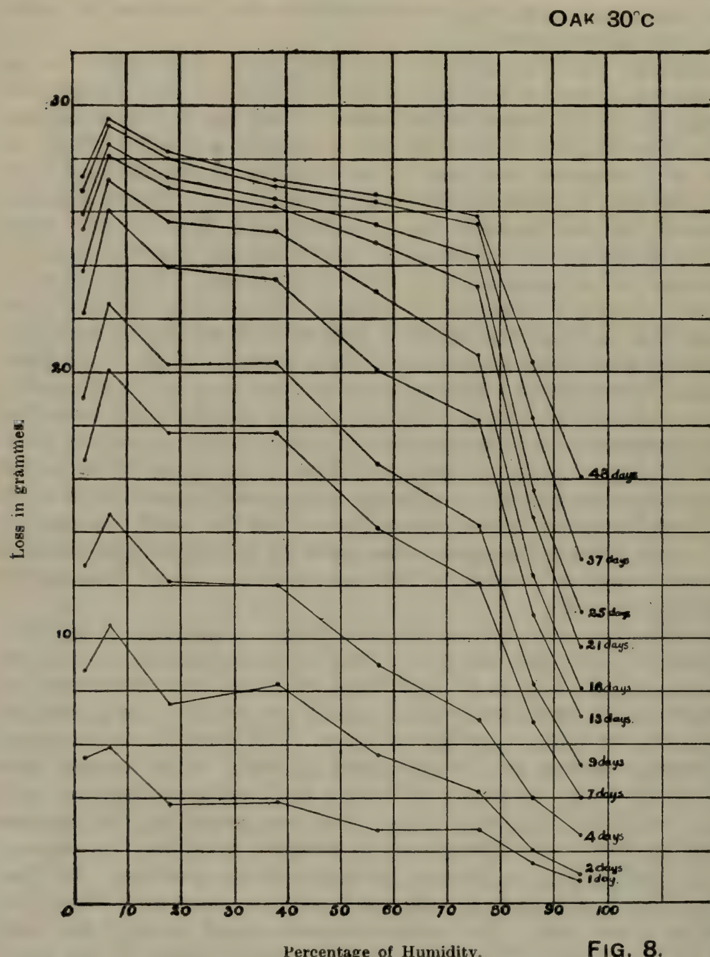


FIG. 8.

TYPICAL SERIES OF LOSSES IN WEIGHT OF BLOCKS, DRYING AT VARIOUS HUMIDITIES.

Since in all the experiments, except that at 20°C, the graphs bent downwards between the 7 per cent. and the 2 per cent. humidities, there does appear to be a limiting humidity below which drying is retarded. Low humidities rarely occur in nature, though it is believed as low a humidity as 4 per cent. has been experienced in this State. As far as air drying in this State is concerned, therefore, we may say that drying would never be retarded. It has already been remarked that the curve of loss is a composite curve, and is made up of two types of curves. The first part of the curve of loss gives the losses when the wood is actively drying. These losses will now be considered. In Table V. are given the ratios of the loss of weight on the first day to those on subsequent days. In this experiment the blocks were dried at 90 per cent. humidity.

TABLE V.

Temp.	Time in Days. 4	9	15	25
20	4	9	16	22
30	3.1	6.6	9.0	11.8
40	2.9	3.7	5.6	—
50	{3.6	7.0	8.7	—
	{3.2	6 6	7.8	—

Ratios of loss at 90% Humidity.

It will be seen that in the case of the specimen at 20°C. the ratios are the same, except the last, as the time in days. In other words, the curve of loss is a straight line. As will be seen in Fig. 9, when this happens drying is very slow. It will also be seen that the higher the temperature the less the ratio, although it may be noted that an exception occurrs at 40°C. This happened with every specimen at 40°. There was no material available for a second experiment. The second experiment at 50°C. gave similar results to the first.

In Table VI. are given the ratios of loss for specimens drying in a 50 per cent. humidity.

TABLE VI.

Temp.	Time in Days. 4	9	16	25
20	3.6	7.4	12.5	17.1
30	2.9	5.1	6.4	7.1
40	2.0	3.0	—	—
50	{2.8	4 4	5 1	—
	{2.5	3.6	4.5	—

Ratios of loss at 50% Humidity.

The ratios in the case of 20°C. are somewhat removed from the values of the time in days. There is again a decrease in the ratios with increasing temperature. In Table VII. are given the ratios of loss for specimens drying at 10 per cent. humidity.

TABLE VII.

Temp.	Time in Days. 4	9	16	25
20	3.5	7.1	10.1	12.5
30	2.5	3.9	4.7	5.0
40	2.0	—	—	—
50	{2.4	.4	—	—
	{2.	3.2	—	—

Ratios of loss at 10% Humidity.

The ratios are only calculated for the period of active drying. In the last table it will be seen that the values of the ratios approach the value of the root of the time. In the 40° experiment the ratio is actually t. From all the tables it will be seen that the ratio of the first day's loss to any subsequent loss always lies between "t" and "$\sqrt{t}$." It never goes outside these limits. With high humidities the curve of loss always approaches a straight line. The nearer, however, that the curve of loss approaches a straight line the slower

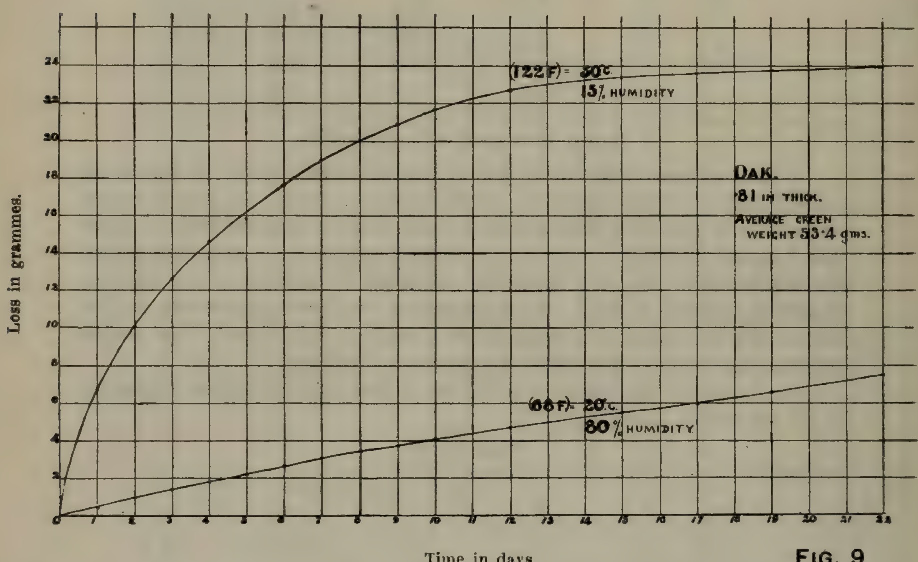


FIG. 9

Two Types of Drying Curves, The Upper High Temperature and Low Humidity, The Lower Low Temperature and High Humidity.

the drying, as is well shown in Fig. 9. In this last figure are shown two curves of loss, one for drying at 50°C. and 15 per cent. humidity, the other at 20°C. and 80 per cent. humidity. In both cases the vapor pressure was 14 mm. Each curve is the average of three results. The slower the drying the nearer the curve approaches the time axis. The general formula for this period of drying is $l = atb$ where b varies from unity to ·5. As b increases in value from ·5 to 1, the value of "a" decreases. The smaller the value of "b" within the limits stated the faster the rate of drying. Rapid drying, however, although advantageous from the point of view of saving of time increases the amount of shrinkage. This is not surprising, for it is quite conceivable that the higher temperatures make the wood somewhat plastic. Increase of shrinkage is very undesirable from a commercial point of view. What has recently been termed collapse in timber is in many cases undoubtedly due to high temperatures in the kiln. In Table VIII. are given the amounts of shrinkage for a series of oak blocks, averaging 2·06 cms. in thickness. Three blocks were dried at each temperature, and at the humidities given in the table. After the completion of the experiment the blocks were left on the shelf in the laboratory for twelve months, before the final measurements were made for the amount of shrinkage. The moisture contents of the blocks at the final measuring were very similar.

TABLE VIII.

Temperature.	Humidity.	Shrinkage.
20°c.	80%	.13 cms.
30°	44	.15
40°	25	.17
50°	15	.20

Amount of shrinkage increases with better drying conditions.

That the greatest amount of shrinkage occurred at the highest temperature is evidence that there was no case hardening, so-called. It has been shown (4) that a rapid loss of moisture from the surface prevents shrinkage to a certain extent. It has also been shown (4) that steaming timber prior to seasoning induces shrinkage. Both high temperatures and steaming are recommended in ordinary commercial operations in kiln drying. In Fig. 9 are given the drying curves of two series of blocks, one drying at 20°C. and other at 50°C. The drying conditions of the series at 50°C. are representative of the best drying conditions found in nature in this State during the summer. The highest temperature recorded in this State is 123·5°F. The equivalent temperature of this in degrees centrigrade is 51°.

Humidities lower than 15 per cent. are frequently recorded. The blocks were radially cut, and were ·81 inches thick. This thickness would take about the same time to dry as tangentially cut specimens one inch thick. The lower curve is representative of drying under more or less average weather conditions. The upper tends to prove what has already been pointed out(4) that inch boards can season in this State in a few weeks.

BIBLIOGRAPHY.

1. Regional Spread of Moisture in the Wood of Trees. W. G. Craip. (Notes Roy. Bot. Garden, Edinburgh, Nov., 1918.)
2. Kiln Drying of Lumber. H. D. Tiemann.
3. Seasoning of Wood. J. B. Wagner.
4. On the Seasoning of Hardwoods. Proc. Roy. Soc. Vict., 1919, by R. T. Patton.

[Proc. Roy. Soc. Victoria 35 (N.S.), Pt. I., 1922.]

Art. VI.—*Contributions from the National Herbarium of Victoria, No. 2.*[1]

By J. R. TOVEY and P. F. MORRIS.

(With Plate VI.)

[Read 8th June, 1922.]

Aristida Behriana, F.v.M. "Brush Spear Grass." (Gramineae).

North Wangaratta, Mrs. A. M. C. Nason, November, 1920, and September to November, 1921.

An additional locality in Victoria for this native grass. It was previously recorded from the north-western district of Victoria. It is found also in New South Wales, Queensland and South Australia.

Helipterum australa (A. Gray), Ostenf in Danske Videns Selsk. Biol. Medd. III., 2, 142 (1921), (*Dimorpholepis australis*, A. Gray (1852). (*Helipterum dimorpholepis*, Benth (1866), (Compositae).

Under the laws of botanical nomenclature Gray's original specific name has priority over that of Bentham's. Druce, in Heyward and Druce Advent, Fl. Tweedside P., 103 (1919), proposes *Helipterum pygmaeum*, Druce, (*Triptilodiscus pygmaeus*, Turcz (1851), for this species, but we have already a *H. pygmaeum*, Benth. (*Pteropogon pygmaeus*, D.C. (1837). A. Gray's name must be used, and not Turczaninow's.

Helipterum roseum, Benth. var. patens (Ewart), Black (Compositae).

In the Trans. Roy. Soc., S.A., XLV., 21 (1921), under the above heading, J. M. Black has placed *H. Troedelii*, F.v.M. var. *patens*, Ewart, as a synonym. The reasons given evidently justify this course.

The following localities were quoted, i.e., Ooldea, Miss D. Bates, July, 1920, Mt. Lyndhurst, M. Kock, No. 1644 (1889) and Fraser Range, W.A., R. Helms (1891). The latter two were also given in the Proc. Roy. Soc. Vict., XXII., 15 (1909), where the varietal name was first published. The specimens from Mt. Lyndhurst were inserted in the variety *patens* in error. As their stems and branches are beset with appressed, lanuginous vestiture, as in *H. Troedelii*, whilst those of the variety *patens* are glabrous, the inflorescence of the Mt. Lyndhurst specimens are similar to those of *H. Troedelii*, and hence must be transferred from the variety, *H. roseum*, var. *patens*, to *H. Troedelii.* Mr. Black had not seen Kock's specimens from Mt. Lyndhurst, but only quoted from the Proc. Roy. Soc. Vict. Specimens have since been submitted to him, and he has confirmed our determination.

1 No 1. in Proc. Roy. Soc. Vict. vol. XXXIV., p. 207, 1922.

Microseris scapigera, Sch. Bip. in Pollichia XXII.-XXIV., 310 (1866), (O. Hoffm. in Englers Pflanzenfamilien Teil IV. Abt. 5, p. 358 (1894), (*Scorzonera scapigera*, Forst. Prod. 534 (1786), (*Microseris Forsteri*, Hook, f Fl. Nov. Zel. 1, 151 (1853), (Compositae.)

According to Article 48 of the Vienna Botanical Congress (1905), Forster's original specific name has priority over that of Hooker's.

Oxalis purpurata, Jacq. "Purplish Wood-Sorrel" (Oxalidaceae).

Kyneton, Victoria, E. J. Semmens.
An additional locality in Victoria for this South African weed.

Paulownia tomentosa, Steud. (*Paulownia imperialis*, Siebold, and Zuc.), "Downy or Imperial Paulownia" (Scrophulariaceae).

A hardy, deciduous tree, height 20 to 30 ft. Branches horizontal tortuous; leaves opposite, entire or three-lobed, broad, soft, villous or pubescent, 6 to 18 inches long; flowers showy; corolla pale violet, with dark spots on the inside, $1\frac{1}{2}$ to 2 inches long, with an elongated tube, and a five-lobed spreading limb; panicles terminal, with opposite, many-flowered branches. Capsule usually 1 in. long, ovoid acuminate, In a rocky gully on the edge of a stream at Wandiligong, Victoria, J. A. Fraser, March, 1922.

This deciduous tree is a native of Japan, and has not been previously recorded as growing wild in Victoria. It is sometimes grown in gardens as an ornamental tree. The seed has probably been carried down the stream by storm water and lodged in the gully, where it has propagated and developed into a tree. As it is only recorded from one locality, it may be classed as an exotic not yet sufficiently established to be considered naturalised.

Pterostylis alata (Lab.), Reichb, f, var. robusta (Ewart), comb. nov. (*P. praecox*, Lindl. var. *robusta*, Ewart, in Proc. Roy. Soc. Vict. XXVII., 234 (1916).

Herba 10-15 cm. alta; foliis et floribus majoribus quam typi—*P. alata.*

The general appearance and habit of the plant is the same as *P. alata*, but it is taller and stouter, the hood being 2-3 times as large.

Scorzonera laciniata, L., "Torn Vipers Grass" (Compositae).

A perennial with long tapering roots; stems sub-erect, naked and one-headed at the apex; leaves deeply cut (pinnatisect); lobes linear, entire; flowers yellow, involucral scales slightly hooked at the apex.

Kerang district, E. J. Semmens, Sept., 1921.

It is a native of the Mediterranean regions and the Caucasus. It has not been previously recorded as growing wild in Victoria. It may be classed as an exotic not yet sufficiently established to be considered naturalised. Several species of *Scorzonera* are cultivated in gardens for the use of their long, tapering roots, which are cooked in a similar way to those of the "Salsify."

SOLANUM ROSTRATUM, Dunal. "Buffalo Burr," or Pincushion Nightshade" (Solanaceae).

Annual, herbaceous, woody when old; somewhat hoary or yellowish; 8 inches to 2 feet high; covered with copious stellate pubescence; the branches and stems covered with sharp, yellow prickles; leaves 1-3 times pinnatifid; lobes roundish or obtuse, with uneven margins, covered with soft pubescence, hairs star-shaped; flowers yellow; corolla gamopetalous, 1 in. in diameter, nearly regular, the sharp lobes of the corolla broadly ovate; stamens, 5 declined, anthers tapering upward, linear lanceolate, dissimilar, the lowest much larger and longer with incurved beak, hence the technical name rostratum; style much declined; fruit a berry, but enclosed by the close fitting and prickly calyx, fruit erect; seeds thick, irregular, round or somewhat longer than broad, wrinkled showing numerous small pits; seeds surrounded by a gelatinous substance.

Echuca, W. W. Cain, March, 1909; Benalla, W. B. Tiernan, Jan., 1913; Boweya, Vic., Feb., 1915; Neilborough district, Feb., 1921; also in New South Wales and South Australia.

In the "Weeds, Poison Plants and Naturalised Aliens of Victoria, the foregoing specimens are given under the name of *Solanum heterandrum*, Pursh., but on critical examination the material (in the Herbarium) from Australian localities proved to be identical with authentic specimens of *S. rostratum*, Dunal., and agreed with the description of that species. The North American material (in our Herbarium), apparently authentically labelled *S. heterandrum*, Pursh., also agreed with the specimens and description of *S. rostratum*, Dunal.; *S. heterandrum*, Pursh. is therefore apparently a synonym to *S. rostratum*, Dunal., and will have to be deleted from the list of the Introduced Flora of Victoria, and *S. rostratum* substituted for it.

SOLANUM TRIFLORUM, Nutt., "Spreading or Three-flowered Nightshade" (Solanaceae).

Annual, low spreading, slightly hairy or nearly glabrous, leaves acute, pinnatifid 7-9 lobed; peduncles, 5-3 flowered; corolla white; berries greenish or inclined to blackish, about the size of a small cherry; pedicles reflexed in fruit.

Black Mountains, 83 miles east of Bairnsdale, Vic., J. Clyde Rogers, Feb., 1922 (per G. Renner, Botanical Assistant, Department of Agriculture). Professor Chesnut says experiments on guinea pigs show that the berries are poisonous. The active constituent is no doubt solanin. The berry is not attractive to the eye, but has an agreeable odour and taste. This plant, a native of North-West America, has not been previously recorded as growing wild in Victoria, but it will probably be found to have a fairly wide range, and is likely to become a troublesome pest if allowed to spread. This plant has been brought under the provisions of the Thistle Act for the whole State.

Teucrium racemosum, R.Br.
var. polymorphom, var. nov.

TEUCRIUM RACEMOSUM, R. Br. var. POLYMORPHUM, var. nov. (Labiatae), Corona 1-1½''' longis, staminis non exertis, stigmatis brevissimis exertis.

Kerang, Victoria, E. J. Semmens, September, 1920.

The variety somewhat resembles the type *T. racemosum*, from which it differs in having the stamens inserted in the corolla and not exserted, the stigma only slightly exserted. The ovary has four cells in most cases, two of the cocci are non-fertile or abortive.

TRICHINIUM EXALTATUM, Benth. "Lambstails," (*Amarantaceae*).

Dookie district, Victoria, D. McLean, November, 1921.

A new locality in Victoria for this native plant; it was previously recorded in Victoria from the north-western district only; it is also found in all the other Australian States except Tasmania.

DESCRIPTION OF PLATE VI.

TEUCRIUM RACEMOSUM, R. Br. var. POLYMORPHUM, var. nov.

Fig. 1.—Portion of plant.
„ 2.—T.S. of ovary, showing variation of cells.
„ 3.—Flower (magnified).
„ 4.—Corolla (magnified), showing length of stamens and stigma.
„ 5.—Flower of *T. racemosum* (magnified).

[PROC. ROY. SOC. VICTORIA 35 (N.S.), PT. I., 1922.]

ART. VII.—*Gravity Determinations in Australia.*

By E. F. J. LOVE, M.A., D.Sc., F.R.A.S., F. Phys. Soc. Lond.

[Read 13th July, 1922.]

§ 1. Introduction.

The recent appointment, by the National Research Council of Australia, of a committee to report on the subject of a gravity survey of the continent, necessitates a critical discussion of the determinations of the gravitational acceleration which are already in existence. As regards those for Brisbane, Hobart and Perth, little can be said; each depends on a single set of observations, and, until checked, must be regarded as provisional. The work of Budik at Brisbane and Hobart is considered by Helmert[1] to be affected by a mean error of $\pm 0 \cdot 010$ cm. sec^{-2}; to that of Alessio, at Perth[2], the mean error $\pm 0 \cdot 007$ may be assigned. We therefore have, as provisional values only—

For Brisbane	:	$g = 979 \cdot 148 \pm 0 \cdot 010$ cm. sec^{-2}
„ Hobart	:	$g = 980 \cdot 441 \pm 0 \cdot 010$ „ „
„ Perth	:	$g = 979 \cdot 374 \pm 0 \cdot 007$ „ „

The case is different as regards the Melbourne and Sydney observatories. For each of these we have a determination by means of Kater pendulums, and several others by means of half-seconds pendulum, both of the von Sterneck and Potsdam types. Suitable averaging of these should therefore furnish definite values of g for both stations; also of their difference, which has an importance of its own, as it has already served,[3] and may possibly serve again, as a sort of "Fundamental Interval," for the calibration of gravimeters of statical type.

An error pointed out by Helmert (*l.c.*) necessitates a partial revision of the Kater pendulum reductions; this constitutes §2. §3 contains the evaluation of g for the two observatories, and §4 deals with the gravitational anomalies. The Appendices contain details which it seemed advisable to keep apart from the main paper. The notation is that in general use among geodesists. The methods of the theory of errors are used in the computing; the small quantities preceded by the sign ± are in all cases mean error.

§ 2. Revision of Results of Observations with Kater Pendulums.

Helmert (*l.c.*) has taken exception to the formula employed, both by Baracchi and myself,[4] in the reduction of our observations to the

1. Assoc. Geodes. Int., compt. rend. 13 ieme conf. gen.; II.e vol., 1901. Frequent reference is made to this paper.
2. His work at Perth and at Melbourne is about on a par; the latter is discussed in §3.
3. Threlfall and Pollock, Phil. Trans. 193 A, 1900.
4. Proc. Roy. Soc. Vict., 1893, p. 168; do., 1894, p. 8.

standard pressure of 26·in. of mercury at 32°F. His criticism is sound as regards the form, but in error as to the numerical coefficient.

The formula employed by previous workers was—

$$0.32 \left\{ \frac{B}{1+0\cdot0023(F-32)} - 26 \right\} \text{ vibration/day,}$$

where B denotes the *uncorrected* barometer reading and F that of the Fahrenheit thermometers employed. But according to the data supplied to us by General Walker,[5] the coefficient 0·32 should be replaced by 0·34. The formula used by us was, however,

$$0\cdot34 \frac{B-26}{1+0\cdot0023(F-32)} \text{ vibration/day.}$$

where B now denotes the *corrected* barometer reading; the computed vibration numbers for the pendulums were accordingly too large. Now the expression, $1+0\cdot0023(F-32)$, is really an approximation to $[+0\cdot0022(F-32)]\ [1+0\cdot0001\ (F-32)]$, the first factor being the density-temperature reduction for air (containing moisture), the second the barometer reduction. To correct the eror we must therefore add to the mean observed vibration number of each pendulum at each station the appropriate numerical value of

$$0\cdot34 \left\{ (B-26)\frac{0\cdot0001(F-32)}{1+0\cdot000\text{-}(F-32)} - 26\ \frac{0\cdot0023(F-32)}{1+0\cdot0023(F-32)} \right\}$$

For these values I obtain

Pendulum No.	Melbourne.	Sydney.
4	−0·438	−0 703
6	−0·438	−0·704
11	−0·438	−0·708

which give for the corrected vibration numbers and their differences, in place of those in our previous papers (*q.v.*)

Pendulum.	Melbourne.	Sydney.	Difference.
4	86098·83	86086·40	12·43
6	85998·99	85986·42	12·57
11	86050·62	86037·69	12·93
		Mean difference	12·64±0·15

To obtain the difference, g (Melbourne) $-$ g (Sydney), we have, therefore, to a sufficient approximation

[g (Melbourne) $-$ g (Sydney)]/g (Melbourne) $= 2\cdot94\ 10^{-4}$; also g (Melbourne) $= 980\cdot0$.cm sec^{-2} – – (*q.p.*) whence g (Melbourne) $-$ g (Sydney) $= 0\cdot288 \pm 0\cdot003$.cm sec^{-2}. For reasons given in Appendix 1, this figure is increased by 0·002, giving

$$g\ (\text{Melbourne}) - g\ (\text{Sydney}) = 0\cdot290.\text{cm sec}^{-2}$$

so far as the Kater pendulums[6] are concerned. The Kater pendulum

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5. General Walker's letters and "Instructions to Observers" are preserved at the Melbourne Observatory.

6. The differences obtained with half-seconds pendulums range from 0·299 to 0·313.cm sec^{-2}.

value of g for Sydney is 979·687.cm sec^{-2} on the Potsdam system; consequently the corresponding value for Melbourne is 979·977.cm sec^{-2}. This figure replaces both the previous incorrect one, viz.: 979·969, and Borrass's semi-conjectural emendation of it, 979·993, which is given in many tables.

§ 3. Gravity at the Melbourne and Sydney Observatories on the Potsdam System.

This problem has already been discussed in part by Borrass,[7] but his discussion requires revision in view of Alessio's subsequently published work,[8] and of the results in §2 above.

Alessio's outfit was, in its main features, a replica of Hecker's;[9] their observations are characterised by much the same care and attention to detail, and each determined the flexure correction at every station, instead of trusting to its constancy as all previous experimenters had done. They differ, however, in that Hecker used five pendulums as against Alessio's four. They differ also in their manner of observing, in that Hecker used his own clock, while Alessio used clocks in regular use at the observatories, in preference to his own, arguing quite justly that a clock in steady work is less liable to systematic acceleration of rate than one recently set up;[10] on the whole, Alessio's procedure seems to be slightly the more advantageous. Comparison of their work discloses no other material advantage on either side as regards method. Nevertheless, the mean errors of their results differ, Hecker's being decidedly the smaller, especially for Sydney. Alessio's Melbourne determination is therefore assigned three-fourths, his Sydney determination one-half the weight of Hecker's.

For the relative weights, as compared with Hecker's, of other determinations in which half-seconds pendulums were used, Borrass's (*l.c.*) estimates are accepted.

As regards the Kater pendulum determinations, Helmert (*l.c.*) has assigned to that obtained at Sydney the same mean error, ±0·010, as to those of von Elblein and Budik; the corresponding mean error for the Melbourne determination—in which twice as many experimental stations are involved—would be ±0·014; but, for reasons given in Appendix 1, this is increased to ± 0 020; hence the Melbourne determination is allowed half the weight of the Sydney one.

The data for the evaluation of g for the Melbourne observatory are given in Table I.

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7. Assoc. geodes. int., compt. rend. 16 ieme conf. gen., III.e vol., p. 224. Frequent reference is made to this paper.

8. Osservazioni Gravimetrische, Genova, 1912. I owe my copy of this paper to Dr. Baldwin's kindness.

9. Hecker's masterly pendulum work is detailed in a series of monographs published by "Zentralbureau der Internationalen Erdmessung," and "Koniglich-preussisches geodatisches Institut."

10. Further details on this point are given in Appendix 2.

TABLE I.

Observer.		Type of apparatus.		g cm. sec.$^{-2}$		Weight.		Diff. from weighted mean
Baracchi-Love	-	Kater	-	979·977	-	0·5	-	− ·010
v. Elblein	-	v. Sterneck	-	·991	-	1·	-	+ ·004
Guberth	-	,,	-	·997	-	1·	-	+ ·010
Hecker	-	Potsdam	-	·985	-	2·	-	− ·002
Alessio	-	,,	-	·985	-	1·5	-	− ·002
			-	Weighted mean: 979·987				
			-	Mean error: ±·0027				

Bernacchi's determination is omitted; Borrass also omits it. Wright's determination is, apparently, not yet published.

The data for the evaluation of g for the Sydney observatory are given in Table II.

TABLE II.

Observer.		Type of apparatus.		g cm. sec.$^{-2}$		Weight.		Diff. from weighted mean.
Smith	-	Kater	-	979·687	-	1·	-	+ ·007
v. Elblein	-	v. Sterneck	-	·678	-	1	-	− ·002
Guberth	-	,,	-	·698	-	0·5	-	+ ·018
Budik	-	,,	-	·686	-	1·	-	+ ·006
,,	-	,,	-	·674	-	1·	-	+ ·006
Hecker	-	Potsdam	-	·681	-	2·	-	+ ·001
Alessio	-	,,	-	·675	-	1·	-	− ·005
			-	Weighted mean: 979·680				
			-	Mean error: ±·0018				

Duperrey's determination (included by Borrass) is omitted, as it was not made at the observatory.

From Tables I. and II. we obtain the definite values:—

For Melbourne Observatory: $g = 979{\cdot}987 \pm {\cdot}002_7$ cm. sec.$^{-2}$
For Sydney ,, $979{\cdot}680 \pm {\cdot}001_8$,,
For difference: g (Melb.) $-\, g$ (Syd.) $= 0{\cdot}307 \pm {\cdot}003_2$,,

Both stations are obviously well established, the mean errors being quite small for results based on so many observations, and so large a range of methods; Sydney observatory, indeed, takes rank among the best established stations. Either would serve the purpose of a primary station for gravity survey.

§ 4 Gravitational Anomalies.

The additional figures required to obtain these anomalies are given (except those for Perth) by Borrass (*l.c.*). Taking first those for Melbourne and Sydney we obtain, in terms of the Helmert geoid of 1901, viz.:—

$$\gamma_0 = 978{\cdot}030\ (1 + 0{\cdot}005302\sin^2\phi - 0{\cdot}000007\sin^2 2\phi),$$

for Melbourne: $g_0 = 979{\cdot}995$, $g_0'' = 979{\cdot}992$, $\gamma_0 = 979{\cdot}974$,

$g_0'' - \gamma_0 = +{\cdot}018$, $g_0 - \gamma_0 = +{\cdot}021$

for Sydney: $g_0 = 979{\cdot}693$, $g_0'' = 979{\cdot}689$, $\gamma_0 = 979{\cdot}634$,

$g_0' - \gamma_0 = +{\cdot}055$, $g_0 - \gamma_0 = +{\cdot}059$

In terms of the Helmert geoid of 1915, in which the ellipticity of the equator and parallels first makes its appearance (and that with a somewhat surprisingly large coefficient for the longitude term) I find that both anomalies are much smaller. The equation of the new geoid is:—

$$\gamma_0 = 978{\cdot}052\ [1 + 0{\cdot}005285\sin^2\phi - 0{\cdot}000007\sin^2 2\phi$$
$$\qquad\ \pm 3 \qquad\qquad \pm 5$$
$$+ 0{\cdot}000018\cos^2\phi\cos 2(\lambda + 17)]$$
$$\qquad \pm 3 \qquad\qquad \pm 4$$

where λ denotes the longitude, reckoned positive when E. of Greenwich. Hence we obtain:—

for Melbourne: $\gamma_0 = 979{\cdot}999$, $g_0'' - \gamma_0 = -{\cdot}007$, $g_0 - \gamma_0 = -{\cdot}004$,

for Sydney: $\gamma_0 = 979{\cdot}662$, $g_0'' - \gamma_0 = +{\cdot}027$, $g_0 - \gamma_0 = +{\cdot}031$.

The negative sign of these anomalies for Melbourne is noteworthy. Melbourne is, to all intent, an inland station in an extended region of low topograhic relief;[11] for it, therefore, the free-air and isostasy anomalies are not likely to differ much, and the negative sign of the former may possibly be correlated with its position in a region largely covered with relatively light rocks of late geological age, and, where of earlier age, mainly Silurian. Sydney, being a coastal station near to deep water, the correlation between its gravitational anomaly and the geological age of the neighbouring surface rocks is very likely to be masked by a large topographic effect, of which the Bouguer and free-air reductions fail to take account; a fresh reduction by the Hayford-Bowie method might clear up this point.

The anomalies, $g_0'' - \gamma_0$ and $g_0 - \gamma_0$ for Brisbane and Hobart, in terms of Helmert's 1901 geoid, are given by Borrass (*l.c.*). Those for Perth,[12] together with the anomalies for all three stations in terms of the 1915 geoid, are as follows:—

1901 geoid. Perth: $g_0 = 979{\cdot}392$, $g_0'' = 979{\cdot}387$, $\gamma_0 = 979{\cdot}477$,

$g_0'' - \gamma_0 = -{\cdot}090$, $g_0 - \gamma_0 = -{\cdot}085$*

1915 geoid, Perth: $\gamma_0 = 979{\cdot}493$, $g_0'' - \gamma_0 = -{\cdot}106$, $g_0 - \gamma_0 = -{\cdot}101$.

Brisbane: $\gamma_0 = 979{\cdot}160$, $g_0'' - \gamma_0 = -{\cdot}004$, $g_0 - \gamma_0 = .000$.

Hobart: $\gamma_0 = 980{\cdot}446$, $g_0'' - \gamma_0 = +{\cdot}007$, $g_0 - \gamma_0 = +{\cdot}013$.

The asterisked figure is also given by Alessio.

11. Port Phillip, geodetically speaking, is a shallow lake.

12. See Appenidix 4.

The anomalies for Hobart and Brisbane are reduced, those for Perth increased, by employing the new formula; the large negative values for Perth are very curious. For the reason given in §1, these anomalies must not be trusted too far; so far as they go, they favour Helmert's new formula.

Appendix 1.

In order to ascertain the proper weight to assign to the Kater pendulum determination of g for Melbourne we must investigate—

(a) The differential character of the pendulums;

(b) The relative precision of the sets of observations.

The difference between the vibration numbers of any pair of the pendulums, being small compared with the vibration numbers themselves, will be nearly the same in all four sets if differentiality is preserved. Arranging them in order of time we have—

Pendulums.	Sydney 1882 (S).	Kew 1889 (K).	Melbourne 1893 (B).	Sydney 1894 (L).
(4)-(6)	100·61	99·47	99·84	99·98
(11)-(6)	51·76	50·24	51·63	51·27

Mean: (4)-(6) = 99·98 ± ·24

Mean: (11)-(6) = 51·22 ± ·34

It is clear that the pendulums maintained their differentiality over the whole eleven years.

For the sets we obtain the following difference table:—

Pendulum.	K—S	K—B	K—L	B—S	B—L	S—L
4	66·02	58·12	70·55	7·90	12·43	4·53
6	67·18	58·49	71·06	8·67	12·57	3·90
11	65·64	57·10	70·03	8·54	12·93	4·39
Mean	66·28	57·90	70·55	8·37	12·64	4·27
Mean error	±·46	±·42	±·30	±·24	±·15	±·19

From these figures we conclude:—

1. That there is no material difference between the precision of sets S, B and L; the weakest set is K.

2. That the pendulum support was distinctly less rigid in 1893-4 than in 1882 or 1889; but slightly more rigid during my observations than during Baracchi's, by an amount apparently corresponding to an incease in the difference, g (Melbourne) $-g$ (Sydney), of about 0·002.cm sec^{-2} above that computed from the vibration numbers; hence this addition in §2. The uncertainty, however, is not entirely removed; so I have increased my estimate of the mean error from ±0·014 to the outside value ±0·020.

Appendix 2.

Alessio found, by experiments made to test the point, that his own coincidence clock was liable to accelerations of rate (sometimes positive, sometimes negative) for a few days after starting. Hecker's clock was of the same make; risky as it is to argue from the behaviour of one clock to that of another, even of the same construction, the fact is significant. Hecker also found that the mere stopping and restarting of his own clock altered its rate, on one occasion, by nearly 1½ sec/day; so it had peculiarities of its own.

Appendix 3.

No corrections need be applied to the Sydney figures of 1882, or to the Kew figures, for the change in pressure factor from 0.32 to 0.34; the diminished pressures, under which they were obtained, were purposely chosen so as to render the pressure reductions to 26·in., at the mean temperatures of the respective observations, nearly or quite evanescent.

Appendix 4.

Mr. Curlewis informs me that the Perth observatory is built on solid sand; for reasons given in his letter, the sand appears to be of great depth. I have therefore assumed $2 \cdot 2 \pm 0 \cdot 2$ as a sufficient approximation to the density required for computing the Bouguer reduction.

[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. I., 1922].

Art. VIII.—*A Revision of the Genus Pultenaea, Part III.*

H. B. WILLIAMSON, F.L.S.

(With Plate VII.)

[Read 13th July, 1922.]

Pultenaea capitellata, Sieber.

An authentic Victorian record for this plant is "Bendoc, C. French, Jan., 1899."

In the reference to the specimen "Port Jackson, Sieb., n. 313," in my Revision, Part I. "313" was in error written for "413."

Pultenaea ferruginea, Rudge.

Mr. A. A. Hamilton in Trans. Linn. Soc. of N.S.W., Vol. XLV., p. 262 (1920), restored this species.

I did not see Mr. Hamilton's paper, and had no intimation of what he had done till it was too late to make any reference to it in my Revision Part II., in which I also restored this species.

Pultenaea canaliculata, F. v. M.

(Trans. Vic. Inst. 1855.).

A coast shrub with silky-villous terete leaves channelled above, and long, pubescent stipules. The large flowers with long calyx lobes are sessile, and crowded in the upper axils, with no bracts except the stipules of the floral leaves. The bracteoles are long, narrow, silky, and fixed below the calyx. It differs from *P. mollis* in not having capitate flower heads, in the more hairy, and sometimes golden-silky pubescence, and in its long narrow bracteoles.

On the coast from Port Lincoln to Corner Inlet.

Specimens from Cape Otway have leaves 7 lines long, with stipules over 2 lines long, while those from Warrnambool and Port Lincoln have leaves 4-5 lines long, less silky, somewhat clavate, with stipules 1 line.

Var. *latifolia*, var. nov.

Variat foliis oblongo-lanceolatis concavis subtus puberulis supra glabrescentibus.

A less hairy form with oblong-lanceolate leaves, concave, almost glabrous above.

Port Lincoln, S.A. S. Dixon, 1883.

Pultenaea pedunculata, Hooker.

(Bot. Mag. t. 2859, 1828.)

P. Ausfeldii, Regel in Gartenflora 14 (1865).

Hooker described his species from plants grown at Kew in 1828, from seed sent from "New Holland" by Fraser, Govt. Botanist of the Colony. Regel described his from plants grown at Berlin in 1865, from seed supplied by Dr. Ausfeldt, from Bendigo, in Victoria.

Unfortunately no type specimen of the former was preserved at Kew; but the plant found commonly in South Eastern Australia—Bendigo included—has been accepted by Mueller, Bentham and others as tallying sufficiently with Hooker's description and plate.

Let us consider the differences on which Regel founded his species. He says. "*P. pedunculata* differs from it (a) in having flowers in twos, which, to begin with, arise at the tips of the branches, and only later are pushed to one side." Hooker's description of *P. pedunculata* says: "Flowers in pairs from the extremity of the young branches, but they afterwards become lateral from the prolongation of the branches." *P. Ausfeldii* has "axillary flowers." On all specimens from Bendigo district I find a number of young branches showing flowers two, and sometimes three, together at the ends. As these become lateral from the prolongation of the branchlets, they show as axillary, and a close examination of the pairs shows them to be axillary from the first, but much crowded, so that Hooker's description is not incompatible with "axillary flowers." When becoming lateral, they do not remain so close as to be considered twin flowers. May we presume that Hooker appears to have laid stress on the earlier stage, while Regel appears to have ignored it? (b) Regel says, quoting from Hooker, "Flower-stalks one inch or more." We have specimens from Port Lincoln with peduncles about one inch long, and except for rather broader leaves, tallying in every other respect with the Bendigo specimens. I scarcely think that a species should be founded on that difference only. (c) "Zig-zag lower branches." Just a minor difference of habit. (d) "Only pointed leaves." Hooker's description omits any reference to the points on the leaves. His plate shows them only pointed, but the omission in his description does not mean that the "sharp thorny tip" mentioned in Regel's description was not present. (e) "Not united stipules." Hooker's description says: "two brown membranous stipules which stand upright, and are appressed to the stem." That does not mean that they are not partly united when at or near the ends of young branches, among crowded leaves. In the Bendigo specimens they certainly are so, but I find pairs of broad, membranous stipules showing exactly as in the Bot. Mag. plate. Lower down, I find stipules quite disunited. It should be remembered that right through the genus examples may occur where, on the same specimen, within a range of a few inches, stipules are: "broad, reddish, scarious, appressed and united," and "narrow, recurved, blackish and quite disunited." (f) "Erect calyx lobes." Hooker's description does not say so, although the plate shows some lobes scarcely spreading. I am of opinion that the plate drawn in 1828 represents, rather incorrectly, the plant grown at Kew from seeds from the form accepted by Bentham and Mueller as *pedunculata*, growing from Port Jackson to Spencer Gulf, and that Regel described his species from a plant grown from the same seeds, i.e., that both lots of seeds were from the same species. Dr. Stapf, of Kew, in a report to the

Director, Dr. Prain, says:—"There can be little doubt that certain specimens enumerated in the Flora Aust., under *pedunculata* represent *P. Ausfeldii*, especially those from 'Windu Valley, Robertson,' 'Bugle Range, Mueller,' (Mueller Exped. 1838). 'Belair,' (931), 'Koch.' Unfortunately no specimen of *P. pedunculata* was laid down at the time when the species was described, and I have failed to identify any of our specimens written up as *P. pedunculata* with the Bot. Mag. plate." Dr. Prain, commenting on this last statement, says: "This may either mean that the Bot. Mag. figure is not correctly drawn, or that the plant which flowered at Kew in 1828 was a member of the same group of forms, but one that has never been met with again." It will be seen that I have decided in favour of the former of these possibilities. Copies of descriptions, figures and comments thereon kindly sent from Kew have helped me considerably in discussing this difficult matter. Two forms divergent from the type may be noted as varieties:—

Var. *pilosa*, var. nov.

Variat calyce et pedunculis sericeo-pilosis, foliis paulo recurvatis.

A form with silky hairs on calyx and peduncles, and leaves somewhat recurved at the tips.

Chewton, near Bendigo, Vic. (Coll?)

Var. *latifolia*, var. nov.

Variat foliis oblongo-lanceolatis, bracteolis calycis lobis longo-subulatis pedunculis pollicem longis.

A form with oblong lanceolate leaves, long-subulate calyx lobes and bracteoles and peduncles an inch long.

Port Lincoln, S.A. (Coll?)

Pultenaea Cunninghamii, (Bth) F. v. M.

(*Spadostyles Cunninghamii*, Bth. in Ann. Wien Mus. ii. 81, 1838; *Pultenaca ternata*, F. Muell. Fragm, 1, 8, and iv, 21, 1858.)

The combin. "*P. Cunninghamii*" was suggested by Mueller in Fragm. iv. 21, as a name for *P. ternata* and *P. styphelioides* if united, so we may accept the suggestion except as regards the inclusion of the latter plant.

A shrub usually glabrous, often glaucous, with sessile leaves all in whorls of three, broadly rhomboidal, truncate or shortly tapering, the midrib produced into a sharp thorny point, 2 to 9 lines long, usually broader than long, often 3 to 5 nerved at the base, with flowers in axils on pedicels 2 to 3 lines long, with bracteoles narrow-lanceolate or linear, subulate, inserted on the base of the calyx. Calyx 3 to 5 lines long, with lower lobes longer than the tube, upper much broader, united above the middle. Ovary glabrous, tapering into a flattened style.

Vic.: Buffalo Mts., Mitta Mitta, Whitfield. N.S.W.: Blue Mts., Narrogas; source of Hunter R., Carter; Mudgee and Gilmore, J. L. Boorman; Port Jackson.

Specimens gathered at Whitfield, N.E. Vic. by myself, have flowers and leaves of the largest size.

Var. *pubescens*, Bth.

A small-leaved form, with branches more or less pubescent, and flowers on shorter pedicels.

Vic.: Upper Murray, and Mitta Mitta. N.S.W.: Hunter and Clarence Rivers. Queensland: Helidon, F. M. Bailey; Darling Downs, with large leaves, H. Law.

PULTENAEA SPINOSA (D.C.) comb. nov.

Oxylobium spinosum, D.C., Prod. ii. 104, *Euchilus cuspidatus*, F. v. M. Trans. Phil. Inst. Vic. ii, 68, *Pultenaea, ternata*, F. v. M. var. *cuspidata*, Bth. Fl. Aust. ii, 122.

" Branches slender, pubescent, leaves small, tapering into a pungent point."

Qld.: Burnett and Brisbane Rivers, F. Mueller. Wide Bay, Bidwill. Ipswich, Nernst. Enoggera, C. T. White, Mar. 1922. N.S.W.: Clarence River.

This plant is sufficiently distinct to rank as a species owing to its very small much tapering leaves with long, straight points, its long peduncles, and very small flowers with sharp points on calyx lobes.

This and *P. Cunninghamii* appear to be extremes of a series of intermediates, the position of which will not be easy to determine, but an attempt must be made to do so. We must agree with Messrs. Maiden and Betche, who point out, (Proc. Linn. Soc. N.S.W. XXXIII. 310), that we must draw arbitrary lines where series of intermediates occur, and that if we were to unite all species between which connecting links exist, we would reduce many large genera to only a few species, which would be neither practicable nor expedient.

PULTENAEA KENNYI, sp. nov.

Frutex circiter 30 cm altus, ramulis pubescentibus, foliis truncatis 5-9 cm longis, 3 mm latis breviter petiolatis planis vel margine paululum recurvatis mucronulo recurvo terminantibus supra glabris infra exigue minutissime puberulis, stipulis 1 mm longis, floribus solitariis prope apicem ramulorum axillaribus, pedicellis sericeo-villosis 2 mm longis, bracteis nullis, bracteolis circiter 1 mm longis, medio calycis affixis, calyce 5 mm longo lobis tubo aequilongis superioribus falcatis albo-sericeo-villoso, vexillo et alis flavis, carina sordide flavescente, ovario sericeo-villoso, stylo subulato, legumine non viso.

Shrub about 3 ft. high, similar in appearance to *P. retusa* Sm. Leaves 3-4 lines long, truncate, slightly recurved at the margin, the midrib ending in a minute recurved point, glabrous above, but with a few silky hairs below. Flowers solitary in the upper axils with no bracts. The bracteoles are about half a line long, and are fixed high on the calyx tube.

This plant belongs to the Section *Eupultenaea*, and in foliage reminds one of *P. retusa* Sm. Only three other plants in the Section have flowers not in terminal heads, viz., *P. conferta* Bth., *P. Millari* Bail. and *P pedunculata* H.K. The first-named is easily distinguished by its peculiar calyx with its free upper lobes. *P. Millari* differs from the new plant in having larger, almost ovate leaves with a dense, silky tomentum beneath, and in its larger stipules, a flattened style, hairy from below upwards, and long bracteoles, fixed at the base of the calyx.

Crow's Nest, on the Northern Darling Downs, Southern Queensland. Dr. Frederick Hamilton Kenny, Feb. 1922.

Dr. Kenny, after whom the plant is named, is an enthusiastic botanist, and was accompanying Mr. C. T. White, F.L.S., Government Botanist of Queensland, on a botanising trip when the plant was found.

PULTENAEA TERETIFOLIA, sp. nov.

Frutex parvus, ramulis pubescentibus, foliis tenuissimis leneari-cylindricis supra canaliculatis puberulis vel hispidulis 8-12 mm longis, floribus breves ramulos terminantibus in capitula confertis, stipulis subulatis, bracteis nullis vel paucis brevibusque, bracteolis linearibus villosis tubo calycis aequilongis eoque ad basin affixis, calyce pubescente canescente lobis acutis tubo subaequilongis superioribus latiusculis quam inferiora, ovario villoso, stylo subulato.

A shrub with very slender terete leaves minutely hispid, and with a light coloured calyx and linear ciliate bracteoles.

South Australia: "Murray Scrub," Spencer Gulf (Coll?), Warunda, near Port Lincoln, Griffith. Kangaroo I., O. Tepper. Marble Range, Wilhelmi.

This plant has been included by Bentham under *P. mollis* Lindl. as "var. *canescens?*" p. 128, Fl. Aust. The query mark shows that he was doubtful. It should rank as a species, being well away from *P. mollis* in indumentum, inflorescence and bracteoles, which latter are linear ciliate not keeled. It is nearest to *P. canaliculata* F. v. M. under which written name indeed one specimen was placed as a variety by Mueller in his herbarium. Its fine leaves, hispid, not silky, its flowers capitular crowded, and short bracteoles fixed on the calyx, not under it, keep it distinct from that species.

Var. *brachyphylla*, var. nov.

Variat floribus paucis, petalis atro-rubris, foliis 4mm longis.

A plant with thicker and shorter leaves and fewer flowers and darker petals which has been found labelled "*P. adunca* Turcz."

S.A.: Kangaroo I. and Harriet, O. Tepper.

PULTENAEA D'ALTONII, sp. nov.

Frutex 60-80 cm altus, ramulis pubescentibus, foliis lineari-cylindricis supra canaliculatis subclavatis obtusis divaricatis 4-6 mm longis apice paululum recurvis minute patenti-hispidis, stipulis latiusculis subulatis recurvatis, floribus axillaribus apice ramulorum inter latas stipulas foliorum floralium confertis, bracteolis foliis similibus ad basin calyce affixis latas stipulas scariosas gerentibus, calyce 8 mm longo pilis patentibus pubescente lobis tubo longioribus, superioribus falcatis latioribus et conjunctioribus, ovario sericeo-villoso, stylo usque ad medium villoso, legumine non viso.

Shrub to 3 ft. high, with terete, much spreading, somewhat clavate, minutely-hispid leaves, and with a calyx with much falcate upper lobes and leafy bracteoles fixed to the base of the calyx, and provided with broad scarious stipules.

This plant has been placed under *P. tenuifolia* R. Br. from which it differs in its divaricate, blunt, and somewhat clavate leaves not at all fascicular as in *tenuifolia.* Flowers are not terminal or two together, or enclosed by bracts. Bracteoles are leafy and stipulate, which is not the case in the typical *tenuifolia* of Brown. The calyx is very different, being twice as large, with falcate upper lobes. *P. tenuifolia* has a calyx with almost equal lobes which, when not glabrous, are beset with long, straight white hairs (Port Lincoln specimen, Griffith).

In foliage the plant has a marked resemblance to *P. teretifolia* (above).

It is nearest to *P. laxiflora,* Bth. var. *pilosa,* Williamson, having the same calyx and bracteoles, but there are no bracts except the broad stipules of the floral leaves, and the flowers are sessile in dense clusters, and the leaves divaricate, and hispid with short hairs.

Between Nhill and Goroke, N.W. Victoria, St. Eloy D'Alton, Oct. 1897.

This species is named after Mr. St. Eloy D'Alton, whose records of many years' collecting in the North West of Victoria are a valuable addition to the Botany of that State.

PULTENAEA PROLIFERA, sp. nov.

Frutex erectus circiter 60 cm altus ramulis pubescentibus, foliis linearibus margine incurvatis vel lineari-cylindricis supra canaliculatis 8 mm longis patentibus incurvatis minute hispidis, stipulis subulatis, floribus singulis vel binis sessilibus apice ramulorum brevissimorum, fructibus lateralibus ob proliferum incrementum ramulorum juvenum, bracteis 4-5 imbricatis latis appressis minute pilosis bifidis lobis obtusis interioribus calyce aequilongis, bracteolis oblongis calyce aequilongis infra tubum affixis eumque fere cingentibus, calyce 4 mm longo subglabrescente membranaceo lobis ciliolatis acutis inferioribus tubo aequilongis superioribus brevioribus, vexillo et alis flavis, carina atro-rubra, ovario sericeo-villoso, stylo tenui, legumine lato-ovato villoso.

A shrub to 2 ft. high, somewhat like *P. mollis* Lindl. in foliage, but with leaves hispid with minute hairs. Like *P. tenuifolia* R. Br., its nearest affinity, it has flowers in pairs, or singly terminal at the end of very short branchlets, which are proliferous, causing the fruit to appear lateral, but the bracts are not acute, nor twice as long as the calyx, nor glabrous, but have broad, rounded lobes, hairy, and closely imbricate. The calyx, also, is very different, the upper lobes being united almost to the summit. It is an erect shrub with incurved hispid leaves, while *P. tenuifolia* is prostrate, and has straight and almost glabrous leaves.

Carlisle River, Otway Forest, Vic. Miss Sceaney, Nov. 1906, and Willie Lucas, Nov. 1921.

There is a fruiting specimen from the same district labelled in Mueller's handwriting; "*P. mollis*, var. Heaths between the Gellibrand R. and Curdie's River, Mar. 1874."

PULTENAEA BOORMANII, sp. nov.

Frutex erectus, ramulis puberulis, foliis lineari-cylindricis supra canaliculatis 7-12 mm longis appresso-pilosulis in mucronem recurvulum desinentibus, stipulis lineari-setaceis recurvatis, floribus paucis prope apicem ramulorum axillaribus, bracteis nullis, bracteolis lineari-subulatis calyce aequilongis stipulas setaceas ad basin gerentibus tubo affixis, calyce 9 mm longo villoso lobis subulatis 7 mm longis superioribus paululum latioribus, ovario glabro, ad summum cirrum album gerente, stylo subulato, legumine non viso.

An erect shrub to 2 ft. with very slender terete leaves and axillary flowers with a remarkably short calyx tube, and with stipulate bracteoles fixed at the base of the calyx.

In foliage this species resembles *P. mollis* Lindl. but it has flowers axillary, and not in terminal heads. It must be placed in subsection F. of Sect. *Coelophyllum*, between *P. humilis* and *P. setulosa.*

It resembles the former in its long narrow calyx lobes and its glabrous ovary surmounted by a tuft of white hairs, but differs from it in having very slender terete leaves, and stipulate bracteoles set higher on the calyx tube. *P. setulosa* with its fine points to leaves, stipules and calyx lobes, and its longer calyx tube, can be easily distinguished from this species.

It is named after Mr. J. L. Boorman, who first collected it.

Mr. Cheel, Chief Asst. to the Government Botanist, Sydney, has supplied the following notes on the plant:—

"It was originally collected at Minore, N.S.W., by Mr. J. L. Boorman, in Feb., 1899, and was determined by the late J. H. Camfield as a doubtful form of *P. echinula* Sieb. In 1904, some additional specimens were collected at Bidden Road, 7 miles from Gilgandra, North of Dubbo, by Mr. R. H. Cambage, who sent them in under No. 1110, Oct. 15, '04, as a doubtful form of *Dillwynia ericifolia.* Duplicates of the same plant from the same locality were sent in later by Mr. Cambage. These were determined by the late Mr. Betche as *P. mollis*, Lindl., and recorded in the Proc. Linn. Soc. of N.S.W., Vol. XXX. p. 360, as new for N.S.W. In August, 1908, Mr. Boorman collected a small specimen at Goonoo, near Mudgee, and again in June, 1909, from the same locality, with the following note: "A small, bushy plant, 1-2 ft. high, growing in dry places in forest land. No flowers hitherto met with. Identical plants found at Nundle, and at Warialda." Later, Mr. Cheel, in sending in his report on a specimen sent to me, gave his opinion that it was not *P. mollis*, but an undescribed species, and it was arranged on the advice of Mr. J. H. Maiden, that I should describe the plant.

PULTENAEA READERIANA, sp. nov.

Frutex circiter 1 m altus, ramulis pubescentibus, foliis ovato-lanceolatis vel subcuneatis patentibus. 5-10 mm longis margine paululum incurvatis molle patenti-villosis, petiolis 1.5 mm longis, stipulis subulatis recurvatis vel appressis latioribusque in ramulis junioribus, floribus 3-5 breves ramulos terminantibus in capitula foliosa confertis, bracteis nullis praeter latas stipulas foliorum floralium, bracteolis linearibus ciliatis tubo calycis subaequilongis interdum stipulas gerentibus, calyce 4-5 mm longo pubescente, lobis acutis tubo longioribus, inferioribus angustioribus, ovario sericeo-villoso, legumine non viso.

A shrub about 3 ft. high, with leaves ovate-lanceolate to almost cuneate, much spreading, about two lines long, on very distinct petioles, slightly incurved at the margin, and beset with soft spreading hairlets. Flowers are in terminal leafy heads, 3 or 4 together on the very short branchlets. The broad stipules of the floral leaves take the place of bracts, and the bracteoles are linear, beset with hairs, nearly as long as the calyx lobes, fixed at the very base of the calyx tube, and occasionally provided with scarious stipules. The calyx is about two lines long, with narrow acute lobes, membranous, and beset with hairs. The ovary is quite covered with silky hairs.

This plant has been wrongly determined as a form of *P. villosa* Sm. In foliage it resembles that species, but its flowers are all terminal, its calyx a very different shape, not being falcate, and its bracteoles are not leafy, as in *P. villosa.* Its nearest ally is *P. hispidula* R. Br. from which it differs in not having a very small calyx with short lobes and long bracteoles.

Southern Grampians, Vic., Nov. 1907, H. B. Williamson. No. 1369. Merton, Vic. A. W. Howitt, No. 974.

Some specimens collected in the Dandenong Ranges and determined as *P. villosa* are referable to this species.

Named in memory of the late F. M. Reader, who first examined the plant at my request in 1907, and who was well-known as an enthusiastic and careful botanist, who did much valuable research work on the flora of Victoria, especially in the Mallee District.

PULTENAEA BARBATA, C. Andrews.

(Journal, W.A. Nat. Hist. Soc., No. 1, p. 38, 1904.)

An erect shrub of two feet with virgate branches, glabrous or slightly silky when young. Leaves alternate or scattered, narrow-linear, 3-5 lines long on very short petioles, minutely hispid and tuberculate, with closely revolute margins. Stipules suppressed. Flowers in heads or umbels apparently terminal, but with a short leafy shoot slightly exceeding the flowers in the middle of the umbel. Pedicels very short. Bracts not apparent even in the bud. Bracteoles linear-lanceolate, villous, persistent, inserted under and free from the calyx, 2-2½ lines long. Calyx silky, villous, 2-2½ lines long, the three lower lobes slightly longer than the tube, subulate, the upper lobes broader, and united higher up. Standard 3 lines long, broad, dark-brown. Wings slightly shorter and similar in colour. Keel obtuse, slightly incurved, yellow. . Ovary villous, tapering into a long incurved style, of which the lower part is villous all over, and the upper part glabrous except for the fringe of white silky hairs on the inner side. Pod not seen.

This species belongs to the section *Eupultenaea*. The habit, foliage, and style are like those of *Phyllota barbata*, Benth., but it has the free stamens and strophiolate ovules of *Pultenaea*.. Its nearest ally is perhaps *P. pinifolia*, Meiss., from which it differs in shorter leaves, absence of stipules, persistent bracteoles, narrow calyx lobes, smaller flowers and peculiar style.

In flower, October, 1903, near Phillip's River, W.A. Andrews.

The above is taken from the Journal Nat. Hist. Soc. W.A. I have not been able to ascertain where the type specimen of the plant was placed, if indeed it was preserved at all.

It would be well if the rule:—"That for a species to be recognised, the type must be deposited in some leading Botanical Institution of the country in which it is gathered." were always followed.

PULTENAEA ARIDA, E. Pritzel.

(Engler's Bot. Jahrb. Bd. XXXV. 258, 1905.)

"Shrub 20-30 cm. high, with opposite spreading branches, sometimes spinescent, the young branches hoary-pubescent. Leaves opposite or ternate, very shortly petiolate, 3-5 mm. long, 2 mm. broad obovate, or almost truncate, obtuse, nearly flat, densely and finely silky pubescent. Stipules small and brown. Flowers 1-3 in axils on pedicels of 3 mm. long. Bracteoles dark-brown scarious, very small and adnate to the calyx. Calyx silky, with a very short tube, upper lobes much broader and longer than the lower."

I have examined a piece of the type which the authorities of the Berlin Museum of Botany kindly sent along, and I find the bracteoles fixed well below the calyx. The plant comes between *P. obcordata* Bth., and *P. rotundifolia*, Bth., from which two species it differs in its rigid spinescent branches, length of pedicels, size and indumentum of leaves and shape of calyx.

PULTENAEA SUBALPINA, (F. v. M.), Druce.

(2nd. Suppl. Bot. Exch. Club Report, 1916, p. 643.)

This is *P. rosea* of Mueller, who described the plant under the name *Burtonia subalpina* (Trans. Phil. Inst. Vic., i., p. 39, 1855), and afterwards removed it to the genus *Pultenaea*, giving it the appropriate and euphonious species name *rosea*, which, however, was corrected by Druce as above, in accordance with the Vienna Rules.

PULTENAEA HIBBERTIOIDES, Hooker, f.

(Fl. Tasm. i., 89, 1860.)

A shrub with branches and leaves of *P. mollis*, Lindl., and inflorescence very similar, but differing from that species in having imbricate bifid bracts, the inner ones over two lines long, and usually striate. The bracteoles also, are different, being at least as long as the calyx, and fixed distinctly under the tube, not upon it. The calyx lobes are not so short, being as long as the tube, and acute or acuminate. From *P. viscosa* it differs in having narrower terete leaves, larger bracts, etc.

Vic.: Buffalo Mts., Mueller, Mt. Hotham, and other parts of the Alps. N.S.W.: Aust. Alps. Tas.: Between Launceston and George Town.

Var. *conferta*, Bth.

Pedicels short, bracts and bracteoles smaller. "Australia felix," Mueller.

I have not seen Mueller's specimens, but specimens from Cobden, S.W. Vic. (Coll?), I have determined as this variety.

PULTENAEA MOLLIS, Lindl.

(Mitchell's Three Expeditions ii., 260, 1838.)

A shrub with branches clothed with soft hairs, and having terete or narrow-linear leaves ½ to 1 in. long, which are also covered with soft, appressed hairs. Flowers are in terminal heads, each on a pedicel of a line long. The calyx lobes are broad, shorter than the tube, and all nearly equal. Bracts are short, and few besides the broad bract-like stipules of the floral leaves. Bracteoles are lanceolate, keeled, and set on the base of the calyx tube, from one-half to nearly the length of the calyx, thin, shining or viscid, and ciliate at the edges.

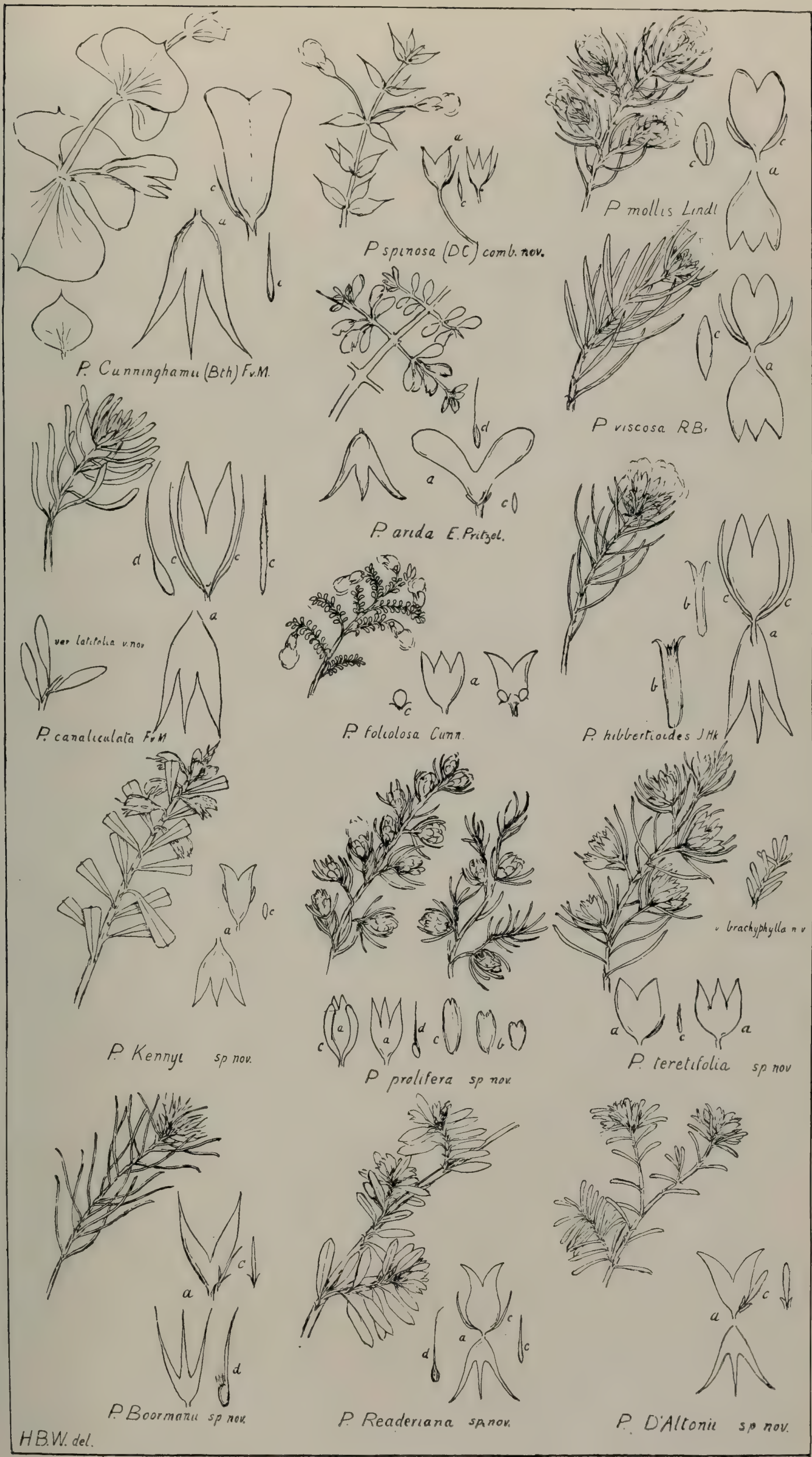
Vic.: Mt. William and Wannon River, Grampians.

Specimens from Mt. Macedon and the Dandenong Ranges differ from the type in having almost glabrous leaves, smaller and less hairy calyx with very short lobes, and with broad and very short bracteoles.

PULTENAEA VISCOSA, R. Brown.

(Bth. Fl. Aust., ii., 127. 1864.)

A shrub to 4 ft. resembling *P. mollis*, but with leaves constantly open on the upper side, and sometimes nearly flat, with midrib showing distinctly both above and below. The flowers are more crowded in the heads than those of *P. mollis*, and the pedicels are shorter. It differs also from *P. mollis* in having larger bracts and bracteoles, which latter are fixed under the calyx, and are not ciliate. No speci-


P. Cunninghamii (Bth) F.v.M.
P spinosa (DC) comb. nov.
P mollis Lindl
P viscosa RBr
P arida E. Pritzel.
P. canaliculata F.v.M
var latifolia v. nov
P. foliolosa Cunn.
P. hibbertioides J.Hk
P. Kennyi sp nov.
P prolifera sp nov
v brachyphylla n v
P. teretifolia sp nov
P. Boormanii sp nov
P. Readeriana sp nov.
P. D'Altonii sp nov.
H.B.W. del.

mens that I have seen seem to deserve the name "*viscosa*," which certainly would fit the calyx of some specimens of *P. mollis* from the Grampians.

N.S.W.: Parramatta, (type), Clyde Mts., Wombaya Ra. Vic.: Southern Grampians; Portland.

The specimens from Portland, and some from the Grampians vary from the type in having shorter and more incurved leaves almost closed on the upper surface.

Much confusion has existed regarding these last three species, Mueller himself having labelled as "*P. mollis*," specimens from the Buffalo Mts., which are undoubtedly *P. hibbertioides*. And between *P. viscosa* and *P. mollis*, the same confusion has arisen.. Robertson's Mt. Sturgeon specimens (p. 127, Fl. Aust.), which Mueller and Bentham both considered as *P. viscosa*, are not available, but it is probable that the specimens I sent to Mueller in 1898 from Mt. Sturgeon, and which he determined as *P. viscosa*, were from the same plants as Robertson found, and yet we have specimens from the same locality, gathered by Mueller himself apparently from the same bushes, labelled "*P. mollis*, Lindl." and initialed by Bentham.

Some must be wrong, and I suggest that the name *P. mollis* be kept for the plant with very slender leaves, from the Grampians, Dandenongs, and Macedon. In all these the bracteoles are broad and keeled, and fixed below the calyx, not on it. In no specimen written up as *mollis* have I found the bracteoles narrow. However, until we ascertain where Lindley's type specimen is to be seen, we shall still be in doubt as to what plant is *P. mollis*. With regard to *P. viscosa*, my opinion is that we have in the Grampians the normal plant with almost flat leaves as in the Parramatta specimens, and also a variety differing only in the shorter and more incurved leaves.

There are two other recognised species, *P. styphelioides*, A. Cunn. and *P. procumbens*, A. Cunn., which cannot be safely dealt with without reference to type specimens, and they are not at present available in Australia. Quoting the words of Messrs. Maiden and Betche in a paper dealing with the doubtful position of certain forms of *P. microphylla* (Proc. Linn. Soc. of N.S.W., Vol. 38, 1908, p. 311), I believe that:—"In doubtful cases we can only record our difficulties, and honest and careful expression may have value even if they prove erroneous, since they will help to a better understanding of the flora."

EXPLANATION OF PLATE VII.

Leafy branches, nat, size.
(a) Calyx lobes x 2.
(b) Bracts x 2.
(c) Bracteoles x 2.
(d) Ovary and style x 2.

[Proc. Roy. Soc. Victoria 35 (N.S.), Pt. I., 1922].

Art. IX.—*Two New Species of Bryozoa.*

By W. M. Bale, F.R.M.S.

(With Plate VIII.)

[Read 13th July, 1922.]

The two species of Bryozoa to be described belong to the series of forms included by Busk in the genus *Catenicella.* The members of this genus are among the most abundant of the Bryozoa which are found on our beaches, and are known to seaside visitors as "curly seaweeds." Nearly all of them are found in Australia, and but few elsewhere; none at all in the Northern Hemisphere. In MacGillivray's Catalogue of recent Victorian Polyzoa are comprised about 35 species, including those separated by him under the name *Claviporella.* The greater number of species were originally described by Busk, others have been added by Wyville Thompson, MacGillivray, Maplestone, and Wilson. Many fossil forms were described by MacGillivray and Maplestone in the publications of this Society, some of them identical with recent forms.

More recently Levinsen has dismembered the group, assigning a number of new generic names to many of the species, and adopting for the rest the name *Catenaria* instead of *Catenicella.* Whether all Levinsen's genera will be accepted is uncertain; for the present I retain the old classification as given in MacGillivray's Catalogue.

The two species before us were handed by me to Mr. Bretnall, of the Australian Museum, the only Australian zoologist known to me to be now working on the Bryozoa. Mr. Bretnall intended to describe them, but, unfortunately, illness, the result of war injuries, has temporarily interrupted his work, so I have undertaken the task.

Our first species is a very interesting one. It was among a quantity of material sent to me by Mr. E. H. Matthews, of Largs, South Australia, and it was recognised at first sight as different from any of the known forms. The outstanding difference between it and more familiar forms is that the alae or lateral expansions of the zooecia are perfectly clear and uncalcified, contrasting strongly with the darker more opaque substance of the remainder of the cell. Comparison with other species, however, shows instances of similar structure, though to a far less extent. In *C. plagiostoma* and *C. intermedia,* for example, that portion of the alae which is at the top of the zooecia seems as free from calcareous matter as in the present species; while in other forms, such as *C. alata,* the alae, though strongly calcified, contain definite areas wholly chitinous.

Mr. Bretnall informs me that in Levinsen's system this species would come under the proposed genus *Pterocella,* or may possibly have to be separated as a new genus. After the discoverer I name it *Catenicella* (or *Pterocella*) *matthewsi.* It appears plentiful at Corny Point, Spencer's Gulf, where Mr. Matthews collected it.

The other species belongs to MacGillivray's genus *Claviporella*, distinguished from *Catenicella* by the keyhole-shaped orifice of the zooecium, and by its obtuse tubular processes. There are only a couple of rough mounts left by Goldstein, and marked in pencil, "*Cat. MacCoyi*, new." Goldstein's general collection of Bryozoa was disposed of in his life-time, and is supposed to have been sent to England, but the slides in question were among a quantity of unfinished material handed to me after his decease. Mr. Bretnall has already pointed out that in Miss Jelly's "Synonymic Catalogue of the Bryozoa," are included several species ascribed to Goldstein, but without any reference. Miss Jelly was assisted by Waters, with whom Goldstein corresponded, and the presumption is that she got these names from him, but it seems extraordinary that Waters should have sanctioned the inclusion in the list of species which had never been described, and especially the reference of two of MacGillivray's published species as synonyms of these nomina nuda. *C. MacCoyi* was one of the names included, and it will now be accounted for as *Claviporella goldsteini*. Possibly some of the other species may be identical with those since described by others.

In passing, I should like to add a few words on the methods of preparing and mounting these polyzoaries. Too often they have been described from examples of the dry material only; MacGillivray's specimens, except a few special ones which were mounted in fluid, and which have gone or are going, the way of all fluid mounts, are mounted dry. This method is in some cases incapable of showing all the detail. For example, there are two species, *Thairopora jervoisi* and *Diploporella cincta*, which contain numerous minute spicules, the former species especially having them in great profusion, and very evident in balsam mounts, yet the friend to whom I showed them —though familiar with the species for many years as a dry mount— was not yet aware of their existence. Similar insufficient methods have been responsible for the descriptions of "openings" in the alae of various species, which are really only clear areas, and minute avicularia have sometimes been overlooked. The method which I have been accustomed to use in mounting polyzoaries and polypidoms is to boil them in water till all air is removed, transfer them to methylated spirit, thence to phenol, and thence to balsam. For clean specimens this suffices, but if very dirty they should be first heated in liquor potassae to remove foreign matter. This is also useful for swelling out tissues, which have shrunk in drying; for example, it is often impossible to decide whether the chitinous alae have openings in them when they are shrunk together. As mentioned further on, also, it is often desirable to decalcify and stain. Liquor potassae is sometimes too strong, and acetic acid may give better results, but of course it is only available when decalcification is desired.

Catenicella matthewsi, n. sp. (Plate VIII., Figs. 1a-1f).

Colonies about an inch in height, much branched, branches always springing from geminate zooecia.

Zooecia elongate oval, with about 11-13 small round fenestrae with fissures converging to a minute sub-oral pore. Orifice semi-elliptic, contracted at base, with two lateral teeth. Avicularian processes long and narrow, at angles of about 45° with the axis, avicularia terminal, very minute. Alae very large, not calcified, hyaline, apparently structureless.

Ooecium galeate, terminal on one of the cells of a geminate pair; orifice transverse, wider than high, below the lip two long, linear, widely divergent fenestrae with three or four small round ones.

Type in the National Museum Collection.

This is a remarkable species, which it is impossible to mistake for any other, owing to the unique character of the alae. The zooecia are oval, more convex behind than in front; at the back they appear somewhat barrel-shaped, in front they are more ventricose, and in the lower half is a thin lateral extension on each side with a convex outer border, more conspicuous after decalcification. The zooecia at the ends of the side branches are commonly rather narrower than the others, and possess narrower alae.

The orifice is rather large, semi-elliptic, but with the sides becoming convergent near the base, and at the points where the convergence begins there are two lateral teeth. The lower side of the orifice is somewhat convex, and below it is a minute pore, connected with the lip by a straight fissure. The operculum is of similar form to the orifice; its rim is slightly thickened, with an enlargement just at the points subtending the lateral teeth. It has no ornamentation except a vertical bar or median thickening which runs from the top of the operculum downwards for about two-fifths of its length, and is continuous with the rim. The back of the zooecium is plain.

The fenestrae are small, and form an outer series of seven or eight, enclosing a sub-triangular area in which are from two to five others. They are connected by rough-edged fissures with the sub-oral pore.

The avicularian processes form long narrow arms rising from the shoulders of the zooecia, tapering outwards to about the middle, and then enlarging slightly to the obtuse ends. The avicularium itself is very minute (only about 15 μ from base to apex); it is of the usual sub-triangular form, with rounded angles and a thinner median area; the apical tooth generally found in the larger forms is wanting. A similar avicularium is usually sessile in the upper part of the area between the two cells of a geminate pair.

The alae are wide and form the most striking feature of the species. The lower chambers are outwardly convex, and the superior ones are still more so; on the summit of the geminate zooecia especially they form large inflated bladder-like expansions. At the two outer angles of the avicularian process the alae form little prominent points, and occasionally the superior inflation of a geminate pair tends towards a bilobed condition, and may run out into similar points. The most remarkable feature of the alae is the entire absence of calcification or of any perceptible structure; they are therefore only visible by their outline, and by any lines of shrinkage which may be present. With a pocket lens they are invisible, and the same is the case when they are examined in the microscope between crossed nicols. In the dry specimens they are more or less shrunken, the superior chambers especially being much contracted, but treatment with acetic acid or liquor potassae plumps them up and removes shrinkage marks, restoring them to what I suppose to have been their original condition. They have no external openings nor specialised areas.

Only four ooecia were seen. In each case they were at the end of a small side branch springing from the older part of the shoot, where the ramification was sparse. The ooecium is geminate with a zooecium, which is not necessarily terminal. The orifice is quite unlike that of the zooecia, being widened laterally and narrowed to the ends, its form is accentuated by its being seen foreshortened owing to its position in the lower part of the pear-shaped ooecium. Below it are two long, widely-divergent fenestrae, with three or four minute round ones. There is a sub-oral pore. The ooecial chamber is a densely cribrose structure, opaque and strongly calcareous. It is encircled by a band, plain below, undulated above, the median undulations being extended upwards into vertical bands reaching the top of the ooecium, the back band being very wide, the front one less so. In one case there was also a very narrow lateral band. The bands are very finely granular, and resemble a veil overlying the coarse structure. On the summit of the ooecium are two short obtuse processes surrounded by a slight chitinous web. From analogy it seems likely that these processes may support avicularia, but I was not able to discover any.

Decalcification with acetic acid, by removing the semi-opaque material from the sides of the zooecia and the avicularian processes renders the whole transparent, and makes them as clear and structureless as the alae. It leaves the tissues somewhat flaccid, so that many of the zooecia become more or less crumpled; this, however, is not material, as some of the cells, especially the older ones, retain their shape sufficiently, except that the back shrinks a little. The only points of structure which I observed to become wholly obliterated were the fissures which converge from the fenestrae towards the suboral pore; these are evidently confined to the calcareous layer, as they disappear completely. The fissure connecting the suboral pore with the orifice is not affected. But though the alae and the body of the cell are thus made to appear alike hyaline and structureless, they seem to be of different composition, as they reacted differently to a staining process. The stain used was an anilin "indigo-blue," mixed with acetic acid, and giving a blue or green stain varying according to proportion. Ordinarily the corneous joints between the cells, normally a deep yellow, came out an intense green, as did the tendrils which spring from the back of some of the cells. The zooecia themselves, with the avicularian processes (that is to say, all parts which had been originally calcified), were also green, while the alae, as well as the fenestrae, became bright purple.

There are two species which are allied in many respects to the present, though differing widely in their general aspect from it, and also from each other; these are *C. alata* and *C. carinata.* Apart from mere differences in the form of the zooecia, and of the alae, the structure of the latter is very distinctive. In *C. alata* they are far wider than in our species, in *C. carinata* they are narrower, but in each case they are strongly calcareous, though presenting several large, clear spaces, which have been described by Busk, MacGillivray and others as "openings," but which are really areas wanting the calcareous layer. They may be aptly described as "fenestrae," and just as the small fenestrae on the front of the zooecia usually have fissures (in the calcareous layer only), proceeding from them towards the orifice, so these large fenestrae have similar fissures. The most important distinction, then, between these two species and *C. matthewsi* is that in the former the alae possess certain limited areas of an uncalcified hyaline substance, while in the latter the whole of the alae are similarly constituted.

All three species agree in the possession of the very long avicularian chambers, with the minute avicularia seated on their obtuse extremities. Thompson and Busk mentioned these little avicularia in *C. alata;* in *C. carinata* Busk failed to find them. As, however, he described the avicularian chambers as open in front, which is not the case, it appears likely that he may have observed corroded specimens. The avicularia seem to be readily lost in this species; in the only specimen which I have available only two or three remain. In my slide of *C. alata,* on the other hand, containing a great number of zooecia, almost all are intact. So far as I can judge, the avicularia in these two species are alike; as they are all edgewise in the slides, however, I cannot make out their exact form; but they seem to me to have the angles more rounded, and, therefore, to approach more nearly to a semi-circular form, than those of *C. matthewsi.*

The orifice in *C. alata* does not differ much from that of our species, that of *C. carinata* is so concave below as to approach the circular form, but in both species the lateral teeth are present, and in both the operculum has the vertical bar more or less distinct.

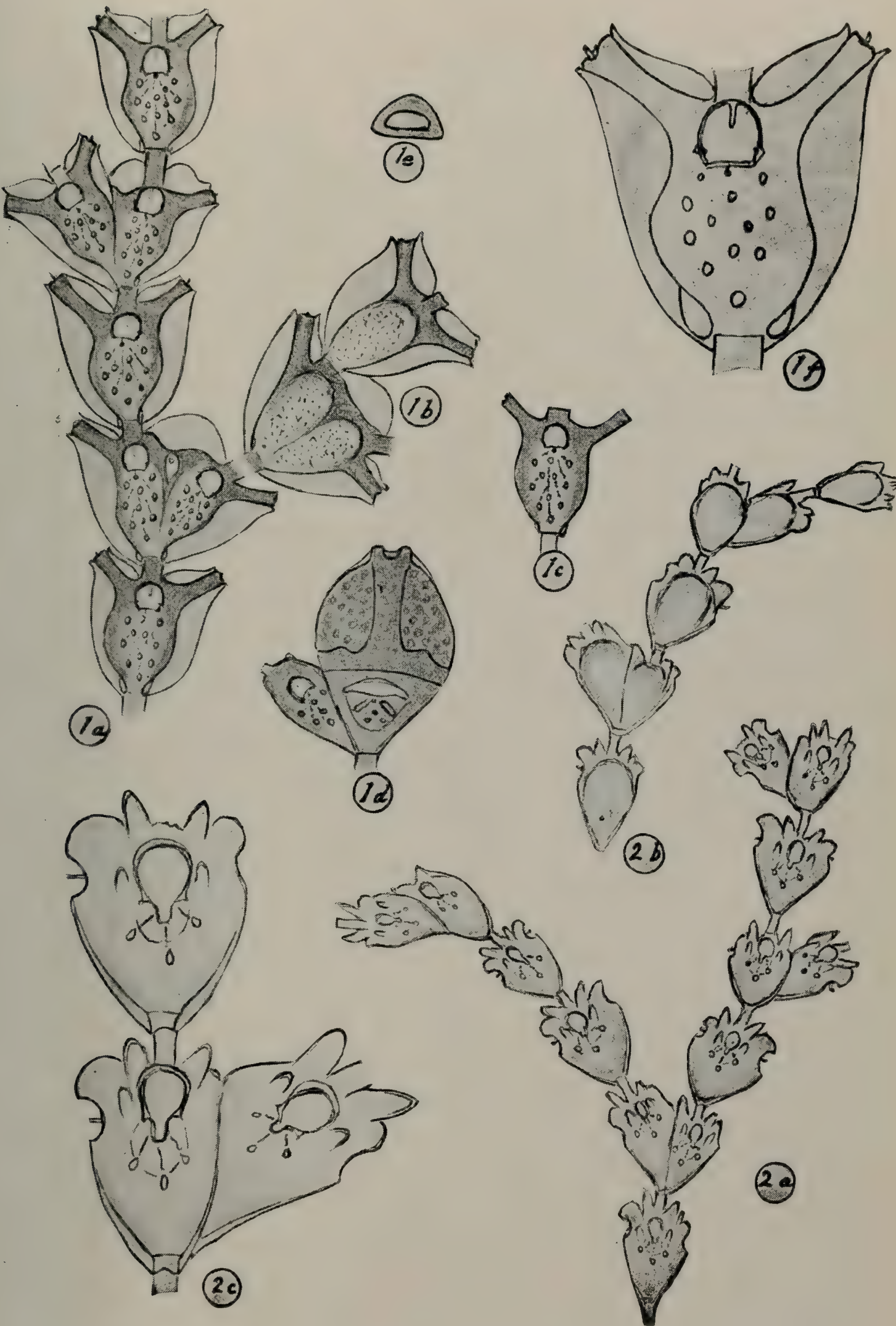
The ooecia of *C. alata* and *C. carinata* are very similar, they agree in possessing a modified zooecium sessile on the top of the ooecium; in this respect they differ from the species before us.

Claviporella goldsteini, n. sp. (Plate VIII., Figs. 2a-2c).

Catenicella maccoyi, Goldstein, nomen nudum, Jelly, Synonymic Catalogue of the Bryozoa.

Shoots very small, branches springing from geminate cells, but also occasionally from the side of a single cell.

Zooecia oval, with a large gaping avicularium on each side, generally unequal, a small rounded, slightly thicker, sub-oral area embracing the inferior prolongation of the orifice; a pseudo-pore surrounded by three minute but distinct fenestrae, all connected with the orifice by rough-edged fissures; a prominent obtuse process at each side of the orifice and two larger ones above; front papillose, back without conspicuous markings, nearly smooth.


1a
1b
1c
1d
1e
1f
2a
2b
2c

Ooecia (?)

Type in the National Museum Collection.

The specimens available do not exceed about half an inch in height. In some instances the branches spring from the sides of single zooecia, and there may even be one on each side. This is the character on which Wilson founded the genus *Catenicellopsis*, but it was not deemed valid by MacGillivray, who mentions having met with the same character in *Claviporella*. It is only in a few of the proximal internodes in one of these specimens that it occurs; higher up the typical mode of branching is constant.

There are usually four obtuse processes, as in *C. aurita*. The avicularia are most commonly unequal, but not differing otherwise; sometimes the inequality is considerable, but there are not in these specimens any of the gigantic forms sometimes found in *C. aurita*.

The ornamentation of the zooecium affords a ready means of distinguishing the species from its allies. In place of the large elliptic pore of *C. aurita* we have here a minute pseudo-pore, often quite indistinct, and the broad band surrounding the pore is here represented by a less distinct circular area. The fenestrae in *C. aurita* are mostly four or five, and somewhat irregular; in our species there are almost invariably three, regularly placed, and though so minute, both the fenestrae and their fissures are sharply defined. This character also distinguishes the species from *C. imperforata* and *C. pulchra*, which latter species, moreover, has an oval central pore and narrower zooecia.

Large circular cavities behind the zooecia are extremely numerous, indicating where tendrils have been detached. The cavities are inside the zooecium, and the tendrils have been broken off flush with the surface, only one remaining. If they all existed at once some of the branches must have fairly bristled with them, but being so brittle it is likely that as new zooecia were produced the tendrils fell from the older ones. In some cases two had existed on a single zooecium.

EXPLANATION OF PLATE VIII.

Fig.	1a	*Catenicella matthewsi*	× 30.
,,	1b	,,	back.
,,	1c	,,	between crossed nicols.
,,	1d	,,	Ooecium.
,,	1e	,,	Avicularium × 400.
,,	1f	,,	Decalcified × 75.
,,	2a	*Claviporella goldsteini,*	× 30.
,,	2b	,,	back.
,,	2c	,,	× 75.

END OF VOLUME XXXV., PART I.

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Victorian Institute for the Advancement of Science.

Transactions. Vol. 1. 1855.

Philosophical Society of Victoria.

Transactions. Vol. 1. 1855.

These two Societies then amalgamated and became:—

Philosophical Institute of Victoria.

Transactions. Vols. 1–4.

The Society then became:—

Royal Society of Victoria.

Transactions and Proceedings (Vol. 5, *entitled* Transactions). (8vo). Vols. 5–24.

Transactions. (4to). Vols. 1, 2, 3 (Pt. 1 only was published), 4, 5, 6——1888——.

Proceedings (New Series). (8vo). Vols. 1——1888——.

Microscopical Society of Victoria.

Journal (Vol. 1, Pt. 1, *entitled* Quarterly Journal). Vol. 1 (Pts. 1 to 4), 2 (Pt. 1), title page and index [*all published*]. 1879–82.

[*The Society then combined with the* Royal Society of Victoria].

Note.—*Most of the volumes published before 1890 are out of print.*

PROCEEDINGS

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[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. II., 1923].

Art. X.—*The Occipital Bones of the Dipnoi.*

By HARLEY S. BAIRD, B.Sc.
(Zoological Laboratory, Melbourne University).

(Communicated by Professor W. E. Agar.)

[Read 10th August, 1922.]

In 1897 Bridge made the statement, "The only endochondral bones in *Ceratodus* are the two exoccipitals." K. Furbringer (1904) draws attention to the fact that Bridge separates these bones sharply from all other bones in the *Ceratodus* skull on the grounds that they are endochondral. Goodrich (1909) accepts Bridge's view of the nature of the bone in the words, "The bone described by Huxley as an exoccipital, the only endochondral ossification in the skull of any Dipnoi, appears to represent the first of the occipital neural arches."

That the exoccipital bone of the Dipnoi is the enlarged first neural arch has been shown by K. Furbringer (1904) for *Ceratodus*, and by Agar (1906) for *Lepidosiren* and *Protopterus*. The reasons for considering it to be an endochondral bone do not appear ever to have been definitely stated. As the question is of some importance in deciding the evolutionary status of the Dipnoi, a histological examination of the bone was undertaken at Professor Agar's suggestion. Well preserved *Ceratodus* skulls were kindly provided by Dr. T. L. Bancroft, of Eidsvold, Queensland, and also by the Director of the Queensland Museum. Comparative material was available in the form of larvæ and young of *Lepidosiren*.

Much depends upon the definition of the term endochondral, which appears to be used in different senses. Adopting Goodrich's classification of the types of bone found in Fishes (1909, p. 63), and which corresponds with Gaupp's nomenclature (1906, p. 610), cartilage bone is of two kinds, perichondral and endochondral. In the former, the bone is deposited layer upon layer by osteoblasts lining the inner surface of the perichondrium (which now becomes the periosteum), thus gradually restricting or replacing the cartilage from outside inwards. Endochondral bone, on the other hand, is formed, not in this, but rather in the opposite way. Spaces are eaten out of the cartilage by osteoclasts, and bone is deposited in the interior of the cavities so formed, and spreads outwards.

Examination of sections of the bone in half-grown *Ceratodus* skulls, and of the development of the bone in *Lepidosiren*, gives no evidence of the formation of endochondral bone in the above sense.

In *Ceratodus* the exoccipital bones are imbedded in the side walls of the chondrocranium. Each is a small hollow bone shaped rather like an hour glass. The anterior end is slightly more expanded than the posterior, and the whole bone is filled with cartilage (even in the adult), with the exception of the narrow constricted region, where it is bone all through. Transverse sections of one of the exoccipitals from a young *Ceratodus* showed that the ossification was taking place in the periosteum, i.e., it was perichondral. No traces of endochondral bone formation could be observed at all, and since the ossification was very nearly as complete as it ever would be, it seems unlikely that it would occur in a later stage.

The general shape of the occipital bones in *Lepidosiren* is very similar to that of *Ceratodus*, but proportionally they are much larger, as they themselves form the lateral walls for the posterior region of the skull, their anterior surfaces only being in contact with the cartilage of the auditory capsule. They are slightly constricted in the middle owing to their being grooved anteriorly by the vagus, and posteriorly by the first spinal nerve. In the adult *Lepidosiren*, the exoccipital "bones" are very nearly completely ossified, only a small plug of cartilage remains at the dorsal end. Examination of transverse sections of the occipital region at different stages of development indicate that the formation of bone begins in the periosteum, and gradually spreads inwards, upwards, and downwards, replacing the cartilage. As in *Ceratodus* no definite signs of endochondral ossification could be found at any stage.

It would appear therefore that there is not sufficient foundation for the statement that the exoccipital bone in *Ceratodus* or other Dipnoi is an endochondral bone. Such mode of ossification does not seem to have evolved yet in the Dipnoi.

REFERENCES.

Agar, W. E.—Trans. Roy. Soc. Edinburgh, 45, 1906.
Bridge, T. W.—Trans. Zool. Soc. London, 14, 1898.
Gaupp, E.—In Hertwig's Handbuch der Vergleichenden und experimentellen Entwicklungslehre der Wirbelthiere, 1906.
Goodrich, E. S.—Lankester's Treatise on Zoology, 1909.
Fürbringer, K.—In Semon's Zoologische Forschungsreisen in Australien, 1904.

[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. II., 1923.]

Art. XI.—*New Australian Coleoptera, with Notes on some previously described species. Part 2.*

By F. ERASMUS WILSON.

[Read 10th August, 1922.]

PSELAPHIDAE.

Genus Rybaxis.

M. Raffray dealing with this genus in Junk's catalogue, after having transferred *electrica*, King, and *lunatica*, King, to *Anabaxis*, records nineteen species from Australia. Mr. A. M. Lea has described a further sixteen species bringing the total up to thirty-five. These, together with the five new species here dealt with, make the genus the third largest of the family in Australia. Having recently had occasion to prepare an up to date catalogue of the Pselaphidae, I find that we have, including my new forms, a grand total of 403 species.

The following three new species are all allied to *strigicollis*, Westw. They belong to Raffray's first group of the genus,[1] i.e., in which the transverse prothoracic furrow is well defined, and the median fovea very small or wanting. They are distinguished from all other Australian species of this group except *strigicollis*, by their curious prothoracic sculpture. Westwood, in describing *strigicollis*, refers to this sculpture as striolate. It consists of very distinct, irregularly longitudinal ridges, frequently running into each other, and thus forming enclosed areas, these being usually more noticeable anteriorly. The above form of sculpture is referred to as strigose in the following descriptions.

Rybaxis strigicephalus, n.sp.

♂ Dark castaneous, appendages and portion of elytra slightly paler. Upper surface clothed with minute pale pubescence, antennae and undersurface with longer pale pubescence.

Head large, slightly longer than wide, lightly narrowed before eyes, somewhat flattened on disc, declivous on sides and between antennae, sides incised about middle for the reception of eyes, these rather prominent, apical three-fourths coarsely longitudinally strigose, basal fourth with a few large punctures particularly at sides, with an obscure fovea on either side of middle at about basal fourth; antennae somewhat slender, joint 1 subcylindric, viewed from above wider than, and about twice as long as 2, 3 and 4, subequal, narrower than

1. Trans. Linn. Soc. N.S.W., 1900, Part II., p. 149.

2, 5 longer and a little wider than 4 or 6, 7 wider than 6, widened internally, 8 much shorter than 7, 9 much longer and wider than 8, 10 larger than 9, 11 about one and one-half longer than 10, lightly bent, bluntly pointed, and with a tubercule about middle on inner side beneath. Prothorax feebly transverse, strongly convex, sides strongly and evenly rounded almost to base, thence very lightly arcuate; base rounded, transversal groove strongly defined, a little widened in middle and terminating on either side in a large fovea; disc in front of groove coarsely longitudinally strigose as on head; behind groove with somewhat sparse but well-defined punctures. Elytra transverse, sides a little sinuate, widest just before apex, apical margin of each elytron a little produced about centre, sutural striae strongly, dorsal rather weakly, defined, the latter traceable to about apical fourth, lightly deflected outwards towards apex, with well distributed but obscurely defined puncturation. Abdomen with puncturation more clearly defined than on elytra, with two medio-basal carinules. Metasternum widely impressed down middle. Undersurface of abdomen armed with two lamelliform protuberances at apex of second segment, these placed near together about the middle, and produced backwards, overhanging the third and part of fourth segments, thence recurved abruptly outwards, their apices rounded; fifth segment greatly constricted in middle, sixth almost wholly occupied by a very large and deep excavation. Legs with femora robust, and anterior tibiae toothed internally near apex.

Length, 2.75 mm.

♀ Similar, but with antennae normal; front tibiae unarmed, non strigose portion of head not punctate, apices of each elytron lightly rounded, abdominal puncturation rather indistinct and undersurface of abdomen convex.

Habitat.—Victoria: Healesville, in moss. (F. E. Wilson). Eltham (C. Oke).

The only Australian species of Rybaxis with strigose head.

Type in author's collection.

Rybaxis longipilosus, n.sp.

♂ Reddish-castaneous, elytra and appendages paler; clothed with long, erect, somewhat sparse pale pubescence.

Head, with apical three-quarters covered on disc with a close meshwork of very large shallow punctures, basal quarter almost impunctate, with a round fovea on either side of middle at about basal quarter; antennae of moderate length, joint 1 rather stout, subcylindric, 3, 4, 5 each lightly increasing in width from base to apex, 3 slightly longer than 4, and 5 than 3, 6 shorter than but slightly wider than 5, 7 a little wider but slightly shorter than 6, 8 subquadrate, much shorter than 7, 9 to 11 forming a moderate club, 11 rather sharply pointed, a little bent and about equal in length to the two preceding joints together. Prothorax transverse, rather strongly convex, sides strongly rounded, widest a little in advance of middle, the two lateral foveae connected by a strongly-defined groove, much as in the preceding species, in front of groove with disc coarsely longitudinally strigose, behind rather sparsely punctate. Elytra transverse, apical margin of each elytron produced in middle, dorsal striae traceable to about apical fourth, its apex lightly deflected outwards, with sparse moderately defined punctures, epipleural furrow arising from a small round fovea at about basal fourth and terminating a little before apical fourth. Abdomen about width of elytra at their widest part, with two somewhat indistinct medio-basal carinules. Metasternum widely impressed down middle. Intermediate trochanters each with a small tooth. Abdomen with second ventral segment armed at apex with a wide lamelliform protuberance overhanging the third segment, and then abruptly recurved outwards, evenly rounded at apex; apical segment almost wholly occupied by a very large and deep excavation. Legs with front femora stout, front tibiae with an internal tooth towards apex.

Length, 3 mm.

♀ Similar, but tibiae, trochanters and ventral segments unarmed. Undersurface of abdomen convex, but ultimate segment lightly bi-impressed.

Habitat.—Victoria: Ringwood, (F. E. Wilson and C. Oke), Ferntree Gully (C. Oke), Lakes' Entrance (F. E. Wilson).

This species frequents moss growing on the ground in damp situations.

Type in author's collection.

Var. picea.

Size smaller (2.5 mm.). Dark brownish-black, elytra except for a large discal infuscation on basal half (which sometimes extends down the suture), and appendages, dark castaneous; undersurface piceus.

A number of specimens both mature and immature are before me, but though in size and general colouration looking very different from the typical form, I am unable to distinguish any marked character by which to separate them. Some specimens are a little less pilose and a little more nitid than in the typical form, but others again agree very well in these rspects. The immature specimens are wholly flavous.

Habitat.—South Australia: Myponga (A. H. Elston).

RYBAXIS MIRABILIS, n.sp.

♂ Pale castaneous, elytra and appendages slightly paler; sparsely clothed with short pale pubescence.

Head about as long as wide, lightly impressed between antennae, with fairly large and evenly distributed punctures, with two prominent round inter-ocular foveae; antennae with joint 1 a little wider than 2, and about as long as 2 and 3 combined, 3 and 4 subequal, narrower than 2, 5 longer than 4, 6 as long as 5, and slightly wider, 7 shorter, but wider than 6, 8 much shorter, 11 lightly bent, and about as long as 9 and 10 combined, the last three forming a fairly strong club. Prothorax very lightly transverse, convex, sides strongly rounded to about middle, thence to base very lightly bisinuate, transverse basal groove and lateral foveae as in *strigicephalus*, in front of groove with disc coarsely longitudinally strigose, behind with punctures as on head. Elytra lightly transverse, apical margin of each elytron produced about middle, sutural and dorsal striae well defined, the latter very lightly deflected outwards at their apices; epipleural furrow very distinct, arising from a small roundish fovea at basal and terminating at apical fourth, puncturation well distributed, but somewhat obscure. Abdomen about equal in width to elytra at their widest, with two short medio-basal carinules, puncturation much as on elytra. Metasternum widely and somewhat deeply impressed down middle. Anterior trochanters rather strongly toothed. Undersurface of abdomen with second segment impressed on disc and with two medio apical lamelliform protuberances, these lightly overhanging the following segment and then recurved strongly outwards, their apices rounded, and their bases lightly connected, fourth segment at sides with two subapical lamelliform protuberances directed obliquely backwards, apex of segment straight across middle, and forming the basal margin of a large cavernous apical excavation with straight diverging sides. Legs with femora fairly stout, the anterior ones with a blunt tooth a little nearer base than apex; front tibiae straight, increasing in width from base to about apical fourth, thence suddenly constricted, thus forming a blunt tooth; intermediate tibiae narrower, lightly arcuate and weakly constricted just before apex, hind tibiae much inflated on apical half, and strongly notched close to apex, much excavated on side in neighbourhood of notch.

Length, 3 mm. (vix).

♀ Similar, but a little smaller, with an additional small fovea on disc immediately behind inter-ocular foveae, no armature on femora, tibiae normal. Abdomen beneath convex.

Habitat.—Victoria: Lakes Entrance (F. E. Wilson).

This species, of which I collected ♂♂ ♀♀ from moss growing on the ground, is readily distinguished from its allied species by the remarkable armature of the ♂ ventral segments.

Type in author's collection.

RYBAXIS STRIGICOLLIS, Westw.

This fine species was described in Trans. Ent. Soc. Lond. 1856, p. 269, and a very excellent figure is given in Plate 16, f. 1. It is in my experience a very rare insect. Westwood records Melbourne as the type locality, his specimen having been taken in association with ants. My unique example was secured from a nest of the ant *Iridomyrmex nitidus* at Ringwood, near Melbourne. The antennal club alone serves to distinguish it from its allied species, as the 9th and 10th joints are black, forming a striking contrast to the other pale joints. The eleventh joint is also rather strongly bent.

Westwood's specimen must have been a female (he does not state the sex), and the following well marked male characters should be associated with his description.

The metasternum is widely and rather deeply impressed down the middle, and the anterior trochanters have a minute tubercule on their outer edges, near their points of insertion with the coxae. The undersurface of the abdomen has the second segment armed with a lamelliform protuberance similar to that found in *longipilosus.* Immediately behind this there is a wide, shallow depression, which extends to the apex of the abdomen. The front tibiae are also armed with an internal tooth toward their apices.

R. strigicollis, and the three allied species here described, which might appropriately be termed the "strigicollis group," may be conveniently tabulated from characters of their uppersurface as follows.

A. Prothorax and head longitudinally strigose. *strigicephalus.*

A.A. Prothorax only longitudinally strigose.

B. Antennae with two subapical joints very much darker than the rest, apical joint markedly bent. *strigicollis.*

B.B. Antennae not so.

C. Clothing consisting of long, somewhat sparse, hairs. *longipilosus.*

C.C. Clothing consisting of short hairs. *mirabilis.*

Rybaxis otwayensis, n.sp.

♂ Castaneous, elytra and appendages slightly paler, moderately clothed with short pale pubescence.

Head about as long as broad, lightly attenuate in front, incised at sides for the reception of eyes, inter-oculate foveae very prominent, with a shallow inter-antennal impression, and small but evenly distributed punctures; antennae with joint 1 cylindric, viewed from above a little shorter than 2 and 3 combined, 2 subovate, narrower than 1, 3-7 more or less elongate, subequal in width, 5 longer than the adjacent joints, 8 much shorter and lightly narrower than 7, 9 a little longer and broader than 8, 10 trapezoidal, not much longer than 9, 11 equal in length to 9 and 10 combined, curved, acuminate. Prothorax lightly transverse, convex, sides broadly rounded to their widest part just before middle, thence lightly rounded to base, base a little rounded, transversal groove joining lateral foveae pronounced, more angulate hindwards than usual; puncturation rather strong and evenly distributed. Elytra transverse, apical margin of each elytron produced in middle; dorsal striae strongly defined, passing apical fourth, their apices deflected outwards; puncturation a little less distinct than on prothorax. Abdomen rather long, a little narrower than elytra at their widest, segments strongly margined, no medio-basal carinules. Metasternum broadly depressed down middle, with two small, round, fascicle filled foveae immediately behind intermediate coxae. Anterior trochanters with a minute tooth near base in front, intermediate with a prominent curved tooth at base behind. Undersurface of abdomen with a wide, somewhat shallow excavation common to the second, third and fourth segments, fourth segment with a median subapical lamelliform protuberace directed obliquely backwards, broader at base than apex, which is somewhat truncated; apical segment lightly transversely impressed at base. Legs with femora robust; anterior tibiae robust, lightly arcuate, toothed internally just in front of middle; intermediate tibiae with a similar, somewhat more pronounced tooth just before middle, posterior much longer, thin, and lightly curved.

Length, 2.5 mm., approx. (my specimen is bent somewhat).

Habitat.—Victoria: Lorne, in moss. (F. E. Wilson).

Type unique, in author's collection.

RYBAXIS SIMILIS, n.sp.

♂ Very close to *otwayensis*, but differs in having an additional small sub-median tooth on its anterior trochanters, and in the very different structure of its second ventral segment. This, at its apex, is straight across the middle half, but on either side of the straight portion it is produced in the form of a thin plate continuing the same plane as the rest of the segment. Apparently the plate is continuous right round the dorsal surface. Being somewhat transparent ventrally it is possible to discern the normal margin of the segment beneath it. The basal abdominal excavation is also a little more pronounced than in the preceding species.

Length, 2.5 mm.

Habitat.—Victoria: Lorne, in moss. (F. E. Wilson).

This species can only be distinguished from *otwayensis* by the characters of its undersurface. In fact, I had the two specimens mounted on the same card as being identical.

Type unique, in author's collection.

RYBAXIS CRASSIPES, Lea.

Proc. Linn. Soc. N.S.W., 1910, p. 735.

I have recently taken a specimen of what almost certainly appears to be this species, from tussocks of snow grass growing on the summit of Mount Donna-Buang, Victoria. Mr. Lea's specimen was taken at Zeehan, Tasmania.

COLLACEROTHORAX SPINICOLLIS, n.sp.

♂ Dark reddish-castaneous; legs, palpi and apical joints of antennae a little paler; uppersurface generally clothed with long black hairs, but on the head and prothorax particularly; there is also a shorter pale pubescence, this most noticeable along the median lines, and in the prothoracic excavations; undersurface with pale decumbent pubescence.

Head a little elongate, with well-marked antennal tubercules, immediately behind which it is strongly constricted; deeply excavated along median line, excavation bordered on either side by a prominent ridge terminating posteriorly in an acute tooth directed obliquely backwards, between the ridges and the eyes there is on either side a rather deep longitudinal excavation, rounded in front and bordered posteriorly by another shorter tooth directed obliquely backwards, both median and lateral excavations filled with pale pubescence; with numerous moderately defined punctures; antennae of moderate length, club of three joints, apical joint pointed. Prothorax broader than head, sides much widened on their apical halves and recurved into the form of a strong spine which is itself toothed, and which is directed upwards, a little outwards and a little backwards. On either side of prothorax is a wide, deep excavation, which forms a rather sharp edge with the uppersurface, thus making the whole discal area look like a raised shield; with puncturation as on head. Elytra a little transverse, sutural striae deep, dorsal well marked to about apical third; puncturation irregular, and not very distinct. Abdomen at widest wider than elytra, second and third segments with a very short black carina on either side, placed nearer the outer margin than the centre. Legs unarmed.

Length, 2.5 mm.

Habitat.—Victoria: Ringwood, Beaconsfield, Healesville, (F. E. Wilson).

Type in author's collection.

This insect is undoubtedly congeneric with *C. sculpticeps*, Lea[2], although its second abdominal segment is not tricarinate. The armed prothorax and different abdominal carination readily distinguishes it from that species. The antennal club differs greatly from Mr. Lea's species, the ninth and tenth joints being much less markedly transverse, and the eleventh joint being pointed instead of widely rounded. Owing to the rather dense pubescence it is somewhat difficult to see the sculpture of the head and prothorax. All my specimens were taken in damp moss growing on the ground.

SCHISTODACTYLUS ARMIPECTUS, n.sp.

♂ Castaneous, elytra and appendages paler; antennal joints 7-10 inclusive strongly infuscated; somewhat sparsely clothed with pale decumbent pubescence.

Head about as long as broad, lightly impressed between antennae, with two somewhat indistinct inter-ocular foveae; with dense, very clearly defined, punctures, becoming more sparse on disc near base; antennae with joint 1 cylindric, longer than 2 and 3 combined, 2 broader and scarcely perceptibly longer than 3, 4, 5, 6 and 7 decreasing in length, 8 wider and a little shorter than 7, 9 much wider than 8 and slightly longer, 10 wider and shorter than 9, 11 subovate, longer than 9 and 10 combined, and forming with them a three jointed club. Prothorax about as long as wide, widest at about apical third, sides strongly rounded to their widest part, thence almost straight to base which is subequal in width to apex; puncturation as on head. Elytra

2. Proc. Linn. Soc. N.S.W., 1911, Vol. xxxvi., pp. 451, Pl. xvii., f. 2, 3, 4.

short, rounded at shoulders, strongly dilated to apex; dorsal striae traceable to about apical third, both sutural and dorsal striae arising from minute foveae; with puncturation about same size but not quite so distinct as on prothorax. Abdomen about twice as long as elytra, widest at apex of second segment, on either side of which there is a rather deep fovea. Metasternum impressed in middle; with scattered punctures. Prosternum with a small conical tubercle on either side, these surmounted with a long sharp seta. Anterior trochanters about middle, and anterior femora near base, armed with a long, thin spine, the femoral ones being slightly longer. All tibiae rather strongly curved near apex. Tarsi with third joint slightly longer than the second, and armed with two unequal, widely diverging claws. Undersurface of abdomen slightly flattened along centre, with a shallow transverse fovea on sub-apical segment, this segment rather strongly produced in centre.

Length, 1.75-2 mm.

Habitat.—Victoria: Mt. Donna Buang, Belgrave, (F. E. Wilson).

This description will be found almost identical with that of *brevipennis*, Lea[3], but the fact remains that it agrees in practically every character with that species except that it has the additional armature on the prosternum. This, however, is very distinct, and is constant in all my examples. Its palpi are as in *brevipennis*, but the two spines on the sub-basal joint are about equal in length. The spine at the apex of the ultimate joint is much longer than its accompanying seta, and near the apex there are also a few very much finer setae or hairs.

Two specimens that are almost certainly females, are a little larger and have the undersurface of the abdomen much more convex, particularly on the basal segments. My examples from Mt. Donna Buang were secured from tussocks of snow grass growing on the summit, and a single example from Belgrave was sieved from moss.

Type in author's collection.

Schistodactylus foveiventris, n.sp.

♂ Differs from *armipectus* in having the antennal joints 1-10 almost concolourus, and 11 very little lighter than 10; in its vestiture being a little sparser, its head more punctured on disc near base, in its less pronounced inter-ocular foveae, and in the very different undersurface of its abdomen. The first segment is very convex and declivous at apex, the third very narrow and constricted in the middle. It overhangs the base of a large cavernous fovea which extends to the apex of abdomen. The sub-apical segment only appears as a triangle on either side of the fovea. Apex of abdomen sharply produced. The transverse rows of punctures on the ventral segments are much stronger also than in *armipectus*. Apical joint of maxillary palpus furnished at apex with a spine not accompanied by a strong seta.

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3. Proc. Linn. Soc. N.S.W., Vol. xxxv., (4), p. 771, Pl. xxi., f. 10.

Length, 2 mm.

Habitat.—New South Wales: Blue Mountains, (Dr. E. W. Ferguson).

In the Proc. Linn. Soc. N.S.W., Vol. xxxvi., (3), p. 455, Mr. A. M Lea records Blue Mountains, N.S.W., as a new locality for *Schistodactylus brevipennis*, Lea, on the strength of a specimen in Dr. Ferguson's collection. This specimen is the one upon which I have founded the above description. It was gummed right side up upon a card so that none of its undersurface or palpi were visible. As the uppersurface is almost identical with that *brevipennis* it is easy to see how Mr. Lea mistook it for that species. The discovery of *armipectus* so markedly resembling *brevipennis* in the characters of its uppersurface, led me to wonder if this specimen might also have an armed prosternum. On floating it off and cleaning it, I found that it was still another new species. It will thus be seen that for positive identification of a *Schistodactylus* it is absolutely essential to examine the characters of the undersurface.

For this interesting species together with many other fine *Pselaphids*, I am indebted to the generosity of my friend, Dr. E. W. Ferguson.

Type in author's collection.

The genus now comprises four species, viz., *phantasma*, Raff., from Western Australia, *brevipennis*, Lea, from Tasmania, *armipectus*, n.sp., from Victoria, and *foveiventris*, n.sp., from New South Wales. These may be tabulated as follow:—

A. Apical joint of palpi simple at extremity. *phantasma*, Raff.

A.A. Apical joint of palpi not simple at extremity.

B. Apical joint of palpi with a spine and a strong seta at extremity.

C. Prosternum unarmed. *brevipennis*, Lea.

C.C. Prosternum armed. *armipectus*, n.sp.

B.B. Apical joint of palpi with a spine, but no strong seta at extremity. *foveiventris*, n.sp.

Palimbolus armatipes, n.sp.

♂ Reddish castaneous; legs, palpi and elytra slightly paler; with somewhat sparse lightly golden pubescence, shorter and more decumbent on prothorax than elsewhere.

Head strongly convex, very slightly longer than broad, with two small round foveae, one on either side close to eye, and a discal fovea a little in advance of these; midway between discal fovea and antennal ridges with a deep transverse fovea; inter-antennal region raised; eyes moderately prominent; puncturation sparse and minute; antennae moderately long, joint 1 cylindric, viewed from side longer than 2 and 3 combined, 2 slightly longer than 3, 4 and 5 much broader, the latter being a little longer and broader than the former, both widened internally, 6, 7, 8, subequal and narrower than 5, 9 and 10 about equal in length to 5, but wider, the latter lightly wider than the former, these together with 11 forming a three jointed club, 11 wider than 10, and nearly twice as long, subovate, bluntly pointed. Prothorax as broad as long, widest just before middle, with a strong longitudinal basal fovea and two round lateral foveae on either side, one basal and one submedian; puncturation as on head. Elytra transverse, with four basal foveae; rather strongly raised at shoulders. Metasternum with two prominent tubercules close together on disc midway between posterior and intermediate coxae, each tubercule crowned with a small bunch of hairs. Undersurface of abdomen with a wide shallow impression down middle, apex of fourth segment on either side at outer edge with a prominent lamellated ridge or tooth directed obliquely hindwards, its axis longitudinal. Intermediate and posterior trochanters bluntly toothed. Four front femora stout, hind femora each with a prominent black carina traversing slightly less than the middle half of its uppersurface, inner basal halves deeply excavated, excavation apicaly overhung by a wide thin plate. Hind tibiae strongly arcuate, each with a blunt oblique protuberance or tooth near base, this crowned with long fasciculate setae, a very prominent sharp tooth on inner edge of uppersurface at about middle, and a shorter sharp tooth on inner edge of lowersurface a little nearer base. Legs with puncturation rather stronger than elsewhere. Inner claw of anterior tarsi trifid.

Length, 2.8 mm.

♀ Differs in having joints 4 and 5 of antennae not appreciably wider than 3, abdomen not impressed beneath; no armature on legs and ventral segments.

Habitat.—Victoria: Healesville (F. E. Wilson), Belgrave (F. E. Wilson and C. Oke).

This species seems to have affinities with *mamillatus*, Lea[4], in its tuberculate metasternum, and *leana*, Raff.,[5] in the possession of a sub-basal tooth on its hind tibiae. Its very remarkable hind femora and tuberculate metasternum, however, serve easily to distinguish it from the latter species, and the armature of the hind tibiae readily separate it from the former.

It is sometimes a difficult matter on mounted specimens, however well set, to see the lower submedian tooth on the hind tibiae, although the upper one is always prominent. This latter, viewed from some directions, is seen to be somewhat lamelliform as in *victoriae*,[6] King. Also from some directions the fourth and fifth antennal joints do not appear to be anything like as wide as they actually are.

My Healesville specimens were taken from moss growing on old logs, and those from Belgrave were sieved from fallen leaf debris.

Type in author's collection.

Palimbolus robusticornis, n.sp.

♂ Dark reddish castaneous, elytra and appendages paler; lateral margins of prothorax black or infuscated on their anterior halves;

4. Proc. Linn. Soc. N.S.W., Vol. xxxvi. (3), p. 449, Pl. xvii., f. 1.
5. Proc. Linn. Soc. N.S.W., Vol. xxv. (2), p. 223, Pl. x., f. 38.
6. Trans. Ent. Soc. N.S.W., 1865, p. 168, Pl. x., f. 39.

with rather dense lightly golden pubescence, this shorter on head and prothorax.

Head as long as broad, strongly impressed between antennal ridges, with two well marked inter-ocular foveae, placed well up on disc, and a faint impression on disc near base; with sparse indistinct punctures except on antennal ridges where they are very coarse; antennae of moderate length, very robust, joint 1 viewed from the side, as long as 2 and 3 combined, 2 slightly narrower than 1, almost moniliform, 3 as long as 2, widened from base to apex, 4-8 of equal width, lightly transverse, 5 a little longer than adjacent ones, 9 and 10 transverse, subequal, much wider than 8, 11 wider than 10 and about equal in length to the two preceding combined, subovate, lightly hollowed out on undersurface at base; all joints very coarsely punctured. Prothorax lightly transverse, rather more widened than usual on its apical half, with a strong medio-basal fovea, and two round lateral foveae on each side, one basal and one submedian; puncturation as on head. Elytra strongly transverse, sides increasing in width to near apex, with well marked sutural striae, and a short but wide basal impression on either side, midway between suture and lateral border; puncturation as on prothorax. Abdomen rather long, wider than elytra. Metasternum much raised in front, with two small, somewhat transverse tubercules near together in disc, immediately behind intermediate coxae; between these and posterior coxae the surface is strongly declivous, and somewhat excavated. Hind trochanters very feebly armed. Undersurface of abdomen strongly flattened, lightly excavate near apex. Hind tibiae gradually inflated internally to about the middle, thence becoming rather suddenly reduced in width, from some angles the internal inflation seems to take the form of a carina.

Length, 3.3 mm.

♀ Similar, but with hind tibiae normal and abdomen convex beneath.

Habitat.—Victoria: Warburton, in tussocks (F. E. Wilson), Belgrave, in moss (C. Oke and F. E. Wilson).

Type in author's collection.

Palimbolus pacifica, n.sp.

♂ Rather slender, flavous; antennae and abdomen slightly darker; head and prothorax sparsely clothed with moderately long pale pubescence, that on elytra longer and a little darker, appearing almost black in some lights; abdomen densely pubescent.

Head as wide as long, inter-antennal ridges rather broad, and coarsely punctate, with a deep impression between them; inter-ocular foveae strongly defined, placed well up on disc; puncturation sparse, larger on base and sides, smaller on disc; antennae of moderate length, joint 1 subcylindric, viewed from the side, larger than 2 and 3 combined, 2-6, subequal; subquadrate, lightly narrower than 1, 7 and 8 about as long as 6 but slightly increasing in width, 9 about one and a-half times larger than 8, dilated towards apex, 10 of similar shape as 9, but a little wider and noticeably shorter, 11 narrower at base than 10, lightly curved, obtusely pointed and a little shorter than 9 and 10 combined, all joints with numerous punctures, those on basal ones being the larger. Prothorax transverse, sides widest about middle, medio-basal impression strong, lateral foveae three in number on each side, one near base, one near apex, and one submedian; punctures fairly numerous, evenly distributed, similar to those on disc of head. Elytra strongly convex, transverse, evenly rounded at shoulders, then gradually increasing in width to near apex, with a large basal impression on either side, midway between suture and lateral border, a round fovea at base of sutural striae, and these impressions; puncturation indistinct, almost wanting on disc. Abdomen about as long as, but a little narrower than elytra, its margins pronounced, and with puncturation stronger than on elytra. Metasternum a little impressed along middle of its apical half, minutely punctured, and almost glabrous on disc of its basal half, with a small round fovea filled with hairs, immediately behind intermediate coxae. Undersurface of abdomen flattened, with a very small and indistinct impression on apical segment. Maxilliary palpi with apical joint strongly inflated inwardly on its basal two thirds, sharply pointed at apex, somewhat hollowed out beneath.

Length, 2.8 mm., breadth, 1.1 mm.

Habitat.—Victoria: Lakes Entrance, in moss, (F. E. Wilson).

This interesting species differs in two main characters from all other species of the genus, firstly in possessing no armature, and secondly in the very different structure of the apical joint of the maxilliary palpus. At first glance I was inclined to exclude it from the genus, in spite of its *Palimbolus* like facies. What decided me to include it, however, was that, like the males of all other *Palimbolus* known to me, it has the inner tarsal claws on the anterior tarsi trifid.

This character has apparently not been previously commented upon, and my attention was first called to it by Mr. A. M. Lea, who showed me a specimen of a *Palimbolus* from the late Canon Blackburn's collection, to which was attached a note stating that the front claws were trifid. Species which I know to have this character are *mirandus*, Sharp, *victoriae*, King, *leana*, Raff., *foveicornis*, Lea, and the new species here dealt with. I think that upon examination all the other species also, will be found to have trifid claws.

Type in author's collection.

PALIMBOLUS? MINOR, n.sp.

♂ Dark reddish-castaneous, palpi paler; moderately clothed with short pale pubescence.

Head very lightly transverse, rather strongly narrowed in front of eyes, raised and very convex on basal half; inter antennal elevations not very pronounced, with a very shallow impression between them; with close, but indistinct punctures much obscured by clothing; eyes placed far back, prominent; antennae with joint 1 subcylindric, about equal to 2 and 3 combined, 2 cylindric narrower than 1 and slightly longer than 3; 3, 4, 5 subequal, 6 a little shorter than 5, 7 slightly longer than adjacent ones, 9 much wider than 8, slightly transverse, 10 a little longer and wider than 9, 11 longer than 9 and 10 combined, subovate, rather strongly pointed, the last three forming a pronounced club. Prothorax lightly elongate, very convex on disc, widest just in front of middle, with a wide medio-basal longitudinal fovea and three round lateral foveae, one each near base and apex, and one submedian, on either side; puncturation as on head. Elytra lightly transverse, sides evenly rounded to their widest part just before apex; strongly convex; sutural striae well marked; with a short basal impression on either side about midway between suture and lateral margin; with numerous minute punctures. Abdomen slightly narrower than elytra, lateral margins pronounced; with puncturation as on elytra. Metasternum with two prominent conical tubercules placed side by side on disc midway between intermediate and posterior coxae, behind tubercules with surface depressed down middle. Undersurface of abdomen a little flattened. Intermediate tibiae with a strong subapical internal tooth. Trochanters unarmed. Maxilliary palpus with the three apical joints inflated externally, apical joint bluntly pointed and with several small setae at its apex, and along its inner margin. Front tarsi with inner claw trifid, hind tibiae almost straight. Femora rather stout.

Length, 1.75 mm.

Habitat.—Victoria: Fern Tree Gully, (F. E. Wilson).

A very aberrant species with head somewhat like that of a *Rytus*, strange palpi, and armed intermediate tibiae, but nevertheless I think best left in Palimbolus. Its palpi approach more those of *pacifica* than any of the other species. Its armed intermediate tibiae should serve to easily distinguish it from all other species.

Type unique, in author's collection.

EROTYLIDAE.

Thallis atricornis, n.sp.

Flavous tinged with red; glabrous, nitid. Head less a medio-basal spot, two very large blotches on either side of prothorax, connected at their bases by a thin line traversing the basal margin, scutellum, a large circum-scutellary area, shoulders, a broad irregular median fascia with front margin angularly depressed at suture, a large blotch on either side at about apical third, each narrowly connected with a large median blotch, which is triangular in shape on its front margin and posteriorly, gradually narrowed to the apex of elytra, black. Undersurface black, except prosternum, and apical segments of abdomen. Femora black at apex, diluted with red elsewhere; tibiae and antennae black; tarsi obscurely reddish.

Head with numerous distinct punctures in front, more sparse elsewhere; antennae of moderate length, joint 3 about one and one fourth longer than either 2 or 4, 8 a little wider than 7, 9 and

10 about twice as wide as long, 11 a little longer than broad, widely rounded at apex. Prothorax a little more than one and one fourth times broader than long, its apex truncate in middle, sides very lightly rounded, with a strong notch on each side of apical margin, lateral furrows obsolete, basal furrow moderately distinct at sides, with punctures much as on base of head, but a little more evenly distributed. Elytra wider than prothorax, parallel-sided to about apical third, with regular rows of well defined punctures, becoming somewhat obscured on apical declivity, with a few extremely minute punctures on interstices. Prosternum with numerous distinct punctures on disc, almost impunctate in front and behind; intercoxal process a little widened and broadly rounded at apex. Metasternum with a longitudinal sulcus on disc, beginning at apex and traceable a little beyond the middle, with punctures very much larger at sides than on disc. Legs of normal length; front femora with two rows of finely serrated ridges on undersurface, serrations more prominent towards apex where they take rather the form of blunt teeth.

Length, 7 mm.

Habitat.—Queensland.—Mt. Tambourine (H. L. Pottinger).

This species appears to be most closely allied to *serratipes*, Lea,[7] but amongst other things it differs from the description of that species in having no well defined lateral prothoracic furrows, by the elytral punctures not being in shallow striae, in having a double instead of a single serrated ridge on the undersurfaces of the front femora, and in having legs of normal length.

Type in author's collection.

MALACODERMIDAE.

Hypattalus queenslandicus, n.sp.

♂ Head black, with muzzle flavous, antennae with joints 1-4, and apical half of 11 infuscate, the rest black; prothorax, base and apex of elytra broadly, suture very narrowly flavous, rest of elytra dark bluish black; all appendages flavous.

Head transverse, highly polished and smooth, with two faint longitudinal impressions on either side between antennae; antennae reaching about middle of elytra, joints 4-10 feebly serrate internally, joint 11 a little pointed, and about one and one quarter longer than 10; prothorax impunctate, broadest at about apical third, apex arcuate outwardly, basal angles rounded, with a rather strong marginal impression widely bordering the base, and continuing around the sides to about the middle; elytra about 2½ times longer than head and prothorax combined, convex, feebly but regularly increasing in width to its broadest portion at about apical fourth; with a strong longitudinal impression on either side at lateral margin, beginning near shoulders and becoming deepest and broadest at about position of hind coxae; with strong and fairly close punctures on dark parts becoming

7. Records of the S. Australian Museum, Vol. ii., No. 2, p. 291.

a little sparser and less apparent elsewhere. Scutellum invisible. Legs long and thin, anterior tibiae feebly, posterior very strongly, arcuate.

Length, 3.75, width 1.5 mm.

Habitat.—Queensland: Blackall Ranges, (F. E. Wilson).

Type unique, in author's collection.

In Lea's table of species, Trans. Ent. Soc. Lond., 1909 (1), p. 169, this species would come under the same heading as *alphabeticus*, Lea, but the impunctate head, and prothoracic and elytral impressions, amongst other things should serve easily to differentiate it from that species.

CERAMBYCIDAE.

Sub-family PRIONINI.

Elaptus pilosicollis, n.sp.

♂ Uniformly light brown, nitid; apex and margins of mandibles, jugular processes, knees, and margins of tibiae and tibial spurs, black or darker; undersurface slightly paler; head, portions of mandibles, prothorax, scutellum, femora, tibiae, and all the undersurface except the ventral segments covered with a long erect golden pubescence; clothing of ventral segments a little shorter and more decumbent. Elytra apparently glabrous, but viewed from the side seen to be furnished with sparse very minute setae.

Head rather small, with a fairly well defined sulcus on disc, punctuation rather sparse on disc, much closer together on clypeus and behind eyes; eyes rather wide apart; mandibles sharply pointed, with numerous punctures on their paler portions; antennae reaching apical third of elytra, scape barely over-reaching hind margin of eye, and stouter than joint 3, joints 1 and 2 somewhat closely and coarsely punctured, almost glabrous and nitid, the rest, with the exception of a small nitid spot at the apex of the 3rd, 4th, 5th, and 6th joints, covered with a very minute puncturation, and a depressed pubescence, giving them an opaque appearance.

Prothorax 4.5 x 7 mm., convex, and depressed forward, broadest at about basal third, and lightly decreasing in width towards apex, sides lightly marginate, and evenly rounded to meet basal and apical margin, apical margin lightly advanced in centre; median sulcus almost obsolete, midway between it and the lateral borders are two obscurely defined depressions, the whole closely punctured generally, but becoming a little less frequent towards the front of disc; basal and apical margins ciliated.

Elytra at base broader than prothorax, gently decreasing in width towards apex, with five somewhat obscure costae on each elytron, the first and third being the most prominent; the whole covered with large round punctures, well defined except at extreme base. Scutellum a little transverse, and broadly rounded at apex, with fairly numerous though not well defined punctures. Prosternum, metasternum, and its episternums covered with a fine, very close puncturation, this becoming sparser on centres of ventral segments. Front tibiae widened and furnished on their outer edges with a few very blunt teeth, directed forwards; the intermediate and hind tibiae have on their outer edges some minute spinous processes; femora and tibiae fairly strongly punctured.

Length, 25 mm.

♀ Differs from the ♂ in the following characters:—Prothorax a little broader, with sides showing a tendency towards angulation just behind the middle, and pubescence mostly confined to the sides and front margin, leaving the disc almost glabrous; antennae much shorter, barely reaching the middle of elytra, and much more slender, though the scape differs in being broader than the third joint; the puncturation of joints 3-7 inclusive is much coarser than in the ♂, and the nitid spaces at the apices of the joints are much more extensive and traceable to the 9th joint. The mandibles do not exhibit any sexual dimorphism. The front tibiae are armed with six rather sharp teeth, and the spiny processes on the other tibiae are rather more apparent; the tarsi are a little less widened than in the ♂.

Length (excluding ovipositor), 28.5 mm.

It is with some hesitation that I have placed this species under Pascoe's genus *Elaptus*, firstly, because of the armature of the front tibiae, (Pascoe says "tibiae haud dentatae,") and secondly because the prothorax differs in shape so much from all the other members of the genus.

There is a small ♂ before me measuring only 19 mm. in length in which the antennae almost attain the full length of the insect.

Habitat.—West Australia: Geraldton (J. Clark), 5 ♂ ♂ 1 ♀.

Types in author's collection.

Co-types 2 ♂ ♂ in collection of West Australian Museum, Nos. 7936, 268 (1916), 2 ♂ ♂ in collection of Mr. J. Clark. For my specimens of this species I am indebted to the generosity of my friend, Mr. J. Clark, of Perth.

Cnemoplites (Hermerius) intermedia, n.sp.

♂, Dark chestnut-brown, prothorax a little darker; head and prothorax sparsely clothed with short upright pale pubescence, this lacking on the smooth, glossy discal areas of prothorax; anterior tibiae strongly hirsute beneath on their outer halves, this character becoming less pronounced on the four hind tibiae; shoulders, slightly pubescent; undersurface of head and prothorax with clothing similar to that upon their dorsal surfaces; metasternum and its episternums densely clothed with a very much shorter, and somewhat decumbent golden pubescence, this almost wanting on disc, but possibly due to abrasion; the brushes of the ventral segments are very dense and golden in colour, and semi-lunar in shape on the first four arches; on the last segment the hairs are shorter, and occupy a fairly large zone around the vent.

Head, moderate, disc coarsely punctured, punctures tending towards confluency; mandibles strong, coarsely punctured on their lateral declivities; antennae reaching apical third of elytra, joint 1 over-reaching apical margin of prothorax, a little longer than 3, 3 one and one-half times longer than 4; on joint 1 the puncturation is fairly close and strong, but on the other joints they become increasingly more fine and sparse; internal keel of joints only traceable on the two apical joints. Prothorax about one and three-quarter times broader than long, depressed on disc, sides declivous, lateral borders generally rounded, but crenulate or bluntly toothed, and with a small slightly upturned lobe at apical angle, towards the base the teeth become somewhat longer, but this is apparently variable, as it is more noticeable on the left side than on the right; the depressed discal area is highly polished; the puncturation which covers all the surface except a spot just above the basal centre, and two large spaces on either side of the discal impression, is very coarse, becoming somewhat rugose at the sides; the anterior border is rather strongly arched inwards about the middle, and the posterior is weakly margined. Elytra rather short, convex, wider at base than prothorax, spined at sutural angles, somewhat smoothly punctured, and glossy on basal half about suture, rugose elsewhere. Scutellum bluntly pointed behind, sparsely punctured except on a longitudinal band on basal half. Front femora coarsely granulate above, granules becoming almost spinose in parts, more finely granulate beneath; intermediate and posterior femora almost smooth above, undersurface of intermediate with sparse fine granules, and of posterior with sparse punctures; front tarsi much widened; front tibiae rather broadly channelled down the centre of the uppersurface.

Length, 48 mm.

Habitat.—New South Wales: Grenfell (T. G. Sloane).

This species seems to fall between the other two forms assigned to the sub-genus *Hermerius*, viz., *impar*, Newm., and *howei*, Thoms. I have not been able to gain access to Newman's description of *impar*, but have had to rely upon the notes given by Lameere, who examined the types at the British Museum. My species differs from *impar* in having the third antennal joint not nearly twice the length of the fourth, the internal keel of the antennal joints not rather prominent, the elytra not without spines at sutural angles, and the femora not rugose throughout. These distinctions, together with the possession of the depressed prothoracic discal area, with its nitid smooth spaces should serve to distinguish it from Newman's species.

From *howei* it differs in being larger, in having the elytra not graulate, the body not generally pubescent above, the third antennal joint not longer than the first, nor twice the length of the fourth.

Type in author's collection.

For my specimen I am indebted to the kindness of my friend, Mr. T. G. Sloane, of Young, N.S.W.

[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. II., 1923.]

Art. XII.—*The Relationship between Dacite and Granodiorite in Victoria.*

BY H. S. SUMMERS, D.Sc.

Associate Professor of Geology, University of Melbourne.

(With one text figure.)

[Read 10th August, 1922.]

The association and field relations of dacite and granodiorite[1] at Macedon, Mt. Dandenong, Warburton and Healesville, together with the somewhat related occurrences in the Cerberean Ranges, the Strathbogie Ranges, and the Tolmie Highlands, furnish interesting material for students in petrogenesis, and in the mechanics of igneous intrusion.

In all cases the evidence proves that there was an extrusion of lava, followed by the intrusion of granodiorite or adamellite in such a manner that in every area the plutonic and volcanic rocks are brought into contact with one another. As a result of this relationship the dacite, etc., show the effects of contact metamorphism.

The Macedon occurrence is the best known, and may be taken as more or less typical of the relations that exist in the areas named.

The general field relations of the rocks in this area are shown in the map and section (fig. 1). It will be seen that the dacite is shown resting on the granodiorite over a considerable area. As the dacite has been proved to be the older rock, it follows that it must have been piled up on a platform of Ordovician sediments, and that the present justaposition of the dacite and granodiorite has been brought about subsequently.

The relationship of the batholith of granodiorite to the overlying dacite does not seem explainable by Suess's[2] conception that a batholith occupies a space formed during the dislocation of the lithosphere.

Iddings'[3] modification of this idea, viz., "that as the lithosphere in places tended to part, molten magma might enter the fracture and because of its density and hydrostatic pressure might permit the fractured parts to separate, the magma supporting its share of the overlying load," also finds little support in the occurrence under discussion. Iddings considers that the tendency to part is the result of fracturing by thrusting and flexure. It is difficult to picture any

1. Richards, H.C., Proc. Roy. Soc. Vic., Vol. 21 (n.s.), p. 528, 1908.
   Skeats, E. W., Q.J.G.S., Vol. 66, p. 450, 1910.
   Skeats, E. W., and Summers, H. S., Geol. Surv. of Vic., Bull. 24, 1912.
   Summers, H. S.. Proc. Roy. Soc. Vic., Vol. 26, (n.s.), p. 256, 1914.
   Morris, M., Proc. Roy. Soc, Vic., Vol. 26 (n.s.), p. 331, 1914.
   Junner, N. R., Proc. Roy. Soc. Vic., Vol. 27, (n.s.), p. 261, 1915.
2. Suess. E., The Face of the Earth, Vol. 1, page 163, 1904.
3. Iddings, J. P., The Problem of Volcanism, p. 197, 1914.

such fracturing occurring between a dome-shaped mass of volcanic rock, and the platform on which it rests.

Turning to the hypothesis of overhead or magmatic stoping[4] it is found that this hypothesis is capable of giving a reasonable explanation of the occurrences under discussion.

The original magma before the extrusion of the volcanic phase, by means of overhead stoping reached sufficiently near the surface for partial collapse of the batholithic roof to take place, or alternately for the production of fissures connecting the batholithic chamber with the surface. In either case escape to the surface of the upper portion of the magma could take place.

In the Macedon area there is no evidence of the occurrence of any pyroclastic material so that the extrusion was not accompanied by any explosive action. The lava must have been fairly viscous, as the dacite was piled up in a dome-shaped mass, and wide spread lava flows are not found. A small flow occurs forming a tongue to the south west of Upper Macedon. At Healesville, and near Lilydale, in the Mt. Dandenong area, pyroclastic material has been recorded, indicating that conditions were somewhat different in those areas. Dome-shaped masses of dacite are also found in the Dandenong and Healesville areas.

Solidification of the dacite sealed up the vents from the batholithic chamber, and conditions became favourable for the resumption of stoping, with the result that the palaeozoic platform was entirely removed from a considerable area, bringing the granodiorite in direct contact with the dacite. If this explanation be correct then we might expect to find in some area portion of the old platform which had not been entirely removed, and which should occur between the dacite and granodiorite. So far no such occurrence has been recorded, but may exist, and further field work along the contacts should be done.

The dacites and granodiorites are closely related chemically, but exhibit distinct mineralogical differences. Near Braemar House (now called Clyde) in the Macedon district, both these rocks occur, and analyses are given in the following table. A complete list of the analyses is not necessary as all have been recorded, together with variation diagrams, in the publications quoted on the first page of this paper.

The typical dacite of Macedon consist of phenocrysts of labradorite and hypersthene with smaller and less numerous phenocrysts of ilmenite and biotite set in a granulitic groundmass, consisting of quartz, orthoclase, plagioclase, biotite and ilmenite.

The phenocrysts of labradorite and hypersthene generally show corrosion, but this is more marked in the pyroxene than in the felspar. Biotite frequently occurs in aggregates bordering the hypersthene. The granodiorites consist of quartz, labradorite, orthoclase, and biotite, the ratio of plagioclase to orthoclase being nearly 6 to 1. The prin-

4. Daly, R. A., Am. Jour. of Sc., Vol. 15, p. 269, 1903.
Igneous Rocks and their origin, 1914.

cipal mineralogical difference is the presence of the hypersthene in the dacite, and its absence in the granodiorite.

In most cases the groundmass of the dacites is holocrystalline, but in two places, viz., at Cheniston, near Upper Macedon, and at Hesket,

	I.	II.
SiO_2	62·54	64·04
Al_2O_3	16·66	15·58
Fe_2O_3	1·04	0·80
FeO	5·54	4·47
MgO	2·68	2·64
CaO	3·92	3·52
Na_2O	2·66	2·42
K_2O	2·47	2·80
H_2O+	0·46	2·25
H_2O-	0·17	0·38
CO_2	nil	nil
TiO_2	1·20	0·80
P_2O_5	0·20	0·18
MnO	tr.	tr.
Li_2O	tr.	tr.
Cl.	tr.	tr.
	99·54	99·88

I. Dacite 50 yards south of Braemar House (Clyde) Stables.
II. Granodiorite, near Braemar House (Clyde).

are types with fine grained groundmass, consisting of devitrified glass. These types occur near the outer margin of the base of the dacite dome, and are practically in contact with the Ordovician sediments, and so may be taken to represent portion of the original chilled margin. Sections of these two rocks show the presence of the ordinary phenocrysts, so that it seems certain that the phenocrysts had developed prior to extrusion. With the exception of biotite, the phenocrysts are of the high temperature dry fusion type. In the normal dacite the biotite occurs most commonly as aggregates bordering the hypersthene crystals. Near the contact between the dacite and granodiorite the first sign of contact metamorphism is the production of more mica at the expense of the hypersthene, until near the junction of the two rocks the hypersthene is seen to be completely replaced by a mixture of biotite and quartz. The biotite has been formed by reaction between hypersthene and the alkali felspar molecules in the groundmass.

The Hesket and Cheniston types are practically free from biotite so that it may be inferred that the temperature of the magma at the time of extrusion was rather higher than the reaction temperature between hypersthene and alkali felspar, but that in part the cooling after extrusion was sufficiently slow for some reaction to take place.

In the Strathbogie Ranges, and the Tolmie Highlands, the effusive type is better described as quartz porphyrite, being rather more acid and distinctly coarser in grain than the typical dacite. The groundmass has the same granulitic texture, and the phenocrysts are labradorite and biotite with rather rare examples of corroded hypersthene. This suggests that differentiation had proceeded rather further, and that the temperature at which crystallisation ceased had been sufficiently low for the reaction between the hypersthene and felspar to be almost complete.

Dr. N. L. Bowen's[5] theory of differentiation by sinking of crystals provides the most reasonable explanation of the relationship of the dacites to the granodiorites.

It has been shown that in the Macedon area, at the time of the extrusion of the dacite, labradorite and hypersthene had crystallised out, and that the still molten material containing alkali felspar molecules was commencing to react with the hypersthene to form biotite. The magma at this time would contain a certain proportion of water and other volatile ingredients, and some of these gases would escape when the lava reached the surface. This loss of water, etc., and the expansion of the lava due to loss of pressure, would serve to convert a magma sufficiently fluid to be able to slope its way upwards into a moderately viscous lava, incapable of extensive flow from the vent. Solidification at the border under these conditions would be rapid, and no further reaction between the hypersthene and felspar molecules would take place. Away from the margin a higher proportion of biotite would be formed, owing to slower cooling, and the lower temperature of final consolidation due to less loss of volatile constituents.

The solidification of the lava would seal up the batholithic chamber, and crystallisation of the remaining magma would continue at gradually decreasing temperatures.

Bowen believes that differentiation is mainly due to the sinking of crystals, so that the magma shows increasing acidity upwards. In the cases under consideration the upper, more acid portion, found its way to the surface, and the upper portion of the material left in the magma reservoir would be less acid than that which had reached the surface. Further crystallisation and sinking of crystals could go on, and this new upper layer would constantly gain in acidity. According to the length of time between the extrusion and the final solidification of the magma in the reservoir, so would the relative silica percentage of the volcanic and plutonic phases vary.

At Macedon the plutonic rock is the more acid, so that the assumption is made that there was a considerable period, relatively between the extrusion of the dacite and the final solidification of the granodiorite.

At the Strathbogie Range only two analyses have been made, one of quartz porphyrite from near Violet Town, and the other of the plutonic type from near Trawool. The plutonic type has the lower silica percentage. The temperature of the volcanic phase at Strathbogie, at the time of extrusion, was lower than that of the Macedon dacite, and differentiation was further advanced. This is shown by the almost complete replacement of hypersthene by biotite, and the greater acidity of the Strathbogie rock.

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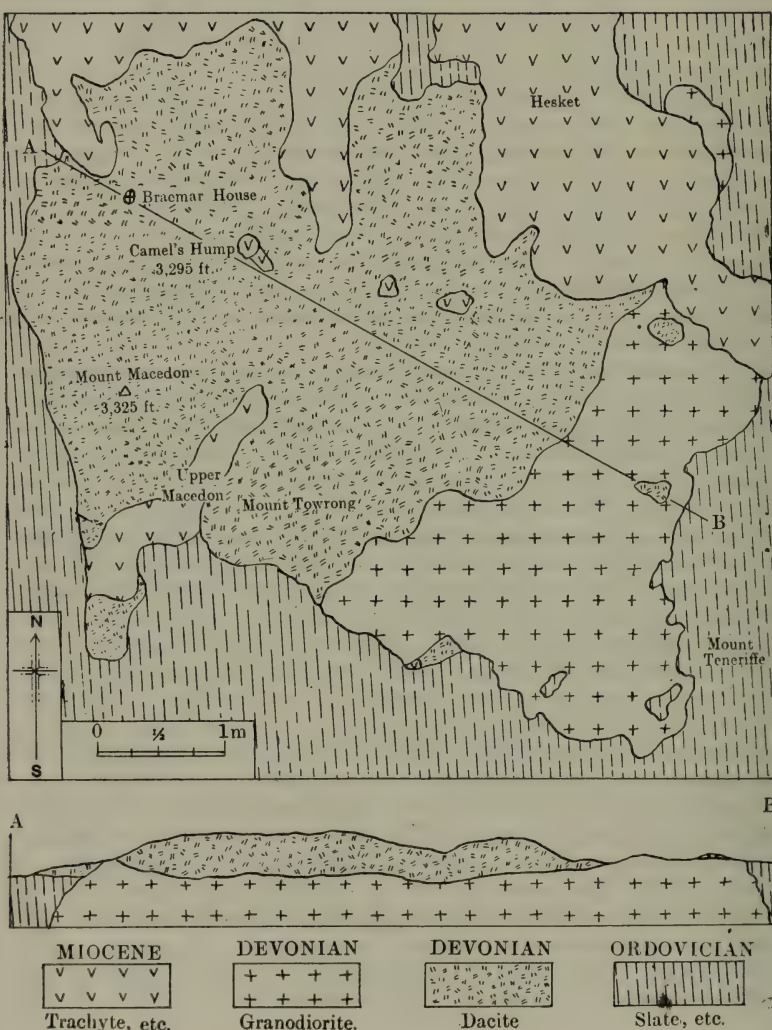
5. Bowen, W. L., Jour. of Geology, Vol. 23, No. 8, Supplement, 1915, and later papers.

After the extrusion the remaining magma would continue crystallising, but with a lower initial temperature than was the case in the Macedon area. Complete solidification would take place in a shorter period (other conditions being equal), so that the sinking of crystals ceased while the silica percentage of the plutonic type was below that of the extended rock.

The Mount Dandenong and Healesville areas are more complex as toscanites and rhyolites are associated with the normal dacites. No reliable analyses of the plutonic types in these areas have been published. Mr. M. Morris has been working out the relations in these areas, but has so far not published the results of his work, so that they cannot be discussed at present.



[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. II., 1923].

Art. XIII.—*Cylindrico-Conical and Cornute Stones.*

By GEORGE HORNE, M.D.

[Read 14th September, 1922].

About three hundred of these stones, which have been dealt with by various authors, exist in our Museums in Australia, and probably as many more may be found in private collections. They are roughly circular in section and taper to a blunt point, while the base is often cupped. Some are oval in section, and these are shorter in length, and are curved to one side, comprising the cornute type. The total length varies from three inches to thirty.

The districts in which they are found are well defined, comprising the country drained by the Darling on the East over to Lake Eyre on the West. This includes all the land of the Itchumundi, Karamundi and Barkinji, as described by Howitt,[1] over to the territory of the Lake Eyre tribes, which include the Yaurorka, Ngameni, Wonkonguru and Dieri tribes.

These stones are very variable in their composition. Some appear to have been shaped out of a mass of clay or kopi, as the gypsum is called, others are chipped out of slate or sandstone, but they may be laboriously worked out of felspar or quartzite.

As a rule the surface is smooth but in some distinct markings may be found. These may be divided into classes:—

1. The tally marks, as the short transverse markings have been named. They may be in groups of two or three up to great numbers, or they may be scattered all over the stone.
2. Longitudinal marks. These sometimes are made haphazard over the stone, or may be made singly or in pairs across the shorter tally marks, as if crossing them out or grouping them together.
3. So-called emu feet or broad arrow markings. These are in any direction and may be well cut or simply scratches.
4. Rings round the pointed end of the stones. These are not commonly found.
5 Indiscriminate markings would include the rare radiating grooves cut at the base of the stone, dints where the stone has been used as a hammer, and similar traces.

There have been at least five uses propounded for these stones:—

1. Pounders. This has been the use to which many of them have been put. When one considers the habits of the aborigines one can quite see how any hard broken fragment would be picked up for a hammer.
2. Tooth avulsion.

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1. Howitt. "Native Tribes of South East Australia."

3. It is said that they were used in the ceremonies for producing a better supply of food.
4. To mark the graves. This is undoubtedly true, but the same might be said of any other conspicuous stone, or of oval balls of *kopi.*
5. It has also been asserted that they are stuck into the ground with the base upwards, and that blood is dropped into the cupped base. I can, however, find no absolute proof that this is done. Etheridge, who has very thoroughly investigated their use, suggests they had a phallic significance.

Dr. Howitt, in his great treatise on the natives, never mentions these stones. Sir Baldwin Spencer, in dealing with them, says, "The evidence in all cases is very meagre, and inconclusive." The early settlers say, to quote Dr. Pulleine,[2] "The natives took no notice of them, neither using them, nor avoiding them in any way, and had no name for them."

Quoting Dr. Pulleine again, he says, "Mr. John Conrick, of Nappa merri, Cooper's Creek . . . . tells me that, although he has lived there since the early seventies, he has never seen them used, or noticed by natives, and that they are known there simply by the name of Moora."

From my own observations, and from those of Mr. Aiston, who is elder brother to the Wonkonguru people, East of Lake Eyre, we found them recognised by the old aborigines, but not at all by the younger men.

The old men would be from seventy to ninety years old. Their age is calculated by their status when McKinley first came to the district, and by their relative ages. Thus—"me boy, this one man"—when told by a seventy years old man makes the second one eighty. This old man when shown the stones, said "Kootchi, Kootchi, Moora," meaning that they were uncanny and belonged to the Moora.

A most interesting stone is the *Karamoola Yudika*, or circumcision stone. Mr. Aiston has one of these which is slightly broken at the lower end, but is not hollowed at the base. He also sent two to Melbourne. One of them is in two pieces, the other whole. They were all found on the sandhills near Kalamurinna. I showed this one that Mr. Aiston has to my old native friends "Koonkoo Nutaculli," and "Tarkarawikari." They each at once averted their eyes and with palms of hands raised and turned outwards, motioned me away with it saying, "Kootchi, Kootchi" (uncanny, uncanny). They stated "Moora use make'em man," but to Mr. Aiston they have each told the following story. He says:—

"They are supposed to be the *wonto* or penis turned to stone, of someone who died as the result of having been circumcised with a firestick. When the Moora's showed how the operation should be performed with a knife, they brought one each of these stones along. The foreskin was stretched over the point of the stone, which was held opposite to, and in prolongation of, the penis. The stone knife then cut around the end of the stone. After the operation was all

2. Pulleine, Trans. Roy. Soc., S. Aust. Vol. XLVI,, 1922,

over, the old man who did the cutting put the *karamoola yudika* under his arm and went away. He was supposed to lose it without knowing where it was dropped. I imagine that his arm tired, and he dropped it without particularly noticing where. If afterwards it was found, the finder covered it up and the place where it lay was carefully noted, so that when wanted again, it could be recovered. These stones were supposed never to be made by man.

"Later it was found that the operation could be performed without the use of the stone, so a small cylinder was employed. This was just held in front of the penis and in prolongation of it. Directly the foreskin was off the stone was dropped on the sand. This substitute was then lost in the same manner as the original. My informant was at great pains to convince me that the aborigines did not make them. The Moora made them, in the same way as he made fossil wood into stone. This old fellow," concludes Mr. Aiston, "nearly fainted when I showed him the *karamoola yudika*. He was horror-struck for the minute, and then told me the above."

At present even the short substitute stone is not used, but a piece of wood, conical in shape, and made like a spear point, is employed.

After the ceremony this is shown to the boy and its significance is explained.

One of the men from Cowarie on the Diamantina had left behind him, at a deserted camp, a box obtained from the homestead containing three *coorie toorooka*, or the mussel shells given to the initiate, a store of *munyeroo* seed, and, wrapt up in a bit of rag, a conical spear point stick. It was plastered thick with red ochre and fat, and it smelt. Evidently these were prepared for the ceremony which is to take place, when the Government bonus for wild dog pups is finished, and the tribe can gather again.

This report has some weak points. The cylindrico-conical stones are found most commonly in the valley of the Darling, and its tributaries.

Here, however, circumcision is unknown, and records of the uses above related are only to be found amongst those who still practise the rite.

There are, to account for this, stories of changes of place amongst various tribes. Thus the Wonkonguru say that they formerly lived north of the Diamantina, but were driven south by the Ngameni. They in their turn displaced the Dieri who now live south of Cooper's Creek.

Something similar may have been the lot of the Itchumundi, Karamundi and Barkinji, who pushed eastward from the Grey and the Barrier Ranges. On the other side of these mountains circumcision is still practised.

Both in weapons and in language there is a remarkable resemblance between those dwelling to the east and those to the west of these mountain ranges.

Take for instance the following list of works quoted from E. M. Curr, Australian Race, Vol. II., p. 168.

English.		Darling Language.	Lake Eyre Languages.		Locality.
mother	-	Ngamukka	Namika	-	Mt. Serle
water	-	Ngookoo	Nguka	-	Cooper's Creek
rain	-	Mukkra	Mukkra	-	Mt. Remarkable
kangaroo	-	Thurlda	Thuldra	-	Cooper's Creek, etc.
opossum	-	Bilta	Pilta	-	Widely spread
native companion	-	Kooroolko	Booralko	-	Cooper's Creek, etc.
one	-	Nitcha	Ninta	-	Macumba R.
mosquito	-	Koondee	Koontee	-	Cooper's Creek, etc.
ear	-	Uri	Uri	-	common
mouth	-	Yalla	Yalla	-	Umbertana
fire	-	Kulla	Kalla	-	Marachovie
boomerang	-	Wana	Wanna	-	Beltana
night	-	Tunka	Tinka	-	Cooper's Creek

Then again on both sides of the ranges we find that there are two exogamous intermarrying classes with female descent.[3]

These are bounded on the east and north by tribes with four classes; and on the west and north by those with four intermarrying groups and descent in the paternal line.[4]

The only thing that can be suggested is that a series of dry seasons, or some plague, drove away all the natives from the Darling Valley, from which they fled, leaving the cylindrico-conical stones. There is a tradition, quoted by Commissioner Lochardt,[5] that a second migration took place long ago, when one man with his two wives, Kilpara and Mukwara, occupied the empty country. These two wives gave class names to the Darling tribes,[6] and, judging by the language resemblances, their arrival could have been at no great date. That circumcision would not be practised amongst these immigrants would, as Curr suggests, be obvious, because the small party could not afford to lose any of its members and food for all was assured.

Bibliography.

1. Walter R. Harper, Proc. Linn. Soc., N.S.W. Vol. 23, 1898, pp. 420-436.
2. Dr. Cox, Proc. Linn. Soc., N.S.W., 25th June, 1884.
3. W. Freeman, Aust. Assoc. Adv. Sc. Vol. IX., 1902, p. 539.
4. R. H. Matthews, Aust. Assoc. Adv. Sc. Vol. XII., 1909, pp. 493-498.
5. R. Etheridge, Jun. Mem. Geolog. Surv., N.S.W., pp. 1-4.
6. Mrs. Rankin, Science of Man, Aboriginal grave at Terragon.
7. R. Pulleine, M.B., Ch.M., Trans. Roy. Soc., S.A. Vol. XLVI., 1922.

3. Howitt, loc. cit., p. 90.
4. Spencer and Gillen. "Northern Tribes of Central Australia." p. 74.
5. Curr., Australian Race, Vol II., Book 7.
6. Howitt, loc. cit. p. 97. Curr, loc. cit.

[PROC. ROY. SOC. VICTORIA, 35 (N.S.), PT. II., 1923).

ART. XIV.—*The Increasing Run-off from the Avoca River Basin (due apparently to Deforestation).*

BY E. T. QUAYLE, B.A.

(With one Text fig.)

[Read 9th November, 1922]

Some consideration has been given to this in a previous paper dealing with the Control of Climate by Human Agency. This, however, was very casual and depended mainly upon the writer's impressions, which are based upon recollections going as far back as 1870.

The chief points of interest are:—

1. The flooding of the river,
2. The duration of the flow each year,
3. The minimum flow each month,
4. The actual run-off.

These are obviously influenced by the changes wrought through our occupation of the drainage areas of the river, which dates back only for about 60 years. Such pastoral use as had been made of it for a few years previously was probably negligible in its effects.

Physiographic Changes.

The recent changes in the stream beds, which appear to have begun about 1880, have been most striking. Up till about that time large waterholes, many of which were 20 to 40 yards long, 10 to 15 yards wide, and 8 to 10 feet deep, were a feature of the streams, and occurred at very short intervals, usually of only a chain or two. The channels connecting these were almost always very shallow. One old resident of Amphitheatre, a lady, testified that she was able, in 1861, to step across the Avoca River, or Glenlogie Creek anywhere. For the next 30 years, or until the early 'nineties, the changes in the channels of the Avoca River, above the town of Avoca, and in its tributaries generally, were not particularly noticeable, but during the last decade or two have become very marked. The destruction by stock of the reeds and coarse grasses lining the channel, and the removal of logs and growing trees, have permitted the beginning of erosion, and this has lately become rapid. The effect is a double one. The aquatic grasses which often covered the beds of the smaller streams, and the coarse grasses and trees which lined the beds being destroyed, the cutting of the channel began. This gradually lowered the level of the water in the water holes, and now in most cases has almost completely drained them. When the flow is rapid, a fairly deep and uniform channel is eroded, but so far I have seen no serious lateral erosion. The rich, black soil flats are being deeply scored, but there has not been any great loss of area, although the deposition of masses of gravel and shingle in talus or delta fashion, where the streams emerge from the hills, or reach flatter country is damaging many rich pastures. Fords are difficult to maintain, and much bridge building is becoming necessary in order to keep up traffic. Another effect of this erosion becomes manifest wherever the streams reach flatter country. The sand resulting from this erosion, especially in granite country, is carried downwards into the waterholes, and is obliterating one after the other. So that, whether the river flow is rapid or slow, the waterholes have to disappear—either by draining or silting. From the angler's point of view, this is particularly sad, as these water holes once provided fine fishing. About Amphitheatre and Avoca, mining operations are popularly blamed for the silting, and no doubt these have had an appreciable effect, but the filling and draining of the water holes were inevitable in any case.

Clearing of the Forest Covering.

Above the junction of the Avoca, with its western tributary, the Amphitheatre or Glenlogie Creek, the area drained by the two systems is about 42 square miles, of which 23 square miles is drained by the Avoca River. Standing on the Sugarloaf, a peak about 1700 feet high between the two drainage areas, a good view of both is obtained. To the eastward lies the Avoca Valley, and to westward that of the Glenlogie Creek. The former was once the site of a large pastoral property, the Amphitheatre station. Though a true basin, and the country not very hilly, it does not seem suited for extensive cereal agriculture. There are, however, many flourishing apple orchards. It is a typical pastoral area, pleasant to look upon, and dotted over with well foliaged trees, mainly Eucalypts. These are apparently retained for shade purposes, and although unusually numerous for those, are not numerous enough to constitute forest. Most of the basin has been in its present state for perhaps 20 or 30 years, but within the last decade much clearing has been done on the slopes of Mt. Lonarch and Ben More, as well as on the Sugarloaf itself. On Mt. Lonarch the clearing is most noticeable, especially within the last five years, and amounts to perhaps two or three thousand acres.

Looking westward from the Sugarloaf over the Glenlogie Creek basin great alterations are apparent during the last five years, the forest country being now limited to a strip a mile or two in width running W.S.W., from the Amphitheatre township for about three miles along the southern side of the railway line, and it evidently will not be long before the firewood cutters will have cleared this area also. In that case the two basins will form one area practically cleared, except for the State forests, which cover the higher portions of the surrounding ranges, the Pyrenees to the north-westward, the Lonarch to the south, and Ben More to the east.

Effects upon the Permanence of the Streams.

It is common knowledge in that district that the clearing of the timber has most strikingly improved the summer flow of the streams, by increasing the activity and duration of the springs. It is within the writer's knowledge that the creek taking its rise in the granite hills south of "The Gap," the highest point on the road from Avoca to Ararat, and on the divide between the Avoca and Wimmera River basins, was, prior to 1881, dry for the greater part of each summer. Now it is a permanent stream, and even on April 19, 1922, was discharging perhaps five cubic feet per minute. The same applies to the Avoca and Glenlogie creeks at their junction below Amphitheatre, and both were running freely on the same date. It was of interest to note, too, that the two streams were there nearly equal, whereas prior to 1880 the Avoca was much the larger whether under flood or summer conditions. For this approach to equality, the cause is evidently the greater recent reduction in the forest covering of the Glenlogie Basin.

The deepening of the channels has had effects upon the extent of the flooding. According to Mr. Ennis, an Amphitheatre resident, the flats are now flooded less frequently and extensively than formerly. This is due in all probability to the increased channel capacity which also involves increased velocity. A proof of the latter was found by inspection of the Avoca branch, coarse sand and gravels generally being distributed very freely over the river flats and to an extent obviously very injurious to their pastoral usefulness. This was not the case formerly.

In response to my request, the Postmaster at Avoca submitted a number of queries to an old Avoca resident, Mr. Henry Brown, who kindly answered them very fully. His statements agreed very well with my impressions, except that he attributed the recent greater permanence of the river flow in summer to good spring rains and its occasional failures to the water carrying capacity of the underground drifts, which, if tested, he said, would show that the river never ceased flowing at all. Floods, he said, came down more rapidly than formerly, for which he blamed the silting up of the large waterholes by mining operations. Thousands of diggers had washed their dirt in the river, and the Golden Stream Gold Mining Coy. had run thousands of tons of "slum" from their puddlers into it. In places this slum in the bed of the river was 5 ft. thick. The floods were also heavier than previously, for which again he blamed the silting up by mining operations, causing lessened channel capacity. These siltings he also blamed for various changes in the course of the channel.

My observations of the changes in the country cover only a small part of the Avoca's drainage area, but it is probable that they apply with equal force to the whole area between the Avoca and the Pyrenees which provides the chief remainder of the effective drainage areas, or of a total of about 1000 square miles.

The flow of the Avoca River is officially measured by the State Rivers and Water Supply Commission at the Coonooer Weir, below which the river gains only negligible additions. These records began in June, 1889. This weir appears to be the only interference with the flow of the Avoca River, the waters of which have never been seriously used for irrigation. The basin is, therefore, very suitable for such a study as the present one.

Summer and Minimum Flow Improving.

Inspection of the data published by the Water Commission shows a remarkable change in the constancy of the flow of the river. If we compare the records for the twenty years, 1890-1909 inclusive, with those for the ten years, 1910-1919, we find that in the former period the river actually had no flow or ceased to run in 79 months; that it, there were 79 months during the whole or a part of which there was no discharge at Coonooer Weir, or at all events nothing more than the leakage which does not exceed one-sixth of a cubic foot per second. During the decade 1910-19, the river has never ceased to flow, nor has it done so up to the end of 1921. A comparison of the two great drought years, 1902 and 1914, is equally instructive. Though the latter was the more severe the river flow never fell below 5 cubic feet per second, whereas in 1902 there were seven months during which the river never ran at all.

The following table shows the average minimum flow in cubic feet per second for all months for the twenty years, 1890-1909, and for the ten years, 1910-1919:—

	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Avg
1890–1909.	1·4	0·65	1·0	1·2	1·8	7·3	16·1	24·7	18·1	10·7	6·0	3·0	7·6
1910-1919.	8·3	7·5	8·7	8·6	8·6	8·8	30·8	29·3	33·5	27·2	15·3	9·1	16·3

This shows that during the summer half of the year, November-April, the average minimum is now from *two to ten times* as great as formerly, and is also considerably greater during the winter half. That this is not due to any marked increase in the frequency of flood rains is shown from the records of Amphitheàtre, Avoca, Stuart Mill, Emu and St. Arnaud. Taking all the occasions when the mean of the daily rainfalls at these stations has equalled or exceeded 50 points, or for two consecutive days 75 points, we get the following:—

	Jan.	Feb.	Mch.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1890–1909	6	5	13	16	16	26	16	10	10	10	9	8	145
1910–1919	2	8	7	4	9	12	10	7	11	5	3	7	85

Here the total "flood falls" for the summer halves are 57 for the former and 31 for the latter, and for the winter halves 88 and 54, showing clearly enough that it is not to any special increase in the number of heavy rains the increased minimum flow of the river is due.

The Floods on the Avoca.

To estimate with any degree of accuracy the maximum volume of flood water likely to follow upon any rainfall seems almost impossible. We should need to know not only the amount of the rain for the day, but its intensities from hour to hour, the distribution in time and place of the heaviest showers, the degree of saturation of the soil, the amount of grass covering it, as well as the state of the river. Present data will not allow of these being weighed. Some generalised results may, however, be valuable.

As before mentioned, Amphitheatre, Avoca, Stuart Mill, Emu and St. Arnaud were the stations selected by me to provide the necessary daily rainfall data. These covered the effective drainage area very well. The rains necessary for flooding were reckoned, those of 50 points or more for one day, and 75 points or over for two days' rain. In the diagram these are shown graphically in spaces allotted for each month since 1889 along with the greatest volume in cubic feet per second, passing over the weir during each month.

During the 32 years with available records, the heaviest flood was in August, 1909, with probably well over 5000 c.ft. per second. Next came that of September, 1916, which was put at 5000 c.ft. Floods of 4000 c.ft. per second or over were reached in May, and in June, 1892, in September and October, 1893, in January, 1897, in March, 1910, in September, 1912, in September 1915, and in September, 1921.

The time distribution of all floods was as follows:—

c. ft. per sec.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Over 5000	—	—	—	—	—	—	—	1	1	—	—	—
4000–5000	1	—	1	—	1	1	—	1	5	1	—	—
3000–4000	—	1	—	—	2	6	3	5	11	2	2	—
2000–3000	—	—	—	1	—	6	4	3	1	—	—	—
1000–2000	—	—	—	—	1	1	7	8	3	4	2	—
	1	1	1	1	4	14	14	18	21	7	4	0

(1000 c.ft. per second would be given approximately by a stream 100 yds. wide and 1 ft. deep, flowing at a rate of 2 miles per hour.)

According to these figures floods are extremely unlikely to occur in the summer months, and they reach their maximum frequency and intensity in August and September.

The importance of the degree of soil saturation is made very obvious by the fact that the heaviest flood falls have not occurred in these months. The greatest of these was in March, 1910, when the mean for two days was 5¼ inches. The flood of January, 1897, was due to a fall of over 4 inches in one day. In February, 1911, a three-day fall gave 436 points. In April, 1890, 313 points fell on one day. In May, 1893, a fairly even five-day fall gave 5·inches. In July, 1903, 320 points fell in two days. The great flood of August, 1909, was due to a series of thunderstorms giving a total fall of 3½ inches in about 19 hours, with its heaviest downpours during the last hour over the head streams. The great flood of September, 1916, was due to 260 points falling in two days.

For the whole 32 years, 1890-1921, the number of rainfalls with flood possibilities (over 50 points for one day or 75 for two) were as follow:—January 9, February 13, March 20, April 20, May 27, June 43, July 28, August 21, September 25, October 15, November 14, December 15. These are very different from the actual numbers of floods occurring these months, except in August and September.

Flood Volumes Increasing.

Owing mainly to the variability in the dates on which the winter rains may be said to have begun, and the soil to become well moistened, the only months which show any approach to consistency in the relation between the rainfalls and resulting floods are July, August, and September. Taking an average of all the rains with flood possibilities, we get the following results for the earlier and later periods:—

—	July.			August.			September.		
	No.	Average Rainfall	Flood in cusecs.	No.	Average Rainfall	Flood in cusecs.	No.	Average Rainfall	Flood in cusecs.
1890–1909 - - -	13	103	1444	11	116	2135	10	114	1766
1910–1921 - - -	10	93	1641	9	110	2092	14	149	3564

So far as these results go, they show an improved run-off during the later period.

Flood Rains and Flood Volumes.

As already remarked, the run-off after any particular rainfall varies enormously and can only be guessed at with any probability of success when other conditions are known. For example, it is only the very exceptional rainfall which will cause serious flooding of the river during the six summer months, November to April. November can only show three floods in 32 years, a rainfall of 194 points, giving 3600 c.ft. in 1893, a rainfall of 277 points, giving 3850 c.ft. in 1903, and a rainfall of 166 points, giving 1900 c.ft. in 1906. In December there have been no floods. In January only one, a 411 points rain in one day, in 1897, giving a flood of 4100 c.ft., in February only one, a three-day fall of 430 points giving a flood of 3850 c.ft. in 1911; in March only one, a three-day fall of 552 points, giving a flood of 4000 c.ft. in 1910; in April only one, a fall of 313 points in 1890, giving a flood of 3500 c.ft. The comparative rareity of floods in May and October is probably also due to the liability of the soil to be dry in those months. In the case of the former, because the dry season is usually scarcely over; in the case of the latter, because growing vegetation is making great demands upon the soil moisture, as well as obstructing the flow of water down the slopes of the drainage area.

Flood Prediction.

As the months of June, July, August and September are obviously the flood months, it may be worth while giving in tabular form some average results based upon the whole 32 years' record. All Junes and Julys preceded by months with less than 2 inches of rain are excluded. The flood rains are grouped as follow:—under 1 inch, from 1 inch to 149 points, from 150 points upwards. While the variation is great for all months, that for June is particularly so.

Month.	Rainfalls under 100 points.			Rainfalls of 100 to 149 points.			Rainfalls of 150 points and over.		
	Average amount.	No.	Flood volume in cusecs.	Average amount.	No.	Flood volumes in cusecs.	Average amount.	No.	Flood volumes in cusecs.
June - -	76 pts.	6	600	126 pts.	6	2190	170 pts.	6	2500
July - -	80 pts.	12	1400	129 pts.	5	1870	235 pts.	2	3600
August -	83 pts.	8	1740	122 pts.	6	2340	230 pts.	3	3970
Sept. -	87 pts.	7	1460	125 pts.	7	3160	196 pts.	9	3590

Annual Run-off Increasing.

That the volume as well as constancy of the flow of the Avoca River over the Coonooer Weir is increasing greatly is shown decisively by the official gaugings. As previously remarked, so many factors powerfully affect the run-off that unless the chief of these are known it is hopeless to attempt to estimate the flood height from any particular rainfall. But by taking a sufficiently long period it may be assumed that average results will provide data for reasonably reliable deductions. The official guagings cover 32 years. These provide three decades, exclusive of the years 1920 and 1921. The first of these, 1890-1899, was the wettest, giving an average of 20·1 inches annual rainfall, and an average annual run-off of 59,278 acre feet. The next decade had an average rainfall of 19·4 inches, and a run-off of 44,230 acre feet. The last decade 1910-1919, had a rainfall of 19:5 inches, and a run-off of 74,439 acre feet. Taking a mean of the first two, we get an average run-off of 51,700 acre feet for a rainfall of 19:7 inches. As the average rainfall for the last decade was 0:2 inches less, and the average run-off 22,700 acre feet more, there seems no reason to doubt that the run-off is increasing. This is made even more emphatic by taking in the years 1920 and 1921, with rainfalls of 19 and 22 inches respectively, and run-off totals of 94,909 and 93,155 acre feet. These make for the last 12 years the average run-off 77,700 acre feet, for an average rainfall of 19:7 inches. The rainfall therefore averages out the same as for the previous 20 years, but the run-off has increased by 26,000 acre feet, or by over 50 per cent. (The rainfall data here used are those published by the Water Commission.)

The improvement in the run-off may be made more obvious perhaps if we limit the comparison periods to the winter months and begin each flood season only with those months prior to which sufficient rain has fallen to make the soil fairly moist. This will require, say, two inches of rain during the preceding month. This means that the period will rarely begin before May and will end not later than October. Adopting this procedure and using the rainfall data from the five stations selected by myself, which are slightly wetter than the average for the basin, the following results were obtained.

The years 1890 to 1909, omitting the great drought year, 1902, gave a total of 102 months with an average rainfall of 2:53 inches, and average mean monthly river flow, of 152 c.ft. per second. The years 1910 to 1921, omitting the drought years 1914 and 1919, gave 50 months, with an average rainfall of 2:75 inches, and average river flow of 270 c.ft. per second. That is, unless the run-off has improved, an increase of 22 points in the rainfall gives an increased run-off of 118 c.ft. per second, or a 10 per cent. rainfall increase means a 60 per cent. run-off increase, which seems hardly possible.

In order to get a series of earlier years with approximately the same rainfall as that of the later series, it will be necessary to reject, in addition to 1902, the rather dry years, 1895, 1896, 1897, 1899, 1904, and 1907. The remaining 13 years give an average monthly rainfall of 273 points, and an average mean river flow of 187 c.ft. per second. Therefore, for practically the same rainfall we get an increase in the run-off of nearly 45 per cent.

The very wet months in these periods, or of over 4 inches, were as follow:—

1890, June, 431 pts.	1909, August, 695 pts.
1893, May, 660; June, 485 pts.	1911, September, 406 pts.
1894. October, 605 pts.	1912, September, 536 pts.
1898, June, 520 pts.	1915, Sept., 547; June, 419 pts.
1899, June, 456 pts.	1916, June, 410; Sept., 457 pts.
1900, August, 403 pts.	1920, August, 505 pts.
1906, May, 448; June, 438 pts.	1921, September, 44 pts.
1903, July, 481, and Sept., 409 pts.	

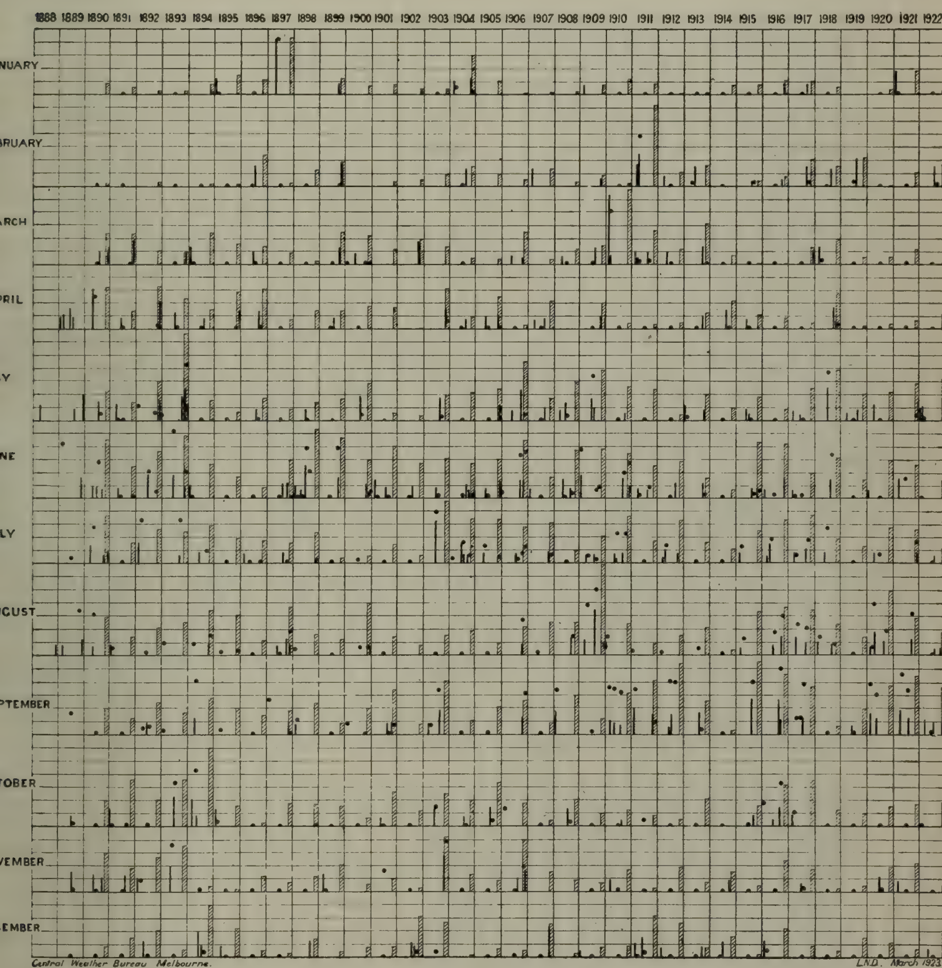
This gives 12 for the 20 earlier years, with an average of 503 pts., and 8 for the later 12-year period, averaging 466 pts.; which rather favours the earlier period as regards flood possibilities.

This 45 or 50 per cent. gain may be apportioned to the two main sources of increased flow, (a) the amount gained by springs from the destruction of the trees, and given to maintain a constant flow; (b) the increased run-off due to the better drainage resulting from erosion of channels, silting up of water holes, formation of paths by stock, moister condition of subsoil, quicker saturation of the subsoil due to killing of the trees, the raising of the water table, etc. It has already been shown that the former results in an average increased minimum flow of 8:7 c.ft. per second. This gives for one year, 6300 acre feet. That leaves, therefore, as the gain due to the second group of causes about 20,000 acre feet.

All the information available goes to show that the changes described for the Avoca River basin are common to all our inland drainages. If so, the results must be of the utmost importance. Our inland water supplies may be increased greatly, and if properly utilised may produce effects, climatic included, beneficial beyond anything we have yet ventured to anticipate.

The bearing of this upon the filling of our inland lakes, such as Torrens and Frome, and the resulting climatic improvement is obvious.

Graph showing for the Avoca River basin: (a) the flood rains; (b) the resulting flood volumes; (c) the total rainfall for the month.



Each vertical space represents, in the case of rainfall, one inch; in the case of flood volume, 1000 cubic feet per second. The rainfalls are indicated by vertical lines and hatched columns, the flood height by the position on the vertical scale of the round dots. For (a) and (b) the dates of occurrence are indicated by their position on the horizontal scale.

[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. II., 1923.]

Art. XV.—*Additions to the Australian Ascomycetes. No. I.*

By ETHEL McLENNAN, D.Sc., and ISABEL COOKSON, B.Sc.

(With Plates IX., X., and 1 Text Figure.)

[Read 9th November, 1922.]

This paper contains an account of several new Victorian Ascomycetes. The Australian forms of this group have so far not received very much attention from botanists, and although several fungal papers have appeared, these deal mainly with the Basidiomycetes of this country. Cooke, in the introduction to his "Handbook of Australian Fungi," remarks on the small number of Discomycetes and Pyrenomycetes recorded for Australia, as compared with other countries. The authors hope from time to time to record and describe new members of these groups in a series of papers under the above heading.

I.—Sphaerosoma alveolatum, sp. nov. (Plate IX.).

Corpore fructigero cervicaliaceo, colore modo atro-fusco modo nigro, ·5-1 cm. diam. sessili. Hymenio perperidium limitato. Ascis cylindricis 40μ diam. cum iodino caeruleis. Sporis octo globularibus subfuscis, alveolatis 34-36μ diam. Paraphysibus clavatis subinde ramulatis.

Fruiting body cushion-like between fleshy and cartilaginous, dark brown to black, viscid, 0.5-1 cm. in diam., and from 1.5-2 mm. high, sessile, with a broad attaching base, hymenium limited by a peridium, internally dark, pseudoparenchymatic. Asci cylindrical, clavate, 40μ diam., and 300-400μ long, blue with iodine, operculate. Spores 8 globular, light brown, uniseriate, irregularly alveolate, 34-36μ diam., 26-28μ without the wing. Paraphyses not exceeding the ripe asci, clavate, septate, often branched.

On open clayey or sandy soil, near Castlemaine, Vic., and at Ringwood, near Melbourne, Vic. (I. Cookson). August and September, 1921.

The plants are mostly scattered, varying in size, with a broad basal attachment, and are not easily detached from the substratum. They are usually rounded in outline, occasionally slightly lobed, the convex upper surface giving to the plant a cushion-like appearance; this surface is nearly always smooth, but sometimes it is slightly convolute. Plants are dark coloured, even when young, and almost black in the adult condition; when moist they are viscid and shining. Internally they are also dark coloured; the hymenium does not cover the entire outer surface of the plant, but is bounded at its extremities by a distinct peridium [Plate IX., figs. 2 and 3 (p)]; it is composed of large cylindrical asci and numerous paraphyses.

The asci when young contain the ascospores grouped towards the distal end of the ascus in a biseriate fashion [Plate IX., fig. 3 (s)], as they become mature the spores are arranged in a monostichous manner, they are 8 in number, globular, and alveolate in character [Plate IX., figs. 4, 7], light brown at maturity and 34-36μ in diameter. The asci turn blue with iodine, and are distinctly operculate.

The paraphyses do not extend beyond the asci to any extent in the ripe specimens; they are septate, swollen towards the apex, very often branched, the two branches being equal [Plate IX., fig. 5], when old they become brown at their apices and tend to shrivel.

The sterile portion of the receptacle is composed of large pseudoparenchymatous cells without a well marked hypothecium, the extension of this sterile tissue in the form of a peridium can be seen macroscopically, when fruiting bodies are cut in vertical section [Plate IX., fig. 2].

The genus *Sphaerosoma* was founded by Klotzsch (1) in 1893, and it has been the subject of much discussion. Uncertainty as to the exact characters of the type species *Sphaerosoma fuscescens*, Klotzsch, collected in the Grunewald, and also in the Botanical Gardens near Berlin, led to many conflicting statements, and as a consequence much confusion existed in regard to the members of the genus. In 1909, Rouppert (2) published a revision of the genus *Sphaerosoma*, and this was followed in 1910 by an exhaustive account of the genus by Setchell (3). This paper includes the principal references to the genus and its various species, so that it is unnecessary to deal with these in detail here.

As Setchell points out, Klotzsch figures his type specimen as possessing echinulate spores, but describes them as verrucose in character. Later Corda (4) and Zobel (5) figured this species with tuberculate spores. As no type specimen had been preserved, much confusion naturally arose. Setchell, after examining material of all the species be could secure, and considering all the points in this mass of conflicting ideas, states that "the weight of probability can hardly prevail against the really convincing figures and description of Klotzsch."[1] He therefore regards the echinate spore as characteristic of the type, and considers that *S. Janczewskianum*, Rouppert, is probably identical with *S. fuscescens*, Klotzsch, as the spines on the spores are short, rather than with *S. echinulatum*, as the spines on the spores of the European (Rehm and Rouppert) and American (Seaver) form of this latter species are longer and stouter.

Setchell in comparing these echinulate-spored forms with others described under the genus *Sphaerosoma*, shows that in addition to their spore marking they are characterised by the possession of a distinct peridium. In a young form of *S. echinulatum*, Seaver, the

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1. The writers are cognisant of a paper "Observations on *Sphaerosoma* and allied genera," by J. F. Seaver (6), but follow Setchell (loc. cit.) in preferring to accept Klotzsch's figure as expressing the characters of the type in the absence of an authentic type specimen.

hymenium was almost completely surrounded by the peridium; for this reason he suggests that these forms do not belong to the Helvellineae, but should probably be regarded as members of the Pezizineae, and restricts the genus *Sphaerosoma* to them. The reticulate-spored forms known at this time did not agree in this respect, and Setchell considers them to belong more properly with the Helvellineae as the hymenium covers the entire outer surface,[2] and to fall into the genus *Ruhlandiella*, Hennings.

The genus *Sphaerosoma* then, according to Setchell, contained 2, or perhaps 3, species:—

1. *S. fuscescens*, Klotzsch, identical with *S. Janczewskiana*, Rouppert.
2. *S. echinulatum*, including *S. echinulatum*, Seaver, the American form, and *S. echinulatum*, Rehm and Rouppert, the European form.

These members agree in possessing a peridium and having echinulate spores. The Australian specimens (*S. alveolatum*) should undoubtedly be included in this genus, they resemble the known forms in their structure, but as they possess reticulated or alveolated spores they illustrate another species of *Sphaerosoma*. The echinate spore marking cannot therefore be regarded as a generic character, and Setchell's idea of the genus as restricted to echinate-spored forms must in consequence be enlarged.

This is the first record of the genus for Victoria. Rodway (8) has recently published a form under the name *S. tasmanica*, Rod., which, however, shows no affinities with *S. alveolatum*, McL. & C. His plant is described as "hollow, closed or opening on one side towards the base, the hymenium lining the internal surface," and, as possessing elliptic spores. These characters differ so widely from the accepted limitations of the genus as to probably exclude from it this Tasmanian form.

LAMPROSPORA AREOLATA, Seaver, var. australis, var. nov.

(Text figure I.).

Plantis 1-3 mm. diam. Hymenio aurantiaco, margine in morem institae exstanti circumdato. Ascis 20-22μ diam., cylindricis. Sporis globosis reticulatis. Areolis 2μ, altispora tota 18-20μ diam. Paraphysibus simplicibus, clavatis 4-6μ diam., granulorum aurantiacorum, refertis.

Plants gregarious but not crowded, 1-3 mm. diam., at first closed, globose, later expanding, hymenium bright orange-red plane, or slightly convex, at first smooth, later roughened by protruding asci, finally spongelike, surrounded by a raised frill-like margin. Asci 20-22μ diam., cylindric, operculate, tapering at the base into a curved pedicel. Spores uniseriate, globose, at first smooth, later the wall becoming reticulate, reticulations 3-6 sided, sides being equal or unequal, areolae

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2. See Setchell (loc. cit.), Pl. 15, figs. 1 and 2, and Hennings (7) text figs. 2 and 3.

2 μ deep, and ridges 1μ thick, entire spore 18-20μ diameter; paraphyses simple, septate, clavate, 4-6μ diam. at tip, and filled with orange granules.

On the ground in open places or in moss, near Castlemaine, Vic., and at Ringwood, near Melbourne, Vic. (E. McLennan), August and September, 1921.

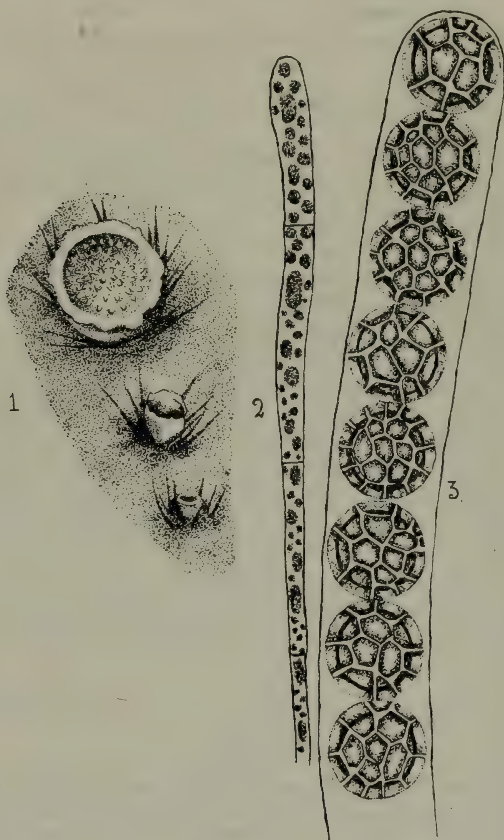


Fig. 1.

1. Plants of **Lamprospora areolata,** Seaver, var. Australis, var. nov.
2. Paraphysis · × 750.
3. Portion of ascus × 750.

The plate above described very closely resembles the form *L. areolata*, Seaver (9 and 10), both in the size of the spore and the nature of the spore marking. It, however, differs in its size, and in the possession of a well-marked fringe at the margin of the apothecium [Text fig. I., fig.I.] such a structure being entirely absent in the latter species. The differences, however, appears to be varietal rather than specific in character, and lead us to regard the Australian representatives of this species as a variety of the American type.

LAMPROSPORA TUBERCULATA, Seaver

Ringwood and Castlemaine, Victoria, E. McLennan, September and October, 1921.

This form is recorded here as new for Victoria, and the plants examined coincide exactly with the description given by Seaver (9 and 10) of the American form. All their characters closely resemble those of a Tasmanian plant *Barlaea verrucosa*, Rod. (11) and it is probable that they are identical since Seaver regards the genus *Lamprospora* as embracing forms described under the generic name *Barlaea* [Sacc] and is defined by him as including "the smaller plants of the globose-spored type of operculate Discomycetes, except those which are commonly placed with the *Ascobolaceae*."

L. tuberculata, Seaver, and *L. areolata*, Seaver, var. *australis*, McL. and C., occur in the same localities, and close to one another. In the field they are quite indistinguishable, their external appearance being identical; it is only after microscopic examination reveals the spore characters that we are able to distinguish the two forms.

IV.—CORDYCEPS FURCATA, sp. nov. (Plate X.).

Stromate simplici, stipite trifido. Aerio stipite brevi rubro-fusco transverse fasciato, 6 mm. longo, 2·5 mm. lato, in tres pares et breviores ramulos sursum diviso, qui capitula fertilia gerunt. Capitulo clavato ovoideo rubro fusco 4-5 mm. longo, 2·5 mm. lato, in rostellum sterile desinenti. Peritheciis penitus immersis. Ascis linearibus, capitatis. Sporis octo, filiformibus, hyalinis in segmenta baculiformia 8-10 μ longa, 2 μ lata se dividentibus.

Stroma single, entomogenous, stem trifid, continued below the surface of the ground as a root-like structure, 1·7 cm. long, and tapering from 2·5-1 cm. in breadth.

Aerial stem short, stout, red-brown transversly banded owing to the disruption of the outer layer at intervals, and the exposure of the more colourless tissue below, [Plate X., fig. 2] 6 mm. long and 2·5 mm. broad, dividing above into 3 equal, shorter, and more slender branches, each 2·5 mm. long, and 1·5 mm. broad, and bearing a fertile capitulum. Capitulum clavate-ovoid, red-brown, 4-5 mm. long, and 2·5 mm. broad, very faintly punctate with the dark-brown ostiola of the perithecia, terminating in a small sterile, beak-like prolongation, darker brown than the capitulum and 1 mm. long, by ·5 mm. broad.

Perithecia flask-shaped, deeply immersed in the tissue of the stroma [Plate X., fig. 3 & 4], 460-500 μ long, and about 135 μ broad, each opening to the exterior by an ostiole visible with slight-magnification as a dark brown circular area on the red-brown surface of the capitulum. Asci linear capitate, 6·5-8 μ broad, Spores 8 filiform soon dividing into numerous rod-like segments, 8-10 μ long, and 2 μ broad, hyaline.

On an undetermined larva at Ringwood, near Melbourne, Vic. (E. McLennan & I. Cookson). September, 1922.

We desire to record our appreciation of assistance given to us by Mr. Laidlaw, B.Sc., Government Botanist and Biologist to the Agricultural Department, who placed the libraries of the National Herbarium and Department of Agriculture (Science Branch) at our disposal, and to Mr. C. C. Brittlebank, Vegetable Pathologist, for his very material assistance and interest in our work.

REFERENCES.

(1) Klotzsch, J. F., *Sphaerosoma fuscescens*, Kl. Flora Regni Borussici, 1839.

(2) Rouppert, C. Revision du genre *Sphaerosoma*. Bull. Internat. de l'Acad. Sci. Cracovie, 1908.

(3) Setchell, W. A. The genus *Sphaerosoma*. Univ. of California Publications in Botany, Vol. IV., 1910.

(4) Corda, A. C. J. Icones Fungorum, Bd. V., 1842.

(5) Zobel, J. B. In Corda, Icones Fungorum, Bd. VI., 1854.

(6) Seaver, F. J. Observations on *Sphaerosoma* and allied genera. Mycologia, vol. VI., 1914.

(7) Hennings, P. *Ruhlandiella berolinensis*, P. Henn. gen. nov. et sp. nov. Hedwigia, Bd. 42, 1903.

(8) Rodway, L. Notes and additions to the fungus flora of Tasmania. Proc. Roy. Soc. of Tasmania, 1919.

(9) Seaver, F. J. The genus *Lamprospora*, with descriptions of two new species. Mycologia 4, No. 2, 1912.

(10) Seaver, F. J. A preliminary study of the genus *Lamprospora*. Mycologia VI., No. 1, 1914.

(11) Rodway, L. Additions to the Fungus Flora of Tasmania, Part III. Proc. Roy. Soc. of Tasmania, 1920.

EXPLANATION OF PLATES.

Detailed drawings have been made with the aid of the camera lucida.

PLATE IX.

Fig. 1. Plants of *Sphaerosoma alveolatum*, sp. nov. × 4.

Fig. 2. Diagrammatic representation of plant in vertical section. p., peridium; h., hymenium; b., broad basal attachment, × 8.

Fig. 3. Longitudinal section through outer portion of young plant. s., spores. × 103.

Fig. 4. Portion of an ascus, showing spores. × 375.

Fig. 5. Paraphyses. × 375.

Fig. 6. Operculate ascus. × 375.

Fig. 7. Mature spore: × 1125.

PLATE X.

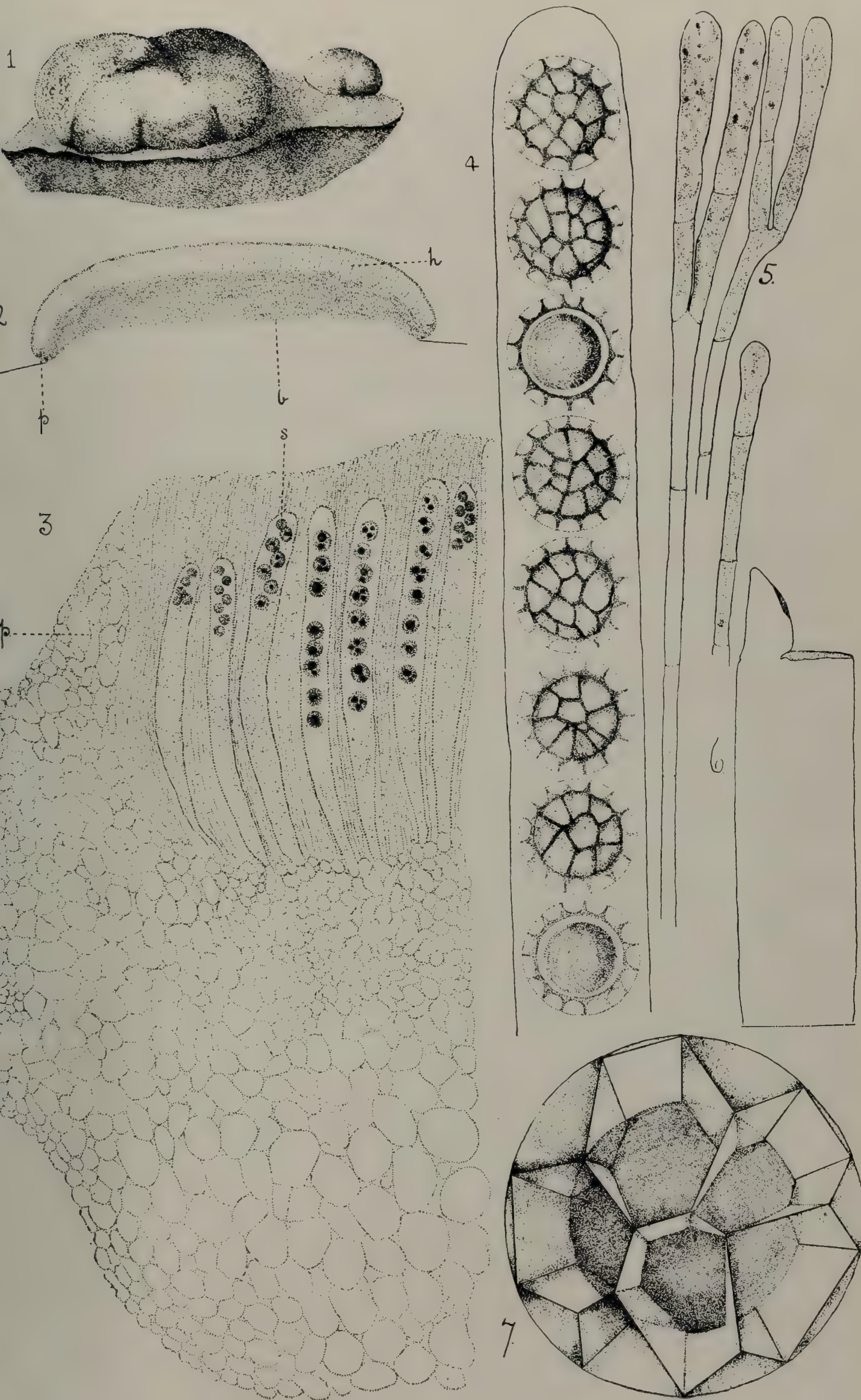
Fig. 1. *Cordyceps furcata*, natural size. g., ground level.

Fig. 2. *Cordyceps furcata*, × 4. g., ground level.

Fig. 3. Longitudinal section through upper portion of capitulum, a., sterile apex. b., ostiole of perithecium. × 23.

Fig. 4. Single perithecium, with asci × 375.

Fig. 5. Portion of ascus. × 750.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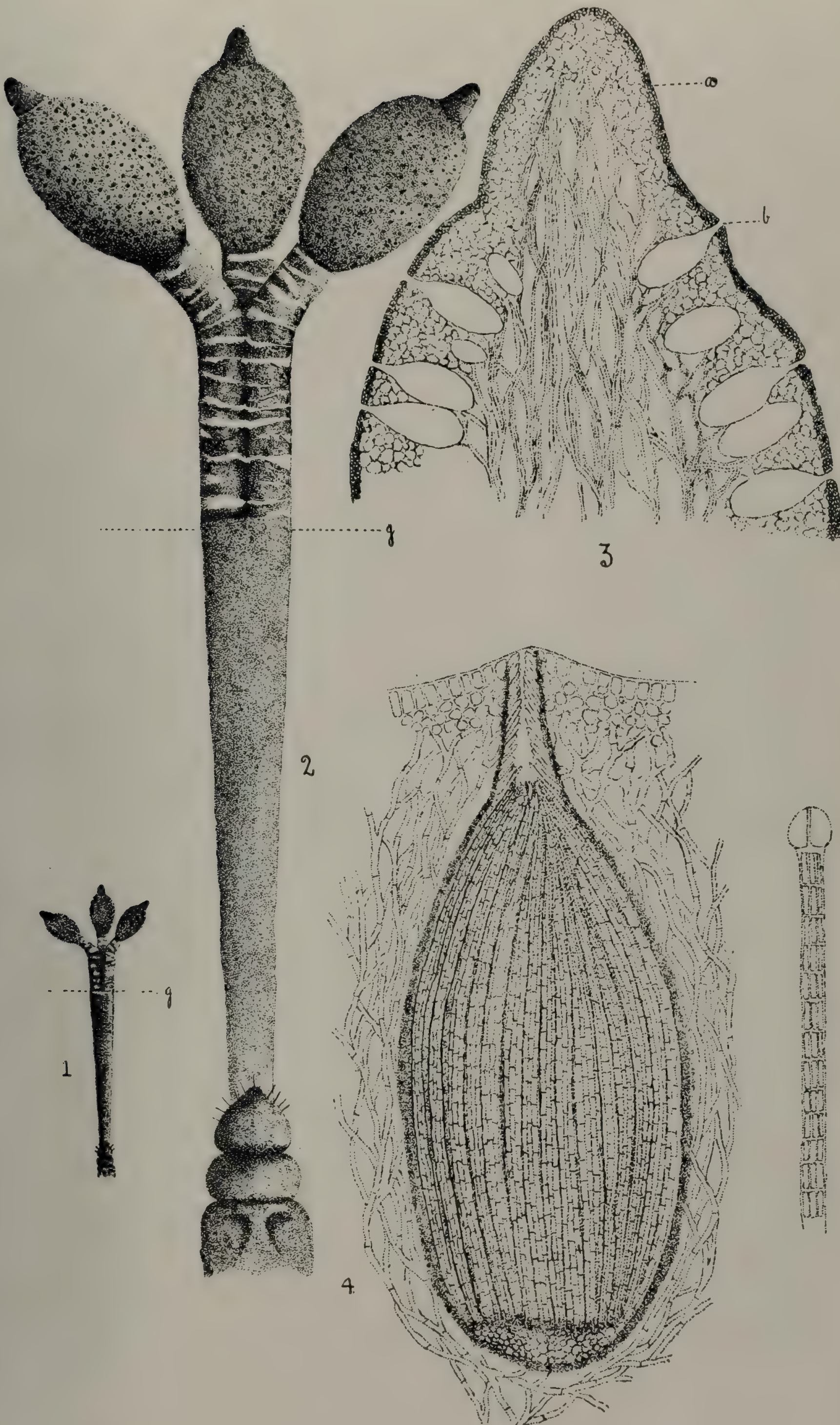
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[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. II.. 1923.]

Art. XVI.—*The Specific Identity of Bacillus parabotulinus.*

By H. R. SEDDON, D.V.Sc.
Veterinary Institute, University of Melbourne.

(Communicated by Professor H. A. Woodruff.)

[Read 9th November, 1922.]

Introduction.

In a previous paper the author[1] has given an account of an anaerobic toxin-forming bacillus, which, whilst resembling *B. botulinus*, very closely in certain respects, yet presented certain characters which were deemed sufficient to warrant the organism being regarded as a distinct species, and the name *B. parabotulinus* was therefore proposed for it.

This organism, *B. parabotulinus*, was recovered from bone of an animal that had died of what, in Tasmania, is locally termed Midland Cattle Disease, but the condition commonly occurs also in at least three States of the mainland of Australia. The condition, further, seems to be identical with Lamziekte of South Africa.

A study of *B. parabotulinus* showed that the administration of bacteria-free filtrates of cultures was followed by the same symptoms as those seen in natural cases of the disease, and the organism was therefore considered to be concerned in the etiology of the condition.

On account of the fact that the symptoms induced are those of progressive bulbar paralysis, the condition was described under the title of Toxic Bulbar Paralysis as it was felt that the geographical and other names used in Australia do not convey a meaning expressive of either the cause or the nature of the condition.

It was shown also that in the horse the administration of toxic filtrates of *B. parabotulinus* lead to symptoms identical with those due to botulinus toxin, whether from human or equine sources, and as Forage Poisoning (Cerebro-spinal Meningitis, so-called) in horse has been shown by several workers in America to be due to Botulism, it would seem possible that there are at least three organisms capable of causing Forage Poisoning in Horses, viz., *B. botulinus*, Types A. and B., and *B. parabotulinus.*

Cases of Bulbar Paralysis in both horses and cattle are of not infrequent occurrence in Australia, but, so far as the horse is concerned, no toxicogenic bacilli have as yet been recovered from suspected fodder. In the case of two outbreaks, however, tests of the blood serum from chronic or recovered cases have indicated the presence of specific antitoxins therein. These were from two widely separated outbreaks, and in the one case it would appear that *B. botulinus* Type A. was responsible, in the other case Type B.

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1. Journal of Comparative Pathology and Therapeutics, Vol. 35, 1922, part 3. p. 147.

In the case of cattle, it would appear that *B. parabotulinus* is the common cause and not *B. botulinus*, for though the toxin of this latter organism is capable of inducing symptoms of Bulbar Paralysis, it has been shown by Hart and Hayes[2] that the ox is relatively insusceptible, the administration of massive doses of toxin being necessary to cause symptoms.

In order therefore to determine definitely the relationship of *B. parabotulinus* to *B. botulinus*, investigations have been continued and the results of toxin-antitoxin tests are given below, together with a short summary of the other points of difference between these two organisms.

Comparison of B. botulinus (Types A and B) and B. parabotulinus.

(a) Morphological and cultural characters.

In the earlier paper it was pointed out that while the two types of *B. botulinus* were identical morphologically and culturally (as is well known), *B. parabotulinus* showed certain differences in that (1) it was distinctly larger, (2) it formed a wholly branched colony in solid media, and (3) it failed to show gas formation in glucose media. It was upon these grounds that the organism isolated here was differentiated from *B. botulinus.*

(b) Toxin formation.

As is well-known, Types A. and B. of *B. botulinus*, both produce powerful toxins, and these toxins are identical in that they both give rise to the same symptoms, but, as has been pointed out by Graham[3] whereas Type A is highly fatal for chickens (in which it induces Limberneck), Type B. toxin is not. Further it was pointed out many years ago by Leuchs, and has been confirmed by others, that the anti-toxin to one type does not protect against the toxin of the other type, and vice versa.

The bacteria-free filtrates of cultures of *B. parabotulinus* likewise induce symptoms identical with those due to botulinus toxin, and, though exact determinations of relative susceptibility have not been made, it has further been shown that cattle and horses possess much the same susceptibility to these filtrates of *B. parabotulinus* (whereas Hart and Hayes[4] have shown that such is not the case with botulinus toxin). The administration of parabotulinus filtrates to chickens in such experiments as have been as yet performed, indicates their behaviour to be similar to that of the toxin of Type B. *B. botulinus.*

Further work has led to the production of much more powerful filtrates of *B. parabotulinus* than those previously recorded, e.g., of one product subcutaneous injection into a guinea pig at the rate of

2. Journal of the American Veterinary Medical Association, Vol. 57 (10), 1920, p. 638.

3. Journal of Infectious Diseases, Vol. 28, 1921, 317.

4. loc. cit.

0.0005 c.c. per kilogramme body weight led to death in 63 hours, and other products have shown almost as high a titre. Even so it is not believed that the limits of toxicity have been reached, and further enquiry is being made into the factors associated with maximal toxin production.

The evidence presented in our earlier paper that *B. parabotulinus* produced a true toxin was as follow:—

1. The administration of germ-free filtrates lead to symptoms identical with those induced by whole cultures. (These filtrates were obtained after passage of culture through Chamberland F. or Doulton candles, and were tested culturally for sterility.)
2. Such symptoms ensued only after a well marked period of incubation, varying according to dosage and route of administration. This period of incubation was commonly of from 15 hours to several days; even after intravenous inoculation of large doses into guinea-pigs no symptoms were manifested for at least six hours.
3. The administration of small doses of such filtrates sufficed to set up the characteristic symptoms and death.
4. The toxicity of a filtrate was diminshed on heating to 60° C. for 15 minutes and entirely destroying by heating to 80° C. for a like period.
5. The fact that filtrates possessed a toxic property analogous to that of botulinus toxin, i.e., were toxic when administered by the mouth.

It was admitted that as no antitoxin had up till then been prepared against these toxic filtrates, the claim that a true specific exotoxin was present in these cultures could not be wholly substantiated.

Production of Antitoxin.

Repeated attempts have been made to immunise small animals against the toxic filtrates of *B. parabotulinus.* In addition to these two horses have also been employed. The first of these horses had to be discontinued for another cause, and the second horse has received as yet only comparatively few injections; a test of its serum reveals the presence of antibodies, but its serum is as yet of too low a potency for critical experiment.*

At first gradual doses of *unaltered toxin*, starting with a small fraction of a lethal dose, were used, but without success, and the animals (guinea pigs and rabbits) invariably succumbed sooner or later as the doses were increased.

For the next attempt *toxin heated to 60° C. for one hour* was employed for the earlier injections, and by this means, two guinea pigs out of six have been successfully immunised. The remainder of these guinea pigs died during the immunisation process; one of those immunised at one time exhibited marked symptoms of paralysis, from which, however, it gradually recovered; the other likewise showed

* This horse has now been successfully immunised. January, 1923. H.R.S.

slight symptoms, and it is noteworthy that with it the initial injections were very much smaller.

In determining the potency of the toxins employed, the minimal lethal dose (m.l.d.) has been interpreted as the smallest quantity which, administered subcutaneously to a 350 grm. guinea pig, has led to death in less than 48 hours.

The following toxin-antitoxin experiments were performed with the serum from one of these guinea pigs (No. 72). The initial dose for this guinea pig was 1/30th m.l.d. of heated toxin (potency determined after heating); nine injections of heated toxin were given, after which the animal received six injections of non-heated toxin; the last injection, nine days before bleeding, was 40 m.l.d. This guinea pig showed symptoms of paralysis after the third injection (1/10th m.l.d.) in consequence of which treatment was suspended for nearly four months; no symptoms have been shown following the subsequent injections, and at time of killing the animal weighed 900 grms. and was in excellent condition.

In order that cross-immunity experiments might be carried out a polyvalent Botulinus antitoxin has been prepared in a cow (Cow 6) by repeated injection of cultures of both type of *B. botulinus*. The strains used were "B. botulinus A1" obtained from the Lister Institute, through the courtesy of the Director, Dr. C. J. Martin, and "B. botulinus, Type B., No. 40" from Dr. K. F. Meyer's collection, kindly supplied by Dr. Hilda Hempl Heller.

Toxin-Antitoxin Experiments.

In the following experiment guinea pigs of 225 to 270 grms. weight were used, and the test was carried out as follows:—The toxin-anti-

Guinea Pig.	Antitoxin.	Toxin.	Result.
336	Parabotulinus 0·2 cc.	Parabotulinus 50 m.l.d.	Lived.
338	Parabotulinus 0·2 cc.	Botulinus A, m.l.d.	Died second day.
340	Parabotulinus 0·2 cc.	Botulinus B, 1 m.l.d.	Died third day.
337	No antitoxin	Parabotulinus 1 m.l.d.	Died second day.
339	No antitoxin	Botulinus A, 1 m.l.d.	Died second day.
341	No antitoxin	Botulinus B, 1 m.l.d,	Died third day.
342	Botulinus 1 cc.	Parabotulinus 1 m.l.d	Died in 20½ hours.
344	Botulinus 1 cc.	Botulihus A, 2 m.l.d.	Lived.
346	Botulinus 1 cc.	Botulinus B, 2 m.l.d.	Lived.
345	Botulinus 1 cc.	Botulinus A, 5 m.l.d.	Lived.
347	Botulinus 1 cc.	Botulinus B, 50 m.l.d.	Lived.
343	Serum normal guinea pig	Parabotulinus 1 m.l.d.	Died in 22 hours.

Antitoxins.—Parabotulinus, Serum G.p. 72.
Botulinus (polyvalent), Serum of Cow 6, 13/9/22.

Toxins.—*B. parabotulinus* of 11/9/22. M.l.d. 0·004 cc.
B. botulinus Type A., A1 of 30/9/22. M.l.d., 1 cc.
B. botulinus, Type B., B·40 of 21/7/22. M.l.d. 0·01 cc.

toxin mixtures, made up to a constant volume (3 cc.) with saline were placed in conical glasses, the contents thoroughly mixed, incubated for 1¼ hours at 37° C., and then injected subcutaneously.

In other experiments it has been shown that 0.1 cc. of this parabotulinus antitoxin is capable of protecting against at least 50 m.l.d. of toxin. Even the administration of 100 m.l.d. of toxin, with a similar quantity of antitoxin, was followed by but slight symptoms and ultimate recovery.

It will be noted that the m.l.d. of Type A. botulinus toxin is very large; this was a very weak toxin, and though this strain has a low degree of toxicity much more powerful products have at times been obtained. The dose selected as the m.l.d. for Type B. botulinus toxin was really less than 1 m.l.d., and this is to be ascribed to the toxicity of this filtrate having diminished somewhat since its potency was determined. These factors, however, only serve to make the test more crucial.

The following conclusions are drawn from the above:—

(a) That the antitoxins employed, parabotulinus and polyvalent botulinus protect against their homologous toxins.

(b) That parabotulinus antitoxin fails to protect against either type of botulinus toxin, and conversely a polyvalent botulinus antitoxin fails to protect against parabotulinus toxin.

(c) That normal guinea pig serum possesses no antitoxic value against parabotulinus toxin.
(In another experiment it has been shown that normal ox serum affords no protection against botulinus toxin.)

(d) That, from immunity tests alone, there is sufficient evidence to regard *B. parabotulinus* as being distinct from *B. botulinus*.

Other tests, though not so comprehensive as that given above, have given the same results.

Conclusion.

(1) That *B. parabotulinus* produces a true toxin, i.e., a soluble exotoxin obtainable by filtration, producing symptoms only after a definite period of incubation, and capable of inducing the formation of an antitoxin.

(2) That though the toxins of *B. parabotulinus* and of *B. botulinus* are identical in their action, the antitoxin to the one does not protect against the other, and vice versa.

(3) As it has been shown previously that *B. parabotulinus* differs from *B. botulinus* (Types A. and B.), both morphologically and culturally, and is now demonstrated by toxin-antitoxin tests to be distinct, the specific identity of *B. parabotulinus* is claimed.

[PROC. ROY. SOC. VICTORIA, 35 (N.S.), PT. II., 1923].

ART. XVII.—*The High Frequency K Series Absorption Spectrum of Erbium.*

BY L. H. MARTIN, B.Sc.

(Communicated by Professor T. H. Laby).

(With one Text Fig.)

[Read 9th November, 1922.]

A critical absorption "edge" in the X-ray spectrum of an element has a wave length such that the element absorbs X-rays of shorter wave length than that of the edge, more than X-rays of longer wave length.

For the heavier elements we find one such edge in the K series, three in the L series, and five in the M series[1].

It is found experimentally[2] that if the element previously used as an absorber is now used as a target in an X-ray tube, the K series of this element are emitted only when the voltage applied to the electrodes of the tube equals, or is superior to V_K given by the quantum relation,

$$h\nu_K = V_K e$$

where $h = 6.556 \times 10^{-27}$ erg. sec. $e = 1.591 \times 10^{-20}$ e.m. C.G.S. units and ν_K is the frequency of the critical absorption edge, which is also greater than the frequency of the shortest K emission line i.e.,

$$\nu_K > \nu_K\gamma > \nu_K\beta > \nu_K\alpha > \nu_K\alpha' \text{ (3) where } \nu_K\gamma \; \nu_K\beta \; \nu_K\alpha \; \nu_K\alpha'$$

are the frequencies of the K emission lines.

In virtue of these facts, critical absorption phenomena have assumed an important significance in the physical model of the atom as developed by Kossel, Bohr, Sommerfeld, and Wentzel. They are expressions of "levels" of energy within the atom.

It is found that we can form a table of the frequencies of these absorption edges [K; L_1 L_2 L_3; M_1 M_2 M_3 M_4 M_5, etc.] the frequency of every X-ray emission line being expressed as the difference of the frequencies of two edges properly chosen[4], every emission line corresponding to a definite pair of energy levels. We have for example:—

$$K\alpha = L_1 \rightarrow K \qquad L\alpha = M_1 \rightarrow L_1$$
$$K\beta = M_3 \rightarrow K \qquad L\beta = M_2 \rightarrow L_2$$

by which we mean, that the frequency of the K_α line equals the difference between the frequencies of the L_1 and K critical absorption edges, or in terms of our atomic structure, the K_α line is emitted by an atom when an electron falls from the L_1 electron shell to the K electron shell.

The aim of X-ray spectroscopy is then to compile a table of the frequencies for all the critical absorption edges of each element rather than tables of emission line wave lengths. Sommerfeld[5] proposes to call such a table (values of ν/R when R is Rydberg's frequency 3.29×10^{15} sec $^{-1}$) a "term" table. This table will contain for the heavier elements $1(K) + 3(L) + 5(M) + 7(N) + 5(O) = 21$ "terms," from definite combinations of which we can determine the values of ν/R for every emission line for each element.

Up to the present terms for elements of atomic numbers $61 \rightarrow 73$ have not been measured, and the purpose of this paper is to show how the K "term" of erbium ($N = 68$) was determined; soon it is hoped to be able to give the K "terms" for the remaining earths.

X-Ray Spectroscopy.

The analysis of an heterogeneous X-ray beam into its homogeneous constituents is made possible by the "three dimensional" grating formed by the arrangement of the atoms in a crystal. Calcite was chosen as grating crystal because of its relatively large reflecting power, and because it is easier to obtain a calcite crystal which is a perfect X-ray grating than a rock-salt crystal. The grating space "d" is such that with the spectrometer used, the K_α $K_{\alpha'}$ lines of tungsten ($\lambda K_{\alpha'} - \lambda K_\alpha = 4.81 \times 10^{-11}$ cm.) are resolved with a slit width equal to .12 mm.

A full description of an X-ray spectrometer, similar to that used, was given by Mr. Rogers in these Proceedings, May, 1922, so that here, only those modifications will be described which have been added in an attempt to increase the accuracy of the determinations, and facility with which the apparatus can be used.

The wave length of the erbium K critical absorption edge is approximately $.217 \times 10^{-8}$ cm., so that Bragg's fundamental equation for the diffraction of X-rays by a crystal,

$$\lambda = 2d \sin\theta \qquad (1)$$

can be written, since the angle of reflection of this wave length amounts to approximately 2°.

$$\lambda = c.\theta \qquad (2)$$

i.e., the wave length is proportional to the angle of reflection.

When photographing the K absorption edge the crystal was made to oscillate about its axis through 7 mins. of arc by means of a cam driven by an electric motor and reduction gear. This was necessary, as exposures of nearly seven hours were required to obtain a suitable photograph of the edge.

A crystal holder was designed so that the crystal could first be made vertical and then brought into the axis of rotation. In fig. 1. (a) the crystal C is held rigidly by a piece of rectangular tubing A, supported by the main carrier B, at the three points B_1, B_2, B_3, by loosely fitting bolts, rigidity being obtained by three very stiff springs, S_1, S_2, S_3.

The crystal can be brought into the vertical by adjustments of the hexagonal nuts N_1, N_2, N_3, B rests on three ball bearings, two of which move in a V groove, and the third on a flat; the crystal being moved along these, by means of a fine thread screw engaging the carrier B.

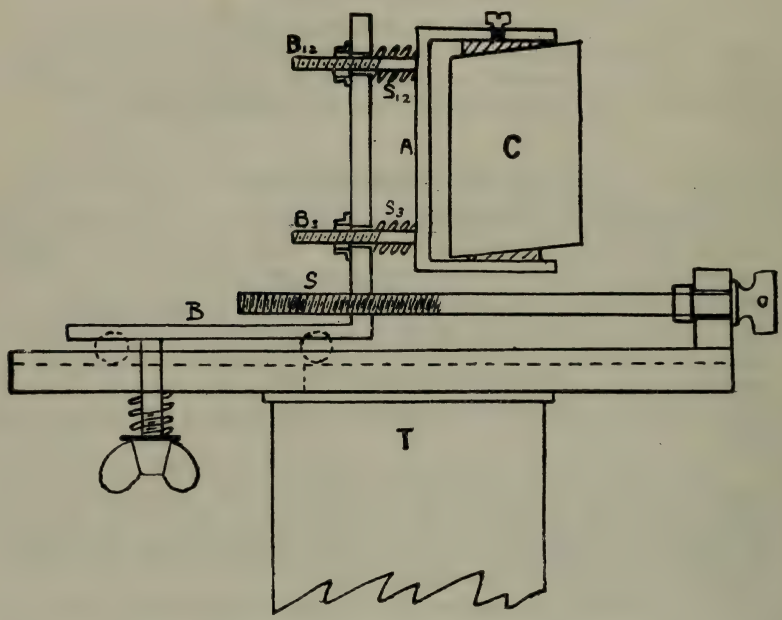

Fig. 1 (a)

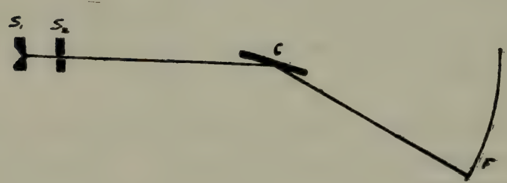

Fig. 1 (b)

Fig. 1 (b) is a diagramatic representation of the disposition of the apparatus. The tube slit S_1, which serves as a fine linear source of X-rays was usually .06 mm. wide. The second slit S_2, serves to limit the angular width of the incident beam. The edges of this slit move in parallel grooves and were arranged parallel to S_1, and symmetrical about S_1, by an optical method.

Adjustments.—The plane of the tube slit S_1 was first adjusted by an optical method to be perpendicular to the radius O S_1 (Fig. 1.) and at the same time vertical.

A reflected image of S_1 was observed in the polished crystal face. The crystal was adjusted as explained above so that the slit S_1 and its image were parallel for all positions of the crystal.

To set the surface of the crystal in the axis of rotation a fine needle point, lying horizontally opposite the middle of the crystal, was observed by a long focus microscope. The needle was adjusted until the point did not move in the field of view when the table was turned through 360° The crystal was brought up until the reflection of the point, and the point itself, just touched when seen under the microscope. In this manner it was possible to set the crystal rapidly so that its middle section coincided with the axis of rotation to within ± .0005 cm.

In order to ensure that the central ray from the target passes through the axis of rotation, the crystal was set at zero and an X-ray photograph taken of the crystal. If the setting of the target is true, the edge of the crystal lies exactly in the centre of the darkening, which is limited by S_2.

Experiment.— As the erbium K absorption edge could not be distinguished from the K_{α}' line of tungsten, it became necessary to use a Gundelach gas tube with a platinum target as a source of general radiation.

Two millimetres thickness of erbium oxalate were placed before slit S_1, and the absorption edge registered on one half of the film, while the reference tungsten K_{α} K_{α}' lines were placed on the other half. The distances $W_{K\alpha} \rightarrow Er_{KL}$, $W_{K\alpha} \rightarrow W_{K\alpha}'$ were measured by projecting the film (magnification 10) on to a vertical platform, motions of which could be read by a dividing engine screw accurately to .0005 mm. Table I. contains an actual series of displacement measurements.*

TABLE I.

$W_{K\alpha} \rightarrow W_{K\alpha}'$.		$W_{K\alpha} \rightarrow Er_{KL}$.		$\lambda Er_K \times$ units.	$W_{K\alpha} \rightarrow W_{K\alpha}'$.		$W_{K\alpha} \rightarrow Er_K$.		$\lambda Er_K \times$ units.
mm.		mm.			mm.		mm.		
1·513	-	2.353	-	216-08	1·497	-	2·346	-	216·14
1·523	-	2·398	-	215·96	1·488	-	2·343	-	216·17
1·524	-	2·386	-	215·99	1·503	-	2·349	-	216·12
1·514	-	2·356	-	216·09	1·508	-	2·358	-	216·12
1·515	-	2·366	-	216·09	1·497	-	2·363	-	216·19
1·512	-	2·350	-	216·07					

* The method, suggested by Professor Laby, developed in this laboratory for measuring these small displacements has been described previously by J. S. Rogers, M.Sc. (l.c.).

The values $W_{K}\alpha = 208.60 \times 10^{-11}$ cm., $W_{K}\alpha' = 213.41 \times 10^{-11}$cm. are those of W. Duane and W. Stenstrom[6], which lead to a value for the erbium K absorption edge.

$$\lambda Er_K = 215.9 \times 10^{-11}\text{cm.}$$

Pl. 2.	Oct. 24.	$\lambda = 216.09 \times$ units.	Weight 1.
Pl. 4.	Nov. 16	$\lambda = 215.85 \times$ units.	Weight 2.
Pl. 5.	Nov. 21.	$\lambda = 215.87 \times$ units.	Weight 2.

Weighted mean $\lambda = 215.9 \times 10^{-11}$ cms.

Term value (ν/R units) = 4222.

Discussion.

In the determination of the wave lengths of such penetrating rays as the above, we are beset with the difficulty, that, owing to crystal penetration the effective plane of reflection lies below the surface of the crystal. If θ is calculated from the geometrical properties of the apparatus, and the distance of "edge" from direct ray impression, an error is introduced amounting to nearly 3% in short wave length determinations. Errors of this magnitude are observed in the K absorption edge determinations of de Broglie[7] for elements Hg to U.

In this method, which might be called a method of coincidences, the reference rays and the erbium K absorption edge have sensibly the same wave length, and the result is free from this objection.

Determinations have been made by Duane and Blake[8], using an ionisation chamber method in which θ was read directly from an accurately divided circle, and by Siegbahn and Jonsson[9], using a photographic method, both of which are free from the above source of error. Siegbahn and Jonsson used their crystal as a transmission grating, a method first devised by Rutherford[10] for his determinations of the wave length of the penetrating γ rays of RaC, the rays being constrained by slits to meet the plane of reflection passing through the axis of rotation.

Although both methods are free from objection, the values obtained by Sieghahn and Jonsson are systematically smaller than those obtained by Blake and Duane for the absorption edge wave lengths of the K series.

Extrapolating the two series of values for the value expected for erbium we find—

Siegbahn and Jonsson	$\lambda = 215 \times 10^{-11}$ cm.
Blake and Duane	$\lambda = 216 \times 10^{-11}$ cm.

The value found here 215.9×10^{-11} cm. agrees better with the results of Blake and Duane. Duane has suggested that the discrepancy may be found in that Siegbahn probably measured from the point at which darkening began, instead of the point corresponding to the centre of the slit. Here that settings were made for those rays which correspond to the centre of the slit.

I wish to thank Professor Laby for his valuable advice and interest during the execution of this work. I am also very much indebted

to Welsbach and Co., U.S.A., for a very pure sample of erbium, which they presented to the Natural Philosophy Dept. X-ray analysis showed that there was no discernable impurity.

References.

(1) Stenstrom, Dissertation Lund, 1919.
(2) D. L. Webster, Physical Review 7, 599, 1916.
(3) D. L. Webster, (l.c.).
(4) Coster, Zeitschr. f. Phys. 185, 1921.
(5) Atombau und Spektrallinien, 3 ed., 1922.
(6) Proc. Nat. Acad. 6, 477, 1920.
(7) Journ. de Phys., 1916.
(8) Phys. Rev., 14, Dec., 1919.
(9) Phys. Zeitschr., 20, p. 252, 1919.
(10) Phil. Mag. 28, p. 266, 1914.

[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. II., 1923.]

Art. XVIII.—*The Austral Rhynchonellacea of the "Nigricans Series," with a special description of the new Genus Tegulorhynchia.*

By FREDK. CHAPMAN, A.L.S., and IRENE CRESPIN, B.A.

(With Plates XI-XIII.)

[Read 14th December, 1922.]

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I.—Introductory.

Since the phylogenetic relationships of the Cainozoic rhynchonellids belonging to the "*Hemithyris nigricans* series" of Buckman[1], of the Australasian (Southern Victoria and New Zealand) and other con-

1. Buckman, 1910, p. 13.

tiguous areas of the southern hemisphere do not seem to have been satisfactorily defined, the opportunity is now taken, with the help of a great deal of new material, to review the evidence already published. This, we hope to show, will prove that the southern stock of these multiplicate Cainozoic and Recent forms is generically distinct from *Hemithyris*, and seems to have been derived from a common Mesozoic type long before the period of the disintegration of the early Antarctic continent.

Until 1910, the Australian rhynchonellids, both fossil and recent, were referred to the genus *Rhynchonella* in the unrestricted sense. In that year, Mr. S. S. Buckman published a paper on Antarctic Fossil Brachiopoda[2], in which he described several fossil forms of rhynchonellids, two of which had been previously recorded under the genus *Rhynchonella* (*R. squamosa*, Hutton, and *R. plicigera*, Ihering). These fossil forms Buckman referred to d'Orbigny's genus *Hemithyris*, which in the original description is stated to possess no dental plates.

In 1914, one of us[3] referred to Hutton's species, *squamosa*, as belonging to the genus *Acanthothyris* of d'Orbigny, on account of the tendency of this form to develop a spinose character along the costae. This spinose character is fundamental in d'Orbigny's Jurassic genus. The genotype of *Acanthothyris* is *A. spinosa*, Schlotheim sp. of the Inferior Oolite of England[4]; but, as we hope to show later, the northern Jurassic and the southern Cainozoic forms belong to different stocks, and therefore the spinose character is an example of convergence of form.

In his revision of the Fossil Brachiopoda, Prof. Chas. Schuchert[5] had included the living spinose form, *Rhynchonella doederleini* of Davidson[6], as a representative of the genus still living in Japanese Seas. From the present evidence this species seems related to the southern types, which fall into the new genus *Tegulorhynchia*.

In reviewing all the evidence given by previous authors, and in the light of a large amount of material recently collected from Victorian and other Australian deposits, we find the results necessitate the establishment of a new genus which will include forms of the *Rhynchonella squamosa* type, the distinctive characters of which are discussed in a later section.

II.—Cainozoic and recent Austral Rhynchonellids: With Critical Notes.

antipoda, Hemithyris, Thomson.

Thomson, 1918[2], p. 117.

> "In *H. antipoda*, the ribs are similar in size to *H. nigricans*, but rather more numerous, and are incipiently spinose."

2. Buckman, 1910, pp. 10-14.
3. Chapman, 1914, pp. 166, 167, fig. 89F.
4. cf. Davidson, 1852, p. 71, pl. xv., figs. 15-20.
5. Schuchert, in Zittel, 1913, p. 400.
6. Davidson, 1887, p. 172.

From specimens kindly lent us by Dr. Thomson from New Zealand, we note that the species *antipoda* differs from *thomsoni* in having a more salient beak and several strong, concentric growth-lines, especially seen on the dorsal valve.

Miocene.—Curiosity Shop, Rakaia River, Canterbury, N. Z.

australis, Hemithyris, Buckman.

Buckman, 1910, p. 12, pl. I., fig. 11.

This smooth, sub-pentagonal form is referred by Buckman to the *Rhynchonella bipartita* series. From its more erect form of beak and even growth-lines, it is possibly a distinct form from the boreal, living hemithyrids; although related forms are known from the Eocene and Miocene of Europe, and *R. lucida* is living in Japanese Seas. It belongs to the hypothyrid section, as pointed out by J. Allan Thompson[7], otherwise it is similar to Thomson's generic form, *Aetheia.*

Miocene.—Glauconitic Bank, Cockburn Island, Graham Land.

coelata, Rhynchonella, McCoy (in Tenison Woods).

Woods, J. E. T., 1878, p. 77.

Generally referred to as an Ms. name of McCoy's. T. Wood's gives a short description of the shell, which places beyond doubt its identity with our common Victorian form, (see *postea*).

"From several Miocene beds in Victoria," Miocene (Janjukian).

colurnus, Hemithyris, Hedley.

Hedley, 1905, p. 44, text-fig., 7, 8.

The nearest ally is *Hemithyris beecheri*, Dall, found in 313 fathoms at Honolulu. This is a triangular, cordate form, smooth, except for faint growth-lines. From the distinctly epithyrid foramen, this species appears to belong to Thomson's genus *Aetheia.*

Recent.—Dredged at 111 fathoms, East of Cape Byron, New South Wales.

depressa, Hemithyris, Thomson.

Thomson, 1918, p. 117.

A small species with short beak. "Possesses numerous fine ribs with imbrication towards the margin."

Miocene (Ototaran and Lower Hutchinsonian stages). —One mile north of Kakanui Quarry, Oamaru District.

doederleini, Rhynchonella, Davidson.

Davidson, 1887, p. 172, pl. XXV., figs. 14, 15, text-fig. 19.

7. Thomson, 1915, p. 390.

Appears to show some interesting annectant characters of the tubular-spined Miocene forms found in Australian deposits.

Recent.—Dredged, Sagami Bay, Japan, in about 160 fathoms.

gerlachei, Rhynchonella, Joubin.

Joubin, 1901, p. 7, pl. I., figs. 5-9; pl. II., fig. 10.

A suboval form with smooth shell, but for faint growth-lines. The beak is erect and deltidial plates are very narrow. It belongs to the *Rhynchonella bipartita* group.

Recent.—Antarctic Seas.

imbricata, Hemithyris, Buckman.

Buckman, 1910, p. 11, pl. I., fig. 12.

Apparently nearly related to some well preserved rhynchonellids from Table Cape, Tasmania, which we have named *Tegulorhynchia coelospina*.

Miocene.—Glauconitic Bank, Cockburn Island, Graham Land.

nigricans, Terebratula, Sowerby.

Sowerby, 1846, p. 342, pl. LXXI., figs. 81, 82.

(*Rhynchonella*). Suess, 1864, p. 60, pl. XIV., figs. 4*a-d* (expl. of plate 5*a-d* in error).

This living and fossils species is a modification of the *squamosa* type, in which the shell is more terebratelloid in form and the ornament less distinctly tegulate.

Miocene.—Oamaruian and Awamoan, New Zealand (Hutton).

Recent.—Coast of New Zealand, in 19 fathoms.

nigricans, var. *pyxidata*, Rhynchonella, Davidson,

Davidson, 1880, p. 59, pl. IV., fig. 14. Id., 1889, p. 171.

This form has been compared by Davidson (op. cit. 1880, p. 60), with McCoy's *R. coelata*, but which we consider distinct.

Recent.—Dredged south of Kerguelen Island, at 150 fathoms, rocky sea-bottom.

patagonica, Rhynchonella, Ihering.

Ihering, 1903, p. 334, pl. III., figs. 11*a*, *b*.

Figures given by Ihering are not very clear, especially as regards ornament, but that difficulty is removed by Ortmann's figure of *R. squamosa*, which is accepted by Ihering as identical with *R. patagonica*. In the description of *R. patagonica* by Ihering it is pointed out that the species differs from *R. squamosa*, Hutton (non Ortmann) in having a larger number of costal rays. We also note that Ortmann's specimen shows about 12 costæ on the sinus, and Ihering mentions 15.

Miocene.—Lake Pueyrredon (Ortmann). Rio Seco and San Julian (Ihering). Patagonia.

plicigera, Rhynchonella, Ihering.

Ihering, 1897, p. 270, text-fig. 7.

Id., 1903, p. 334.

Ortmann, 1901, p. 70, pl. XII., figs. 3*a*-*e*.

This species by its coarse plication, transverse shape and anterior tegulation, closely approaches our new species, *Tegulorhynchia thomsoni.*

Miocene (Lower, Middle and Upper Patagonian). Patagonia.

plicigera, Hemithyris, Buckman (non Ihering).

Buckman, 1910, p. 12, pl. I., fig. 10.

This species appears to differ from Ihering's *R. plicigera* on account of the narrow form of valves and character of ornament, which appears to be confined to the anterior margin.

Miocene.—Glauconitic Bank, Cockburn Island, Graham Land.

racovitae, Rhynchonella, Joubin.

Joubin, 1901, p. 5, pl. I., figs. 1-3.

A smooth, sub-pentagonal hypothyrid rhynchonellid, with only faintly sinuated anterior.

Recent.—Antarctic Seas.

squamosa, Rhynchonella, Hutton.

Hutton, 1873, p. 37.

A suborbicular, finely ribbed form, tending to become elongated vertically, rather than transversely. The topotype from New Zealand shows the species to be distinct from the Victorian one, which we now refer to *T. coelata*, T. Woods sp.

(?) Oligocene (Ototaran stage), Broken River, New Zealand.

striata, Hemithyris, Thomson.

Thomson, 1918, p. 11, pl. XVI., figs. 30, 31, 32, 45.

This appears to belong to the *Hemithyris bipartita* group. Thomson suggests that it is the adult form of the *Hemithyris* (*Frieleia*) *gerlachei*. It is quite distinct from the *Tegulorchynchia* type of the *nigricans* series by the fine radial ornament and lack of folding, as pointed out by Thomson. The short beak is rather striking as in that character it agrees with the *nigricans* type, excepting for the small foramen.

Recent.—Off Shackleton Glacier, Davis Sea, at 358 fathoms.

sublaevis, Hemithyris, Thomson.

Thomson, 1918, p. 117.

" Narrowly and strongly folded and possess numerous fine ribs, little imbricated, and in many specimens almost obsolete."

Miocene (Ototaran stage).—Everett's Limestone Quarry, Kakanui, Oamaru District.

tubulifera, (?) Rhynchonella, Tate.

Tate, 1899, p. 257, pl. VIII., figs. 4, 4*a*.

Tate says, "*R. tubulifera*, if juvenile, is indicative of a much less gibbous shell" (than *R. squamosa*) "in the adult stage." This, although a minute form, is apparently mature, as it shows the contour of a fully developed rhynchonellid.

Oligocene.—(?) Lower beds, Muddy Creek. Victoria.
Miocene.—Polyzoal Rock, Muddy Creek, Victoria.

A note on the European Rhynchonellid erroneously referred to the **Australian Cainozoic Fauna** as *Rhynchonella baileyana*. (See Plate I., figs. 14, 15).

References.—Tate, 1885, pl I. Id., 1886, p. 94, pl. VI., figs. 3*a-c*. Id., 1899, p. 257.

This species was recorded by Tate in 1885, as occurring at Jemmy's Point, Gippsland Lakes, and collected by Mr. J. F. Bailey.

At the time of description, Tate seemed to suspect that it was anomalous as a Tertiary species, for he remarks that it recalls some Mesozoic ones, and adds, "I do not know of any other fossil which has so depressed and broadly oval form, conjoined with marginal plications and small suberect beak as it possesses."

In 1899, Tate added a note for this species (p. 257), and said, "My surmise of its Mesozoic origin is confirmed by Mr. R. Etheridge, jnr., who attributes it to the Cretaceous of Faxoe." We have examined an extensive series of Cretaceous Rhynchonellae in the National Museum, and these, together with a comparison of Davidson's figures in his Cretaceous Memoir, proves that the above form belongs, not to a Danian rhynchonellid, but to a well-known form of the Senonian Chalk, found in England, and on the Continent. That species is *Cyclothyris limbata*, Schlotheim sp., of which the following is the principal synonymy.

Terebratulites limbatus, Schlotheim, 1813, p. 113 (Faujas, 1799, pl. XXIV., fig. 4).

Terebratula subplicata, Mantell, 1822, p. 211, pl. XXVI., fig. 5.

Rhynchonella limbata, Schlotheim sp., Davidson, 1854, p. 79, pl. XII., fig. 1-5.

We are much indebted to Professor Sir Douglas Mawson for his kindness in allowing us to see the specimen in the collection of the Adelaide Museum, and we have taken this opportunity of giving a photograph of it, as well as of a typical specimen from the Senonian of Ciply, Belgium (Nat. Mus. Coll.).

III.—Description of Tegulorhynchia, sp. nov. Genotype "Rhynchonella squamosa," Hutton.

(a).—Definition.

Ventrally uniplicate, generally wider than high; shell moderately stout; typically with a strong undulate and tegulate ornament, corresponding to growth-lines which cross the ribs that are typically constant on valves. By structural specialisation the tegulation becomes tubular, and eventually links up with that seen in *Tegulorhynchia doederleini*. Beak hypothyrid; as seen in edge view erect, usually truncate or only slightly incurved. Deltidial plates strong and tpyically equilaterally triangular. Dental plates well defined and strong, the septum represented on inside of dorsal valve, by a very thin plate which extends to nearly one half of the length of the shell. Muscle areas on interior of the dorsal valve are well marked and sub-quadrate, and fairly large.

(b).—Distinctions from *Hemithyris*.

According to Professor Schuchert, *Hemithyris* is defined as " smooth or faintly plicate rhynchonellae with a high ventral beak and open delthyrium. No dental plates." As a matter of fact, dental plates are present in the genotype *Hemithyris psittacea*, Chemnitz sp., the typical northern form, as indicated by Davidson, Dall and Thomson (see pl. I., fig. 13; pl. II., figs. 16, 19).

So far as we have seen, these dental plates are always slender and not well developed. On the contrary, the forms of the southern *R. nigricans* series are stout and strong compared with the northern *Hemithyris*. The type of *Hemithyris*, d'Orbigny (*Rhynchonella psittacea*) has[8] a " beak sharply pointed and incurved." *R. squamosa* has it erect and more often quite blunt.

In regard to the ornament, *Hemithyris* is typically smooth, or striate, never distinctly costate, so far as we have seen from the specimens in the National Museum collection, which were dredged from the North Sea. In these example, also, the growth-lines are purely concentric and never tend to become strongly undulose or overlapping to the extent of even a form like the living *nigricans*. In *Hemithyris* the septum is rudimentary, low, and barely extending halfway across the shell. In *Tegulorhynchia* the septum is more strongly developed, and extends into the anterior half of the shell. The deltidial plates in a typical *Hemithyris psittacea* are elongated in the form of a scalene triangle, whereas in *Tegulorhynchia* they are almost, to quite, equilateral. These plates are strongly discrete in *H. psittacea*, whereas in *Tegulorhynchia* they may be only slightly so (*T. coelata*), or conjunct (*T. squamosa*).

(c).—Phylogeny of the Genus.

From the widely spread occurrence of the Tertiary rhynchonellids of the *squamosa* type in the southern hemisphere, it is only natural to conclude that these forms sprang from some already well established ancestor in the Mesozoic.

Of the recorded Mesozoic species found in Australia we have:—

Rhynchonella croydonensis, Etheridge, fil., 892, p. 560, pl. XLI., figs. 13, 14.

8. Davidson, 1887, p. 164.

In this the shell is transversely elongate, the dental plates are short, strong and somewhat curved. The lateral areas have six prominent angular ribs; the median sulcus carries four fainter costae. There are traces of distinct transverse lamellae. We are inclined to think that the two figures represent different species, since the ventral valve (fig. 13) has the deep sulcus and prominent beak of Buckman's genus *Kallirhynchia.* Figure 14, if shown by additional specimens to be distinct, might be re-named *Burmirhynchia etheridgei.*

Occurrence.—Cretaceous. Croydon Goldfields, Queensland.

PHYLOGENY OF THE AUSTRAL AND RELATED RHYNCHONELLACEA.

Rhynchonella eyrei, Etheridge, fil., 1902, p. 8, pl. I., fig. 2.

Triangular; costae prominent and coarse, three to four on fold; two to three on the sinus, and three to four on either side. The valves are crossed by numerous, concentric frilled laminae.

Occurrence.—Lower Cretaceous. Central South Australia.

Rhynchonella rustica, Moore, 1870, p. 245, pl. X., fig. 79.

The shell is wider than long, with 20 to 25 costae. The beak is acute and compressed when young. The surface is covered with striae, 20 to 25 in number, which in the adult stage are wavy and irregular.

Occurrence.—Lower Cretaceous. Queensland.

Rhynchonella solitaria, Moore, 1870, p. 245, pl. X., fig. 10.

The shell is wider than longer, with four widely spreading costae, and a single lateral costae on either side of the sinus. Costae evanescent towards the umbo.

Occurence.—Lower Cretaceous. Queensland.

Also Jurassic, Geraldton (cf. *solitaria*,—fide F. C. in Nat. Mus. coll.).

Rhynchonella variabilis, Schlotheim, Moore, 1870, p. 231-232 (list), pl. X., figs. 11, 12.

Shell as high as broad, about 9 costae, which are plicated towards the anterior commissure.

Occurrence.—Jurassic. Geraldton District, W. Australia.

With regard to these Mesozoic Australian rhynchonellids it is interesting to note that one of the forms from the Lower Cretaceous, viz., *R. rustica*, agrees with the general form of the Miocene and later *Tegulorhynchiae*. The shell is wider than long, though the transverse character is not absolutely uniform, but predominant. The numerous costae also form another factor for comparison, although the riblets in the later Tertiary and living forms tend to become less numerous and less acute. The beak in *Rhynchonella rustica* is said to be acute and compressed when young. In his description of *R. rustica*, Moore compares the Australian Cretaceous form with *R. concinna* of the Great Oolite and Bradford clay of England which, he says, "it approaches more closely." From the excellent figures of *R. concinna* given by Davidson[9], it will be seen that the delthyrium is almost exactly comparable with that in *Tegulorhynchia*, for the deltidial plates are disjunct and are almost equiangular, and in no way could *R. rustica* on this evidence be compared with the Cretaceous genus *Cyclothyris*. *R. rustica* may also be compared with the compressed and almost truncated beak in *Tegulorhynchia*. Two other forms, both from the Cretaceous of Central South Australia and Queensland respectively, are *Rhynchonella eyrei* and *R. croydonensis*. Both of these have the ornament characterised by the prominent growth-lines which cross the riblets. In *R. eyrei* these are developed into distinct laminae, and in *R. croydonensis* they also occur, but are less distinct, and more distantly placed.

In "*Rhynchonella*" *variabilis* we have a type of shell which is coarsely plicate, but the entire form of the shell is closely comparable with the variants of *Tegulorhynchia squamosa*, as we have them represented at Waurn Ponds and Keilor. The dorsal valve in these forms, is strongly ventricose, and the ventral valve is subplanate. In regard to the beak in *R. variabilis*, this is not prominent, and the apex varies from being slightly incurved to almost truncate. This seems to suggest the possibility, when compared with the other

9. Davidson, 1852, pl. xvii., figs. 6-12.

forms of beaks in Mesozoic rhynchonellids, that there is a direct relationship in this part of the structure with the Tertiary forms. The foramen also in "*R. variabilis* is distinctly hypothyrid and sub-elliptical, and the deltidial plates, though small, are very similar in shape to those of *Tegulorhynchia.* "*R.*" *variabilis* has the conjunct type of deltidial plates, whereas in the form of *Tegulorhynchia* they are almost invariably disjunct (exception, *T. Squamosa*).

(d).—Variation in Time.

The majority of the Jurassic and Cretaceous forms in Australia (*R. rustica, eyrei, croydonensis*-pars, *solitaria* and *variabilis*) agree in their main characters with Buckman's *Burmirhynchia.* His definition, taking *Burmirhynchia gutta,* nov. as type is[10]—"hypothyrid (beak massive, springing from a gibbous umbo, apex produced and incurving [foramen sub-elliptical, deltidial plates narrow, disjunct]); slightly trilobed; multiplicate; dental plates strong, much divergent; ventral muscle area large, pyriform; dorsal septum strong; dorsal muscle area quadriform to subcircular pattern, the two anterior scars strongly marked, making a cordate figure, being individually more or less pyriform, bounded by well-marked, diverging channels."

In these early forms the dorsal septum is strong. The later, Tertiary and living representatives, have a low dorsal septum, but extended, probably pointing to an ancestral feature of greater development. The dorsal muscle areas agree in shape both in the Indian and Australian Jurassic, and also in the Australian Tertiary types, though in the latter they are of greater extent.

In some of the earlier Mesozoic forms the beak has already been modified by truncation; that is to say, less incurved and prominent. The deltidial plates are disjunct, both in *Burmirhynchia* and *Kallirhynchia,* and these show features ancestral to the austral form, but common to both. The tegulate character is seen developing in the early forms to some extent, but not until the Miocene is it well pronounced.

(e).—Palaeographical Factors.

The *Burmirhynchia* type of shell was already established in the Lias, Inferior Oolite and Greater Oolite of England, and the Continent. It appears to have migrated along a possible shore-line in Upper Jurassic times, judging from the community of Upper Jurassic types of mollusca and brachiopoda seen in the Western Australian beds, where foraminiferal species are also common to both areas.

During this time also, the terrestrial areas were continued, forming a favourable geographical unit from Europe across to India, and thence to Australia. Many Jurassic invertebrates of the Indian area are common to Australia. The interesting fact is here brought out, that of the later type of rhynchonellid, the genus *Cyclothyris* appears to be absent thus far, and our Australian Cretaceous species

10. Buckman, 1917, p. 49.

are of the Jurassic type, which eventually passed into the type, *Tegulorhynchia*—"*nigricans* series"—of the Cainozoic and recent deposits of Australia, New Zealand, Patagonia and Antarctica.

(f).—Evidence of Bathymetrical Habitat.

The majority of the living brachiopods are, as Schuchert has already pointed out[11], deep water and abyssal, and they are practically all thin-shelled.

The present habitat of the living *Tegulorhynchia nigricans* gives a good idea of the probable average depth of the earlier tegulate forms, having a similarly thick shell. It has been recorded 5 miles east of Ruapuke Island in 19 fathoms, on rock and coral; also from Chatham Island. The range given by Canon Norman for the boreal *Hemithyris psittacea* is 10-690 fathoms, at Shetland and near the Dogger Bank. Reeve gives the range from low water to 100 fathoms.

In regard to the living form, *T. doederleini*, this was dredged in about 160 fathoms.

Fischer, in his Manual[12] separates the zone of Brachiopods and Corals, as occurring from 72 to 500 metres in depth (36-250 fathoms). He quotes Macandrew, who dredged *Hemithyris psittacea* from near Finmark, at a depth of 121 to 165 fathoms, in sand.

The group of the genus *Tegulorhynchia*, now discussed, is, generally speaking, thick-shelled. Moreover these forms are associated with shore-loving forms, as at Keilor, near Melbourne, and Table Cape, Tasmania; or in fairly deep water limestones, as at Batesford, near Geelong. In the former case the shells are typically incrassate, whereas in the deeper water habitat they are slightly thiner in build. Instances of the genus in still deeper habitat are found at Fishing Point, Cape Otway, and in the Lower Muddy creek beds.

IV.—Description of the Species of Tegulorhynchia.

1.—Tegulorhynchia squamosa, Hutton, sp.

(Pl. I., figs. 1, 2; pl. II., fig. 22; pl. III., fig. 26.)

Rhynchonella squamosa, Hutton, 1873, p. 37.

Hemithyris squamosa, Hutton, sp., Buckman, 1910, p. 10, pl. I., fig. 13.

Hemithyris squamosa, Hutton, sp., Thomson, 1918, pp. 108 and 117.

Description.—"Shell irregular, more or less orbicular; valves inequal, the ventral flatter, and with a deep groove; dorsal valve very convex; both with find radiating scaly striae. Length, .7 mm.; breadth, 7.5 mm.; height, .5 mm."

Observations.—From a topotype which has been kindly presented to the National Museum by Dr. J. A. Thomson, we note that this

11. Schuchert, 1911, p. 226.
12. Fischer, 1887, p. 188.

species tends to be greater in length than width, although there are exceptional cases where it is slightly wider than long. The beak is much higher than in *T. coelata*, and the deltidial plates are conjunct. The plication is at once seen to be much finer in character than in the Victorian species, *T. coelata*, which in some other respects it resembles. It will be appropriate here to append a synopsis of the average number of plicae which we have counted on the ventral sinus of the principal species of the genus *Tegulorhynchia*.

Species.	Average number of plicae on sinus of ventral valve.	Range in Time.
T. patagonica, *Ihering* sp.	12 to 15	Oligocene or Miocene (Patagonia) Buenos Aires.
T. squamosa, Hutton, sp.	10	(?) Oligocene, New Zealand.
T. coelata T. Woods, sp.	8	Miocene. Victoria. South Australia and Tasmania.
T. thomsoni, sp. nov.	6	Miocene. Tasmania.
T. nigricans, Sow, sp.	4	Upper Miocene to Recent. New Zealand.

Pedicle foramen, long-ovate and well elevated above the cardinal margin, the height being occasioned by the conjunct character of the deltidial plates. The elevation of these plates in some specimens is accompanied by a low, crescentic cavity between the cardinal margins of the ventral and dorsal valves. Viewed in profile, from the anterior aspect, the tegulation in *T. squamosa* seems to be largely confined to the ribs, whereas in *T. coelata* the tegulation is continuous over the ribs and intercostal areas. The discrepant growth-lines in *T. squamosa* are not so strongly marked as in *T. coclata*, and from that we may infer that *T. squamosa* is the older type, compared with *T. coelata*, the latter connecting with *T. nigricans* in this particular character of tegulation.

Occurrence.—(?) Oligocene (Ototaran stage). Broken River, New Zealand.

Miocene. Cockburn Island, Graham Land, Antarctica.

2.—Tegulorhynchia coelata, (McCoy, MS.), T. Woods, sp.

(Pl. I., figs. 3, 4; pl. II., figs. 17, 20; pl. III., fig. 27.)

Rhynchonella coelata (McCoy, MS.), T. Woods, 1878, p. 77.

Rhynchonella squamosa (non Hutton), Tate, 1880, p. 32, pl. IX., figs. 9*a*, *b*.

Rhynchonella squamosa, Hutton, Denant and Kitson, 1903, p. 129.

Acanthothyris squamosa, Hutton sp. Chapman, 1914, p. 167, fig. 89F.

Description.—In his paper on the Tertiary Deposits of Australia, Tenison Woods gives a very brief description of the species which McCoy indicates as the typical Victorian form. Tenison Woods' description is as follows:—"Rounded trigonal, with a strong mesial fold, with many fine imbricated ribs." A note is added from McCoy "from several Miocene beds in Victoria."

Davidson remarks on the relationship of this to the recent form, *T. nigricans*, from New Zealand. "Some examples in external shape cannot be distinguished, but I have not observed on any recent *R. nigricans* such prominent and strongly marked imbricated striae. The fold and sinus seem more strongly marked on the fossil form. The ribs also seem smaller and more delicate than on real *nigricans*."[13]

Specific Characters.—Shell suborbicular, more or less transversely elongated. Ventral valve depressed with a deep sinus. Dorsal valve strongly convex, with a more or less flattened median fold. Umbo rounded, not prominent. Pedicle area truncated. Foramen ovate, not large. Deltidial plates triangular, with slightly vertical prolongation; slightly discrete. The area of the valves near the lateral commissure compressed. Average number of plicae on sinus, 8; on ventral, 36 to 40.

Dimensions.—Specimen *a.*—Length, 14 mm.; width, 17 mm.; thickness of valves, 9mm. Greatest width of delthyrium, 1.25.

Specimen *b.*—Another specimen (figured), length, 16 mm.; width, 18 mm.; thickness of valves, 8.5 mm.

Observations.—This Victorian rhynchonellid has long been held to be identical with the New Zealand species which Hutton described as *R. squamosa.* In various references made subsequently there have been allusions to the several points of difference between the Victorian and New Zealand specimens. From the very fine series placed at our disposal by Mr. F. A. Cudmore, which he collected at Table Cape, Tasmania, in addition to those which we have in the National Museum collection, and others recently collected by us from the ironstone beds of Green Gully, Keilor, we are enabled with some degree of certainty to refer the Victorian specimens of the type to the original species of Tenison Woods.

This species is found in the Tasmanian "*Crassatellites* bed" in company with our new species, *T. thomsoni*, of which the description follows immediately. In that description also will be found a synopsis of the characteristic differences between these two forms. As we have already shown, the shape and ornament, such as number of costae, separate *T. coelata* from Hutton's species *T. squamosa.*

Occurrence.—Oligocene. Muddy Creek, rare. Recorded by Tate.

Miocene.—Tasmania.—*Crassatellites* bed, Table Cape. South Australia.—Aldinga (Glauconitic Limestone); Muloowurtrie, near Ardros-

13. See Woods, J. E. T., 1878, p. 77.

san; Stansbury, Yorke's Peninsula; River Bremer at Salem, near Callington. Victoria.—Aire Coast; Fishing Point, Cape Otway; Lower Moorabool; Maude; Curlewis; Flinders; Waurn Ponds; Keilor.

3.—Tegulorhynchia thomsoni, sp. nov.

(Pl. I., figs. 5, 6; pl. II., figs. 18, 21; pl. III., fig. 28.)

Description.—Shell subovate, tending to subglobose in shape, slightly wider than long. Shell stout, as in *T. coelata.*. Delthyrium is large and open. Deltidial plates strong, triangular and nearly equilateral, reminding one of similar characters in *T. nigricans.* Sinus not so deep as in *T. coelata.* Surface of valves, especially the ventral, showing interrupted growth stages. Twenty-eight plicae seen on ventral valve, six on the sinus. Beak not forwardly projecting, but truncated; deltidial plates discrete.

Dimensions.—Length, 17 mm.; width, 20.5 mm.; thickness of valve, 10:25 mm. Greatest width of delthyrium, 2.5 mm.

Observations.—This species occurs in company with *T. coelata*, T. Woods, at Table Cape, and it is interesting to note that the presence of two species was also suspected by Dr. J. Allan Thomson a few years ago. In 1914, in a letter to one of us he says: "There are two species at least at Table Cape. One appears to be *H. squamosa*, and this was probably the one called *R. coelata* by McCoy. The other is coarser ribbed and less squamose, and is also, I think, represented in New Zealand, but I would like to see a larger series of specimens before making a definite statement."

The differences between the shells of the above species and *T. coelata* are easily seen when a comparative series is laid out. These differences are as follow:—

T. thomsoni.	*T. coelata.*
Beak more prominent, approaching that of *T. nigricans.*	Beak not prominent, apex rounded in edge view, not incurved.
Plicae stouter and less numerous.	More numerous.
Six plicae on sinus.	Eight plicae on sinus.
The growth-lines not conspicuous until reaching the beginning of the ephebic stage.	Tegulation and growth-lines clearly at the beginning of the neanic stage.
Convexity more evenly distributed on both valves.	Dorsal valve tends to become extremely convex, and the fold on the sinus is more pronounced.
Lateral cardinal area evenly convex.	Compression of the lateral cardinal area pronounced.
Foramen large and rounded.	Foramen oval.
Deltidial plates equilateral; discrete, but less so than in *T. coelata.*	Deltidial plates vertically lengthened; discrete.

We have much pleasure in naming this species after Dr. Thomson, who has already done so much in regard to the description of our rhynchonellids.

Occurrence.—Miocene (Janjukian):—"*Crassatellites* bed," Table Cape, Tasmania. Type from the Dennant Collection.

4.—Tegulorhynchia antipoda, Thomson, sp.

Hemithyris antipoda, Thomson, 1918, p. 117.

Description.—The following definition is taken from Dr. Thomson's notes, as recorded above. The shell is of the same size as *nigricans* and *squamosa.* It is distinguished primarily by the character of the ribs. They are similar in size to *H. nigricans*, but are rather more numerous, and are incipiently spinous. To this we may briefly add the above species appears to be near *T. thomsoni*, but differs in the shape of the beak, and in the stronger growth-lines.

Dimensions.—Length, 20 mm.; breadth, 22 mm.; thickness, 11 mm.

Occurrence.—Miocene. Type locality, Curiosity Shop, Rakaia River, Canterbury, New Zealand.

5.—Tegulorhynchia imbricata, Buckman, sp.

Hemithyris imbricata, Buckman, 1910, p. 11, pl. I., fig. 12

Description.—(Ventral valve). "Broadly pentagonal, ornamented with numerous, somewhat stout, rounded radial, costae, which are crossed by growth-lines somewhat conspicuously; and where the crossings occur there is imbrication—the test of the rib being raised into an incipiently spinous projection. The ribs increase in number by intercalation, and by bifurcation, at irregular distances from the beak. The new rib so produced is of smaller size at first than the older ones, so that there is some irregularity of ribbing. There is a distinct mesial sinus."

Observations.—Buckman draws attention to the affinities of this species, with *T. doederleini*, Davidson, sp., the living Japanese form with hollow spines. It also shows some relationship with our new species, *T. coelospina*, described below. From the latter, *T. imbricata* differs in having finer costae, more transverse shell, and a more depressed sinus on the ventral valve.

Occurrence.—Miocene. Glauconitic Bank, Cockburn Island, off Graham Land, Antarctica.

6.—Tegulorhynchia, coelospina, sp. nov. Pl. I., fig. 7; pl. III., fig. 25.

Description.—Shell subcircular, beak fairly prominent, erect. In the type specimen, deltidial plates obscure, but seen in other examples to be triangular and strongly built; slightly discrete. Umbo of dorsal valve acute. Shell depressed, the valves showing almost equal convexity. Sinus and fold little pronounced. Plicae about four on ventral sinus. Costae about twenty-two on margin of valves. Bufurcation of the costae takes place in the later stages. The growth-lines are developed on the costae as incipient tubular spines, somewhat developed to a market extent. The whole surface has a roughened appearance from the numerous short but prominent spines.

Dimensions.—Length, 9 mm.; width, 10 mm. Greatest thickness of valves, 4 mm.

Observations.—This Miocene form seems suggestive in its distinctly spinous characters, of a phylogenetic relationship with the living *T. doederleini.* That Buckman's suggestion that "spinosity is in itself not a generic character, it is only a stage of development to which various stocks attain" may apply in this case, but in the case of the *squamosa* type passing into *nigricans*, this principle does not seem to apply, for *squamosa* and *coelata* have a spinous tendency, but they afterwards develop into the less ornate type of *nigricans* in which the growth-lines are sometimes scarcely perceptible.

Occurrence.—Miocene. Table Cape, Tasmania.

TEGULORHYNCHIA DEPRESSA, Thomson, sp.

Hemithyris depressa, Thomson, 1918, p. 117 (see also p. 108).

Description.—(From Dr. Thomson's notes). *T. depressa* is a small species with a short beak. It is broader than *T. sublaevis*, and more depressed, and possesses numerous fine ribs, and with imbrication towards the margin.

Dimensions.—Length, 14 mm.; breadth, 16 mm.; thickness, 8 mm.

Occurrence.—(?) Oligocene and Miocene. Type locality, limestone above tuffs, one mile north of Kakanui Quarry, Oamaru district.

8.—TEGULORHYNCHIA TUBULIFERA, Tate, sp. (Pl. I., fig. 8; pl. III., figs. 23, 24.).

Rhynchonella (?) *tubulifera*, Tate, 1899, p. 257, pl. VIII., figs. 4, 4*a*.

Description.—(Of the type). "Shell tenticular, suborbicular or transversely quadrate-oval in margin outline; cardinal margin arched, anterior and posterior margins rounded, front margin nearly straight. Pedunculate valve depressed convex; beak bluntly and shortly pointed, straight, and declinous from the hinge; foramen broadly triangular, large, margined by two suberect, narrow lanceolate deltidial pieces."

"The ornament of the valves consists of round radial costae, increasing in numbers by repeated bifurcation, forty or more slightly serrating the margin; there they are a little wider than the subconcave furrows. The ribs are surmounted by stout truncated tabular spines, sufficiently close together to be almost imbricated."

"*Dimensions.* Length, 7.5 mm.; height, including beak, 6.7 mm.; thickness of valves. 2.5 mm."

Observations.—The type from which the above description was taken was referred to by Tate as unique. There is, however, an imperfect specimen in the Dennant collection in the National Museum, which is, without doubt, referable to the above species with which it agrees in main characters and ornament, and differing in the slightly less number of costae, and in the beak being a little more prominent. We have enlisted the good services of Professor Sir Douglas Mawson in endeavouring to find the original specimen, that we might examine it, but it has not come to light. As we have gone into the matter of the identity, or otherwise, of the fragment, with Tate's type, we may note that our conclusions are in favour of the probability of there being two specimens the type evidently having been perfect. Since Tate records his type from Muddy Creek, polyzoal rock series, it is interesting to note that the Dennant specimen came also from the same bed. The differences between this form, and the previously described *T. coelospina* are in the depressed valve of the latter, and the coaser and fewer tubulated costae.

We have been favoured by Mr. Cudmore with a fragmentary valve of a rhynchonellid, presumably from the Lower beds of Muddy Creek, and this we have figured. It appears to approach most nearly *T. tubulifera*, but differs in some respects, and may point to the existence of an additional species in our series.

Occurrence.—Oligocene. (Balcombian). Lower beds, Muddy Creek. Miocene. (Janjukian). Polyzoal Rock, junction of Grange and Muddy Creek.

9.—TEGULORHYNCHIA DOEDERLEINI, Davidson, sp.

Rhynchonella doederleini, Davidson, 1886, p. 1, text-fig. 19.
Rhynchonella doederleini, Davidson, 1887, p. 172, pl. XXV., figs. 14, 15.

Description.—" Shell transversely subpentagonal, wider than long; hinge-line obtusely angular. Dorsal valve deep, posteriorly uniformly convex, anterior divided into three lobes, the central one forming a broad rounded mesial fold varying in elevation according to the age of the individual. Ventral valve much less deep than the dorsal one, with a broad mesial sinus or greater or less depth, commencing at a third of the length of the shell, and extending to the front. Beak moderately produced, almost erect, with an oval-shaped foramen situated under its gently incurved angular extremity, and margined by narrow deltidial plates. Lateral margins of the valves slightly sinuated, and forming in front a more or less elevated curve. Surface of valves marked with numerous delicate radiating ribs, with interspaces between them of almost equal width, and increasing in number at variable distances from the beaks by the interpolation of shorter riblets. Ribs numbering, in full-grown specimens, sixty, close to the margin. Valves closely crossed by numerous equidistant, concentric, raised or foliated lines of growth, giving rise at the margin of each riblet to short sloping or erect hollow spinules. Shell structure fibrous. Colour, light yellowish grey. In the interior of the dorsal valve are two short curved lamellae for the support of the labial appendages."

Dimensions.—" Length, 12 lines; breadth, 13; depth, 7 lines."

Observations.—This living species was compared in its spinosity to the Jurassic "*Rhynchonella*" *spinosa* by Davidson,[14] and was later

14. Davidson, 1886, p. 2.

referred to the Oolitic genus, *Acanthothyris*, by Schuchert.[15] It seems, however, that two distinct races, with senescent spinosity, were thus confused. Buckman[16] has remarked that *T. doederleini* is "more probably a spinous development of *Hemithyris nigricans*"; but here we may point out that, in the light of the structure of the Miocene forms, such as *T. coelospina* and *T. tubulifera*, and even of *T. imbricata*, that it is a direct descendant of the *coelospina* type rather than of the *nigricans* type.

T. doederleini has the beak and deltidial characters precisely identical with the old Miocene and even Oligocene forms, as *T. squamosa* and *T. coelata*, but the extent of development of tubuli formed out of the tegulated frilling has here resulted in long serial and regular spines. In the conjunct deltidial plates it agrees with *T. squamosa*.

Occurrence.—Dredged in 160 fathoms, in Sagami Bay, Japan.

10.—Tegulorhynchia nigricans, Sowerby, sp.

(Pl. I., figs. 9, 10, 11, 12; pl. III., figs. 29, 30.)

Rhynchonella nigricans, Sowerby, 1846, p. 91.
Rhynchonella nigricans, Suess, 1864, p. 60, pl. XIV., fig. 6.
Rhynchonella nigricans, Kirk, 1880, p. 303.
Rhynchonella nigricans, Davidson, 1887, p. 169, pl. XXIV., figs. 16-19.
Rhynchonella nigricans, Hutton, 1905, p. 480.
Hemithyris nigricans, Sow., sp., Thomson, 1915, p. 388, and p. 390, text-fig. 2*a*.

Description.—The following abbreviated description is given by Hutton.[17] "Shell thin, wider than long, but very irregular in shape; margin crenulated, commissure sinuated. Longitudinal ribs, 20 to 25 in each valve."

"*Dimensions.*—Length, 19 mm.; width, 21 mm.; thickness, 10 mm."

Observations.—This species makes its appearance in the Upper Tertiary of New Zealand (probably Upper Miocene and Pliocene), where it is represented by more massive shells than those of the recent specimens dredged around New Zealand. In the living examples the beak is usually more prominent, especially in the younger stages, and the deltidial plates are discrete. In the fossil forms the plates are more closely approximate.

Thomson considers the probability that this species "is a catagenetic development of a coarsely ribbed, imbricated, Oamaruian (probably Miocene), species are not yet named, which differs from *H. squamosa* in its much coarser ribs." This view of Thomson's is upheld by the evidence of the series now before us, *T. thomsoni* helping to connect the extremities of that series.

Occurrence.—Miocene to Recent. New Zealand.

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15. Schuchert (Zittel), 1913, p. 400.
16. Buckman, 1910, p. 11.
17. Hutton, 1905, p. 480.

11.—TEGULORHYNCHIA PYXIDATA, Davidson, sp.

Rhynchonella nigricans, var. *pyxidata*, Davidson, 1880, p. 59, pl. IV., fig. 14.

Rhynchonella nigricans, var. *pyxidata*, R. B. Watson (MS.), Davidson, 1887, p. 170, pl. XXIV., fig. 20.

Hemithyris pyxidata, Davidson, sp. Thomson, 1915, p.391, footnote 4.

Description.—(From Davidson). "Shell transversely oval, widest anteriorly, tapering posteriorly, wider than long. Dorsal valve uniformly convex to about half its length, where a broad mesial fold, scarcely raised above the general convexity of the valve, occupies the anterior half of the valve. Ventral valve rather less deep and convex than the opposite one, with a broad, well-defined mesial sinus, comencing at a short distance from the extremity of the beak, and extending to the front; beak rather small, acute, and incurved; foramen incomplete, situated under its pointed extremity, laterally margined by narrow deltidial plates; surface of both valves ornamented with about forty to forty-six small, angular, radiating ribs, closely intersected by equidistant, squamose, concentric ridges of growth, giving an imbricated appearance to the surface. Colour whitish, sometimes brownish, especally at the beaks."

"*Dimensions.*—Length, 9 lines, breadth 10 lines, depth 6 lines."

Observations.—Davidson states that, "After careful study and comparison with an extensive series of New Zealand types, I am led to the conclusion that *Rhynchonella pyxidata* is merely a local variety of *R. nigricans*." From the present standpoint, after an examination of many other variants of this series, which for convenience are given specific rank, we are inclined to regard *T. pyxidata* as distinct, on the grounds of having a more incurved beak, a less subtrigonal outline, whilst the costation is much finer and the ribs are more distinctly burfurcated towards the anterior commissure. Davidson also remarks that *T. pyxidata* "seems absolutely undistinguishable" from McCoy's "*Rhynchonella*" *coelata* from Table Cape. The Table Cape species, however, appears to have a less acute beak, which is not so strongly incurved; the shell is more elongated transversely, and the tegulation is always well developed, whereas in *T. pyxidata* the growth-lines are is an incipient stage.

In a communication recently received, Dr. Thomson strongly confirms our idea of the specific distinction of *T. pyxidata*. He also points out that the New Zealand *squamosa* has conjunct deltidial plates, whereas in *pyxidata* they are discrete.

Occurrence.—Recent. Dredged by the "Challenger," south of Kerguelen Islands, at a depth of 150 fathoms.

12.—TEGULORHYNCHIA SUBLAEVIS, Thomson, sp.

Hemithyris sublaevis, Thomson, 1918, p. 117, see also p. 108.

Description.—A small species with a short beak, narrowly and strongly folded, with numerous fine ribs, little imbricated and in many specimens almost obsolete. (From Dr. Thomson's notes.).

Dimensions.—Length, 10 mm.; breadth, 10.5 mm.; thickness, 7 mm.

Occurrence.—(?) Oligocene. Type locality, Everett's Limestone Quarry, Kakanui, Oamaru District.

Acknowledgments.

In the preparation of this paper we desire to express our great obligations to Dr. Allan Thomson, M.A., Director of the Dominion Museum, Wellington, who has sent us on loan a most representative collection of New Zealand fossil rhynchonellids, and has presented the topotype of Hutton's *T. squamosa* to the National Museum. In addition he has taken a lively interest in our work, and we have had from him many valuable suggestions.

Our acknowledgements are also due to Mr. J. A. Kershaw, F.E.S., Curator of the National Museum, for kindly supplying us with the recent examples of *Hemithyris psittacea* and *T. nigricans*, from the zoological collections.

To Mr. F. A. Cudmore our best thanks are due for his kindness in placing in our hands the whole of his fine collection of rhynchonellids, for use in descriptive work; and for donating the specimens we have figured, to the National Museum collection.

We have also made use of a topotype of *T. squamosa* kindly sent by Mr. P. Morgan, Director of the Geological Survey of New Zealand, who has also supplied localities of New Zealand specimens in the National Museum, and to him our thanks are due.

We express our best thanks to Mr. F. A. Singleton, M.Sc., for bringing under our notice several references.

To. Mr. H. Finlay we are indebted for a collection of rhynchonellids from Target Gully, New Zealand, which has been useful in our descriptive work.

V.—Summary.

1.—The austral forms of the "*nigricans* series," to which we give the new generic term, *Tegulorhynchia*, constitute a zoological group distinct from the boreal generic type, *Hemithyris*.

2.—The examination of the more spinous members of the genus *Tegulorhynchia*, including *T. coelospina* and *T. doederleini*, confirms the assumption that they have no relationship with the spinous genus, *Acanthothyris*, D'Orbigny, of Jurassic age, but are variants, not necessarily senescent, in which the tegulation is carried to an extreme in the form of redundant ornament.

3.—From an examination of the Australian Mesozoic rhynchonellid fauna, it is postulated that, the Cainozoic species of the *Tegulorhynchia* series have probably evolved from a Jurassic form like that of *Burmirhynchia*, Buckman, and without the intervention of the *Cyclothyris* type, which seems to have been entirely confined to the Cretaceous of Europe.

4.—The particular form which appears to be in the direct line of descent, and which is of Australian occurrence, is the well-known European type, "*Rhynchonella*" *variabilis*, Schlotheim, sp.

5.—The majority of form of *Tegulorhynchia* point to the fact that they were mainly inhabitants of shallow to moderately deep water, probably ranging from shore-line to several hundred fathoms.

6.—Twelve species are here arranged under the genus *Tegulorhynchia*, of which two are new, namely, *T. coelospina* and *T. thomsoni*.

7.—Our present knowledge of the distribution of the genus, both living and fossil, includes Patagonia, Brazil, Antarctica, Kerguelen Island, New Zealand, Victoria, Tasmania and South Australia.

8.—The doubtful record, as an Australian fossil, of "*Rhynchonella baileyana*" has been examined in the light of the figured specimen, and it is here definitely referred to the European species, *Cyclothyris limbata*, Schlotheim, sp.

VI.—Bibliography.

1910.—Buckman, S. S. "Antarctic Fossil Brachiopoda." Schwed., Sud-polar Exped., vol. III., pt. 7.

1917.—Buckman, S. S. "The Brachiopoda of the Namyamu Beds, Northern Shan States, Burma." Mem. Geol. Surv. India. N.S., vol. III., Mem. 2.

1914.—Chapman, F. "Australasian Fossils." Melbourne.

1852.—Davidson, T. "Fossil Brachiopoda of Great Britain." Pt. II. (Pal. Soc. Mon.).

1852.—Davidson, T. "Monograph of British Oolitic and Liassic Brachiopoda." Pt. III. (Pal. Soc. Mon.).

1854.—Davidson, T. "British Cretaceous Brachiopoda." Pt. II. (Pal. Soc. Mon.).

1880.—Davidson, T. "Report on the Brachiopoda, Voyage of H.M.S. 'Challenger.'" Zool., vol. I.

1886.—Davidson, T. "On a Living spinous *Rhynchonella* from Japan." Annals and Magazine Nat. History. Ser. V., vol. XVII.

1887.—Davidson, T. "Monograph of Recent Brachiopoda." Trans. Linn. Soc. Lond. Zool. Ser. II., vol. IV., pt. II.

1892.—Etheridge, R. jnr. "Geology and Palaeontology of Queensland and New Guinea." Brisbane.

1902.—Etheridge, R. jnr. "The Cretaceous Mollusca of South Australia and the Northern Territory." Mem. Roy. Soc. South Australia, Vol. II., pt. I.

1887.—Fischer, P. "Manuel de Conchyliologie." Paris.

1905.—Hedley, C. "Mollusca from One hundred and eleven fathoms, East of Cape Byron, N.S.W." Records Australian Museum. Vol. VI., pt. 2.

1873.—Hutton, F. W. "A Catalogue of the Tertiary Mollusca and Echinodermata of New Zealand." Wellington.

1905.—HUTTON, F. W. "Revision of the Tertiary Brachiopoda of New Zealand." Trans. N.Z. Inst., vol. XXXVII.

1897.—IHERING, H. VON. "Os Molluscos dos Terrenos Terciarios da Patagonia." Revista do Museo Paulista. Vol. II.

1903.—IHERING, H. VON. "Les Brachiopodes Tertiares de Patagonie." Annales del Museo Nacionale du Buenos Aires. Ser. III., vol. II.

1901.—JOUBIN, W. "Resultat du Voyage du S. Y. 'Belgica,' en 1897-1899." Zool.

1880.—KIRK, T. W. "List of Marine Mollusca found in the Neighbourhood of Wellington." Trans. N.Z. Inst., vol. XII.

1822.—MANTELL, G. A. "Geology of Sussex."

1870.—MOORE, C. "Australian Mesozoic Geology." Quart. Journ. Geol. Soc., vol. XXVI., pt. 2.

1901.—ORTMANN, A. E. "Tertiary Invertebrates." Report Princetown Expedition, Patagonia, vol. IV. Palaeontology.

1813.—SCHLOTHEIM, E. F. Leonhard's Taschenbuch, vol. VII.

1911.—SCHUCHERT, C. "Palaeogeographic and Geological Significance of Recent Brachiopoda." Geological Society of America. Bulletin, vol. XXII.

1913.—SCHUCHERT, C. "Brachiopoda." in Zittel. Text-book of Palaeontology. Transl. by Eastman. Vol. I., 2nd. Ed.

1846.—SOWERBY, G. B. "Description of Thirteen New Species of Brachiopoda." Proc. Zool. Soc. Lond.

1864.—SUESS, E. "Fossile Mollusken aus Neu Seeland." Pal. Neu Seeland; Reise der Oisterreich. Freg. Novara. Geol. Theil, I., Abth. I.

1880.—TATE, R. "Australian Tertiary Palliobranchs." Trans. Roy. Soc. South Australia. Vol. III.

1885.—TATE. R. "Miscellaneous Contributions to the Palaeontology of the Older Rocks of Australia." Southern Science Record. Vol. I. (N.S.). No. 1.

1886.—TATE, R. "Supplemental on the Palliobranchs of the Older Tertiary of Australia," and a New Species of Rhynchonella." Trans. Roy. Soc. South Australia. Vol. IX.

1899.—TATE, R. "A Revision of the Older Tertiary Mollusca of Australia." Trans. Roy. Soc. South Australia. Vol. XXIII.

1915.—THOMSON, J. A. "Recent and Tertiary Rhynchonellids." Geol. Mag. Septr.

1918.—THOMSON, J. A. In Park,—"Geology of the Oamaru District, North Otago (Eastern Otago Division)." Bull. N.Z. Geol. Surv. No. 20. (N.S.).

1918 (2).—THOMPSON, J. A. "Brachiopoda. Australian Antarctic Expedition," 1911-1914. Ser. C. Zool., vol. IV., pt. 3.

1878.—WOODS, J. E. T. "Tertiary Deposits of Australia." Journ. Roy. Soc. N.S. Wales, vol. XI.

VII.—EXPLANATION OF PLATES.

Plate XI.

Fig. 1.—*Tegulorhynchia squamosa*, Hutton, sp. Dorsal view of the topotype. Trelissick, Basin, New Zealand. Miocene (Oamaruian). Coll. Dr. J. A. Thomson. Circ., 2 diameters.

„ 2.—*T. squamosa*, Hutton, sp. Ventral view of fig. 1. Circ., 2 diameters.

„ *T. coelata*, T. Woods, sp. Dorsal view. Waurn Ponds, near Geelong. Miocene (Janjukian). Dennant coll. Neotype, from a similar horizon to T. Woods' specimen, but from different locality. Circ., nat. size.

„ 4.—*T. coelata*, T. Woods, sp. Ventral view of fig. 3. Circ., nat. size.

„ 5.—*T. thomsoni*, sp. nov. Ventral view. Table Cape, Tasmania. Miocene (Janjukian), Crassatellites Bed. Dennant coll. Circ., nat. size.

„ 6.—*T. thomsoni*, sp. nov. Dorsal view of fig. 5. Circ., nat. size.

„ 7.—*T. coelospina*, sp. nov. Dorsal view. Table Cape, Tasmania. Miocene (Janjukian). Crassatellites Bed. Dennant coll. Circ., 2 diameters.

„ 8.—*T. tubulifera*, Tate, sp. Part of Dorsal valve. Polyzoal Limestone, junction of Grange Burn, Muddy Creek. Miocene (Janjukian). Dennant coll. Circ. 2 diameters.

„ 9.—*T. nigricans*, Sowerby, sp. Dorsal view. Trelissick Basin, New Zealand. Awamoan (Upper Miocene). Von Haast coll., Nat. Mus. Circ., nat. size.

„ 10.—*T. nigricans*, Sow., sp. Dorsal view. New Zealand. Recent. Nat. Mus. coll. Circ., nat. size.

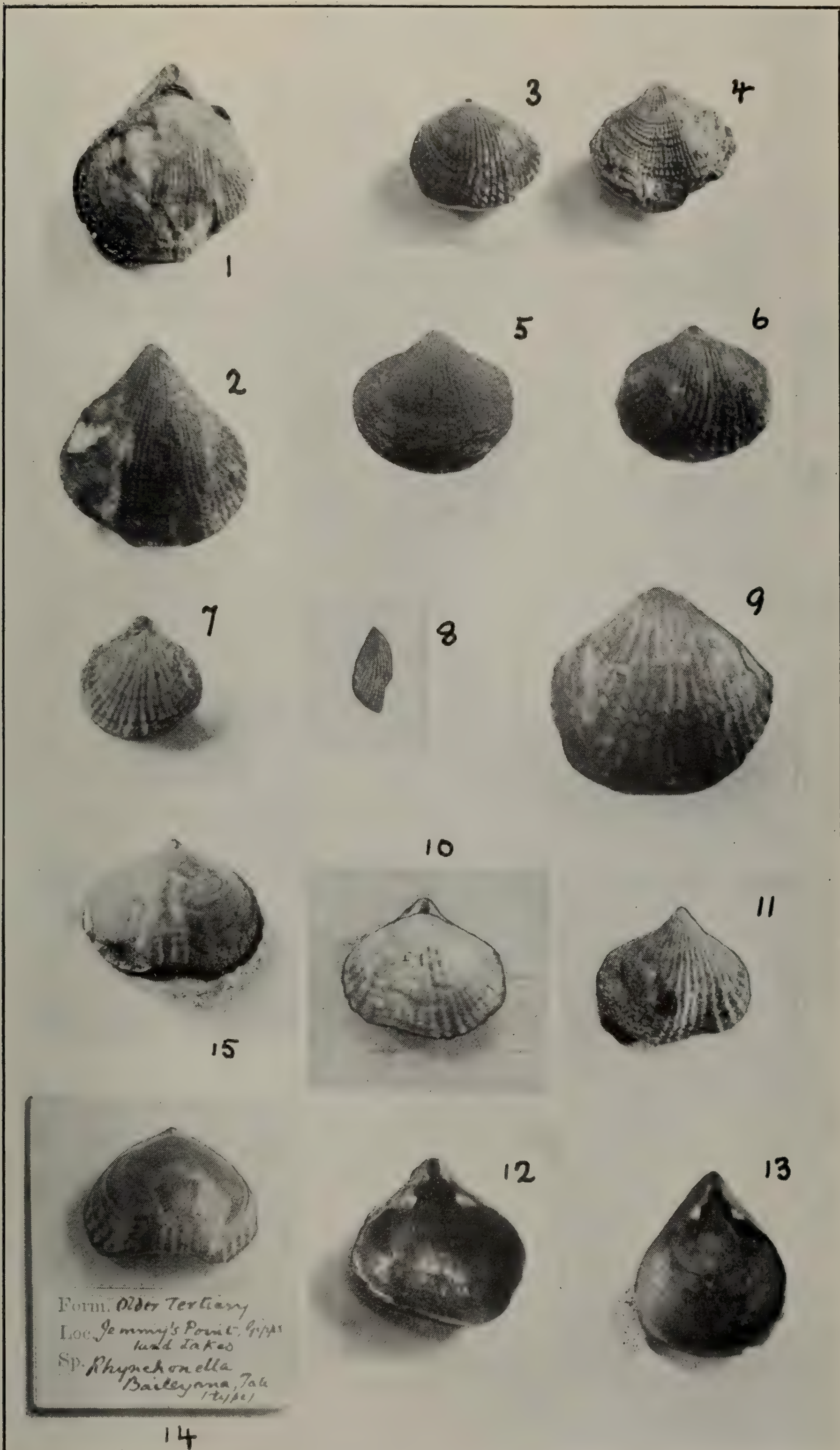
„ 11.—*T. nigricans*, Sow., sp. Ventral view of fig. 10. Circ., nat. size.

„ 12.—*T. nigricans*, Sow., sp. Internal view of ventral valve, showing dental plates. New Zealand. Recent. Nat. Mus. coll. Circ., nat. size.

„ 13.—*Hemithyris psittacea*, Chemnitz, sp. Internal view of ventral valve, showing dental plates. Northern Seas. Recent. Nat. Mus. coll. Circ., nat. size.

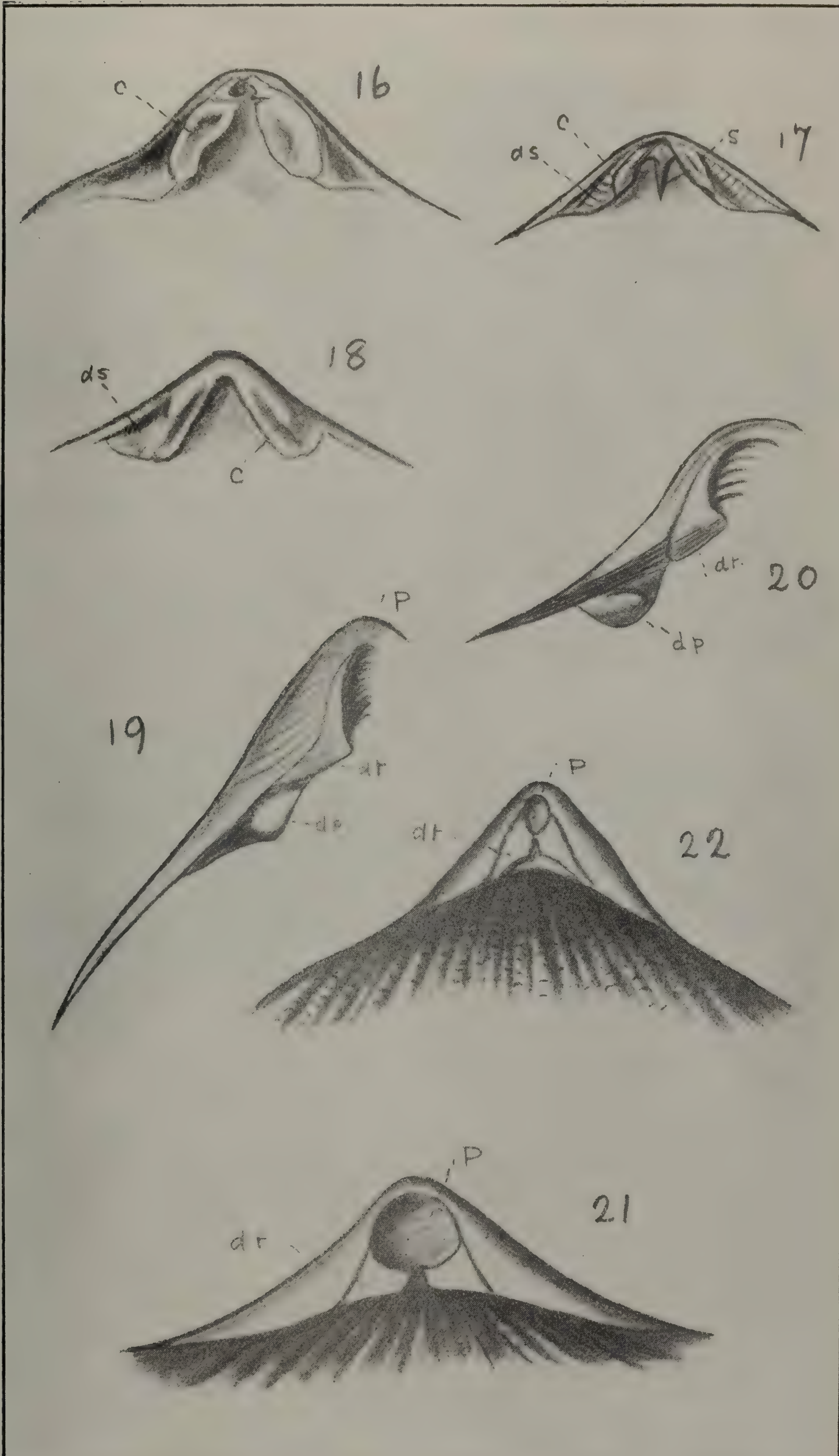
„ 14.—"*Rhynchonella baileyana*," Tate. Dorsal view of Tate's type specimen. The supposed fossil from Jemmy's Point, Gippsland Lakes. = *Cyclothyris limbata*, Schlotheim, sp. The figured specimen from the Adelaide Museum. Circ., nat. size.

„ 15.—*Cyclothyris limbata*, Schlotheim, sp. Dorsal view. Ciply, Belgium. Upper Cretaceous (Senonian). Nat. Mus. coll. Circ., nat. size. Typical example for comparison with Tate's *R. baileyana*.



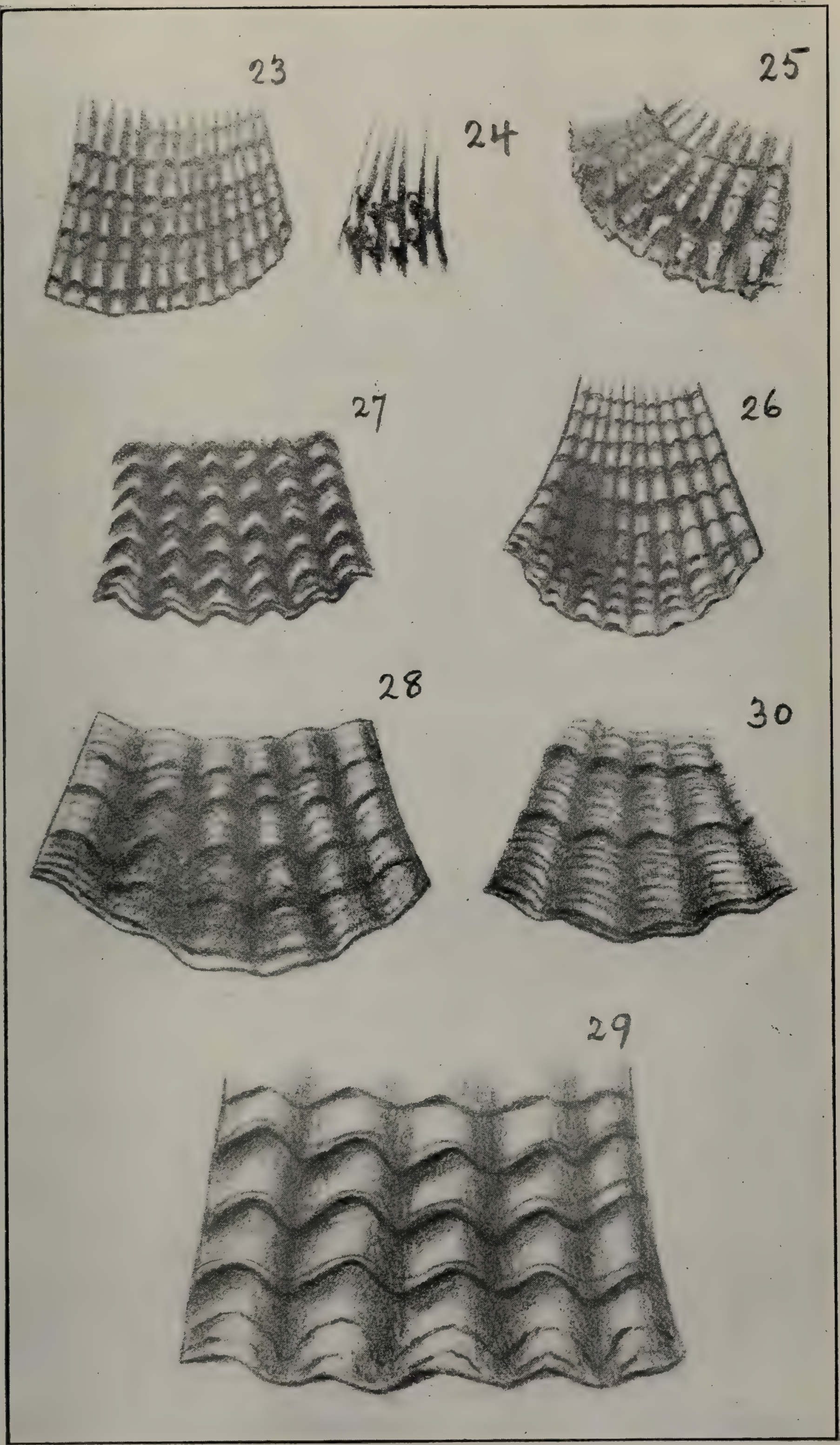
F. C. Photo

Rhynchonellids: Cretaceous, Cainozoic and Recent



I.C. et F.C. ad nat. del.

Crura and Deltidia of Rhynchonellids × 5 diam.



I.C. et F.C. ad nat. del.

Surface Ornament in Tegulorhynchia, gen. nov.

Plate XII.

All figures on this plate enlarged five times.

Fig. 16.—Crura of *Hemithyris psittacea*, Chemnitz, sp. North Seas. Recent.

,, 17.—Crura of *Tegulorhynchia coelata*, T. Woods, sp. Table Cape, Tasmania. Miocene (Janjukian). F. A. Cudmore coll.

,, 18.—Crura of *T. thomsoni*, sp. nov. Table Cape, Tasmania, Miocene (Janjukian). F. A. Cudmore coll.

,, 19.—Dental plate of *Hemithyris psittacea*, Chemn., sp. North Seas. Recent.

,, 20.—Dental plate of *Tegulorhynchia coelata*, T. Woods, sp. Table cape, Tasmania. Miocene (Janjukian). Dennant coll.

,, 21.—Pedicle aspect of *T. thomsoni*, sp. nov. Table Cape, Tasmania. Miocene (Janjukian). F. A. Cudmore coll.

,, 22.—Pedicle aspect of *T. squamosa*, Hutton, sp. New Zealand, Ototaran. J. A. Thomson, coll.

Legend.—P., pedicle passage; c., crural lobes; d.s., dental sockets; dt., deltidial plates; dp., dental plates; s., septum.

Plate XIII.

Surface Ornament.—All figures on this plate enlarged five times.

Fig. 23.—*Tegulorhynchia* (?) *tubulifera*, Tate, sp. From the dorsal valve. Muddy Creek. Oligocene (Balcombian). F. A. Cudmore coll.

,, 24.—*T. tubulifera*, Tate, sp. From side of ventral valve. Grange Burn, Muddy Creek. Miocene (Janjukian). Dennant coll.

,, 25.—*T. coelospina*, sp. nov. From side of ventral valve. Table Cape, Tasmania. Miocene (Janjukian). Dennant coll.

,, 26.—*T. squamosa*, Hutton, sp. From sinus of ventral valve. Trelissic, New Zealand. Ototaran. J. A. Thomson coll.

,, 27.—*T. coelata*, T. Woods, sp. nov. From sinus of ventral valve. Waurn Ponds, near Geelong. Miocene (Janjukian). Dennant coll.

,, 28.—*T. thomsoni*, sp. nov. From sinus of ventral valve. Table Cape, Tasmania. Miocene (Janjukian). F. A. Cudmore, coll.

,, 29.—*T. nigricans*, Sowerby, sp. From sinus of ventral valve, Amuri District, North Canterbury. Tertiary (?Up. Miocene). Von Haast coll., in Nat. Mus.

,, 30.—*T. nigricans*, Sow., sp. From sinus of ventral valve. New Zealand. Recent. Dredged.

[Proc. Roy. Soc. Victoria, 35 (N.S.), Pt. II., 1923.]

Art. XIX.—*Contributions from the National Herbarium of Victoria, No. 3.**

By J. R. TOVEY and P. F. MORRIS.

[Read 14th December, 1922.]

The present paper contains, (1) a description of a new species of Kunzea from West Australia, *Kunzea sulphurea;* (2) records of new regional distribution of native and introduced plants; (3) a new introduction in Victoria; (4) alterations in the botanical nomenclature of plants in accordance with article 48 of the (*Rules of the*) Vienna Botanical Congress (1905); (5) additions to the Introduced Flora of Coode Island, in which six exotic plants have been recorded for the first time.

Kunzea sulphurea, sp. nov.

Frutex ramosus 5m. altus; foliis oblongis-cuneatis 3-4 mm. longis, 1-1.5mm. latis; bracteis 3mm. longis, 2-2.5mm. latis; bracteolis angustioribus. Petalis sulphureis.

A tall, almost arborescent, glabrous shrub up to 18 feet high. Leaves alternate, very shortly petiolate, 3-4 mm. long, 1-1.5mm. broad, oblong-cuneate, obtuse or slightly acuminate, flat, erect or slightly recurved, imbricate on the younger branchlets. Flowers glabrous, sessile, about 20 in a terminal globular head—the branches growing through after flowering; the rhachis pubescent. Bracts ovate, boat shaped, scarious, 3 mm. long, 2 mm. broad, veins plainly visible. Bracteoles narrower. Calyx tube 3-4mm. long, ovoid, glabrous sometimes ridged at the base, oil dots conspicuous; lobes small, ⅓ length of petals, ovate, obtuse. Petals yellow, about ½ the size of the calyx tube. Stamens about 30, nearly 3 times as long as the petals. Ovary 5-celled, about 6 ovules in each cell. Seeds black, oblong. Immature capsule, 3-4 mm. diameter.

Habitat.—Big Brook, Warren District, Western Australia, Max Koch, No. 2539, Nov. 1920.

Placed in the section *Eukunzea* near *K. micrantha.*

Crassula exserta (Reader) Ostenf. (*Crassulaceae*).

Flinders Island, Tasmania, Dr. C. S. Sutton, Nov., 1912.

This plant was previously recorded from Victoria only.

Statice Thouini, Viv. "Thouin's Sea Lavender," (Plumbaginaceae).

Mt. Wycheproof, Rev. W. W. Watts, Nov. 1916; Birchip, Oct., 1918; Ouyen, Mr. McGregor, October, 1922.

*No. 2 in the Proc. Roy. Soc. Vic., Vol. 35, pt. I.

This plant, which was recorded as a garden escape in Proc. Roy. Soc. Vict. XXX. (1918), has now evidently established itself as a naturalized alien in the north-western districts of Victoria.

Bromus Cebadilla, Steud. "Chillian Brome Grass." (*Gramineae*).

Ovens Vale, Victoria, H. M. Campbell; June, 1922.

A new locality in Victoria for this introduced grass. It has a fair pasture value, but is not in the first rank of fodder plants.

Tradescantia fluminensis, Vell. "Water Spiderwort." (Commelinaceae).

Sandringham, Victoria, A. J. Tadgell, Oct., 1922.

This plant, a native of Brazil, may be classed as an exotic not yet sufficiently established to be considered naturalised.

The following, collected at Wattville by Mr. O. B. O'Dowd, have not been previously recorded from the north-eastern districts of Victoria:—*Craspedia chrysantha*, Benth.; *Eritrichium australasicum*, A.D.C.; *Eutaxia empetrifolia*, Schlech.; *Helipterum Jesseni*, F.v.M.; *Myriocephalus rhizocephalus*, Benth.; *Panicum prolutum*, F.v.M.

Alterations in accordance with article 48 of the Vienna Botanical Congress (1905).

Cladium acutum, (Lab.) Poir., syn. (*Cladium schoenoides, R. Br., Schoenus acutus*, Lab). (*Cyperaceae*).

Cladium capillaceum, C. B. Clark., syn. (*Elynanthus capillaceus*, Benth., *Schoenus capillaris*, F.v.M.), *Cyperaceae.*)

Cladium tetragonum, (Lab.), J. M. Black., syn. (Lepidosperma *tetragona*, Lab., *Cladium tetraquetrum*, Hook, f.). (*Cyperaceae*).

Distichlis spicata (L.), Greene., syn. (*Uniola spicata*, L., *Distichlis maritima, Rafin.*).

Helichrysum cuneifolium, (D.C.), comb., nov. (*Cassinia cuneifolia*, D.C., (1837)). (*Ozothamnus Backhousii*, Hook, f., (1860). (*Helichrysum Backhousii*, F.v.M., (1866), (*Compositae*).

De Candolle's original specific name has priority over that of Mueller's. A native of Victoria and Tasmania.

Helichrysum lepidophyllum (D.C.), comb., nov. (*Baccharis lepidophylla*, D.C., (1837), *Ozothamnus lepidophyllus*, Hook, f., (1847); *Helichrysum baccharoides*, F.v.M., (1886). (*Compositae*).

De Candolle's original specific name has priority over that of Mueller's. A native of Victoria, New South Wales and Tasmania.

Helichrysum oblongifolium, comb., nov. (*Helichrysum cuneifolia*, F.v.M., (1866)). (*Compositae*).

As we have already a *H. cuneifolium* (*Cassinia cuneifolia*, D.C., (1837)), we have given this plant the name of *H. oblongifolium*. It is a native of Victoria and New South Wales.

HELICHRYSUM STEETZIANUM, comb., nov. (*Helichrysum lepidophyllum* F.v.M., (1866); *Ozothamnus lepidophyllus*, Steetz., (1844-5)). (Compositae).

As we have already a *H. lepidophyllum* (*Baccharis lepidophylla*, D.C., (1837)), we have given the name of *H. Steetzianum* to this plant, It is endemic to Western Australia.

IMPERATA CYLINDRICA, (L.), Beauv. (*Lagurus cylindricus*, L., *Imperata arundinacea*, Cyr.). (*Gramineae*).

POA DRUMMONDI, Nees. (*Poa nodosa*, Nees); (*Gramineae*).

SCIRPUS AMERICANUS, Pers. (*S. pungens*, Vahl); (*Cyperaceae*).

SCIRPUS ANTARCTICUS, L. (*S. cartilagineus*, Poir.; *Isolepis cartilaginea*, R. Br.); (*Cyperaceae*).

ADDITIONS TO THE INTRODUCED FLORA OF COODE ISLAND.

The following specimens were collected at Coode Island, Victoria, and as they did not agree exactly with the material in our Herbarium, they were submitted to the Director of the Royal Botanic Gardens, Kew, England, for comparison with the material in the Kew Herbarium. The specimens were there identified as follow:—

AGATHOSMA APICULATA, E. Mey. (Rutaceae). J. R. Tovey, Nov. 1912.

ANTHERICUM LONGIFOLIUM, Jacq. (Liliaceae). J. R. Tovey, Nov, 1912.

CAPNOPHYLLUM AFRICANUM, Koch. (*Umbelliferae*). J. R. Tovey and C. French, jnr., March 1912; Geelong Foreshore. H. B. Williamson, (No. 1270), November, 1906.

PASSERINA FILIFORMIS, L. (*Thymelaeaceae*); J. R. Tovey and C. French, jnr., October, 1908.

PHACELIA TANACETIFOLIA, Benth. (*Hydrophyllaceae*). J. R. Tovey, Nov., 1908.

SUTERA FLORIBUNDA, O'Ktze. (*Scrophulariaceae*). J. R. Tovey, Dec., 1908.

They are all natives of South Africa, with the exception of *Phacelia tanacetifolia*, Benth., which is a native of California. All may be classed as exotics not yet sufficiently established to be considered naturalised.

TRICHINIUM OBOVATUM, Gaud., var. GRANDIFLORUM, Benth.; syn. (*Trichinium incanum*, R. Br., var. *intermedium*, Ewart and White); (*Amarantaceae*).

Warrana, South Australia. (Elder Exploring Expedition) R. Helms, May, 1891.

T. incanum, var. *intermedium* was described in the Proc. Roy. Soc. Vic., Vol. 22, p. 97 (1909), as a new variety. The plant has the broad glabrous (or nearly so) bracts, the longer perianth and the ovary slightly hairy on the top, as in *T. obovatum*, and as it agrees in other respects with the variety *grandiflorum*, Benth., of *T. obovatum*, Gaud., it must be transferred to that variety.

ANNUAL REPORT OF THE COUNCIL.

For the Year 1922.

The Council herewith presents to Members of the Society the Annual Report and Statement of Receipts and Expenditure for the past year.

The following meetings were held:—

March 9th.—Annual Meeting.

The following Office-bearers retired by effluxion of time:—President, Professor Ewart; Vice-Presidents, F. Wisewould, Professor Laby; Hon. Treasurer, W. A. Hartnell; Hon. Librarian, A. S. Kenyon; Hon. Secretary, J. A. Kershaw; Members of Council, Professor Skeats, Professor Agar, Dr. Green, Messrs. Chapman, Herman, Shepherd.

The following were elected:—

President, F. Wisewould; Vice-Presidents, Professor Laby, Dr. Baldwin; Hon. Treasurer, E. Kidson; Hon. Librarian, A. S. Kenyon; Hon. Secretary, J. A. Kershaw; Members of Council, Professor Skeats, Professor Agar, Dr. Green, Messrs. Chapman, Herman, Shepherd, Gray.

The Annual Report of the Council, and Financial Statement were read and adopted.

At the close of the Annual Meeting, an ordinary meeting was held. Exhibits: Professor E. W. Skeats showed glacial and other rocks from Mt. Kosciusko, and gave a detailed account of their occurrence. Mr. F. Chapman showed an example of Callus in wood of the Grey Box, probably induced by a fungus, and some remarkable Sea Urchins recently added to the fossil collection of the National Museum. Professor W. A. Osborne showed and described tests for Colour Blindness. Professor T. H. Laby exhibited Double Thermo-couple for determining Recalescence Temperature of Metals. Mr. R. T. Patton showed examples of structure of wood of Moreton Bay Fig.

Mr. George Lancelot Thirkell, B.Sc., and Mr. John Lloyd Strevens were elected Members.

April 20th.—Papers: (1) "New or Little-known Fossils in the National Museum, Part 26. Some Tertiary Mollusca." By F. Chapman, A.L.S. (2) "On Coprosma Baueri, End." By John Shirley, D.Sc., and C. A. Lambert. (3) "Description of a New Victorian Helichrysum." By H. B. Williamson. (4) "Notes on Some Australian Asilidæ (Diptera) in the National Museum." By G. H. Hardy. (5) "Studies in Australian Lepidoptera." By A. Jefferis Turner, M.D., F.E.S.

Mr. Leslie R. Brookes, B.A., and Mr. P. F. Morris were elected Associates.

May 11th.—Lecture: Captain G. H. Pitt-Rivers delivered a lecture on "A Study in Social Anthropology in an Island of the Bismarck Archipelago." The lecture was illustrated by an excellent series of lantern slides, and a large number of native implements and other objects, and was followed by a discussion.

Mr. W. A. Watt was elected a Member, Dr. A. Jefferis Turner a country Member, and Messrs. R. B. Pretty and H. M. Treloar Associates.

June 8th.—Papers: (1) "On the Drying of Timber." By Reuben T. Patton, B.Sc., M.F. (2) "Contributions from the National Herbarium of Victoria." No. 2. By J. R. Tovey, and P. F. Morris.

Miss K. A. Gilman Jones, Dr. H. Flecker and Mr. J. B. Hosking were elected Associates.

July 13th.—Papers: (1) "Gravity Determinations in Australia." By E. F. J. Love, M.A., D.Sc., F.R.A.S. (2) "Revision of the Genus Pultenaea." Part III. By H. B. Williamson, F.L.S. (3) "Two New Species of Bryozoa." By W. M. Bale, F.R.M.S. Lecture: Mr. C. J. Merfield delivered a lecture on "The Total Solar Eclipse of September, 1922." The lecture was well illustrated by lantern slides.

Miss Leslie Ruth Kerr and Mrs. G. R. Thompson, were elected Associates.

August 10th.—Papers: (1) "The Occipital Bones of the Dipnoi." By Harley S. Baird, B.Sc. (Communicated by Professor W. E. Agar). (2) "New Australian Coleoptera, with notes on some previously described species." Part II. By T. Erasmus Wilson. (3) "The Relationship between Dacite and Granodiorite in Victoria." By H. Summers, D.Sc. Exhibits: Mr. D. J. Mahony showed Geological Specimens from the Kimberley District, West Australia. Dr. G. Horne exhibited some Aboriginal Feather Head Ornaments from Lake Eyre District, South Australia. Mr. Ernest Edward Trinder was elected a Member and Miss M. Cousins, and Messrs. John Strickland, R. G. Thomas, B.Ag.Sc., and C. Oke, Associates.

September 14th.—Paper: "Aboriginal Cylindro-Conical Stones." By George Horne, M.D. Lecture: Professor Orme Masson delivered a lecture on "The Structure of the Atom in its Chemical Aspect."

October 12th.—Lecture: Mr. H. Herman delivered a lecture on "Brown Coal." The lecture was illustrated by an interesting series of lantern slides. Exhibit: Dr. Baldwin showed photographs of the Total Solar Eclipse taken by the Melbourne Observatory Eclipse Party at Goondiwindi, Queensland, on September 21, 1922.

Mr. Joseph Dunstan and Mr. Alan Showers were elected Associates.

November 9th.—Papers: (1) "The Increasing Run-off from the Avoca River Basin." By E. T. Quayle, B.A. (2) "Additions to Australian Ascomycetes." No. I. By Ethel McLennan, D.Sc., and Isabel C. Cookson, B.Sc. (3) "The Specific Identity of Bacillus parabotulinus." By H. R. Seddon, D.V.Sc. (Communicated by Professor H. A.

Woodruff). (4) "The High Frequency K Series Absorption Spectra of Erbium." By L. H. Martin, B.Sc. (Communicated by Professor T. H. Laby). Exhibits: Mr. F. Chapman showed a copy of a pre-Linnean work on Shells from the shore of Arimini, written by Janus Plancus (Giovanni Bianchi) and published in 1739. The signature of Janus Plancus on the fly-leaf is interesting as, according to British Museum authorities, there is no other known. Mr. E. J. Dunn showed specimens of Maldovites from Bohemia, and Billitonites from Dutch East Indies.

Messrs W. Baragwanath, S. F. Mann, and E. G. Austin were elected Members.

December 14th.—Messrs. J. E. Gilbert and A. E. V. Richardson, M.A., B.Sc., were elected Honorary Auditors. Papers: (1) "The Austral Rhynchonellacea of the Nigricans Series, with description of the new genus Tegulorhynchia." By F. Chapman, A.L.S., and Irene Crespin, B.A. (2) "Contributions from the National Herbarium of Victoria." No. III. By J. R. Tovey, and P. F. Morris. Exhibits: Professor Skeats showed examples of Varves from the Upper Carboniferous of New South Wales, and Lower Cambrian of South Australia. Mr. R. T. Patton, B.Sc., M.F., formerly an associate, was elected a Member.

During the year eight members, one country member, and fifteen associates were elected, including one associate elected as a member. Ten members, five country members, and fourteen associates resigned, and two members and one associate died.

It is with much regret the Council has to record the losses, by death, of Mr. William A. Hartnell, Mr. A. J. Higgin, F.I.C., and Mr. William Stickland.

Alfred James Higgin, F.I.C., was born in Manchester, and trained at Owen's College, and at Zurich. He came to Ballarat over 30 years ago as Lecturer at the Ballarat School of Mines, and later was appointed Lecturer in Metallurgy at the Adelaide School of Mines, and Demonstrator in Chemistry at the Adelaide University. About 1911 he was appointed Lecturer in Metallurgy at the University of Melbourne. Mr. Higgin was a skilled metallurgist and chemist, and many of the present mining men of Australia received their training under him. His published work includes many papers on organic and inorganic chemistry, and during the war he furnished a valuable report on the manufacture of alloys for use in special stunts. He died in London on July 18, 1922.

Mr. Hartnell joined the Society in 1900, and for thirteen years occupied the position of Hon. Treasurer. In 1921, owing to continued ill-health, he was compelled to relinquish the duties of the position, which he had carried out in a particularly conscientious manner. He took a very keen interest in the work of the Society, and occupied the chair on several occasions. He died on June 21, last, in his 69th year.

Mr. William Stickland was for many years Assistant-Secretary to the Society, during which his valued assistance and uniform courtesy won for him the respect and esteem of the Council and members generally. In 1914, on resigning his position, he became an associate, and kept up his interest in the work of the Society.

The attendance at the Council meetings were as follows:—Mr. Wisewould, 10; Mr. Chapman, 10; Professor Skeats, 9; Mr. Kershaw, 9; Assoc. Professor Summers, 8; Mr. Richardson, 7; Mr. Kidson, 7; Dr. Green, 6; Mr. Picken, 6; Mr. Gray, 6; Mr. Dunn, 6; Mr. Kenyon, 6; Professor Laby, 4; Professor Agar, 4; *Dr. Baldwin, 4; Mr. Herman, 4; *Professor Osborne, 2; *Mr. Shepherd, 1.

The attendances at the ordinary meetings during the year continued satisfactory, and the interest in the work of the Society has been maintained. The continuance of the short, popular lectures on subjects of general interest has been justified by the large attendances. Four of these lectures were delivered during the year by Captain G. H. Pitt-Rivers, Mr. C. J. Merfield, Professor Orme Masson, and Mr. H. Herman.

An important event during the year was the visit to Melbourne of the Wallal Solar Eclipse Party of Astronomers. This Society cooperated with the Melbourne University in arranging a welcome. A reception was held in the Club House at the University on Wednesday, August 9, by the Chancellor of the University, and the President of this Society, and a lecture on the 1922 Solar Eclipse, by Dr. Campbell, Director of the Lick Observatory, was delivered in the Melba Hall. Both of these functions were largely attended.

The Australasian Association for the Advancement of Science held its meeting at Wellington, New Zealand, on January 11.

The Hon. Librarian reports that 2167 volumes and parts were added to the Library during the year. The Assistant-Librarian continued the work of revising the card catalogue, which is now up-to-date. The matter of shelf space for additions is giving some concern, as many publications, which should be placed in the general library, have had to be placed in the store room. Owing to lack of funds no binding was undertaken.

Part II. of Volume XXXIV. of the Proceedings was issued on May 31, and Part I. of Volume XXXV. on December 7. Part II. of this volume is now in the printer's hands, and will be available at an early date.

Mr. P. F. Morris was appointed Hon. Assistant-Treasurer, and has rendered valuable service.

The financial question has caused the Council much concern, owing chiefly to the continued high cost of printing, and to some extent to the heavy charges for postage. The drain on the Society's limited resources has been serious, and necessitated some restriction in both

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* Absent on leave.

printing matter and illustrations. With a view to a reduction in the cost of publishing the Proceedings, a sub-committee was appointed to enquire into the matter, with the result that it was decided to adopt a smaller type. This, while maintaining the general standard of the publication, enabled a substantial saving of approximately £50 to be made on each volume.

The fence behind the caretaker's cottage, which had become greatly dilapidated, was replaced at a cost of £32.

Financial Statement for the year ending 28th February, 1923.

RECEIPTS.

Balance at 1st March, 1922		£31 7 10
Subscriptions—		
Members—Subs. in arrears	£37 16 0	
„ for 1922	132 6 0	
„ for 1923	6 6 0	
Associates—		
Subs. in arrears	38 17 0	
„ for 1922	69 6 0	
„ for 1923	2 2 0	
Country Members –		
Subs. in arrears	5 5 0	
„ for 1922	14 14 0	
„ for 1923	2 2 0	
		308 14 0
Rents—		
Com'wealth Government	£75 0 0	
Field Naturalists' Club...	12 0 0	
		87 0 0
Sales of Publications		5 17 6
Victorian State Government Grant in Aid		100 0 0
Donation		2 0 0
Withdrawn from Building Fund in Savings Bank		189 0 2
Exchange on Cheques		0 8 0
		£724 7 6

EXPENDITURE.

Publication, Printing and Postage—		
Printing and Publication	£325 15 7	
Postage	32 3 0	
		£357 18 7
Maintenance—		
Assistant Secretary ...	£30 0 0	
Assistant Librarian ...	12 0 0	
Caretaker's A/cs. ...	18 19 7	
Rates	14 15 8	
Insurance	5 1 3	
Sundries — Gas, Electric Light, etc.	7 7 9	
Repairs	32 13 0	
Petty Cash	4 15 1	
		125 12 4
Lantern for Lectures	3 18 0	
Collector's Commission and Expenses	14 10 10	
Library	5 16 0	
		507 15 9
Petty Cash in Hand		3 1 11
Balance in Bank		213 9 10
		£724 7 6

We have examined Pass Books and hereby certify that all amounts entered herein have been paid to the credit of the Society. We have seen receipts for all payments.

EDWARD KIDSON, *Hon. Treas.*

JAMES E. GILBERT, } *Hon.*
A. E. V. RICHARDSON, } *Auditors.*

Balance of Building Fund in Savings Bank on July 1st, 1922		£144 18 8
Subscriptions still in arrears—		
Members (3)	£6 6 0	
Associates (19)	30 9 0	
		36 15 0

Since completion of above balance, Messrs. Ford & Son's account for Vol. XXXV., Part 1, has been received, and amounts to £132/7/0.

Part 2 of the same volume is estimated to cost £160.

Royal Society of Victoria.

1922.

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HIS EXCELLENCY THE RIGHT HON. THE EARL OF STRADBROKE, K.C.M.G. C.B., C.V.O., C.B.E.

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F. WISEWOULD.

Vice-Presidents:

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J. M. BALDWIN, D.Sc.

Hon. Treasurer:

E. KIDSON, O.B.E., M.Sc.

Hon. Librarian:

A. S. KENYON, C.E.

Hon. Secretary:

J. A. KERSHAW.

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F. CHAPMAN, A.L.S.
D. K. PICKEN, M.A.
PROF. E. W. SKEATS, D.Sc., A.R.C.S., F.G.S.
PROF. W. E. AGAR, F.R.S., M.A., D.Sc.
W. HEBER GREEN, D.Sc.
A. E. V. RICHARDSON, M.A., B.Sc.
H. HERMAN, B.C.E., M.M.E., F.G.S.
PROF. W. A. OSBORNE, M.B., B.CH., D.Sc.
W. GRAY, M.A., B.Sc.

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House Committee:

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F. WISEWOULD.
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Printing Committee:

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THE HON. SECRETARY.
PROF. E. W. SKEATS.

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F. WISEWOULD.
J. A. KERSHAW.

1923.

LIST OF MEMBERS

WITH THEIR YEAR OF JOINING.

[Members and Associates are requested to send immediate notice of any change of address to the Hon. Secretary.]

Patron.

His Excellency The Right Hon. The Earl of Stradbroke

Honorary Members.

Liversidge, Professor A., LL.D., F.R.S., "Field-head," George-road, Coombe Warren, Kingston, Surrey, England. 1892

Verbeek, Dr. R. D. M., Speelmanstraat, 19, s'Gravenhage, Holland. 1886

Life Members.

Fowler, Thos. Walker, M.C.E., "Fernhill," 8 Fitzwilliam-street, Kew. 1879

Gilbert, J. E., 12 Edward-street, Kew, Vic. 1872

Gregory, Prof. J. W., D.Sc., F.R.S., F.G.S., University, Glasgow. 1900

Love, E. F. J., M.A., D.Sc., F.R.A.S., Moreland Grove, Moreland. 1888

Selby, G. W., "Lindisfarne" Scott-grove, E. Malvern. 1881

Smith, W. Howard, "Moreton," Esplanade, St. Kilda ... 1911

Sticht, Rt., B.Sc., M.Am.Inst.M.E., Mt. Lyell Mine, Queenstown, Tasmania. 1913

Ordinary Members.

Addison, Stanley, M.B.E., B.Sc., University, Melbourne. 1921

Agar, Prof. W. E., F.R.S., M.A., D.Sc., University Melbourne. 1920

Austin, E. G., Boeri Yallock, Skipton 1922

Baker, Thomas, Bond-street, Abbotsford 1889

Bale, W. M., F.R.M.S., Walpole-street. Kew 1887

Baldwin, J. M., D.Sc., Observatory, South Yarra 1915

Balfour, Lewis, B.A., M.B., B.S., Burwood-road, Hawthorn.	1892
Baragwanath, W., Geological Survey Dept., Melb. ...	1922
Barrett, A. O., 25 Orrong-road, Armadale	1908
Barrett, Sir J. W., K.B.E., C.M.G., M.D., M.S., Collins-street. Melb.	1910
Brittlebank, C. C., 48 York-street, Caulfield	1898
Casey, R. G., Caroline-street, South Yarra	1922
Chapman, F., A.L.S., National Museum, Melb.	1902
Cudmore, F. A., 17 Murphy-street, South Yarra	1920
Davis, Captain John King, "Tasma," Parliament-place, Melbourne.	1920
Deane, H., M.A., M.Inst.C.E., 14 Mercer-road, Malvern	1914
Dunn, E. J., F.G.S., "Roseneath," Pakington-street, Kew.	1893
Dyason, E. C., B.Sc., B.M.E., Equitable Buildings, Collins-street, Melbourne.	1913
Ewart, Prof. A. J., D.Sc., Ph.D., F.L.S., University, Melb.	1906
Gault, E. L., M.A., M.B., B.S., Collins-street, Melb.	1899
Gilruth, J. A., D.V.Sc., M.R.C.V.S., F.R.S.E., 520 Munro-street, South Yarra.	1909
Gray, Wm., M.A., B.Sc., Presbyterian Ladies' College, East Melb.	1913
Green, W. Heber, D.Sc., University, Melbourne	1896
Grimwade, W. Russell, B.Sc., 420 Flinders-lane, Melb.	1912
Grut, P. de Jersey, F.R.Met.S., 103 Mathoura-road, Toorak.	1869
Herman, H., B.C.E., M.M.E., F.G.S., "Albany," 8 Redan-street, St. Kilda.	1897
Horne, Dr. G., Lister House, Collins-street, Melbourne	1919
Kenyon, A. S., C.E., Lower Plenty-road, Heidelberg ...	1901
Kelly, Bowes, Glenferrie-road, Malvern.	1919
Kernot, W. N., B.C.E., University, Melb.	1906
Kershaw, J. A., F.E.S., National Museum, Melb.	1900
Kidson, E., O.B.E., M.Sc., Meteorological Bureau, Melb.	1921
Laby, Prof. T. H., M.A., Sc.D., F.Inst.P., University, Melb.	1915
Laidlaw, W., B.Sc., Department of Agriculture, Melb.	1911

Lewis, J. M., D.D.Sc., "Whitethorn," Boundary-road, Burwood. 1921
Littlejohn, W. S., M.A., Scotch College, Melb. 1920
Lyle, Prof. T. R., M.A., D.Sc., F.R.S., Irving-road, Toorak. 1889

MacKenzie, Colin W., M.D., B.S., F.R.C.S., 88 Collins-street, Melb. 1910
Mahony, D. J., M.Sc., "Lister House," Collins-street, Melb. 1904
Mann, S. F., Caramut, Victoria 1922
Masson, Prof. Orme, M.A., D.Sc., F.R.S.E., F.R.S., University, Melb. 1887
Medley, J. D. G., 223 Walsh street, South Yarra ... 1922
Merfield, C. J., Observatory, South Yarra 1913
Michell, J. H., M.A., F.R.S., 52 Prospect Hill-road, Camberwell. 1900
Millen, The Hon. J. D., Batman House, 103 William-street, Melb. 1920
Miller, Leo. F., "Moonga," Power-avenue, Malvern ... 1920
Miller, E. Studley, 396 Flinders-lane, Melbourne 1921
Monash, Lieutenant-General Sir John, G.C.B., M.C.E., B.A., LL.B., 360 Collins-street, Melb. 1913

Oliver, C. E., M.C.E., Mt. Dandenong North 1878
Osborne, Prof. W. A., M.B., B.Ch., D.Sc., University, Melb. 1910
Owen, W. J., "Gaergybi," 935 Rathdown-street, Nth. Carlton. 1919

Patton, R. T., B.Sc., M.F., Biology School, University, Melbourne. 1922
Payne, Prof. H., M.Inst.C.E., M.I.M.E., University, Melb. 1910
Picken, D. K., M.A., Ormond College, Parkville 1916
Piesse, E. L., Prime Minister's Department, Melbourne 1921
Pratt, Ambrose, M.A., 376 Flinders-lane, Melb. 1918

Quayle, E. T., B.A., Meteorological Bureau, Melb. ... 1920

Richardson, A. E. V., M.A., B.Sc., Agricultural Department, Melb. 1912

Schlapp, H. H., 31 Queen-street, Melb. 1906
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Skeats, Prof. E. W., D.Sc., A.R.C.S., F.G.S., University, Melb. 1905

Spencer, Prof. Sir W. Baldwin, K.C.M.G., M.A., D.Sc., F.R.S., "Darley," Upper Fern Tree Gully. 1887

Strevens, John Lloyd, 34 Queen-street, Melbourne ... 1922

Summers, Associate Prof. H. S., D.Sc., University, Melb. 1902

Sweet, Associate Prof. Georgina, D.Sc., University, Carlton. 1906

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Trinder, E. E., "Ruzilma," Orrong-grove, Caulfield 1922

Watt, W. S., Weather Bureau, Victoria-street, Melb. 1922

Walcott, R. H., Technological Museum, Melb. 1897

Wisewould, F., "Mona," Pakenham Upper, Victoria 1902

Woodruff, Prof. H. A., M.R.C.S., L.R.C.P., M.R.C.V.S., Veterinary School, University, Melb. 1913

Country Members.

Crawford, W., Gisborne 1920

Dare, J. H., B.Sc., Elementary High School, Warracknabeal. 1917

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Easton, J. G., Geological Survey, Corryong 1913

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Hart, T. S., M.A., B.C.E., F.G.S., School of Mines, Bairnsdale, Vic. 1894

Hogg, H. R., 2 Gresham Buildings, Basinghall-street, London, E.C.2.

Hope, G. B., B.M.E., "Carrical," Hermitage-road, Newtown, Geelong, 1918

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Langford, W. G., M.Sc., B.M.E., Vailala Oilfields, Popo, via Port Moresby, Papua. 1918

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Trebilcock, Captain, R. E., M.C., Wellington-street, Kerang. 1921

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Brookes, Leslie R., B.A., High School, Echuca 1922

Bryce, Miss L. M., B.Sc., 22 Victoria-avenue, Canterbury. 1918

Buchanan, G., D.Sc., University, Melb. 1921

Chapple, Rev. E. H., The Manse, Warrigal-road Oakleigh. 1919
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Cookson, Miss I. C., B.Sc., 154 Power-street, Hawthorn 1916
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Cousins, Miss M., c/- Mr. Pearson, Palermo-street, Mentone. 1922
Crespin, Miss R., B.A., Geology School, University, Melbourne. 1919
Cronin, J., Botanical Gardens, South Yarra 1921

Danks, A. T., 391 Bourke-street West, Melb. 1883
Dunstan, Joseph, Geology School, University, Melb. 1922

Fenner, C. A., D.Sc., Education Department, Flinders-street, Adelaide, S.A. 1913
Fenton, J. J., 20 Northcote-road, Armadale 1910
Ferguson, W. H., 37 Brinsley-road, E. Camberwell ... 1894
Finney, W. H., 40 Merton-street, Albert Park 1881
Flecker, Dr. H., 4 Collins-street, Melbourne 1922
Yarra.

Gabriel, C. J., 293 Victoria-street, Abbotsford 1908
Gordon, Miss M., B.Sc., Botany School, University, Melb. 1919

Hardy, A. D., F.L.S., Forest Department, Melb. 1903
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Hoadley, C. A., M.Sc., B.M.E., c/o Richardson Gears, Footscray. 1910
Holmes, W. M., M.A., B.Sc., University, Melb. 1913
Hosking, J. B. O., B.M.E., Observatory, Domain, South Yarra. 1922
Howitt, A. M., Department of Mines, Melb. 1910

Jack, A. K., M.Sc., 49 Aroona-road, Caulfield 1913
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Jones, Miss K. A. Gilman, Church of England Girls' Grammar School, Anderson-street, S. Yarra. 1922
Jutson, J. T., B.Sc., "Oakworth," 2 Austin-avenue, St. Kilda. 1902

Keartland, Miss B., B.Sc., Cramer-street, Preston ... 1919
Keble, R. A., Department of Mines, Melb. 1911
Kerr, Miss Lesley Ruth, Biology School, University, Carlton. 1922

Lambert, C. A., Bank of N.S.W., Melbourne 1919
Luher, R. E., B.A., 101 Hickford-street, E. Brunswick 1919
Luly, W. H., Department of Lands, Public Offices, Melb. 1896

McInerney, Miss K., M.Sc., Geology School, University, Melb. 1918
Macdonald, B., Central Weather Bureau, Melbourne 1920
Mackenzie, G., 1 High-street, Prahran 1907
Maclean, C. W., "Devon," Merton-avenue, Elsternwick 1879
McLennan, Ethel, D.Sc., Botany School, University, Melb. 1915
Melhuish, T. D. A., B.A., Port Pirie, South Australia 1919
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Morris, P. F., National Herbarium, S. Yarra 1922

Nicholson, Miss Margaret G., 59 Murray-street, Elsternwick. 1920

Oke, C., 56 Chaucer-street, St. Kilda 1922
Osborne, Miss A., B.Sc., Biology School, University, Melb. 1918

Pern, Dr. Sydney, 16 Collins-street, Melb. 1920
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Pretty, R. B., 99 Primrose-street, Essendon 1922

Raff, Miss J., M.Sc., University, Melb. 1910
Rivett, Assoc. Prof. A. C. D., M.A., D.Sc., University, Melb. 1914
Rosenthal, Newman H., 427 Cardigan-street, Carlton 1921
Rossiter, Captain A. L., M.Sc., University, Melb. 1913

Scott, T. F., M.A., High School, Warragul 1917
Sharman, P. J., M.Sc., "Glenalvie," 9 Daphne-street, Canterbury. 1916
Showers, Alan, Geology School, University, Melbourne 1922
Singleton, F. A., M.Sc., Geology School, University, Melb. 1917

Smith, J. A., 15 Collins-place, Melb. 1905
Stickland, John, 433 Brunswick-street, Fitzroy 1922
Stillman, Miss G., "Taiyuan," 3 Grange-road, Kew 1919
Stillwell, F. L., D.Sc., 44 Elphin-grove, Hawthorn ... 1910
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Thomas, R. G., B.Ag.Sc., Dept. Agriculture, Melb. 1922
Thompson, Mrs. G. R., 26 Fawkner-street, St. Kilda 1922
Thorn, Wm., Mines Department, Melb. 1907
Traill, J. C., B.A., B.C.E., 630 St. Kilda-road.. 1903
Treloar, H. M., Central Weather Bureau, Melbourne 1922
Trüdinger, W., Gerald-street, Murrumbeena 1918

Weatherburn, C. E., D.Sc., M.A., Ormond College, Parkville. 1914
Williamson, H. B., "The Grange," Corner Waverley-road, East Caulfield. 1919
Wilson, F. E., "Jacana," Darling-road, E. Malvern 1921
Woodward, J. H., Queen's Buildings, No. 1 Rathdown-street, Carlton. 1903

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