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(INCORPORATED).

VOL. XLII.

[WITH THIRTY-TWO PLATES AND TWELVE FIGURES IN THE TEXT.]

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CONTENTS.

THE

Transactions

OF

The Royal Society of South Australia.

Vol. XLII.

On the Habitat and Method of Occurrence in South Australia of Two Genera of Lycopods hitherto unrecorded for the State.

By T. G. B. Osborn, M.Sc., Professor of Botany in the University of Adelaide.

[Read November 13, 1917.]

Plate I.

In the course of his presidential address to Section K (Botany) of the British Association delivered at Sydney in 1914 Professor Bower remarked that "the most peculiar living lycopods are certainly *Isoëtes* and *Phylloglossum*." At that time neither of the two genera were included in the South Australian flora. It is the purpose of this note to record their occurrence, together with certain observations that seem of interest upon the plants as they grow in the field; for it appears at least worthy of remark that in South Australia *Isoëtes* and *Phylloglossum* occur side by side as members of a flora specialized to peculiar edaphic and climatic conditions.

Isoëtes.

The species of *Isoëtes* to be recorded is *Isoëtes Drummondii*, A. Br. Bentham (**1:** p. 672) gives the locality for this species as Swan River, and in Sadebeck's monograph on the genus (**10:** p. 776) this is the only locality cited. Von Mueller (**8:** p. 506) records it for the southern district of Victoria, with the remark that it is always submerged. The new census of New South Wales plants (**7:** p. 8) records it for that State, and in a letter Mr. Maiden states that "it is recorded from Pine Mountain on the Upper Murray River, and also from a mountain 2,500 feet high on the Victorian side of the Murray." This record is apparently that given by Ewart and Rees (**6:** p. 5).

The species is of interest in that though it belongs to the section *Aquatica* it is seldom submerged; in one of its known South Australian stations submergence could not take place, in the others submergence would be infrequent. The South Australian specimens on the whole agree well with the diagnosis given by Sadebeck for this section of the genus. The leaves have the usual four wide air passages bounded at the thinnest part by two or three layers of cells, while there are no sclerenchyma strands.

The stock is trilobed (1), small, averaging 1 cm. in cross section. From 8-19 leaves are present, 6-7 cms. in length; the stomates are developed in four rows over the air chambers of the leaf. There is no indusium present covering the sporangia. The megaspores have numerous blunt papillae on all faces, the angular ribs are very prominent. Sadebeck gives the colour of the spores as yellow-white (**10:** p. 777). When observed fresh from the South Australian specimens they vary from a pale greenish-white to olive-green when wet, but are a pure chalky-white when dry. It was only when taken from decaying sporangia and themselves decayed that they appeared yellowish.

The localities are (2):—

(a) National Park, Belair, near Pines Oval.
(b) Roadside below Anstey Hill, near Tea Tree Gully (Miss M. I. Collins).
(c) Victor Harbour, wet sandy soil at Mount Breckan.

Phylloglossum.

Phylloglossum belongs to a monotypic genus; *Phylloglossum Drummondii*, Kunze, being the only species. It is recorded by Bentham (**1:** p. 672) from Western Australia, Victoria, and Tasmania. Maiden and Betche (**7:** p. 8) include it in the New South Wales flora. It is also well known as occurring in the North Island of New Zealand (**4:** p. 1032). The record of the plant from South Australia thus bridges over the gap in its distribution along the southern part of Australia.

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(1) In one instance a bilobed stock has been observed. The specimen in all other respects agreed with the normal trilobed form.

(2) While this note is passing through the press further records for *Isoëtes* have been made at Blackwood and Kersbrook. The habitat in each case was sandy loam, swampy in winter, though not submerged, and in summer dry and baked hard. *Isoëtes* is now known from stations more than 50 miles apart along the Mount Lofty Ranges. It is probably not uncommon but is easily overlooked, since its tufts of leaves superficially resemble those formed by non-flowering specimens of several species of phanaerogams occurring in the area.—Added 24/9/18.

The South Australian specimens, in common with those from the other Australian States, appear to differ somewhat from the New Zealand form in being more slender and in possessing fewer leaves.

The general morphology of this plant is so well known that it is sufficient to say in explanation of what follows that from a subterranean storage tuber a cylindrical stem is produced, crowned by a whorl of linear-subulate leaves. From the stem there arise exogenously 1-3 horizontal, unbranched roots. There is also produced each year at the end of a stalk one new storage tuber. The plant may produce a short cone borne terminally on a peduncle about thrice the length of the leaves.

The plants generally occur gregariously. In order that an accurate idea of the composition of the *Phylloglossum* population might be obtained, three typical areas were

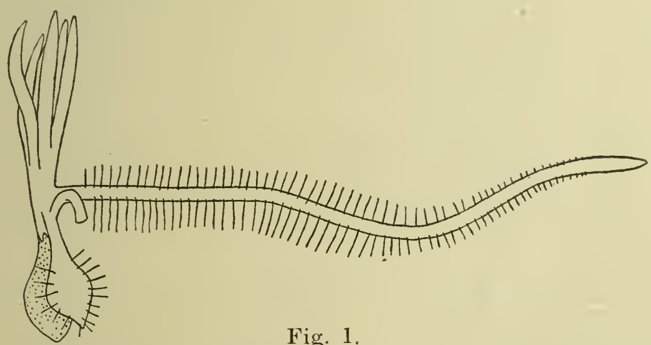

Fig. 1.

Phylloglossum Drummondii. Six-leaved plant with two roots, the full length of one of which is shown in its natural position. The very numerous root hairs are merely indicated diagrammatically as are the hairs on the new tuber. Camera lucida outline $\times 2\frac{1}{3}$.

selected and about 100 sq. cms. of surface soil removed from each to the laboratory. There the sods were carefully washed and the individual plants dissected out. The observations here recorded are thus based to a great extent upon a complete census of all the individuals in certain areas and not upon picked plants. In all 184 plants were counted from the 300 sq. cms. of soil examined. The following points seem worthy of note in connection with the occurrence of the plant in the field:—

(a) Though the course of the roots is described as horizontal, many of the published figures hardly bear this out, possibly because they have been drawn from spirit or herbarium material. Thomas (**12:** p. 291) says: "Its roots

spread horizontally and seldom far downwards into the ground." An examination of living South Australian material fully confirms this; occasionally the upper-surface of the root appears above the ground level. The roots are decidedly long in relation to the size of the plant, and their appearance, projecting at right angles from the stem, is very striking (text fig. 1). A second feature shown by the root is the great abundance of long root hairs. They are only with difficulty to be separated from the soil particles, the rhizoids of a species of *Fossombronia* and filaments of various green algae that occur on or near the surface of the soil. The number of roots is stated to be 1-3. Out of 184 South Australian specimens in which the number was actually counted only 41 had more than a single root.

(b) It would appear that the Australian plants of *Phylloglossum* consistently have fewer leaves than those growing in New Zealand and are less robust (**12:** p. 290). Bertrand (**2**) and Bower (**3:** p. 665) record a maximum number of eight. Eight is the greatest number of leaves found on South Australian specimens; plants with but three leaves occur most plentifully, and there is a high percentage with but a single leaf. (All these specimens grew from tubers of the previous year, there is no question of sporlings to be considered.) Apparently no strict connection exists between the number of leaves and roots that a plant may form. The statistics for 184 specimens are set out in the following table:—

Number of leaves	1	2	3	4	5	6	7	8
Total number of plants	39	29	48	29	27	7	1	4
Number with one root	39	25	43	19	13	2	1	1
Number with two roots	—	4	3	9	12	5	—	1
Number with three roots	—	—	2	1	2	—	—	2

Thus, while it frequently happens that a plant with a high number of leaves has more than a single root, plants with 7 or 8 leaves may have but one root, and conversely plants with 2 or 3 leaves may have as many roots as leaves. No plants have been found in which the number of roots was in excess of the number of leaves.

(c) The small proportion of fertile plants observed among the South Australian specimens is noteworthy. Of the 184 individuals enumerated above but 4 bore cones. They had respectively 2, 3, 5, and 6 leaves. Thomas (**12:** p. 290) has drawn attention to the point that there appears to be no necessary connection between the number of leaves and spore production. Observations in the field in South Australia confirm this.

(d) With a solitary exception all the South Australian specimens of *Phylloglossum* had produced but a single tuber.

An increase in the number of individuals by the formation of two new tubers in a growing season is theoretically possible. Thomas (**12:** p. 290) says this is "quite a common occurrence," though Cheeseman (**4:** p. 1033) says it is rare. A large number (over 100) of Western Australian plants were recently examined by Miss Sampson (**11:** p. 317), who found they had all formed but a single new tuber. It would seem that, in Australia at any rate, the multiplication of individual plants by the formation of more than one annual storage tuber is uncommon.

The exception mentioned above was a fertile plant with 5 leaves and 2 roots that had formed one tuber stalk, which forked at the distal end, producing two tubers. This is figured, and will be more fully described should it prove of anatomical interest (text fig. 2).

At present the only known South Australian station for *Phylloglossum Drummondii* is National Park, Belair.

Habitat.

It has not been found possible to obtain much information as to the conditions of growth of *Isoëtes Drummondii* in other Australian States. The record made by Ewart and Rees (**6:** p. 5) states that the habitat was "in pools on summit, in granite basins on bare rock," and Professor Ewart has kindly furnished the supplementary information that "it was completely submerged in summer time." I have not had an opportunity of examining one of these specimens, but I gratefully acknowledge the kindness of Professor Ewart in loaning me a specimen from the National Herbarium, Victoria, collected in "sub-saline p. [places?], Little Desert, Lowan, North-west Victoria." The megaspore measurements of this specimen agree with those from South Australia. The species may be said to be common in parts of the National Park, growing in damp sandy soils derived from decomposed Cambrian quartzites. The habitat and soil is similar at

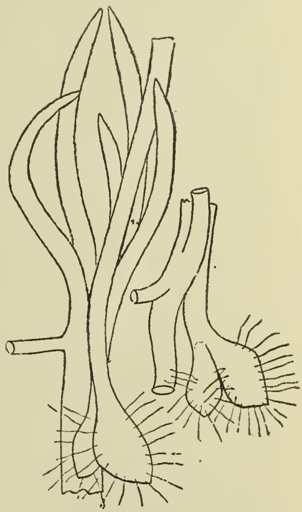

Fig. 2.

Phylloglossum Drummondii. Fertile plant producing two new tubers in one growing season by a bifurcation of the distal end of the tuber stalk. Camera lucida outline ×3½.

Tea Tree Gully. At Victor Harbour the soil is also sandy alluvium overlying the glacial deposits near the mouth of the Hindmarsh River. At this last station some of the specimens were found submerged to a depth of 6 cms. in a waterhole caused by the removal of a tree stump. This pool only contains water during the wet season. Most plants, however, were growing in the open some distance from standing water. In neither of the localities about Adelaide has *Isoëtes* been found submerged. The method of growth of the plant is incidentally referred to below in discussing the plant community in which *Phylloglossum* occurs at Belair.

It is unfortunate but inevitable that of the numerous investigators of *Phylloglossum* only one (Thomas) had access to material growing in the field. The information available as to the natural occurrence of the plant is thus very slight.

Thomas points out that the plant is not a semiaquatic (**12:** p. 291). He says: "*Phylloglossum*, it is true, being a very small plant, can only grow whilst the surface soil is fairly moist, hence it forms a tuber and rests during the dry season. So far as I have seen the plant grows rather better on a hill-top, or at any rate it grows there at least as well as it does down the slope, and I have never found it in an actual swamp. It grows well on a slope where water can never lodge."

The locality given in Cheeseman's Flora (**4:** p. 1033) is "barren clay hills" in the North Island of New Zealand.

In the account by Diels of the Western Australian flora *Phylloglossum* is recorded amongst the "miniature" plants (ephemerals) of the "alluvial formation" in the south-west province (**5:** p. 256). This alluvial flora is included by him in the "swamp formations." It is explained, however, that the area is only a seasonal swamp. The soil retains the rains, and for a time is saturated *(das Land überschwemmen).* It dries slowly, and in the process becomes baked as hard as a brick (p. 249). The tree vegetation is an open stand of eucalypts *(E. patens, E. rudis,* or *E. rostrata)* with local patches of melaleucas. The undergrowth may be shrubby, but in areas in which the water lies for weeks together the shrubs give place to undershrubs or herbs. These latter have a limited growing period, since growth is at a standstill while the ground is sodden, as also when it has dried up. The perennial herbaceous plants of such an area have rhizomes or other underground storage organs, *e.g.*, tuberous droseras and numerous Liliaceae and Orchidaceae. Annuals, especially "miniature" annuals (ephemerals), occur together with the bulbous plants. The similarity in composition between this Western Australian flora and that of the South Australian locality to be described is very striking.

In the National Park, Belair, there is an alluvial flat about half a mile long and some 300 yards across, bounded on either side by a small creek, on the further banks of which the land rises steeply. The surface soil is a cold grey sandy loam formed by decomposition of quartzite rocks of Cambrian Age. The subsoil as exposed by the creek banks is somewhat gravelly, owing to the presence of waterworn stones. The drainage of the flat, however, is insufficient, for the run-off is very slight, and since the area lies in a trough a quantity of water reaches it by soakage. In spite of the sandy nature of the soil there is sufficient silt to prevent rapid percolation of the water, so that frequently, following heavy downpours during the rainy months, there is a shimmer of surface water over the area. During the summer both creeks cease running, and the alluvial area becomes very dry, the soil baking hard at the surface.

There are thus two sharply-defined seasons, neither suitable to the growth of herbaceous plants: the summer when the soil is too dry, and the winter when it is sodden and cold. The active vegetative period for most plants is thus limited to the conclusion of the wet season, when in addition to a rise in the average temperature the ground is reasonably dry for days together. On an average, August to October inclusive may be taken as the chief period of vegetative activity for most flowering plants. During the early part of the wet season (May-July) except for *Drosera Whittakeri* there are few flowering plants to be seen. There is, however, a considerable growth of cryptogams (hepatics, mosses, and algae). Both *Isoëtes* and *Phylloglossum* appear early in the season. They were just visible on May 28 this year (1918), and had not died down till early in November, 1917. They thus have a much longer vegetative period than most of the herbaceous seed plants.

There are occasional trees of *Eucalyptus leucoxylon* (blue gum) and *E. viminalis* (manna gum), ranging up to about 18 m. in height, also *E. odorata* (peppermint), which in this situation often shows a coppice or mallee habit and does not exceed about 5 m. *Acacia pycnantha* (golden wattle) forms the main underwood, but is infrequent. Scattered bushes of *Leptospermum scoparium* are frequent.

Of the undershrubs *Hibbertia stricta* (30 cm.) is the most common. A variety of other undershrubs occur, but only as occasional bushes. Upon the surrounding slopes shrubs to a great extent replace the herbaceous plants to be described below. The alluvial flat flora there gives place to the sclerophyllous scrub or woodland typical of the area.

The swampy nature of the soil is indicated by the sedge, *Schoenus apogon*, which is the dominant ground species, growing in tufted patches but never forming a continuous carpet. Gramineae are hardly noticeable until the ground becomes drier at the close of the wet season. After the spring-flowering bulbous and tuberous plants have died down they become a more prominent element in the flora. The native perennials *Neurachne alopecuroides*, *Danthonia setacea*, and *Stipa semibarbata*, and the introduced annual *Briza major*, are the chief grasses.

The herbaceous perennials (other than grasses) are divisable into two groups: the first, containing such plants as *Halorrhagis*, *Goodenia*, *Helichrysum*, possess stout root stocks, and during the dry season die down more or less completely, but show no special modification; the second and more numerous group is the geophytes. The earliest of these to appear is *Drosera Whittakeri*, which comes into leaf soon after the first winter rains (May-June), and is to be found flowering when the whole area is sodden. *Hypoxis glabella* and *Wurmbea dioica* both flower before there is any sign of the ground drying up (July-August). The majority of the species, however, do not flower till September-October, by which time the ground is appreciably drier, though following a period of heavy precipitation it may remain sodden with a shimmer of surface water for a day or two. The liliaceous *Burchardia umbellata* is the latest geophyte to appear, and may be seen in full bloom when most of the others have died down. On the bare ground between the larger plants a great variety of ephemerals is to be found. The complete vegetative and flowering periods of these plants is limited to a few weeks at the close of the wet season. This miniature flora is a notable constituent in the sclerophyllous areas of South Australia, whether on quartzite, alluvial sands, or in the scrub woodland that develops upon the coastal dunes. Upon the alluvial area considered, as also upon the quartzite wherever there be a local accumulation of water, the abundance of the Centrolepidaceae is especially worthy of note. *Centrolepis aristata* is most frequent, often dominating the ephemeral florula. *Centrolepis strigosa*, *Cyperus tenellus*, and *Stylidium despecta* are all locally abundant. The little bladderwort, *Polypompholyx tenella*, is one of the rarer members of the flora.

Hepaticae are general elements in this ground flora, *e.g.*, *Reboulia hemispherica*, and notably a species of *Fossombronia*.

The following analysis of the flora is fairly complete in regard to the vascular plants, though additional species of orchids might still further increase the number of geophytes:—

Trees.

Eucalyptus leucoxylon	Eucalyptus odorata
E. viminalis	

Shrubs.

Acacia pycnantha
Leptospermum scoparium

Undershrubs (less than ·5 m.).

Grevillea lavandulacea
Hibberta stricta
H. sericea
Pimelia humilis
Pultenea largiflorens
Dillwynia hespidula
Brachyloma humifusa

Herbaceous perennials (with no special storage organs).

Danthonia setacea
Neurachne alopecuroides
Stipa semibarbata
Ranunculus lappaceus
Halorrhagis tetragona
Brunonia australis
Goodenia geniculata
Wahlenbergia gracilis
Helichrysum scorpioides
H. Baxteri
Leptorrhynchos squamatus

Herbaceous perennials (nature of subterranean storage organ indicated).

Phylloglossum Drummondii (tuber)
Isoëtes Drummondii (stock)
Arthropodium strictum (root tuber)
Burchardia umbellata (swollen stem)
Caesia vittata (root tuber)
Chamaescilla corymbosa (root tuber)
Thysanotus Patersoni (root tuber)
Wurmbea dioica (bulb)
Hypoxis glabella (corm)
*Sparaxis tricolor (corm)
Caladenia Menzesii (tuber)
C. reticulata (tuber)
C. dilatata (tuber)
C. leptochila (tuber)
C. deformis (tuber)
Diuris maculata (tuber)
D. pedunculata (tuber)
D. palustris (tuber)
D. longifolia (tuber)
Glossodia major (tuber)
Thelymitra antennifera (tuber)
T. luteocilium (tuber)
Drosera auriculata (tuber)
D. Whittakeri (tuber)
Microseris Forsteri (root tuber)

Annuals.

*Aira caryophyllea
*Briza major
*Briza minor
Schoenus apogon

Ephemerals (miniature annuals).

Aphelia pumilo
Centrolepis aristata
C. strigosa
Cyperus tenellus
Juncus bufonius
Triglochin centricarpa
Drosera glanduligera
Tillaea purpurata
Hydrocotyle callicarpa
Daucus brachiatus
Polypompholyx tenella
Stylidium calcarata
S. despecta
Helipterum exiguum
Rutidosis pumilo

Species marked * are not native, but established members of the alien flora.

The foregoing analysis of the flora shows the area to belong to the formation of sclerophyllous woodland which occurs in the Adelaide district, especially on quartzite (**9:** p. 114). The undergrowth of shrubby plants, the absence of a ground-covering of grass, the large number of bulbous and tuberous plants, together with ephemerals, are all characteristic of this formation. As yet the associations within this formation have to be defined. Forest is represented in the Adelaide district by stringybark *(Eucalyptus obliqua* and *capitellata)*, while scrub is typical of the quartzite hill slopes.

The characteristic scrub association of the sclerophyllous woodland has *Eucalyptus leucoxylon* as the dominant tree, but the bulk of the vegetation consists of very many species of shrubs averaging 1-1·5 m. high, and sometimes forming a close thicket. But little shade is cast, however, owing to the small size of the leaves. Such an association has been compared with the *maqui* of the Mediterranean, or the *chaparral* of California by Warming (**13:** p. 308). Bulbous and tuberous plants are common in this association in South Australia, as in those of the Mediterranean and Cape Colony. In the alluvial area considered they are, however, unusually abundant. It is, moreover atypical in the abundance of the sedge *(Schoenus apogon)* and in the change between the relative proportions of shrubs on the one hand and geophytes and ephemerals on the other. In this respect it agrees with the alluvial swamp described by Diels *(loc. cit.)*. Provided it be understood that the presence of standing water, or indeed any considerable soil moisture, is merely seasonal, and that there is a prolonged period in which the ground is baked hard, the area may be regarded as a swamp. True fresh-water swamps, the soil of which is wet most of the year, are not common in the hilly regions of South Australia, and they present a very different flora.

It is as members of the geophytic element in this seasonal swamp on alluvial sands that *Isoëtes* and *Phylloglossum* occur. *Isoëtes* appears to have a wider range, but in all other stations known at present it is a geophyte on alluvial sandy soil, only isolated plants being actually submerged during the growing season. *Isoëtes* (fig. 3) agrees with many of its cogeners in general size and approximate depth to which the stock is buried. *Phylloglossum* is a much smaller plant than the other geophytes, for which reason Diels perhaps was led to class it with the ephemerals. It is, however, not ephemeral, but typically geophilous in its growth. Its annual tuber, sunken by a stalk to a constant average depth, is functionally comparable with the many other tubers, etc., developed by its geophytic neighbours, from which *Phylloglossum* differs so markedly in size.

Summary.

1. *Isoëtes Drummondii* and *Phylloglossum Drummondii* are recorded for the first time from South Australia, thus

Fig. 3.

Diagram to show the root relationship of some of the geophytes. Reading from left to right: *Thelymitra antennifera*, (Orchid.), *Chamaescilla corymbosa* (Liliac.), *Drosera auriculata*, *Wurmbea dioica* (Liliac.), *Isoëtes Drummondii*, *Glossodia major* (Orchid.), *Phylloglossum Drummondii*, *Hypoxis glabella* (Amaryl.), *Drosera Whittakeri*, *Thysanotus Patersoni* (Liliac.). Ground level indicated by horizontal dotted line. Fig. approx. nat. size.

completing the range of the latter species along southern Australia.

2. A description is given of the association in which *Isoëtes* and *Phylloglossum* occur together. It is regarded as a seasonal swamp developed upon alluvial soil within the formation of sclerophyllous woodland.

3. In South Australia both genera are members of a considerable geophilous element within this association.

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DESCRIPTION OF PLATE I.

Fig. 1. General view of a portion of the area discussed. In the centre is a large tree of *Eucalyptus leucoxylon*, small trees in foreground *Acacia pycnantha*. The bulk of the grass-like vegetation is *Schoenus apogon*, low shrubby plants *Hibbertia*. The white flowers are *Sparaxis*. The dense vegetation in the immediate background is developed along a creek bed.

Fig. 2. *Phylloglossum Drummondii* plants growing *in situ*. Four fertile plants are to be seen with the peduncles elongated to two or three times the length of the leaves. The strobili are ripe.

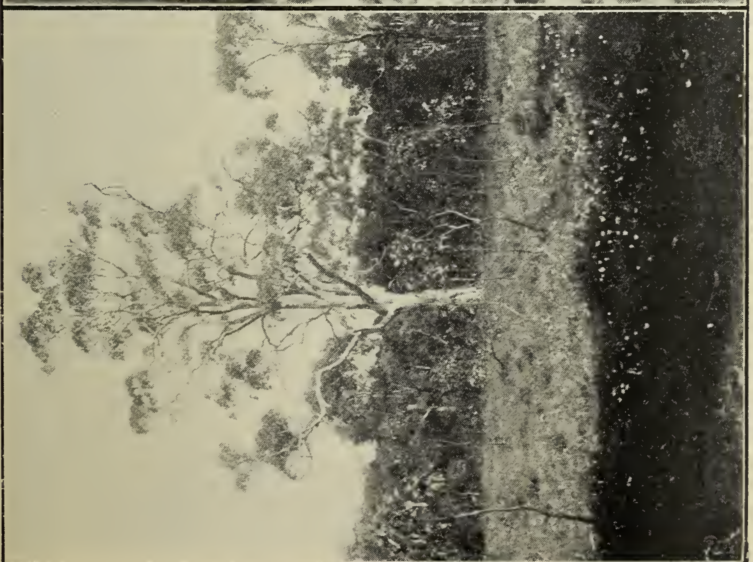

Fig. 1.

Fig. 2.

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The Deflections of Columns under Axial and Eccentric Loading.

By R. W. Chapman, M.A., B.C.E.

[Read May 9, 1918.]

In a paper [1] published in *The Physical Review* for March, 1917, Mr. R. W. Burgess has demonstrated that the ordinary method of solution, for the problem of determining the deflection of a column under load, leads to results that are very considerably in error when applied to the case of a long, thin column, pin-jointed at the ends, and subjected to compression along its axis. In all such problems the solution is obtained by the integration of a certain differential equation. The exact solution is, as a rule, somewhat difficult; but a very simple solution can generally be obtained by neglecting the term involving the square of $\frac{dy}{dx}$, and as this is supposed to give results that are quite sufficiently accurate for all practical purposes, the usual solution of the problem is obtained in this way. This is the method universally adopted in all the text books on Engineering and Physics. It comes, therefore, somewhat as a shock to learn from Mr. Burgess that this universal method of calculation, when applied to determine the deflection of a pin-jointed column under axial load, leads to results that are in error by as much as 100 per cent. One naturally thinks of all the other problems, fundamental in engineering practice, in which the computations of practical engineers are all based upon formulae derived by precisely the same approximate method of solution, and one wonders whether all this practice is fundamentally defective. Of such, for instance, are all computations on continuous girders and all calculations of beam deflections.

As an illustration we will consider the case of the deflection of a beam supported at each end and loaded with a concentrated load W at the centre.

Let l denote the span, and take the origin of co-ordinates at the centre of the beam.

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(1) "The Comparison of a certain Case of the Elastic Curve with its Approximation."

Then the equation to be solved, in order to find the deflection, is

$$E I \frac{\dfrac{d p}{d x}}{(1+p^2)^{\frac{3}{2}}} = \frac{W}{2}\left(\frac{l}{2} - x\right)$$

$$\text{where } p = \frac{d y}{d x}$$

In the usual text-book solutions the denominator on the left-hand side is taken as equivalent to unity, but an exact solution may be obtained as follows:—

Integrating the above equation as it stands, we have

$$\frac{E I p}{\sqrt{(1+p^2)}} = \frac{W}{2}\frac{l}{2} x - \frac{W x^2}{4} \quad (\text{since } x=o \text{ when } p=o)$$

$$\text{Put } a^2 = \frac{4 E I}{W}$$

$$\therefore \frac{p^2}{1+p^2} = \frac{(lx-x^2)^2}{a^4}$$

from which we get

$$p = \frac{\dfrac{l^2}{4} - \left(\dfrac{l}{2} - x\right)^2}{\sqrt{\left[a^4 - \left\{\dfrac{l^2}{4} - \left(\dfrac{l}{2} - x\right)^2\right\}^2\right]}}$$

$$\text{Now put } \frac{l}{2} - x = \frac{l}{2}\cos\phi$$

$$\therefore d x = \frac{l}{2}\sin\phi\, d\phi$$

$\therefore$ deflection at centre $= y$

$$= \int_0^{\frac{\pi}{2}} \frac{\dfrac{l^2}{4}\sin^2\phi \dfrac{l}{2}\sin\phi\, d\phi}{\sqrt{\left(a^4 - \dfrac{l^4}{16}\sin^4\phi\right)}}$$

$$= \int_0^{\frac{\pi}{2}} \frac{l^3}{8\,a^2} \sin^3\phi \left(1 - \frac{l^4}{16\,a^4} \sin^4\phi\right)^{-\frac{1}{2}} d\,\phi$$

= (expanding by the Binomial Theorem)

$$\frac{l^3}{8\,a^2} \int_0^{\frac{\pi}{2}} \sin^3\phi \left(1 + \frac{l^4}{32\,a^4} \sin^4\phi + \text{----}\right) d\,\phi$$

Now integrate each term separately, and we get

$$y = \frac{l^3}{8\,a^2}\,\tfrac{2}{3} + \frac{l^7}{8 \times 32\,a^6}\;\tfrac{6}{7}\cdot\tfrac{4}{5}\cdot\tfrac{2}{3} + \text{----}$$

$$= \frac{l^3\,W}{48\,E\,I} + \frac{1}{560} \cdot \frac{l^7\,W^3}{64\,E^3\,I^3} + \text{----}$$

The first term of this series is the deflection as usually computed, so that if we denote this by d, we have

$$y = d + \frac{\cdot108}{35} \cdot \frac{d^3}{l^2}$$

The ratio of the error made by the ordinary computation to d is thus:

$$\frac{108}{35} \cdot \frac{d^2}{l^2}$$

Since $\dfrac{d}{l}$ is usually in practical calculations something considerably less than ·01, it follows that the error is not worth taking account of and is really quite negligible.

Similar results apply in other cases of the deflections of beams, so that it seems that in such computations the ordinary method of calculation is quite good enough. It appears that the usual mode of solution can only lead to errors of a serious nature, when, in addition to $\left(\dfrac{dy}{dx}\right)^2$ the equation to be solved contains other terms that are themselves of a small order comparable to $\dfrac{d\,y}{d\,x}$, and in problems on the deflections of beams this is not the case.

But in the case of columns the error made is of much more importance. Here, in certain cases at any rate, the error made in calculating the deflection of the column under load by the approximate method is considerable, and when the computed deflection is made the basis for determining the stress in the material, as is done in most modern column formulae, the result may be seriously in error. Accordingly in this paper an attempt is made to compute the deflections of columns without resort to the usual approximations.

Case 1.—Pin-jointed Column with Axial Load.

This is the case that has been worked out by Burgess, and his calculations will not be repeated here.

If I denotes the moment of inertia of the cross section of the column; E, the coefficient of elasticity; and P, the compressive force along the axis, let

$$\frac{E\,I}{P} = a^2$$

Then if l denotes the length of the column, measured around the curve, and h the deflection at the centre, it is demonstrated that

$$l = 2a \int_0^{\frac{\pi}{2}} \frac{d\,\phi}{\sqrt{\left(1 - \frac{h^2}{4a^2}\sin^2\phi\right)}} = 2\,a\,K$$

where K is the complete elliptic integral of the first kind with the modulus $k = \frac{h}{2\,a}$.

Burgess then proceeds by expansion in series to obtain an expression for h in terms of l and a. From the available tables of elliptic integrals, however, the value of h may be obtained much more simply. These tables give corresponding values of k and K, that is of $\frac{h}{2\,a}$ and $\frac{l}{2a}$, from which again we may deduce the corresponding value of h/l.

It will be seen that if there is no deflection of the column, so that $h = o$, the integral gives $l/a = \pi$ or $P = E\,I\;\pi^2/l$, which is Euler's value for the greatest value of P that will not cause collapse of the column. Consequently in order to bend the column $l/2\,a$ must $> \frac{1}{2}\,\pi$. Once this value is exceeded, the tables show that the deflection increases rapidly with increase of P.

The table given at the end of the paper has been formed in the manner indicated above, and gives corresponding values of $l/2a$ and h/l. Values intermediate to those given may be obtained quite correctly, to the given number of decimal places, by interpolation.

Case 2.—Pin-jointed Column with Eccentric Loading.

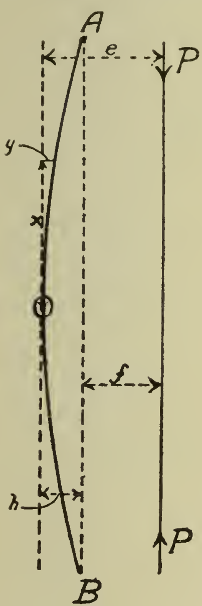

Fig. 1.

In this case, if AB (fig. 1) denotes the original axis of the column, the compressive force P is assumed to act along a line parallel to AB at a distance f from it.

Let the deflection at the centre be h.

Take the origin of co-ordinates at O, the centre of the bent column.

Let $e = f + h$.

Then the fundamental equation, without any approximations, is

$$\frac{EIp\dfrac{dp}{dy}}{(1+p^2)^{\frac{3}{2}}} = P(e-y), \text{ where } p$$

denotes $\dfrac{dy}{dx}$

Write $\dfrac{EI}{P} = a^2$ and integrate

$$\therefore \frac{2a^2}{(1+p^2)^{\frac{1}{2}}} = y^2 - 2ey + 2a^2 = (e-y)^2 - e^2 + 2a^2$$

since $p = o$ when $y = o$.

from which

$$p^2 = \frac{4a^4 - (y^2 - 2ey + 2a^2)^2}{(y^2 - 2ey + 2a^2)^2}$$

Now write $e - y = e\cos\phi$

$$\therefore dy = e\sin\phi\, d\phi$$

$$\therefore \frac{2a^2}{(1+p^2)^{\frac{1}{2}}} = 2a^2 - e^2\sin^2\phi$$

$$\text{and } p^2 = \frac{4a^4 - (2a^2 - e^2\sin^2\phi)^2}{(2a^2 - e^2\sin^2\phi)^2}$$

∴ integrating round the curve, the length of the column

$$= l = 2\int_0^h \sqrt{\left(1 + \frac{1}{p^2}\right)} dy$$

$$= 2\int \frac{2a^2}{\sqrt{\{4a^4 - (2a^2 - e^2\sin^2\phi)^2\}}} e\sin\phi\, d\phi$$

$$= 2\int \frac{2a^2\, d\phi}{\sqrt{(4a^2 - e^2\sin^2\phi)}}$$

$$= 2a\int_0^{\phi_1} \frac{d\phi}{\sqrt{\left(1 - \frac{e^2}{4a^2}\sin^2\phi\right)}}$$

The limits of the integral are from $y = o$ to $y = h$.

When $y = o$, $\phi = o$.

When $y = h$, $\cos\phi = \frac{e-h}{e} = \frac{f}{h+f}$

$$\therefore \cos\phi_1 = \frac{f}{h+f}$$

The value of $\frac{l}{2a}$ is thus expressed in terms of an elliptic integral having a conveniently small modulus $\frac{e}{2a}$, but, as the integral is not this time a complete one, the value of h is not so easily determined as in the previous case.

The integral reduces to the form in case 1 if $f = o$. Also if $e = f$, so that there is no bending, $\frac{l}{2a} = o$ ∴ $P = o$, so that bending begins in this case as soon as any load is put on.

In the ordinary notation of elliptic integrals we have

$$\frac{l}{2a} = F(\theta, \phi)$$

where $\sin\theta = \dfrac{e}{2a}$ and $\cos\phi = \dfrac{f}{h+f}$

or, more neatly, in the inverse notation,

$$\frac{f}{h+f} = cn\,(u, k)$$

where $u = \dfrac{l}{2a}$ and $k = \dfrac{e}{2a}$

According to Euler's theory, the maximum value of $\dfrac{l}{2a}$ when the load is axial is $\frac{1}{2}\pi$. For eccentric loading, therefore, the value must certainly be less than this. In cases of any importance to engineers the value of $\dfrac{e}{2a}$ is quite small, commonly of the order of ·1 or less.

Now the function $cn\,(u, k)$ may be expanded in series, and we have (Cayley, Elliptic Functions, p. 57):

$$cn\,(u, k) = 1 - \frac{u^2}{\underline{|2}} + (1 + 4\,k^2)\frac{u^4}{\underline{|4}} - (1 + 44\,k^2 + 16\,k^4)\frac{u^6}{\underline{|6}} + \text{----}$$

But we know that

$$\cos u = 1 - \frac{u^2}{\underline{|2}} + \frac{u^4}{\underline{|4}} - \frac{u^6}{\underline{|6}} + \text{----}$$

And as $\dfrac{l}{2a}$ is never much greater than 1 and k or $\dfrac{e}{2a}$ is quite small, it follows that it is quite sufficiently accurate to write $\cos u$ in place of $cn\,(u, k)$ and thus obtain the result

$$\frac{f}{h+f} = \cos\frac{l}{2a}$$

from which h may be simply determined. In applying this formula, of course $\dfrac{l}{2a}$ represents the circular measure of the angle, the cosine of which is to be taken.

If $\dfrac{l}{2a} = 1$ and $k = 0{\cdot}1$, the error made by computing h from this simple formula is only $0{\cdot}2$ per cent. If $k = 0{\cdot}2$ the error amounts to $0{\cdot}8$ per cent. If $k = 0{\cdot}3$ the error is $1{\cdot}8$ per cent. If $\dfrac{l}{2a} < 1$ the error will be still less.

The error made in using this simple formula does not become appreciable unless $\dfrac{l}{2a}$ is considerably greater than 1 and k has also a considerable value. In such cases we may write the equation to be solved in the form

$$k\ cn\ (u,\ k) = \frac{f}{2a}$$

where $u = \left(\dfrac{l}{2a}\right)$ and $\dfrac{f}{2a}$ are known and $k \left(= \dfrac{e}{2a}\right)$ is to be determined. A numerical solution of this equation may then be found by the aid of the published tables of the values of elliptic functions. But for the practical problems of engineering this process is not required, and the simplified approximate formula may be adopted.

An inspection of a table of Elliptic Integrals shows that the integral representing the value of $\dfrac{l}{2a}$ is < 1 for all values of k provided that the value of ϕ is not more than 49°,

$$i.e., \text{ if } \frac{f}{h+f} \text{ is not } < \cos 49^\circ$$

or provided that h is not more than $\cdot 524\ f$.

Numerical Illustration.

Suppose that we wish to compute the deflection of a steel column in the form of a British standard steel joist $8'' \times 4''$ and $9'\ 6''$ long, under a load of 30,000 lbs., the line of action of the load being $0{\cdot}5''$ from the axis of the column.

From the tables of standard sections we find the least value of I is $3{\cdot}57$.

$\therefore$ taking the modulus of elasticity as 30,000,000 lbs. per square inch, we have

$$a^2 = \frac{E\,I}{P} = \frac{30000000 \times 3{\cdot}57}{30000} = 3570$$

$$\therefore a = 59{\cdot}805$$

$$\therefore \frac{l}{2a} = \frac{114}{119{\cdot}61} = {\cdot}953 = \text{the circular measure of } 54^\circ\ 36'$$

$$\therefore \frac{f}{h+f} = \cos\ 54^\circ\ 36' = {\cdot}579$$

Now putting $f = 0{\cdot}5''$, this gives us $h = {\cdot}364''$.

It will be seen that in this example, as in most practical cases, the value of k in the exact equation $= \dfrac{e}{2a} = \dfrac{{\cdot}864}{119{\cdot}6}$ is quite small, so that the approximate method of solution used gives no appreciable error.

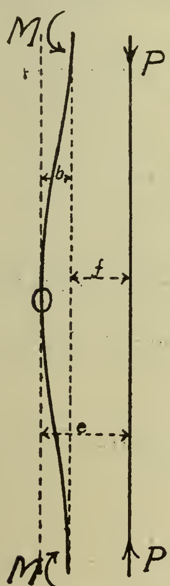

Fig. 2

Case 3.—Column with Fixed Ends and Eccentric Loading.

In this case the ends of the column are supposed to be rigidly held parallel to the direction of the compressive stress. This requires the application of a bending movement M at each end (see fig. 2).

Taking the origin of co-ordinates at the centre of the bent column, and using the same notation as before, we have

$$\frac{E\,I\,p\,\dfrac{dp}{dy}}{(1+p^2)^{\frac{3}{2}}} = P\,(e-y) - M$$

$$= P\,(e-y) - P\,c$$

writing $M = P\,c$

Put $\dfrac{E\,I}{P} = a^2$ as before and integrate

$$\therefore \frac{2a^2}{(1+p^2)^{\frac{1}{2}}} = y^2 - 2\,(e-c)\,y + 2a^2 \text{ (since } p=o \text{ when } y=o)$$

also $p=o$ when $y=h$

$$\therefore h^2 - 2\,(e-c)\,h = o \qquad \therefore e-c = \frac{h}{2}$$

$$\therefore \frac{2\,a^2}{(1+p^2)^{\frac{1}{2}}} = y^2 - h\,y + 2\,a^2$$

This is a differential equation of the same form as in Case 2. Dealing with it in precisely the same manner, we obtain the result

$$l = 2\,a \int_0^{\pi} \frac{d\,\phi}{\sqrt{1 - \frac{h^2}{16a^2}\sin^2\theta}}$$

$$= 4\,a \int_0^{\frac{\pi}{2}} \frac{d\,\phi}{\sqrt{1 - \frac{h^2}{16a^2}\sin^2\theta}}$$

the limits of the integral in this case taking a more simple form.

Thus $\frac{l}{4a} = K$, where K is the complete elliptic integral of the first kind with $k = \frac{h}{4a}$.

If $h=o$, or there is no deflection, $\frac{l}{4a} = \frac{\pi}{2}$

i.e., $P = \frac{4\,E\,I\,\pi^2}{l^2}$ is the least value of P which can produce any deflection, and we see that the least possible value of $\frac{l}{4\,a}$ is $\frac{\pi}{2}$.

The bending moment at the top and bottom of the column $= P\,f - M = P\,(e-h) - P\,c = P\,\frac{h}{2}$.

The bending moment at the centre of the column $= P\,(e-h) = P\,\frac{h}{2}$ also.

In this case the deflection h of the column in no way depends upon the eccentricity of the loading. The further the line of stress is from the axis of the column the greater will be the bending moment M upon the holding supports at the ends, but, provided these remain firm, the deflection of the column is in no way affected.

The table supplied to enable computations to be made of the deflection in Case 1 will also serve for the same purpose for Case 3.

In modern formulae for the computation of the load on long columns, especially when there is eccentricity of loading, the deflection of the column under load is made the basis of the formula used. In many of these the assumptions made as to the deflection of the column are far from correct according to the foregoing calculations. The object of the writer is to make some contribution towards that more exact knowledge necessary for progress in engineering design.

Table giving maximum of deflections of Pin-jointed Columns under axial load or deflections of Columns with ends fixed under any load the line of action of which is parallel to the axis:—

Values of $\frac{l}{2a}$ for pin-jointed columns or $\frac{l}{4a}$ for columns with fixed ends.	Corresponding values of $\frac{h}{l}$.
1·57080	0
1·57092	·0111
1·57127	·0222
1·57187	·0333
1·57271	·0444
1·57379	·0554
1·57511	·0664
1·57668	·0773
1·57849	·0882
1·58054	·0990
1·58284	·1097
1·58539	·1204
1·58820	·1310
1·59125	·1414
1·59457	·1517
1·59814	·1619
1·60198	·1721

In this table l = length of column.

h = maximum deflection.

$a^2 = \frac{E\,I}{P}$ where P is the load in compression.

Notes on Australian Orchids, together with a Description of Some New Species.

By R. S. Rogers, M.A., M.D.

[Read May 9, 1918.]

Plates II. to IV.

1. Calochilus cupreus, n. sp.

Plate ii.

A robust plant 15 inches to 2 feet in height. Leaf comparatively short, 4½-6 inches, rather rigid or fleshy, triangular in section, erect, pointed, channelled on the inside.

Stem-bracts 2, from 2 to 3 inches long, coppery coloured, subulate, clasping, lower one close to insertion of leaf, upper one about middle of stem; floral bracts subtending pedicels of flowers, subulate, 1½ inches or less in length.

Flowers in a raceme of 8 to 15, with prevailing tints of yellow and reddish-brown.

Sepals equal in length, yellow with reddish-brown stripes or dots; the dorsal one ovate, cucullate, shortly acuminate, streaked or dotted with reddish-brown markings; the lateral ones ovate-lanceolate, slightly narrower than the dorsal sepal.

Lateral petals narrowly ovate-lanceolate, slightly shorter and much narrower than the sepals, yellow with darker stripes.

Labellum with fleshy rectangular base and wide triangular lamina, longer than perianth, protruding between lateral sepals, golden-yellow, with fimbriated margins and reddish-blue hairs with metallic lustre; basal portion with brilliant reddish-blue raised lines with metallic sheen, the two outer ones rather fleshy glandular linear-lanceolate, the intervening ones linear, sometimes fused at their bases or along their course, all ending in free divergent hair-like extremities; other hairs on lamina not dense and rather shorter than in other species of *Calochilus;* tip of labellum recurved and ending in a short, hairless, sinuous ribbon.

Column short and widely winged, with reddish-brown markings, very open at base with a comma-shaped purple gland at each lower angle; no castellated ridge connecting the glands, but generally a more or less indistinct yellowish-brown marking between them; anther long, horizontal, with duck-bill point; stigma just below the anther, transverse, reniform with convex margin directed downwards.

Three valid species of *Calochilus* have been recorded, and from these the new species differs mainly in the following particulars:—

1. The leaf is relatively shorter and much more rigid than in the other species. It is also triangular in section, whereas the section is crescentic in the others.
2. The raceme bears a large number of flowers, *viz.*, 8 to 15, whereas 8 flowers may probably be regarded as the maximum in other species.
3. Its copper-coloured bracts and the colour of its flowers are distinctive.
4. The glabrous oblong base of the labellum with the characteristic raised lines, serve at once to distinguish it from other members of the genus.

The following differential table will further show the relations of *Calochilus cupreus* to other species:—

Column-wing without dark gland on each side near base of column. Tip of labellum ligulate	1. *C. paludosus*
Column-wing with dark gland on each side near base of column.	
Tip of labellum without ligulate process, whole of surface of labellum hirsute ...	2. *C. Robertsoni*
Tip of labellum with ligulate process, labellum not hairy at base.	
Base of labellum glabrous, with several raised longitudinal lines	3. *C. cupreus*
Base of labellum smooth and thickened, without raised longitudinal lines ...	4. *C. campestris*

It should be noted the *C. paludosus*, Br., is incorrectly figured in Fitzgerald's Australian Orchids with two glands at the base of the column. This is not in conformity with the original description in Brown's Prodomus, nor is it supported by Bentham in the Flora Australiensis, nor indeed is it supported by Fitzgerald himself in Moore's Flora of New South Wales (see page 394).

Of the above species, *C. paludosus* has been recorded only from Queensland and New South Wales; *C. campestris* from all the Eastern States, including Tasmania; and *C. Robertsoni* from New South Wales, Victoria, South Australia, and Western Australia.

The new species was found by Mrs. R. S. Rogers near McLaren Vale early in November. The plants were mostly in advanced fruit, and evidently bloom in October.

The name *cupreus* has reference to the coppery colour of the bracts and flowers.

2. Pterostylis pusilla, n. sp.

Plate iii.

A slender, glabrous plant, $2\frac{1}{2}$ to $3\frac{1}{2}$ inches high; 2 closely sheathing bracts on stem and one subtending each flower.

Flowers 1 to 4, on relatively long, slender pedicels. Leaves shortly petiolate, oblong-lanceolate, in a green radical rosette.

Galea from ovary to extreme point of dorsal sepal $\frac{1}{3}$ inch or less, with short recurved point and dark green stripes; lateral sepals conjoined, subulate, reflexed, margins involute, about the same length as galea.

Labellum fleshy, on a wide claw, reddish-green, oblong-ovate, concave on its upper-surface, with thickened posterior margin; tip straight; under-surface with deep mesial channel running from base to tip between two pyriform swellings, the apices of which are directed forward, but do not reach the tip; a few long hairs from lateral margins but not from posterior margin, lower mesial channel beset with very stiff transverse hairs, tip and posterior margin shortly ciliated.

Column incurved, much shorter than galea, membranous wings roughly quadrangular, with rounded or obtuse angles, anterior margins and lower lobe ciliated; a secondary expansion, ovate-lanceolate in shape, on either side of stigma, extending from the membranous wings to the junction of the middle and lower third of column; stigma rather narrow, oblong-elliptical.

The affinities of this *Pterostylis* are with *P. rufa*, *P. Mitchelli*, and *P. squamata*.

From all of these it is readily distinguished by the diminutive size of the plant and flowers and by the absence of caudae to the lateral sepals.

From *P. rufa*, Br., it further differs in the possession of a *green*, as opposed to a *withered* radical rosette of leaves; also in a fleshy, as opposed to a membranous labellum, the tip of which is quite straight in the new species and upturned in the other; also in the absence of long hairs or setae from the vestigial appendage, represented in this instance by a thickened posterior margin; the column wings have rounded angles and are without points, whereas in *P. rufa* they are acute, the upper one being produced into a short point.

From *P. Mitchelli*, Lindl., it further differs in regard to its labellum, which has turgid pyriform swellings on its under-surface, and has a straight tip as opposed to a depressed tip in the former species; also in the absence of a point to the upper angle of the column-wings; the stigmas likewise are quite different, being narrow oblong-elliptical in *P. pusilla* and semi-elliptical in *P. Mitchelli*.

From *P. squamata*, Br., it may be distinguished by the absence of the *withered* radical rosette and numerous stem-bracts which characterize that species; also by the absence of long hairs on the vestigial appendage and by the presence of turgid pyriform swellings on the under-surface of the labellum.

The following table will indicate the position of the new *Pterostylis* in regard to related species:—

Leaves in a radical rosette, persistent or fading away before flowering; flowers usually multiple.	
Sepals all obtuse, lower lip shortly bilobed; flowers diminutive; rosette green.	
Slender species, appendage labellum pointing backwards	1. *P. mutica*
Rather stout species, appendage labellum looking forwards	2. *P. cycnocephala*
Sepals caudate or acute, lower lip deeply bilobed.	
Sepals caudate; labellum fleshy, tip depressed; bracts few; rosette green; flowers not diminutive ...	3. *P. Mitchelli*
Sepals caudate; labellum fleshy, tip upturned; bracts numerous; rosette withered; flowers not diminutive ...	4. *P. squamata*
Sepals caudate; labellum membranous, tip upturned; bracts few; rosette withered; flowers not diminutive ...	5. *P. rufa*
Sepals acute but not caudate; labellum fleshy, tip straight; bracts 2, rosette green; flowers diminutive	6. *P. pusilla*

This plant blooms early in October, which is later than *P. Mitchelli*, so far as this State is concerned, but considerably earlier than *P. rufa* or *P. squamata*.

It has reached me from the following localities:—South Australia—Geranium, Miss Nora E. Jacob; Wirrega, Prof. Osborn. Victoria—The Grampians, C. Walter; Greensborough, E. E. Pescott; Blackburn, Miss Dorothy Coleman.

The specific name *pusilla* has reference to its diminutive size.

3. Prasophyllum regium, n. sp.

Plant robust, $2\frac{1}{2}$ to $3\frac{1}{2}$ or more feet high; leaf not reaching to top of spike; bracts somewhat small and rather acute, subtending each flower, about one-third length of ovary.

Flowers in rather a loose spike; spike sometimes 16 inches long, and comprising upwards of 50 flowers; lower flowers distant; ovaries long and very attenuated.

Sepals acute and rather narrow, about equal in length, 6 lines; lateral sepals distinct at extreme base and tips, connate elsewhere; dorsal sepal reflexed in mature flower.

Petals rather narrow, falcate-lanceolate, shorter than sepals, about 5 lines.

Labellum on a distinct and narrow claw, oblong-lanceolate, margins crenulate, erect in its basal third, horizontal in its anterior part, nearly as long as the petals; inner plate with wide orbicular base and free entire margins, suddenly contracting at the bend into a rather bluntly lanceolate part with entire margins, extending to within a short distance of the tip.

Column with a blunt sessile anther; long, narrow rostellum greatly exceeding in length the anther; caudicle very long and strap-like; lateral wings blunt, oblong-falcate, membranous, with a basal thickening on dorsal margin, much higher than rostellum.

Found by Dr. R. Pulleine, December, 1917, a little south of Manjimup, not far from Forest Diamond Tree, Western Australia.

Two large Western Australian *prasophylla* have been described under the name of *P. giganteum* by Lindley (Swan River Appendix, 1839, and Genera et Species, 1840) and Endlicher (Plantae Preissianae, 1844-7) respectively. The Latin descriptions are not in either case sufficiently definite and detailed to enable one to identify the plant, but Bentham, who had access to both types, states that they are not forms of the same species. He reduces Lindley's species to *P. elatum*, Br., and Endlicher's to *P. Fimbria*, Reich. f.

The new species certainly cannot be referred either to *P. elatum* or *P. Fimbria*, although it bears a superficial resemblance to both.

It must also be differentiated from three other tall Eastern *Prasophylla*, *viz.*, *P. australe*, Br., *P. flavum*, Br., and *P. odoratum*, Rogers.

All the above species, including *P. regium*, generally exceed 2 feet in height, but only in the latter have I seen a spike bearing between 50 and 60 flowers, or indeed anything approaching this number.

It falls under Bentham's Section 2, *Podochilus*, in which the labellum is on a distinct claw.

The following table will effect the necessary separation:—

Plants tall, generally exceeding 2 feet in height.
- Labellum sessile, lateral sepals connate, at least in the middle.
  - Labellum sharply flexed; with very much raised prominent inner plate scarcely reaching beyond bend; lateral appendages of column not exceeding rostellum in height; leaf-lamina long ... 1. *P. australe*

Labellum gradually recurved; inner plate not prominent, beginning about middle and extending nearly to tip; lateral appendages of column not exceeding rostellum in height; leaf-lamina exceptionally short, rarely exceeding 1 inch ... ... 2. *P. flavum*

Labellum hardly recurved; inner plate with free margins covering most of surface of lamina, extending nearly to tip, not prominent; lateral appendages of column much exceeding rostellum in height; leaf-lamina rather long ... ... 3. *P. elatum*

Labellum on a distinct claw. Lateral sepals connate or free.

Lateral sepals connate.

Labellum gradually recurved; inner plate with free margins copiously fringed, and within it a second rather conspicuous plate; lateral appendages not exceeding rostellum; ovary elongated ... ... 4. *P. Fimbria*

Labellum recurved at right angles; inner plate orbicular-lanceolate with free entire margin, extending nearly to tip, no secondary plate; lateral appendages column as long as in *P. elatum* much exceeding rostellum; ovary very narrow, elongated ... ... 5. *P. regium*

Lateral sepals free and divergent.

Labellum sharply reflexed about middle; inner plate not reaching far beyond bend in voluminous membranous part of lamina; lateral appendages column not so high as rostellum; ovary turgid ... ... 6. *P. odoratum*

The new species differs from *P. elatum* not only in its possession of a distinct claw to the labellum, but also in the shape of the labellum and inner plate, the former being oblong-lanceolate, whilst the latter is orbicular in its basal portion and narrow-lanceolate anteriorly; while in *P. elatum* both labellum and inner plate are ovate. Further, the rostellum and perianth segments are much wider in *P. elatum* than in *P. regium*.

4. Caladenia testacea, Br.

A slender plant, 6 to 17 inches high, with a slightly hairy stem and rather acute bract near middle; leaf narrow-linear to oblong-lanceolate, not nearly so hairy as in most *Caladenias*.

Flowers in a raceme, 1 to 5 on slender pedicels, each subtended by an acute bract reaching to the base of the ovary.

Perianth segments covered with short glandular hairs; generally dark reddish-brown, except towards the base and inner sides, where they are light coloured; sometimes quite white; lateral sepals and lateral petals spreading, about equal in length, 5 lines, falcate-lanceolate, contracted at base; dorsal sepal a trifle shorter, much incurved.

Labellum on a moveable claw, with basal portion erect against column; tip triangular recurved; lateral lobes not well defined, sometimes almost absent; margins entire except towards the tip, the edges of which are shortly, bluntly, and rather sparsely denticulated; calli of lamina in 4 rows, reaching to within a short distance of the tip, where the rows are not so well defined, clavate, the stalks shorter towards the tip; two or three pink stripes near base.

Column shorter than dorsal sepal, beneath which it is incurved, markedly winged, especially in its upper half; anther with a short point; stigma circular just below anther.

The buds are characteristic, being bluntly falcate in shape, with dark glandular exteriors.

This *Caladenia* has not hitherto appeared on the records of this State, although there are specimens in the University Herbarium, collected in November at Glencoe and Millicent Flats. Notes in the folder by the late Professor Tate indicate that he thought of calling it *C. quadraserriata*, but finally left it unidentified and undescribed.

It has been recorded from all the Eastern States except Queensland.

The following are some localities in which it has been found:—New South Wales—Port Jackson to Blue Mountains, R. Brown, A. Cunningham, Woolls, and others; Mount Penang, Rogers. Victoria—Port Phillip, Gunn; Upper Fern Tree Gully, Pescott; Cravensville, Braine; Grampians, Pescott, French, jun., and Audas. Tasmania—Port Dalrymple, R. Brown; Southport, C. Stuart; Hobart and Circular Head, R. C. Gunn; Gould Country and St. Patrick River, A. Simson; Sandford, Miss A. L. Rogers. South Australia—Glencoe and Millicent Flats, R. Tate.

It blooms in October and November. Its relations to the other *Caladenias* will be shown below when dealing with *C. congesta*.

5. Caladenia congesta, Br.

Plant slender, from 7 to 24 inches high; leaf linear; stem slightly hairy, with a closely-appressed rather acute bract about the middle.

Flowers pink, rarely white, single or in a scattered raceme of 2 or 3, on slender pedicels, subtended by a bract often reaching as high as the hairy ovary.

Segments of perianth covered with glandular hairs; lateral sepals spreading, lanceolate, contracted at base, about

9 lines long; lateral petals falcate, narrower and rather shorter than lateral sepals; dorsal sepal shorter than the other segments, incurved over column, contracted at base.

Labellum pink, about 4½ lines, on a rather long and narrow claw, basal portion rather erect against column, the lamina gradually curved forward, divided very distinctly into 3 lobes; margins entire; lateral lobes falcate, acute, reaching well beyond the middle of labellum; middle lobe oblong-lanceolate; calli dark crimson, imbricate, completely covering middle lobe, at first placed longitudinally in 2 rather obscure rows, the two nearest the claw being stalked, the others large sessile, flat-topped; calli in anterior half arranged transversely, large, sessile, more or less oblong, flat-topped.

Column rather shorter than dorsal sepal and labellum, incurved, with rather wide wings, especially in its upper portion, blotched with pink markings; anther mucronate; stigma circular, disc-like, just below the anther.

Found by Mr. J. M. Black in Glencoe scrub, November 27, 1917. Only a single specimen was seen, the normal time of blooming being earlier in the month.

This plant has not hitherto been recorded from this State, but it occurs in New South Wales, Victoria, and Tasmania. I have never received or seen it from Western Australia, although Bentham notes a plant in Lindley's herbarium as possibly belonging to this species.

Caladenia testacea, Br., and *Caladenia congesta*, Br., belong to Bentham's Section Eucaladenia, in which "the sepals are acute or obscurely acuminate, rarely obtuse, the dorsal one usually erect and concave. Labellum inconspicuously veined, the disc with 2 or more rows of calli (sometimes arranged or united at the base almost in a semicircle)."

They fall under the subsection where the flowers are pink or white, *leaf narrow-linear or absent*, labellum with broad lateral lobes.

Differential Table.

Leaf narrow-linear or absent; flowers pink, pinkish, or white.

  Calli arranged distinctly or obscurely in 2 rows.

    Labellum not exceeding half length of lateral sepals; lateral lobes broad, obtuse, and prominent, middle lobe denticulated; leaf narrow-linear; flowers pink or white ... ... *C. carnea*, Br.

    Labellum exceeding half length of lateral sepals; lateral lobes falcate, almost acute, incurved; middle lobe entire; leaf absent at time of flowering ... *C. aphylla*, Benth.

Labellum not exceeding half length of lateral sepals; lateral lobes entire, acute, falcate; middle lobe entirely covered with large crowded calli, arranged posteriorly in 2 obscure rows; leaf linear ... ... *C. congesta*, Br.

Calli arranged in 4 rows.

Lateral lobes of labellum ill-defined, the margins entire posteriorly, denticulated or fringed anteriorly; calli not reaching tip; dorsal sepal gradually incurved; column gradually bent forward, striped with pink; lateral sepals about 5 lines; flowers generally reddish-brown, but sometimes white *C. testacea*, Br.

Lateral lobes of labellum broad, definite, obtuse, margins entire throughout; dorsal sepal abruptly incurved at or below middle; column abruptly bent forward; lateral sepals about 8 lines; flowers whitish ... ... *C. cucullata*, Fitz.

Labellum hardly 3-lobed, contracting to a point for about two-thirds length, markedly denticulated for same length; calli reaching to tip; dorsal sepal gradually incurved; lateral sepals about 9 lines; flowers white *C. dimorpha*, Fitz.

Caladenia congesta is a larger species than *C. testacea*, with larger flowers, the lateral sepals being about 9 lines as compared with 5 lines in the latter plant. The pink flowers of the former species are quite unlike the reddish-brown or white colours of *C. testacea*.

Distribution:—New South Wales—Near Bathurst, A. Cunningham; Bowral, Sheaffe. Victoria—Cravensville, A. B. Braine. Tasmania—Port Dalrymple, R. Brown; Cheshunt and Port Sorrell, Archer. South Australia—Glencoe, J. M. Black.

6. Drakea Huntiana, F. v. M.

Plate iv.

A somewhat sturdy little plant, $3\frac{1}{2}$ to 7 inches in height; leafless at the time of flowering; with 2 rather blunt, short, clasping bracts on the stem and a small sheathing radical bract; stem generally reddish-brown, sometimes green.

Flowers reddish-green, or occasionally quite green; 2 to 7; reversed; on fairly long, slender pedicels (about $\frac{1}{2}$ inch), each pedicel embraced by a short obtuse bract; ovary slender, terete.

Segments of perianth nearly equal in length, about 2 lines, all reflexed against the ovary; lateral sepals green or reddish-green, oblong-spathulate, convex on outer surface, concave on inner, reflexed against ovary like a pair of insect's wings; dorsal sepal green or reddish-green, quite blunt, about same width as lateral sepals, concave, reflexed against the ovary and slightly incurved towards the column; lateral petals narrow-linear, much narrower than the sepals, green, rather blunt, reflexed against the sides of the ovary.

Column green or greenish-red, acutely reflexed from its base towards the ovary, about the same length as the perianth segments. The upper half expanded in a concave disc-like surface, from the edges of which proceed two pairs of appendages of nearly equal length; the upper pair narrow-lanceolate, divergent, curving forward on each side of the apex of the anther; the inferior pair falcate-lanceolate, divergent, curving upwards and forwards on each side of the stigma. Rostellum rudimentary. Stigma prominent, very wide, reniform, the concave border immediately below and in contact with the anther.

Labellum articulated by a moveable joint to a linear projection of the column 3 lines long; peltate on a linear claw which is nearly as long as the column-foot. Lamina reddish-purple, insectiform, about as long as the claw (3 lines); anteriorly giving origin to a pair of pedunculated processes, each terminating in a globular purple gland; posteriorly dividing into two long narrow-lanceolate, divergent tails, from which proceed numerous long-jointed, purplish or reddish hairs; an intermediate or thoracic portion, on the under-surface of which is inserted the claw, fringed with numerous long purple hairs, on its upper-surface a large purple triangular gland, situated at the base of the anterior peduncles.

The reversed appearance of the flowers is due to the fact that the column and perianth segments are all acutely reflexed on the ovary.

In the bud the upper-surface of the lamina is in close apposition with the front of the column, the pair of pedunculated glands embracing its extreme base at its junction with the foot; the triangular gland in contact with the middle of the undilated portion of the column; the rest of the intermediate portion covers the stigma, and lies between the lower pair of columnar processes which clasp it; the posterior divergent tails curl up between the upper pair of columnar processes, giving off hairs over the anther and tip of the dorsal sepal, which at this stage is in close contact with the back of the column.

At this stage, also, the segments of the perianth form a complete covering to the reproductive mechanism; the lateral sepals protecting the antero-lateral aspects, their tips being in close apposition with the tip of the dorsal sepal, and their inner margins in close contact, except for a small slit in the middle, through which is seen to project the angular process formed by the junction of the columnar foot and labellar claw.

When the flower is about to expand the lateral sepals separate and suddenly rotate on their bases, so as to take up a position on the opposite side of the ovary, with their convex surfaces now facing each other; the dorsal sepal also retracts a little from the column; the columnar processes relax their grip of the lamina, and the labellum suddenly flies out with the claw at right angles to the columnar foot.

Baron von Mueller mentions that "Mr. Bauerlin noticed in *D. Huntiana*, that at the slightest touch the labellum snatches across to the anther and stigma, subsequently returning with slowness to its remote positions."

Through the kindness of Mr. A. B. Braine, who supplied me with fresh specimens of this plant, I was able to closely observe the mechanism of expansion, but never on any occasion did I find the labellum irritable. I understand, too, that Mr. Braine, who was able to study them under more natural conditions, also failed to observe irritability. So remarkable a conformation is exceedingly suggestive of this peculiarity, and it is possible that irritable movements are only displayed under certain meteorological conditions.

This singular and rare little orchid was first recorded from Mount Tingi Ringy (4,700 feet), and later at Blackheath (L. H. Stephenson), in the Blue Mountains. It has not hitherto been recorded from any other locality. The present plants have reached me from Cravensville, near Tallangatta, in Victoria, and were collected by Mr. A. B. Braine in December, 1917.

The genus *Drakea* contains 5 known species, two of which, *D. irritabilis*, Reich., and *D. Huntiana*, F. v. M., are natives of Eastern Australia; the others, *D. elastica*, Lindl., *D. glyptodon*, Fitz., and *D. ciliata*, Reich., come from Western Australia.

Differential Table.

Labellum articulated directly by its claw to column without intervening basal projection; lanceolate or ovate-lanceolate leaf at time of flowering.
  Leaf-like bract on stem; column not reflexed on ovary ... ... *D. ciliata*
Labellum articulated at end of basal projection of column.
  Leafless at time of flowering.
    Dorsal sepal greatly exceeding other segments of perianth, column reflexed at right angles with ovary ... ... *D. irritabilis*
    Segments of perianth about equal in length; column actually reflexed on ovary ... ... *D. Huntiana*
  Leaf present at time of flowering; rigid, orbicular or ovate-cordate.

Posterior lobe of lamina of labellum broad, upturned, smooth; middle portion glandular and very hairy; anterior lobe hairy and very glandular; anther with marked sharp point	*D. elastica*
Posterior lobe of lamina smooth, horizontal, conical; middle portion very hairy, not glandular; anterior lobe very glandular, not hairy; anther quite blunt	*D. glyptodon*

7. Chiloglottis Muelleri, Fitz.

This very rare orchid, which was discovered by Mr. C. French, sen., on the Lodden River, Victoria, and described by the late R. D. Fitzgerald many years ago, seems to have been lost sight of since that period.

Recently I have received it from three localities, *viz.*, Fern Tree Gully, Healesville, and Ben Cairn, near Warburton.

The specimens were collected between October 27 and December 3, 1917, and I am indebted for them to Mr. E. E. Pescott, of Melbourne.

Strangely enough, it has never received recognition in Victoria, and does not appear on the listed plants of that State. It was merged by Baron von Mueller into *C. Gunnii*, Lindl., from which, however, it differs in several important respects.

These differences may be shown as follows:—

	C. Muelleri.	*C. Gunnii.*
1. Plant ...	Rather slender.	Rather stout.
2. Leaves ...	Relatively long and narrow; elliptical-lanceolate or oblong-lanceolate.	Relatively short and broad; oblong-lanceolate or ovate.
3. Flower ...	Narrow; quite green.	Broad; reddish-brown.
4. Labellum ...	Ovate-lanceolate; green.	Broadly ovate; reddish-brown.
5. Calli	Dark bottle-green or brown; generally sessile but occasionally very shortly stalked; mostly large with rounded or elongated contours; often crescentic, reniform or sausage-shaped; irregularly grouped in centre and at base of lamina.	Reddish-brown; a large, long-stalked, clavate callus at base of lamina, and a short, thick, almost sessile gland in front of this near the centre: a somewhat irregular row of small stalked calli on either side of these.
6. Petals ...	Spreading.	Ascending.

All my specimens were found growing on the trunks of tree-ferns *(Dicksonia)*. This habit appears to be shared in a much more limited extent by *C. Gunii*, and is referred to by Mueller,(1) C. French, sen., and others.

An illustration of the plant will be found in Fitzgerald's Australian Orchids, vol. ii., plate 16.

EXPLANATION OF PLATES.

Plate II.

Calochilus cupreus.

The central figures show the plant in its natural size.

Fig. 1. Upper-surface of labellum, ×2. Shows the fleshy glabrous rectangular base with the longitudinal raised lines and the hairy triangular lamina.

,, 2. Side view of the same, ×2. Shows the tip of the labellum produced into a ligulate process.

,, 3. Front view of column, ×2. Shows in its upper part the duck-bill anther, immediately below which is the rostellum, situated in the upper concave margin of the stigma. The dark comma-shaped glands are shown within the column wings at the base.

,, 4. Side view of the same, ×2. Shows anther in profile, and also the lateral winging of the column.

Plate III.

Pterostylis pusilla.

Central figure showing plant in its natural size.

Fig. 1. A flower (natural size) from the front.

,, 2. Labellum from above, ×3. Note labellum with raised lateral and posterior margins and scooped-out upper-surface, with long hairs on sides and very short ones on tip and vestigial appendage; the broad claw; the pyriform bodies on the lower-surface are partly to be seen projecting on each side of the labellum at the base.

,, 3. Lateral view of labellum and claw, ×3.

,, 4. Labellum seen from below, ×3. Note the pyriform bodies, one on each side of the deep central channel which traverses the entire length of the lower-surface.

,, 5. Column from front, ×3. Note the membranous wings just below the anther, and the secondary ovate-lanceolate expansion traversed by the narrow stigma.

,, 6. Column in profile, ×3. Note its curvature; also the side views of the anther and the membranous wings.

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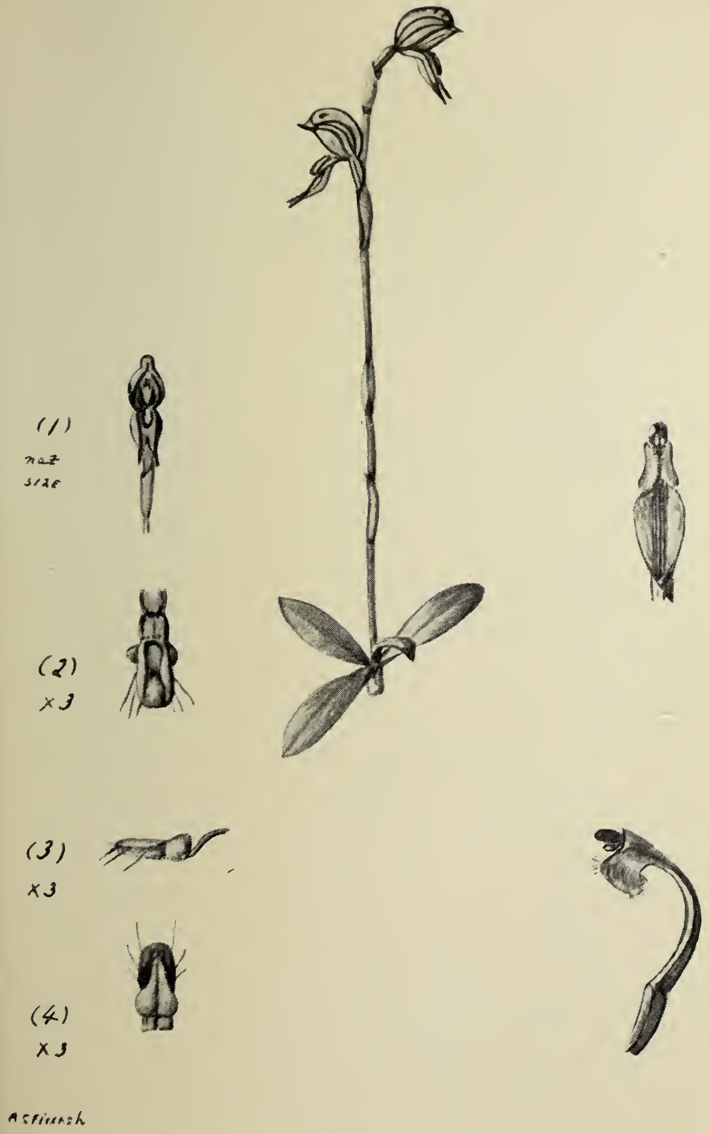
(1) Fragmenta, viii., 151; x., 117.

Calochilus cupreus, n. sp.



Pterostylis pusilla, n. sp.

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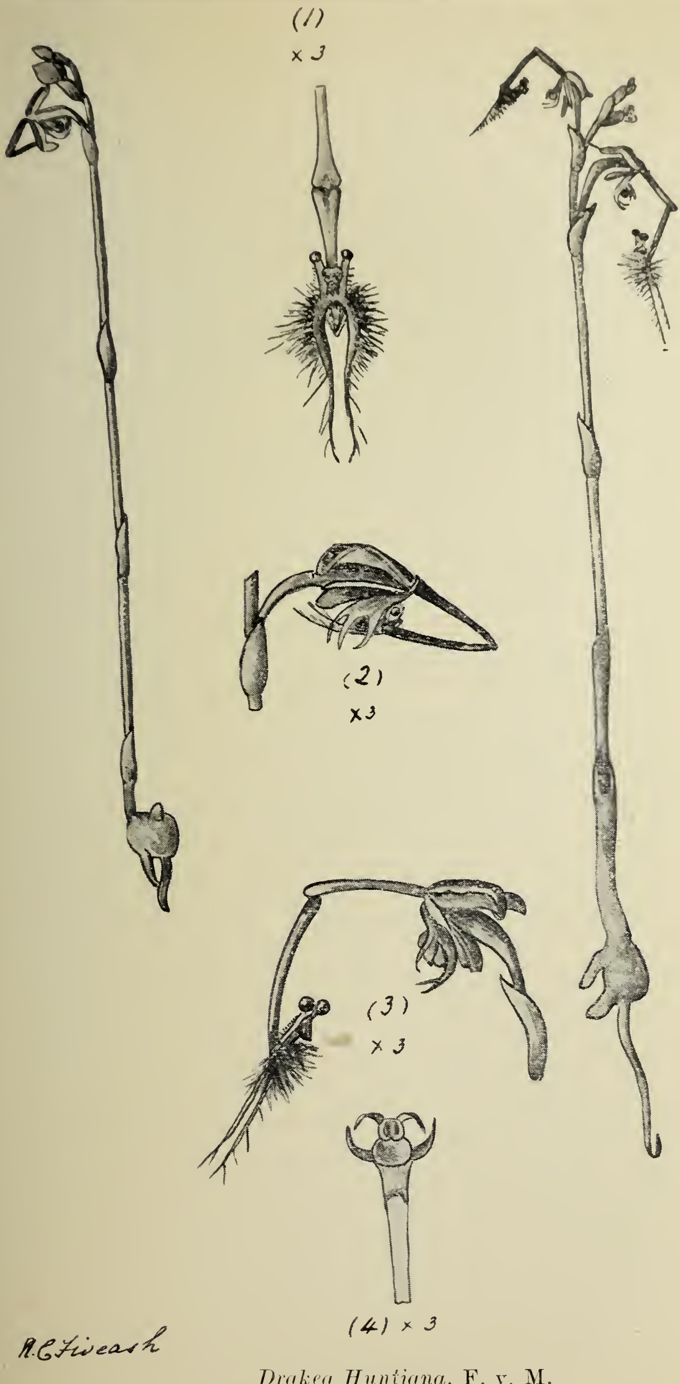

Drakea Huntiana, F. v. M.

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Plate IV.

Drakea Huntiana, F. v. M.

At each side of the plate the plant is shown in its natural size; on the right with two flowers expanded, and on the left a flower about to expand and several very young buds.

Fig. 1. Labellum seen from above, ×3. In the upper part of the drawing note the columnar foot (projection) articulated with the labellar claw, which is of about equal length; also the two anterior peduncles terminating in globular glands and the large triangular gland lying between them; also the divergent posterior tails with their numerous hairs.

,, 2. An enlargement of a bud just about to expand. The lateral sepals have already rotated to the opposite side of the ovary, but the claw-like processes of the column have not yet released their grip of the labellum.

,, 3. Lateral view of fully-expanded flower, ×3. Note that the flower appears inverted owing to the acute flexion of the column and perianth segments on the ovary. The claw is seen to be inserted into the under-surface of the middle or thoracic segment of the labellum.

,, 4. Front view of column, ×3. This shows the lower unexpanded portion of the column and also the upper expanded part. In the latter will be seen the upper and lower claw-like processes, the anther between the former and stigma between the latter.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA. No. 13.

By J. M. Black.

[Read June 13, 1918.]

Plates V. to VIII.

Most of the notes in this paper are the result of a visit to the 90-mile Desert and the South-eastern District made in the end of November and the beginning of December of last year. Several other collectors have also kindly furnished me with specimens from various parts of the State, some of which are dealt with here.

Two species believed to be new to science, in the genera *Dicrastylis* and *Limnanthemum*, are described.

The following species, native in other parts of Australia, are here recorded for the first time in South Australia:—*Cardamine tenuifolia*, *Hydrocotyle plebeia*, *Hypolaena exsulca*, *Goodenia humilis*, *Melaleuca fasciculiflora*, *M. pauperiflora*, *Potamogeton tricarinatus*, *Scaevola nitida*.

Aliens are indicated by an asterisk, and the new introductions recorded are:—*Atriplex patulum*, *Carthamus glaucus*, *Dipsacus fullonum*, *Festuca elatior*, *Leontodon hispidus*, *Medicago orbicularis*, *Moenchia erecta*, *Pentaschistis Thunbergii*.

Where a new record is made for one of Tate's districts, the name of the district is given within brackets immediately after the locality.

Marsileaceae.

Marsilea Drummondii, A. Braun. "Nardoo." Bordertown, growing in mud along the Tatiara Creek (Dist. T). Leaflets silky on both sides and entire at summit.

Selaginellaceae.

Selaginella Preissiana, Spring. Dismal Swamp.

Coniferae.

Callitris propinqua, R. Br. Scrub near Enfield. Large or small tree with spreading branches.

Potamogetonaceae.

Potamogeton tricarinatus, A. Benn. Renmark (E. C. Black). River Murray, without exact locality (Mrs. Mellor).

Floating leaves 15-nerved. First record for South Australia; the type came from the Murrumbidgee River, N.S.W. *P. Tepperi*, A. Benn. Finniss R. (H. Griffith); drains at Millicent. Upper leaves 19-23-nerved; those of the Millicent specimens are broad-ovate or quite orbicular.

Gramineae.

Lepturus incurvatus, Trin. Robe (C. D. Black); Beachport (Dist. G).

Danthonia penicillata, (Labill.) F. v. M., var. *racemosa*, Maid. et Betche. Cheltenham; Keith; Millicent; Bordertown. A small grass 20-30 cm. high, with filiform, hispid leaves; the short broad outer glumes and short awn not much exceeding the lateral lobes give it the aspect of *D. carphoides*, F. v. M., but the lateral lobes are twice as long as the base.

Calamagrostis aemula, (R. Br.) Steud. Beachport. In south-eastern specimens the bristle of the rhachilla is $\frac{1}{2}$ or $\frac{3}{4}$ as long as the flowering glume, and the spikelet is 6 mm. long, while in the midland and northern specimens the bristle is very short or the rhachilla is merely produced in a tuft of hairs at the base of the palea, and the spikelets are rather shorter. An inland form with the ordinary small spikelets, but with the panicle much exceeding the leaves, as in var. *Billardieri*, is found at Millicent and Kybybolite. Mr. E. S. Alcock states that it is known at the former place as "Blown grass," because the ripe panicles are broken off near the base of the brittle stems and collect in bunches along the fences. Var. *plebeia*, Maid. et Betche (*Deyeuxia plebeia*, Benth.). Beachport.

Glyceria fluitans, R. Br. Dismal Swamp (Dist. G). Rooting at the nodes below water; erect stems 1-1·50 m. high.

Poa caespitosa, Forst., var. *laevis*, Benth. Beachport. Not tall; leaves filiform, smooth; panicle contracted, short (about 3 cm. long). Var. *tenera*, Benth. Caroline scrub. Rootstock creeping; stems more or less procumbent; panicle 1-2 cm. long, lowest branch solitary, or the panicle reduced to a raceme of 2 or 3 spikelets, each containing only 2-3 flowers.

Stipa flavescens, Labill. Robe; Beachport (Dist. G). *S. setacea*, R. Br. Bordertown (Dist. T). *S. pubescens*, R. Br. West of Bordertown; Keith (Dist. T); Beachport (Dist. G). *S. teretifolia*, Steud. Robe (C. D. Black); Beachport (Dist. G).

Amphibromus nervosus, (R. Br.) Hook. f. (*A. Neesii*, Steud.). Belair road. Brown's original specific name cannot, under the laws of nomenclature, be rejected in favour of Steudel's later appellation.

Sporobolus indicus, R. Br. Naracoorte (Dist. T; H. W. Andrew).

Triodia irritans, R. Br. Keith (Dist. T).

Panicum prolutum, F. v. M. Reserve of railway reservoir, Bordertown (Dist. T).

**Festuca elatior*, L., var. *arundinacea*, Hack. Millicent. First record for South Australia.—Europe, temperate Asia, and North Africa.

**Pentaschistis Thunbergii.* Golden Grove (H. W. Andrew). First record. Growing over a considerable patch of ground.—A handsome South African grass, common near Cape Town. Determination made at Royal Botanic Garden, Kew.

**Poa pratensis*, L. Common about Millicent, especially near drains and swamps; Blue Lake, Mount Gambier; Robe.

**Agrostis verticillata*, Vill. Common in wet ground at Millicent.

**Aira caryophyllea*, L. Caroline scrub.

**Polypogon maritimus*, Willd. Woolley Lake, Beachport. Already recorded for Robe.

**Hordeum maritimum*, With. Millicent; Bordertown.

**Lagurus ovatus*, L. Beachport; Caroline scrub. This beautiful Mediterranean grass appears to be spreading all round our coastline.

CYPERACEAE.

Cyperus tenellus, L. Between Mount Gambier and Glencoe; Dismal Swamp (Dist. G). *C. Gunnii*, Hook. f. Myponga; near Onkaparinga River at Ambleside (Dist. A); between Mount Gambier and Glencoe (Dist. G).

Scirpus cernuus, Vahl. Onkaparinga River at Ambleside; Beachport; Dismal Swamp; drains at Millicent. *S. antarcticus*, L. Between Glencoe and Lake Edward.

Schoenus axillaris, (R. Br.) Poir. Millicent (Dist. G). Almost all the spikelets examined contained 2 fertile flowers, and, when ripe, 2 nuts, so that the early description by Hooker f. (Fl. Nov. Zel., i. 274) seems to be more correct than the later one by Bentham, Mueller, and others. *S. nitens*, (R. Br.) Poir. Beachport; Millicent drains; Glenelg River. *S. apogon*, Roem. et Schult. West of Bordertown (Dist. T).

Gahnia trifida, Labill. Robe (C. D. Black); shores of Lake George near Beachport (Dist. G). Locally known as "Cutting Grass." Nut about 2 mm. long, black and shining when ripe; leaves very rough downwards. *Cladium filum*, R. Br., which is scarcely to be distinguished from *G. trifida* except by the long, narrow, light-coloured nut and the smoother leaves, is also found at Robe.

Carex Gunniana, Boott. Drains at Millicent. A form remarkable for its broad leaves (to 9 mm.) with scabrous margins and the lowest female spikelet on a long peduncle, sometimes twice as long as the spikelet. *C. inversa*, R. Br. Bordertown railway reserve (Dist. T).

Cladium junceum, R. Br. Keith (Dist. T).

Lepidosperma exaltatum, R. Br. Between Mount Gambier and Glencoe; Dismal Swamp. Stems 1-1·50 m. high; growing near water. *L. longitudinale*, Labill. Myponga (Dist. A; A. D. Black). *L. concavum*, R. Br. Stansbury (Dist. Y); Tintinara; Keith (Dist. T).

L. elatius, Labill., is given by Tate (Fl., 265) for the Adelaide district, but the only specimen in his herbarium is from Mount Macedon, Victoria. Mueller, in his Key to the System of Victorian Plants, does not record it for any place further west than his "Southern District," which includes the country round Port Phillip as far west as Cape Otway. The occurrence of this plant in our State seems doubtful.

Chorizandra enodis, Nees. West of Bordertown (Dist. T).

Restionaceae.

Hypolaena exsulca, R. Br. Keith. First record of this Western Australian species in our State. The male plant appears indistinguishable from that of *H. fastigiata*, but the female has flexuose branches covered with a white, almost scaly tomentum; style-branches very short, much thickened towards the base. *H. fastigiata*, R. Br. Keith (Dist. T).

Lepidobolus drapetocoleus, F. v. M. Keith; Bordertown (Dist. T).

Centrolepidaceae.

Brizula pumilio, (F. v. M.) Hieron. Between Glencoe and Lake Edward. Stems 1-3 cm. high.

Centrolepis glabra, (F. v. M.) Hieron. Dismal Swamp (Dist. G). Stems red, 20-35 mm. long; leaves shorter.

Trithuria submersa, Hook. f. Dismal Swamp (Dist. G). A dwarf, reddish plant, growing in mud; involucral bracts 4, not "5 or 6 or sometimes 1 or 2 more," as stated by Bentham. Hooker (Fl. Tasm., ii., 79) says 4; Hieronymus (Nat. Pflanzenfam.) says 2-4. In the flowers I examined the 3 styles were divided to the base into 2 branches. The name *Juncella*, F. v. M., has been substituted for *Trithuria* by Hieronymus in the Nat. Pflanzenfam., and by Maiden and Betche in the Census of N.S.W. Plants, on the ground of priority, but as Mueller's name was announced in 1854 without any description, it cannot, under art. 38 of the Vienna rules, replace Hooker's name, published with a description in 1860. Mueller himself accepted this position in his 1st and 2nd Census.

Juncaceae.

Juncus maritimus, Lamk., var. *australiensis*, Buch. Robe; Beachport (Dist. G).

**J. capitatus*, Weig. Dismal Swamp.

Liliaceae.

Dianella revoluta, R. Br. Cummins, E.P. (Dist. L); Bordertown (Dist. T).

Arthropodium fimbriatum, R. Br. Keith (Dist. T). *A. minus*, R. Br. Bordertown (Dist. T).

Burchardia umbellata, R. Br. Keith (Dist. T).

Tricoryne elatior, R. Br. Keith; Bordertown (Dist. T).

Casuarinaceae.

Casuarina Luehmannii, R. T. Baker. "Bull Oak." Bordertown. Teeth usually 12, mostly truncate owing to the points having fallen; branchlets nearly 2 mm. in diameter, hoary with a minute pubescence visible under the lens, and very bitter to the taste, so that it is said stock will not eat this oak, although they are fond of most Casuarinas. Cones with the valves in only 2 rows in the specimens seen and therefore much depressed. *C. stricta*, Ait. Wooley Lake, Beachport, on sandy slope near the sea; branchlets drooping. *C. suberosa*, Otto et Dietr. Scrub between Macclesfield and Strathalbyn; Barossa Ranges (Dist. A); Keith; Tintinara. At Keith this was a dwarf shrub 1-1·50 m. high, and in the Tintinara specimens many of the flowers in the cone were abortive, especially towards the summit, which was consequently produced in the form of a beak; valves of fertile flowers very prominent; sheathing-teeth 6.

Salicaceae.

**Populus alba*, L. "White Poplar." Millicent. Spreading numerously by suckers in several places, some of the young trees standing 4 m. high.

Proteaceae.

Hakea vittata, R. Br. Beachport (Dist. G). A low shrub, not more than 30 cm. high; stems procumbent. *H. ulicina*, R. Br., var. *flexilis*, F. v. M. East Wellington; Keith; Bordertown.

Polygonaceae.

Rumex Brownii, Campd. Dismal Swamp. Dwarf form about 10 cm. high, with 3 teeth on each side of the inner perianth-segments, as in most South Australian specimens. Deceptively like stunted forms of **R. acetosella*, L. (Sorrel), which were growing in the same damp ground. *R. bidens*, R. Br. Drains at Millicent; Lake Edward.

CHENOPODIACEAE.

Atriplex angulatum, Benth. Willochra Creek, near Quorn. Perianth appears quite distinct from that of *A. campanulatum*, Benth., although the two species were united by Mueller. This is the first time I have seen this plant. The specimen was collected on the Willochra Creek by Mr. Vosler, the Californian parasitologist who visited this country in March, 1918.

**A. patulum*, L. "Common Orache." Outer Harbour, close to sea and inland from Henley Beach, fruiting perianth submuricate; ballast dump, Port Adelaide, perianth smooth (H. W. Andrew). First record for South Australia.—A common and very variable weed of the Old World.

Chenopodium glaucum, L. A form with small leaves (mostly 5-10 mm. long) and succulent red stems, is numerous on the bed of Lake Ormerod, near Naracoorte, when the water recedes.

PORTULACACEAE.

Anacampseros australiana, J. M. Black. On February 2, 1918, a plant of this species, cultivated in my garden, opened its flowers for the first time in my experience, the 5 very pale pink concave petals almost erect and as long as the sepals; stamens 8. The flowering state in which the calyx scarcely opens and the petals are much shorter than the sepals, and on which the description was founded, is therefore not constant, although it appears to be the normal one.

Claytonia australasica, Hook. f. Swamps at Murray Bridge (Dist. M); Dismal Swamp.

CARYOPHYLLACEAE.

**Moenchia erecta*, (L.) Gaertn. Between Glencoe and Lake Edward. A small weed of Central and Southern Europe. First record for South Australia; recorded for Victoria (as *Cerastium quaternellum*) in 1893.

**Silene conica*, L. Millicent, roadsides and fields. Already recorded for Robe in 1911.

CRUCIFERAE.

Cardamine tenuifolia, Hook. Dismal Swamp. Growing in water; stems weak. This plant, with its large white petals, leaves all with linear lobes and pod terminating in a style 2 mm. long, is so distinct in appearance from *C. hirsuta*, L., that I prefer to follow Bentham in keeping it a separate species. Not previously recorded in South Australia.

Brassica adpressa*, (Moench) Boiss. (*Sinapis incana*, L.) "Hoary Mustard." Roadsides and uncultivated fields; said also to occur in cultivation. Locally called "Buchan weed." Also at Naracoorte (H. W. Andrew). A European weed, previously recorded for Port Lincoln. In the South-east it appears to take the place of the Wild Turnip (Rapistrum rugosum*) of the North.

**Alyssum maritimum*, Lamk. Millicent. Growing wild in abundance on allotments and fields near the town. Already recorded for Robe.

RESEDACEAE.

**Reseda alba*, L. "White Mignonette." This handsome plant, previously found on Kangaroo Island and at Robe, is common on vacant land near the railway station, Beachport.

CRASSULACEAE.

Tillaea colorata, Nees. Dr. C. H. Ostenfeld, of Copenhagen, who is writing a series of papers on the flora of Western Australia, tells me in a letter that, having compared specimens of *T. acuminata*, Reader, with *T. adscendens* and *T. colorata*, Nees, he finds they are all one and the same species, and as Nees' specific name has a priority of 54 years it must replace that of Reader in our flora. *Colorata* is chosen, because *adscendens* is already employed for a species of *Crassula*, with which *Tillaea* has been recently united as a subgenus by European botanists. *T. macrantha*, Hook. f., var. *pedicellosa*, F. v. M. Between Glencoe and Lake Edward. *T. recurva*, Hook. f. Dismal Swamp. Petals 4, white, nearly twice as long as the sepals; scale oblong, nearly half as long as the carpel, which contains 3-4 seeds. *T. Sieberiana*, Schult. Hundred of Caroline.

LEGUMINOSAE.

Dillwynia ericifolia, Sm., var. *peduncularis*, Benth. Penola Forest (W. Gill); between Mount Gambier and Glencoe. *D. hispida*, Lindl. Bordertown; Keith (Dist. T); between Murray Bridge and Callington (Dist. M).

Pultenaea pedunculata, Hook. Bordertown (Dist. T). *P. tenuifolia*, R. Br. Strathalbyn (Dist. A); Warunda (Dist. L; H. Griffith). Var. *recurvifolia*, Benth. Mount Burr, near Millicent.

Acacia farinosa, Lindl. Edilillie; Lake Wangary (Dist. L; H. Griffith); Port Vincent (Dist. Y).

A. acinacea, Lindl. Bordertown (Dist. T). A small shrub, only 50 cm. high or less, with spreading stems and branches, sometimes very long and procumbent; Mount Thisbe, K.I. (Dist. K; H. Griffith). The specimens from Bordertown have the phyllodia broader in the centre and more contracted towards the base than those from Eyre Peninsula and Kangaroo Island, and the pod is broader (4-5 mm. as against 3 mm.).

A. retinodes, Schlecht. The phyllodia vary from linear-lanceolate and 3-5 mm. broad to oblanceolate and 6-12 mm. broad. In maritime forms from Wedge Island and Beachport they are thick and rigid, with a breadth of 10-25 mm.

A. salicina, Lindl. "Umbrella Bush." Naracoorte (Dist. T; H. W. Andrew).

A. rigens, A. Cunn. Monarto South (Dist. A; Miss A. McMahon).

A. Menzelii, J. M. Black. Through the kindness of Miss A. McMahon, school teacher at Monarto South, pods and seeds of this species have now been obtained, and are figured on plate v. The pods of *A. Menzelii* are linear, straight or curved, 25-45 mm. long, 2-3 mm. broad, the valves viscid-pustulate; the seeds black, shining, oblong, 4 mm. long by 1½ mm. broad, the last 2 folds of the funicle swollen into a large, fleshy aril. They show a close relationship to those of *A. rigens* and *A. Bynoeana*, but the pod of *Menzelii* is much straighter and the seeds are narrower.

A. Bynoeana, Benth. After reading the original description of *A. Wilhelmiana*, F. v. M., in Trans. Phil. Soc. Vic., i., 37 (erroneously quoted as "*A. Wilhelmsiana*" and the reference as "Trans. Phil. Inst. Vict." in Fl. Aust., ii., 339), I have no doubt that this species is the same as *A. Bynoeana*. Mueller describes it as having "phyllodia incurved, upright, short, linear, filiform, compressed, ending in a broader, blunt, recurved apex, above or on both sides furrowed and furnished with 2 thin veins." This description agrees with *A. Bynoeana* and not with *A. calamifolia*, of which Bentham wished to make it a short-leaved variety. Besides *A. Wilhelmiana* comes from the "mallee scrub on the Murray, where it was first discovered by Mr. Wilhelmi," and that is just the locality where *A. Bynoeana* is found. This identification, if corroborated by examination of the types, would entail no change of name, as *A. Bynoeana* has the right of priority by at least one year. In specimens from Loxton and Karoonda the phyllodes are flat and 2-3 mm. broad, much resembling those of *A. sclerophylla*, but the latter has the phyllodes with 3 prominent nerves and 4 faint intermediate ones on each surface, while those of *A. Bynoeana* have 2 prominent nerves and (in the broad-leaved form) 2-3 faint intermediate ones, and the mucro is curved at a more acute angle.

A. microcarpa, F. v. M. Yumali (Dist. T; S. A. White); Halbury scrub (Dist. N).

**Trifolium resupinatum*, L. "Reversed Clover." Stockyards at Mount Gambier; roadside between Mount Gambier and Glencoe; common at Millicent. First record for South Australia, although listed for Victoria by Mueller in 1887. It is rather conspicuous by its bright pink flowers, and in its woolliness bears considerable resemblance to *T. tomentosum* and *T. fragiferum*. The former is also common in the South-east. **T. incarnatum*, L. "Crimson Clover." Between Mount Gambier and Glencoe.

**Medicago orbicularis*, All. Field near Collinswood (H. W. Andrew). This flat-podded medic has not previously been noticed in S.A., but was recorded for Victoria in 1907.—Mediterranean region. **M. lupulina*, L. "Black Medic." Very common in moist place near Millicent. **M. hispida*, Gaertn., var. *inermis*, Urb. (*M. reticulata*, Benth.). Bordertown. Var. *lappacea*. Millicent. Pod black and larger than in var. *denticulata*, Urb. (*M. denticulata*, Willd.).

**Cytisus canariensis*, L. "Canary Broom." Established in fields and roadsides near Mount Gambier

Geraniaceae.

Pelargonium Rodneyanum, Lindl. Naracoorte; Bordertown; Keith. Petals pink, streaked with crimson. *P. australe*, Willd., var. *erodioides*, Benth. Beachport; Caroline Scrub; Dismal Swamp.

**Geranium molle*, L. This delicate little plant, rare near Adelaide, is common in the moister climate of Mount Gambier.

Euphorbiaceae.

Beyeria viscosa, (Labill.) Miq., and *B. opaca*, F. v. M. Tate, in his Flora, gives *B. viscosa* for the Adelaide district, and in another place (although I have lost the reference) he says, "Mount Lofty Range, near water." His herbarium, however, contains no typical specimens of that species. Bentham (Fl. Aust., vi., 65) gives only *B. opaca* for South Australia. Mueller, in Fragm., i., 230 (1859), united *B. opaca* with *B. viscosa*, but later on he changed his opinion, and they remain distinct in his 1st and 2nd Census. Bentham distinguished *B. opaca* chiefly by its smaller leaves, and laid little stress on the length of the pedicel or the shape of the fruit. In his key to the system of Victorian plants (1887-8) Mueller divided the species as follows: —

Leaves oval or elliptical-lanceolate; stalkets much longer than calyx; fruit comparatively large ... *B. viscosa*
Leaves broad-linear, blunt; stalklets about as long as the calyx; fruit comparatively small ... ... *B. opaca*

Unfortunately many South Australian specimens, especially from Robe and Beachport, in the South-east, have leaves broadly lanceolate and acute, 2-4 cm. long, but the pedicels are always short, never as long as the almost globular fruit, and very different from specimens collected in Tasmania, which have pedicels 12-15 mm. long, much longer than the large obovoid capsule, which is almost lobed, owing to the deep furrows between the cells. This is the typical *B. viscosa*, as shown in Labillardière's figure. In short, if the two species are distinguished by the pedicels and fruits, we do not, on the present evidence, possess *B. viscosa* in South Australia; if they are distinguished by the leaves, we do. Probably the two species should be united, but if they are maintained distinct, I should feel inclined to make the pedicels and fruit the leading characteristic, and in that case we have only *B. opaca*, with the following localities: Robe, Beachport, Port Vincent, Kangaroo Island, Marino, Cape Thevenard (leaves lanceolate or oblanceolate, long or short, acute or obtuse, very white below); Loxton, Ooldea (leaves oblanceolate, short, light green below); Alawoona, Loxton, Yaninee, Gladstone, Quorn (leaves broad-linear, usually short, 1-2 cm. long). Var. *linearis*, Benth. Torrens Gorge; Clarendon.

Phyllanthus trachyspermus, F. v. M. Mount Lyndhurst (border of Dists. C and S). Sent to the Department of Agriculture under suspicion of poisoning stock.

Bertya Mitchellii, J. Muell. Eight miles inland from Port Broughton (Dist. N; F. S. Salisbury); Yumali (Dist. T.; S. A. White). This species has been recently united with *B. oleifolia*, Planch., from which it was distinguished in the Fl. Aust. by its narrower leaves.

**Euphorbia helioscopia*, L. Paddock near Walkerville terminus (H. W. Andrew). Already recorded from Port Lincoln.

RHAMNACEAE.

Spyridium eriocephalum, Fenzl., var. n. **adpressum.** *Variat foliis confertis adpressis subcylindricis 3 mm. longis apiculo deflexo terminatis, petiolis brevibus sed conspicuis, capitulis sessilibus, foliis floralibus 2-3.*

Port Lincoln; Edilillie (H. Griffith). A slender shrub, easily recognized by its small, crowded, erect, glossy leaves. The typical form of *S. eriocephalum*, with spreading leaves 3-10 mm. long, is found at Karoonda and in other parts of the Murray scrub, Woodchester, Keith, Bordertown, Stansbury, and Minnipa. It is a shrub with intricate branches, about 50 cm. high. A form with thicker and broader leaves, sometimes with a slight groove on the upper face, occurs on Kangaroo Island and at Port Vincent.

S. vexilliferum, Reiss. The typical form, with rather long, spreading leaves, hispid and deeply grooved above owing to the prominent midrib below, is found in many parts of the Mount Lofty Range, while var. *latifolium*, Benth., grows at Square Waterhole, at Victor Harbor, and on Kangaroo Island.

S. bifidum, F. v. M. The typical form, with cuneate bifid leaves, occurs at Port Lincoln and Hog Bay, K.I.; also in the Flinders Range near Beetaloo, with the leaves narrower and merely emarginate or sometimes entire at the summit; from Port Lincoln I have specimens with the same foliage, large heads, and conspicuous floral leaves, but all the leaves entire at the summit.

Cryptandra amara, Sm. Yumali (Dist. T; S. A. White). Var. *longiflora*, F. v. M. Bundaleer (Dist. N). *C. tomentosa*, Lindl. Yumali (Dist. T; S. A. White).

Malvaceae.

Hibiscus Drummondii, Turcz. Hundred of Goode. B. P. Bowering. Already recorded for Minnipa.

Sterculiaceae.

Thomasia petalocalyx. F. v. M. Pinery near Reedbeds; Sandergrove; Port Willunga; Kingscote, K.I. The calyx is divided to ½-1 mm. from the base, so that in this respect there is nothing to distinguish this species from a *Lasiopetalum*. The anthers, however, open in slits extending about halfway down the cells.

Dilleniaceae.

Hibbertia stricta, R. Br., var. *hirtiflora*, Benth. Cape Borda (H. Griffith); Tintinara; Keith. Sepals villous: stamens about 9; carpels 6-ovulate, but usually only 1 of the 2 carpels ripens a seed, which is globular and arillate at base. Var. *canescens*, Benth. Snug Cove; Ravine Creek, K.I. (H. Griffith). *H. fasciculata*, R. Br. Between Mount Gambier and Glencoe. Petals obovate, not emarginate; leaves very slender.

Violaceae.

Viola hederacea, Labill. Growing in shady spots under stringybarks in the Caroline scrub, also round lakes at Dismal Swamp. Petals violet, edged with white.

Hybanthus floribundus, (Lindl.) F v. M. Karoonda (Dist. M; E. Ashby); Beetaloo (Dist. N).

Thymelaeaceae.

Pimelea octophylla, R. Br. Keith (Dist. T).

Lythraceae.

Lythrum salicaria, L. Murray Bridge (Dist. M; A. R. Hilton). *L. hyssopifolia*, L. Bordertown (Dist. T).

Myrtaceae.

Eucalyptus oleosa, F. v. M. Enfield, in a small patch of untouched scrub; Strathalbyn; Dublin scrub (Dist. A); Cis-Murray scrub near Monarto (Dist. M). On the western side of the Murray it is a "scrub mallee"; at Enfield it is a large or small tree with a very rough bark, and resembles "peppermint" *(E. odorata)*.

E. ovata, Labill. *(E. Gunnii*, F. v. M., non Hook. f.). Myponga, a large tree with rough, dark bark on the stem, umbels 4-8-flowered; Glenelg River, a small tree; Cape Northumberland; road from Mount Gambier to Glencoe, a small tree about 4 m. high, with light bark except at the very base, and drooping branches, some of the leaves ovate-lanceolate.

E. capitellata, Sm. "Stringybark." Glencoe (with large fruits); Bordertown (with smaller ones).

E. obliqua, L'Hér. Hd. of Caroline; Millicent; road from Mount Gambier to Glencoe. "Stringybark," and also sometimes called "Messmate" in the South-East, as in Victoria.

E. diversifolia, Bonpl. Beachport.

E. viminalis, Labill. Dismal Swamp. A large tree with dark bark and spreading branches.

E. uncinata, Turcz. Keith. A whipstick mallee, 1·50-2 m. high, with light bark, buds 8-12 in umbel.

E. leucoxylon, F. v. M. Bordertown. A large tree with glaucous foliage, but with the small, almost hemispherical fruits of var. *pauperita*, J. E. Brown; valves of capsule usually 7.

E. incrassata, Labill. Keith; Bordertown. The form with large fruits (15 mm. long); the brown bark peeling off in the usual way and lying in long strips on the ground.

Melaleuca pauperiflora, F. v. M. (plate v.). One of the "Paper-bark teatrees." Dublin scrub (H. Griffith); between Iron Knob and Franklin Harbor (J. Sincock); Minnipa; a few miles north of Murat Bay. A Western Australian species, now first recorded for S.A., and hitherto confused (in our State) with *M. pustulata*. The determination was made by Mr. Edwin Cheel, botanical assistant at the Sydney National Herbarium, who is devoting special attention to this genus. The species is recognizable by its blunt, compressed-cylindrical leaves, 4-6 mm. long, with a shallow groove running along the upper face, and by the short, obtuse calyx-lobes. The small ovoid or globular fruits are in clusters of 2-6 on the previous year's wood. A single specimen exists in the Tate Herbarium unlabelled, but a loose label is marked "Ardrossan," and it probably exists on Yorke Peninsula. The shrubs which I saw north of Murat Bay were 2-3 m. high, with loose, light-coloured, papery bark.

M. fasciculiflora, Benth. Torrens Gorge; Beachport. The Tate Herbarium contains similar specimens from Port Lincoln district and Yallum. A shrub, usually rather low and always growing near fresh water; a Western Australian species not hitherto recorded for S.A., because it has been confused with *M. ericifolia*, Sm. This identification is also due to Mr. Cheel. The white flowers grow in small clusters on the previous year's wood, but sometimes flowers which are male only form small globose terminal heads; the fruits, which are truncate, rough, and somewhat corky, occur still lower on the branches, solitary or in clusters of 2 to 6; the leaves are 3-8 mm. long, flat above, convex below, and with 2 parallel rows of more or less immersed tubercles on the under-surface. The filaments in each bundle vary from 10-20, while in Bentham's description they are given as 7-11.

M. quadrifaria, F. v. M. (plate v.). The type was collected at Eucla by J. D. Batt in 1886, and sent to Baron von Mueller, who evidently intended to describe it in Wing's Southern Science Record. In the 2nd Census (1889) the reference is: "F. v. M., in Wing's S. Sc. Rec., April, 1886." In the 1st supplement of the Index Kewensis (1895) it appears as "F. Muell., in Wing's South. Sc. Record, N.S., ii. (April, 1886)." In spite of these two statements it appears certain that the number for April, 1886, was never published. The copies of this periodical in the Adelaide and Melbourne Public Libraries and in the Victorian National Herbarium contain no such number. Mr. F. A. G. Barnard, writing in the Victorian Naturalist, xvi., 112-3 (1899), claims to have a complete set of the Record, and says that the undertaking was frequently interrupted owing to pecuniary difficulties, and that only four monthly numbers were issued in 1885 and one (for January) in 1886, after which publication ceased altogether. The only known description of *M. quadrifaria* is in Tate's Fl. Extra-trop. S.A., 93, and is as follows:—

Leaves elongate, recurved-pointed.
Leaves opposite in 4 decussate rows; flowers in well-developed heads ... ... *quadrifaria*

The leaves are not elongate, being only 4-6 mm. long, and as short as those of any other South Australian species except *M. gibbosa*, while the point is rather slightly oblique than recurved. The remainder of the description would apply equally well to a number of other species of the genus. There is no specimen in the Tate Herbarium, and Professor Ewart very kindly lent me one from the Victorian National

Herbarium for examination and drawing. In order to validate Mueller's name a short diagnosis is here given: —

Melaleuca quadrifaria, F. v. M. *Herb.* (*tab. v*). *Frutex fere glaber, ramulis ad folia inserenda excavatis, floriferis incrassatis puberulis, foliis sessilibus decussatis confertis erectiusculis 4-6 mm. longis semicylindricis (supra planis vel parum canaliculatis infra convexis) acutis apice paululum recurvis basi latâ obliquâ orbiculari subpeltatim affixis, floribus albis circiter 15 in capitulum terminale aggregatis, calyce ovoideo 4 mm. longo, lobis acutis 1 mm. longis, filamentis cujusque phalangis 7-11 ungui duplo longioribus, fructibus globosis circiter 3 mm. diametro.*

Although the leaves in size and shape rather resemble those of *M. cymbifolia* and *cuticularis* than those of any species belonging to Bentham's Series vii., *Peltatae*, Mueller was no doubt right in placing it in his Census next to *M. tamariscina*, on account of the manner in which the leaves are attached by their broad base almost peltately to the excavations of the branchlets, leaving behind them, when they fall, large circular scars. A copy of some manuscript notes by Mueller was also supplied by Professor Ewart, and (if I interpret the contractions correctly) they are as follows: —"Bracts very narrow, shorter than calyx; axis slightly downy; calyx glabrous, its lobes deltoid, 3 times shorter than the tube and hardly half as long as the orbicular white petals; stamens 7-11 in each bundle, the filaments arising fascicularly from the connate part and surpassing it nearly twice in length."

M. Wilsonii, F. v. M. West of Bordertown. A straggling shrub about 1·50 m. high; filaments 11-15; fruiting-calyx 5-angled at summit by the persistant portion of the lobes.

M. squarrosa, Sm. Dismal Swamp; Glenelg River; between Mount Gambier and Glencoe. Petals and filaments white, a variation in colour already noticed by Mueller (Fragm., v., 55).

Oenotheraceae.

Epilobium glabellum, Forst. Near Glenelg River; Beachport. At Dismal Swamp a dwarf form was common, 3-10 cm. high; leaves only 6-12 mm. long, glabrous, oblong, irregularly and rather prominently toothed; flowers small; perhaps a distinct species. *E. junceum*, Forst. Waterfall Gully; Scott Creek; Woodside; Hamilton.

Halorrhagidaceae.

Halorrhagis heterophylla, Brongn. Bordertown (Dist. T). Small, rather typical specimens, hispid, with leaves lanceolate, entire or 3-lobed.

Umbelliferae.

Hydrocotyle plebeia, R. Br. Beachport. Creeping among other plants in sheltered spots. Resembles *H. pterocarpa*, F. v. M., but the fruit, although not quite ripe, has no sign of wings, and is 1½-2 mm. broad; plant glabrous, except for a small tuft of hairs at the base of the leaf, which is also sometimes found in *H. pterocarpa;* petals purple, spreading. A Western Australian species, not hitherto recorded for South Australia. Bentham suggests that *H. pterocarpa* may prove to be a variety of *H. plebeia.*

**Pastinaca sativa*, L. "Parsnip." Growing wild along the railway reserve, Millicent, to a height of 1½ m. Recorded by Bentham as growing near Adelaide, but I have not previously seen it wild.

**Conium maculatum*, L. "Hemlock." This handsome but poisonous weed is becoming common in fields and vacant lots near Mount Gambier and Millicent.

Epacridaceae.

Acrotriche ovalifolia, R. Br. Beachport. Fruit 3-4-celled. *A. serrulata*, R. Br. Beachport (Dist. G). An almost glabrous plant, the leaves broader than usual, and 6-10-nerved below. My specimens are in fruit only, and possibly represent a new species.

Brachyloma ciliatum, Benth. Between Mount Gambier and Glencoe. A small shrub 20-30 cm. high, apparently rare, or at least localized.

Leucopogon costatus, F. v. M. Keith (Dist. T). Appears to be the first record of this species on the mainland. The new specimens agree with those from Western Bay, K.I. Leaves only 2-3 mm. long, ciliolate, often half-clasping by the cordate base; bracteoles small; sepals oblong, ciliolate, longer than the corolla-tube; ovary 2-celled.

Gentianaceae.

Limnanthemum stygium, *n. sp. (tab. vi.). Herba aquatica stolonifera, foliis radicalibus longe petiolatis ovato-cordatis 20-25 mm. longis; caule florifero unum folium oblongum petiolatum racemum suffulcientem gerente; pedicellis geminatis bracteolatis ad basin racemi folio florali vel bracteâ amplexicauli suffultis; calycis segmentis ovatis 3-nerviis 3-4 mm. longis, corollae roseae lobis margine fimbrillatis calycem vix superantibus ad basin staminum barbatis, stigmate late bilobo, fructu ignoto.*

Dismal Swamp, 15 miles north of Mount Gambier. A small water-plant, near *L. geminatum*, (R. Br.) Griseb., but differs in the pink and shorter corolla, the leaves ovate instead of orbicular, and to some extent in the inflorescence. The specific name is given in allusion to the name of the locality, but the swamp has now been drained to a considerable extent, and consists chiefly of small lakes or marshes, interspersed with woodland.

Sebaea albidiflora, F. v. M. Robe; Dismal Swamp.

CONVOLVULACEAE.

Wilsonia Backhousii, Hook. f. Covering considerable areas on the flats beside Lake George at Beachport. The following observations were made on the fresh plant:—Leaves succulent, lanceolate, tapering at base; corolla white, the tube nearly twice as long as the green, succulent calyx; anthers oblong, purple, spirally twisted after flowering; stigmas ovoid, greenish, somewhat laterally affixed to the summit of the geniculate style-branches.

Evolvulus alsinoides, L. Wynbring, East-West Railway (Dist. W; S. A. White).

Cuscuta tasmanica, Engelm. Beachport, on southern shores of Lake George. The whole plant has an orange tint, so that its tangled masses make broad orange patches or bands on the ground, sometimes taking the shape of rings. Parasitic on *Wilsonia Backhousii*, *Lepturus incurvatus*, and other lowly plants.

**Convolvulus arvensis*, L. Millicent. Flowers almost white.

BORRAGINACEAE.

Cynoglossum suaveolens, R. Br. Millicent; Lucindale. Corolla white; scales closing the throat yellow; flowers not scented.

VERBENACEAE.

Dicrastylis verticillata, *n. sp. (tab. vii.). Fruticulus ramosus, omnino pilis stellato-ramosis vestitus, foliis plerisque ternis verticillatis sessilibus linearibus 7-10 mm. longis margine revolutis et saepe rugosis, floribus subsessilibus in fasciculos ternos 2-4-floros (cymas abbreviatas) aggregatis verticillastros distantes formantibus, bracteolis sub quoque fasciculo 2 lanceolatis, bracteis verticillastri 3 ovatis, omnibus longe ciliatis, calyce 4 mm. longo usque ad basin in segmenta linearia diviso, corollae albidae tubo calycem subaequante intus barbato, lobo infimo orbiculato 4 mm. longo ceteros breves rotundatos multo superante, staminibus 5 exsertis, ovario stylo et parte inferiore ramorum styli dense pilosis, ramis stylo longioribus.*

Hundred of Goode, north of Murat Bay (B. P. Bowering). Placed in *Dicrastylis* on account of the long style branches and the 5 stamens, the leading characteristics of that genus, but in the large lowest lobe of the corolla and the verticillate, arrangement of the leaves in 3's it stands near several species of *Pityrodia*. In the shape of the leaves and flowers it bears a resemblance to *D. parvifolia*, F. v. M., which also has one of the corolla-lobes larger than the others, but it differs in the whorled arrangement of foliage and flowers, which gives it somewhat the aspect of a Labiate. The calyx and corolla are also twice as large in *D. verticillata*, and the inflorescence distinguishes it from any hitherto described species of *Dicrastylis*.

Solanaceae.

**Lycium campanulatum*, E. Mey. "Boxthorn." Millicent and Mount Gambier; numerous in places.

Scrophulariaceae.

Mimulus repens, R. Br. Lake Ormerod (Dist. T; H. W. Andrew).

Mazus pumilio, R. Br. Millicent drains; Dismal Swamp.

Limosella aquatica, L. Dismal Swamp.

**Bartsia viscosa*, L. Millicent. Already recorded from Myponga.

**Veronica anagallis*, L. "Water Speedwell." Main drain at Millicent. A common and rather coarse plant, the hollow stems rising 20-30 cm. above the water. The stems are pubescent, with spreading hairs below the water-line, elsewhere the plant is glabrous. It must have been naturalized for many years in the South-east, as there is a specimen from Millicent in the Tate Herbarium.

Myoporaceae.

Myoporum acuminatum, R. Br. (*M. montanum*, R. Br.). Wooley Lake, Beachport (Dist. G); Wirrabara (Dist. N).

Rubiaceae.

Opercularia ovata, Hook. f. Between Glencoe and Lake Edward. Stems procumbent and sheltered under the scrub; stamens only 2 in the flowers examined.

Galium Gaudichaudii, DC. In sand near Salt Lake, Beachport. A small plant with erect or ascending stems and hispid leaves, sometimes with a woody root-stock and far-spreading roots, so as to appear perennial; fruits smooth when fresh; corolla light-yellow.

Caprifoliaceae.

Sambucus Gaudichaudiana, DC. A solitary specimen of this beautifully scented shrub was growing in the scrub on the hillside above Wooley Lake, Beachport.

Dipsacaceae.

**Dipsacus fullonum*, L. "Fuller's Teasel." Tantanoola. The scales of the receptacle are hooked, but 3 or 4 of the involucral bracts are ascending, thus showing a tendency towards the wild European plant (*D. silvestris*, Huds.). First record for South Australia.

**Scabiosa maritima*, L. "Purple pincushion." Common at Millicent, as it is near Adelaide.

Campanulaceae.

Lobelia concolor, R. Br. Bordertown, in drains near railway reservoir (Dist. T).

Goodeniaceae.

Velleia paradoxa, R. Br. Clare (H. W. Andrew). Flowers white instead of yellow. Bordertown (Dist. T), luxuriant specimens, over 60 cm. high.

Scaevola nitida, R. Br. Beachport. Hitherto recorded only for Western Australia.

Goodenia humilis, R. Br. Dismal Swamp, near Mount Gambier. First record for South Australia, but given in the Fl. Aust. for the Glenelg River, Vict., which runs close to our border. *G. glauca*, F. v. M. Bordertown (Dist. T). *G. varia*, R. Br. Bordertown (Dist. T). *G. pinnatifida*, Schlecht. Bordertown. A form more glabrous than usual, and with many of the radical leaves oblanceolate and entire.

Selliera radicans, Cav. Millicent; Glenelg River (Dist. G); Lake Ormerod (Dist. T; H. W. Andrew).

Dampiera marifolia, Benth. One mile west of Bordertown (Dist. T).

Stylidiaceae.

Stylidium graminifolium, Swartz. Between Mount Gambier and Glencoe. Slender specimens compared with those of the Mount Lofty Range; leaves about 10 cm. long.

Compositae.

Brachycome debilis, Sond. Robe (C. D. Black); Hundred of Caroline (Dist. G).

Cotula reptans, Benth. Beachport; Millicent drains.

Senecio lautus, Sol., var. *lanceolatus*, Benth. Beachport. A handsome perennial $1\frac{1}{2}$ m. high; ray-flowers 6-8, those of the disk about 25; leaves broad, deeply toothed or lobed, with large, stem-clasping auricles.

Eclipta platyglossa, F. v. M. River Murray (H. Griffith); Renmark (H. W. Andrew); Bordertown. A variable species; the achenes are sometimes warted, as in Mueller's description

(Fragm., ii., 135), and in plate 39 of Pl. Vict., and sometimes quite smooth. The leaves vary much in size.

Helichrysum leucopsidium, DC. Bordertown (Dist. T).

Cassinia aculeata, R. Br., *C. laevis*, R. Br., and *Humea punctulata*, F. v. M. In these Transactions, xii., 63 (1889), Professor Tate wrote:—

"*Cassinia laevis*. This proves to be conspecific with *Humea punctulata*, and the correct designation will be *Cassinia punctulata*, F. v. M. and Tate. It is recorded as *Humea cassiniacea* in the Ardrossan list, and as *Cassinia alasia*, F. v. M., MS., from Coonalpyn."

The proposal here made to substitute such a combination as *C. punctulata (H. punctulata* only dates from 1863) for *C. laevis*, which dates from 1817, is, of course, impossible. In his Census at p. 67 of the same volume of the transactions, and in Fl. Extratrop., S.A., published in the following year (1890), Tate retains both *C. laevis*, *C. punctulata*, and *C. aculeata*. Mueller, in his 2nd Census (1889) dropped *Humea punctulata*, but did not reproduce the specific name under *Cassinia*. Thus, in his Flora, Tate appears desirous of introducing *C. punctulata* as a species intermediate between *aculeata* and *laevis*, and in his description (p. 123) he repeats the old error which was made as regards *Humea punctulata* ("one flower in each headlet"). This mistake arose because the original specimens submitted to Mueller were in bud only (Fragm., iii., 137), and it was repeated by Bentham (Fl. Aust., iii., 590). Turning to the Tate Herbarium we find the only specimens labelled "*C. aculeata*" are from the eastern States, the leaves typically scabrous-hispid, with short hairs on the upper face. Under "*C. laevis*" are some specimens from the Flinders and Gawler Ranges, the branchlets white-tomentose, the panicle or corymb varying greatly in size and density, the lateral branches sometimes exceeding the inflorescence. The type of *C. laevis* came from the head of Spencer Gulf. Under "*C. punctulata*" Tate has placed various specimens collected at places from Port Elliot to Melrose, with leaves similarly glabrous above, but with the branchlets less hairy and often viscid. They do not appear specifically different from *C. laevis*, and that was evidently Mueller's opinion also. Nor do I think, with the specimens we now possess, that a specific difference can be maintained between *C. aculeata* and *C. laevis*. At first I thought this could be done under Brown's original formula—that *C. aculeata* had leaves hispid above, while *C. laevis* had them smooth—but in the 90-mile Desert, just west of Bordertown, I collected specimens with the young leaves scabrous and hispid, and the older ones glabrous and smooth, in some cases even the young leaves were glabrous. Thus it would seem that the two constitute one species, coalescing about the border of South Australia and Victoria. Bentham appears to me to sanction the union when he writes (Fl. Aust., iii., 586) that the leaves of *C. aculeata* are "very rarely smooth or nearly so." They are of equal date, but *C. aculeata* has priority of paging. The arrangement for South Australia would therefore be:—

C. aculeata, R. Br. (approaching the type), Bordertown. Var. *laevis*, Port Elliot; Murray Lagoon, K.I.; Caloot, near Mannum; Coonalpyn; Sherlock; Ardrossan scrub; Pitcairn Station, near Nackara; Beetaloo; Melrose; Telowie Gorge; Telowie scrub; Aroona; Gawler Ranges.

[Since writing this I have received from Hawker (Miss Reed) a typical specimen of *C. aculeata* as regards the scabrous leaves, which are also conspicuously decurrent; flowers 10-12 in head; pappus-bristles about 12, barbellate in the upper part only.]

Olearia picridifolia, Benth. Yumali (S. A. White). See these Trans., xxxv., 2. *O. pimeleoides*, var. *minor*, Benth. Yumali (Dist. T; S. A. White).

Helichrysum retusum, Sond. et F. v. M. Yumali (Dist. T; S. A. White). *H. ferrugineum*, Less. This rather rare shrub, which in our specimens has always a white (not rusty) tomentum, was found on the Glenelg River and at Lake Edward, near Glencoe.

Calocephalus Dittrichii, F. v. M. (pl. viii.). The drawing was made from a specimen in Mr. Walter Gill's herbarium, collected on Coward Springs Mound, November 19, 1891. The type came from near Charlotte Waters, N.T. It is given for District C in Tate's Flora, but there is no specimen in the Tate Herbarium. Professor Ewart says that Mr. Gill's specimen agrees well with the type in the Victorian National Herbarium, and it is certainly the same as a named specimen which Mr. J. H. Maiden kindly sent me from the National Herbarium of New South Wales, and which was collected by Max Koch near Catt Springs, Murnpeowie, in September, 1898. The species is recorded by Moore for the northern interior of New South Wales. The original description was published by Baron von Mueller in Uhlworms Botanisches Centralblatt, xxvii., 300 (1886), and as this periodical is very rare, if not inaccessible, in Australia, the diagnosis, kindly supplied by Professor Ewart, is here given in full:—

"*Calocephalus Dittrichii* (*Myriocephalus Dittrichii*, F. v. M. Coll.). Annual, woolly-tomentose, neither tall nor much branched; leaves scattered, linear, blunt, nearly flat or somewhat channelled, slightly broader at the base; glomerules rather small, terminal, solitary, depressed-globular, the summit of the branchlets forming often a short peduncle; general involucre not exceeding the glomerule, constituted of several rows of bracts; the latter green, narrow, woolly, and terminated by a minute scarious yellow glabrous ovate- or cordate-roundish lamina; general receptacle small, not conspicuous, elevated, bearing numerous flower heads; bracts constituting the ultimate involucres several, oblong or linear-cuneate, hyaline, 1-nerved, woolly only under the small yellow roundish radiating lamina; flowers minute, 11-24 in each head; corolla slender, gradually widening upwards; achenes truncate-ellipsoid, subtle-papillular; pappus very tender, white, formed of very few laxely plumous-bearded somewhat intricate bristles, those at the summit slightly tufted, at the very base connate.

"Near Charlotte Waters; Lieutenant Dittrich; collected during Mr. Lindsay's expedition.

"The specimens seen about hand-high. Leaves $\frac{1}{3}$-$\frac{2}{3}$ inches long, the lowest early evanescent. Clusters of flower-heads about $\frac{1}{2}$ inch broad. General receptacle crowded with the persistent woolly involucral bracts. Flower-heads with their proper bracts singly separable; the latter hardly exceeding the corollas, appressed. Neither stamens nor stigmas exserted. Achenes pale-brown, nearly all ripening.

"Among congeners this well-marked species finds its place nearest to *C. Francisii*, differing, however, already in external feature, in the extensive vestiture, in glomerules constantly broader than long, in more developed general involucre and bright appendages of the ultimate involucral scales. Some relationship to the genus *Myriocephalus* is indicated by the copiousness of the empty involucrating bracts of the glomerule. On superficial inspection this plant might easily be passed as an *Angianthus* or *Craspedia*, especially as it was found accompanied by a small variety of *C. pleiocephala*."

Professor Ewart adds:—"The original description is given in English among the literature references in the Botanisches Centralblatt, following a reference from Wing's Southern Science Record, vol. 2, May, 1886, in which no reference to the plant occurs. Evidently Baron v. Mueller sent the description direct to the Botanisches Centralblatt, where it was issued among the records of published literature."

Among South Australian species *C. Dittrichii* stands nearest to *C. platycephalus*, from which it differs in fewer branches, closer tomentum, shorter leaves, compound heads more compact and more globular, pappus-bristles less flexuose and united at base in a broader ring.

Erechthites prenanthoides, DC. Blue Lake and Leg-of-mutton Lake, Mount Gambier; Robe. *E. picridioides*, Turcz.

Murray Bridge; Sherlock; Kangaroo Island; Port Lincoln; Robe; Beachport (Dist. G). On the road between Mount Gambier and Glencoe were found puzzling specimens with the involucre and leaves of *prenanthoides*, but the panicle less open and a woolly tomentum on the under-surface of the leaves.

Olearia ramulosa, Benth. I have not found in South Australia anything answering to the typical form of this species, as it occurs, for instance, near Melbourne, with 6-10 ray-flowers, about 8 disk-flowers, and an involucre about 5 mm. long. The form we have here tends toward *O. revoluta*, F. v. M., var. *minor*, Benth., and *O. floribunda*, Benth., but appears to have usually longer leaves and ligules than the former and much longer leaves than the latter. It is a shrub from 50 cm. to 1·50 m. high, with leaves usually 5-15 mm. long, linear or linear-oblong; involucre about 3 mm. long; ray-flowers 3-4, rarely 2, ligule conspicuous, 2-4 mm. long and much longer than the style and its branches; disk-flowers 3-4, rarely 5 or 6. Flowering more or less from October to June. Greenhill Road; Mount Lofty; Myponga; Slape Gully; Waterfall Gully; Burnside; Black Hill; between Kingscote and Cassini, K.I.; near Port Vincent, Y.P. Usually an inland shrub, but I have a specimen from an island in Pondalowie Bay, Y.P. (S. A. White), a maritime form with thick leaves, showing the white tomentum below and almost indistinguishable, except by the ligulate flowers, from specimens of *O. axillaris*, taken by the same collector on the shores of Pondalowie Bay. Indeed, the distinction between several species consists of little more than the comparative length of the ligule, and as this is a variable quantity, I have little doubt that further investigations throughout Australia will result in *O. tubuliflora*, *axillaris*, *revoluta*, *exilifolia*, and *floribunda* being united with *O. ramulosa*, (Labill.) Benth., as varieties or forms. Diels and Pritzel (Fragm. phyt. Aust. occid.) consider that several Western Australian species, including *axillaris*, *revoluta*, and *exilifolia*, had better be united with *ramulosa*, and they quote Mueller's remarks (Fragm., v., 65) as to the variable length of the ligule.

O. axillaris, F. v. M. Glenelg; Henley Beach; Port Vincent and Pondalowie Bay, Y.P.; Coorong. A large, spreading shrub, usually 2-3 m. high, growing among the sandhills close to the sea; the young leaves often snow-white; hairs of the achenes forked. Flowering March to May. *O. tubuliflora*, Benth. Slape Gully; Kangarilla. An erect shrub, 1-2 m. high, growing close to creek; ray-flowers 3-4, rarely 5, without any ligule; disk-flowers the same number. *O. glandulosa*, (Labill.) Benth. Myponga (Dist. A). Shrub 1-1·50 m. high, growing in swampy country; ray-flowers 12-20.

**Lactuca scariola*, L. "Prickly Lettuce." Berri; numerous but not widely spread (H. W. Andrew). First record for South Australia, although it was observed some years ago in the Eastern States.—Europe.

**Taraxacum officinale*, Weber. "European Dandelion." Common on roadsides at Mount Gambier.

**Leontodon hispidus*, L. "Common Hawkbit." Millicent, near drains. First record for South Australia. A European and West-Asiatic weed.

**Senecio elegans*, L. "Purple Ragwort." This showy Cape plant, already recorded for Robe, grows numerously at Beachport on sandhills close to the sea, beneath the shelter of *Acacia longifolia*.

**Scorzonera laciniata*, L. Paddock at Mile End goods sheds (H. W. Andrew). Previously recorded from Collinswood.

**Cirsium arvense*, Scop. This troublesome weed has been found growing in patches near Mount Gambier.

**Chrysanthemum Parthenium*, Bernh. "Feverfew." Roadside near Mount Barker (H. W. Andrew). Not previously found wild in South Australia, but recorded for Victoria in 1893.

**Carthamus glaucus*, Bieb. (*Kentrophyllum glaucum*, Fisch. et Mey.). Naracoorte (H. W. Andrew). Occupying large areas in this district. Distinguished from *C. lanatus*, L. (*K. lanatum*, DC.), by its smaller flower-heads, the inner involucral bracts all entire, and none of the middle ones contracted near the summit, and then dilated into a small appendage, as in *C. lanatus*, flowers purple instead of yellow, and smaller achenes. A prickly weed of the eastern Mediterranean region, which does not appear to have been previously recorded in Australia. It has, however, been established in the South-East for some time, because a single head was sent to me from Bordertown in 1909.

DESCRIPTION OF PLATES.

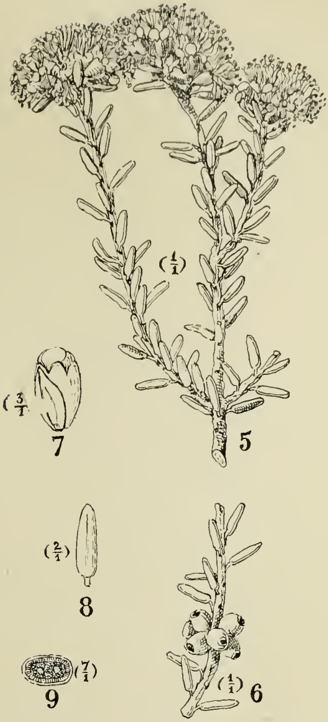
Plate V.

Melaleuca quadrifaria, F. v. M. 1, flowering branch; 2, fruiting branch; 3, under-surface of leaf, showing the oblique orbicular base; 4, transverse section of leaf.

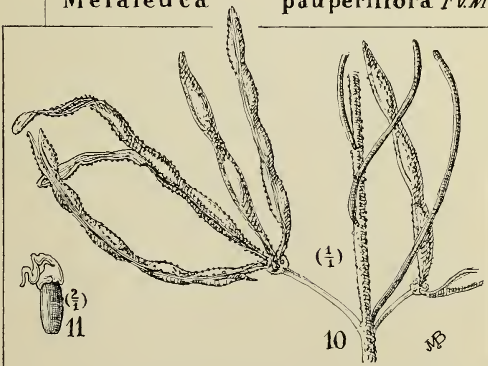
Melaleuca pauperiflora, F. v. M. 5, flowering branch; 6, fruiting branch; 7, bud and bract; 8, leaf; 9, transverse section of leaf.

Acacia Menzelii, J. M. Black. 10, pods; 11, seed.

Melaleuca quadrifaria *F. v. M.*



Melaleuca pauperiflora *F.v.M.*



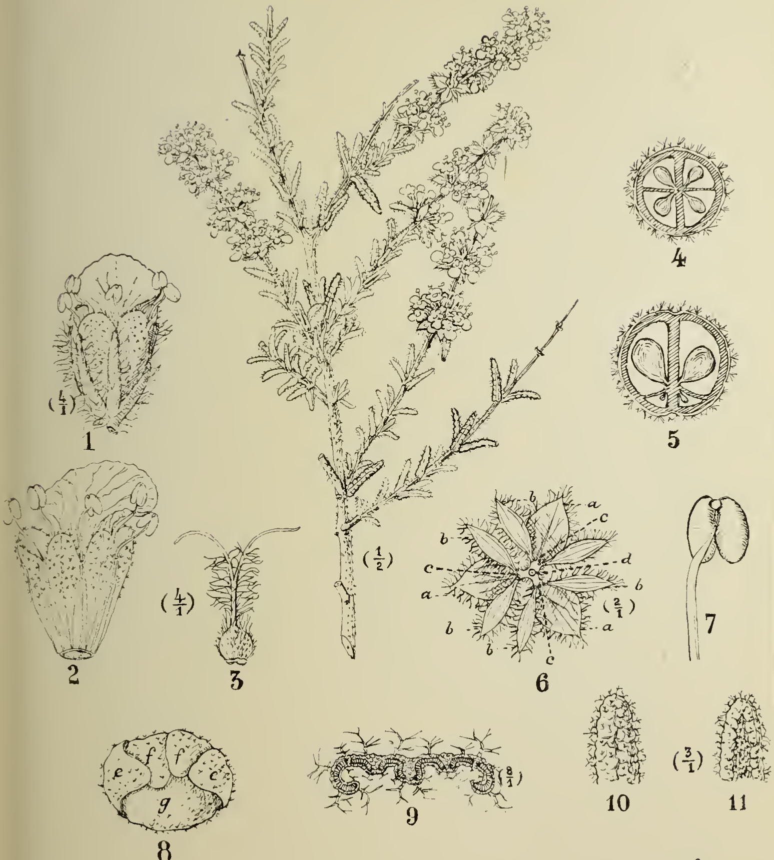
Acacia Menzelii *J.M.Black*

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SD. AUS.

Limnanthemum stygium

sp. nova

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO. AUS.



Dicrastylis verticillata *sp.n.*

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO. AUS

Calocephalus Dittrichii *F.v.M.*

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO. AUS.

Plate VI.

Limnanthemum stygium, n. sp. 1, flower; 2, transverse section of ovary.

Plate VII.

Dicrastylis verticillata, n. sp. 1, flower; 2, corolla; 3, pistil; 4, transverse section of ovary, showing the 4 cells, with 2 of the partitions much thinner than the other 2; 5, ovary more advanced, with 2 ripening and 2 abortive ovules, the 2 thin partitions being gradually pressed out of position; 6, bracts and bracteoles at base of flower-whorl, which is regarded from above:—*a*, *a*, *a*, the 3 bracts; *b*, *b*, the bracteoles (2 at the base of each cluster); *c*, *c*, *c*, the bases (concrete peduncles[?]) of the 3 clusters or reduced cymes, all the flowers having been removed; *d*, axis of the flowering branch. 7, anther and part of filament; 8, corolla in bud viewed from above:—*e*, *e*, the 2 lateral lobes folded outside the others; *f*, *f*, the 2 upper lobes; *g*, the lowest and largest lobe. 9, transverse section of leaf; 10, upper-surface of leaf near summit; 11, lower-surface of same.

Plate VIII.

Calocephalus Dittrichii, F. v. M. 1, flower; 2, style; 3, bract of general involucre; 4, outer bract of partial involucre; 5, innermost bract of same.

A Review of the Australian Representatives of the Genus Ischnoradsia.

By Edwin Ashby.

[Read April 11, 1918.]

This genus, one of the subdivisions of the Ischnochitonidae, Dall, was made by Shuttleworth in 1853 (Berner Mittheil, 1853, p. 65), the characteristics being described as follows: — "Valves having sharp but rather thick insertion plates, those of the median valves with two or several slits. Girdle covered with convex, pebble-like, smooth scales. Type, *Chiton australis*, Sowerby." In addition to the Australian representatives, several species have been found in Japanese waters. Four species have been described as from Australia.

In the "Mag. Nat. Hist. (Charlesworth)", vol. iv., June, 1840, Sowerby described (p. 290) *Chiton australis* (Conch. Illus., fig. 46), Australia, and (p. 291) *Chiton evanidus* (Conch. Illus., fig. 139), New Holland. Reeve in 1847, pl. xxi., sp. 142, *Chiton novae-hollandiae*, New Holland, Mus. Brit., and *Chiton metallicus*, Rve., Conch. Icon., t. 17, f. 1041, 1847.

Pilsbry made *I. evanidus* and *I. metallicus* synonymous with *I. australis*, Sby., retaining two Australian species only, *I. australis*, Sby., and *I. novae-hollandiae*, Rve. Iredale and May, in the Proc. Mal. Soc., vol. xii., pts. ii. and iii., 1916, revive the name *evanida*, Sby., and distinguish two species in Tasmania, the Eastern corresponding with Sowerby's description of his *evanidus*: —"Central areas smooth in the middle, faintly striated at the sides; lateral areas rather elevated, with radiating granular striae." And go on to say: —"The North-west Tasmanian form differs in the absolutely smoothness of its pleural areas, and seems identical with the South Australian shells known as *I. novae-hollandiae*, Reeve."

I can endorse Iredale and May's contention that the North-west Tasmanian form is identical with the South Australian shell. The examination of a fairly extensive series from North-west, Eastern, and Southern Tasmania, Mid-Victoria, and South Australia in my own collection, and also a series from Port Arthur, South-east Tasmania, from the collections of Mr. W. L. May and Dr. Torr, establishes the fact to my mind that only one species is common to these localities. All the adult shells from the widely-extended places are more or less ornamented with striae. "The absolute smoothness of the pleural area," quoted by Iredale and May, is only met with in juvenile shells, and the majority of adults conform to Sowerby's description of *evanida*.

Reeve's *I. novae-hollandiae* (1847) must therefore be relegated to the place of a synonym of Sowerby's *I. evanida* (1840).

But while the majority of adult specimens conform to Sowerby's description of *I. evanida*, a few show continuous ribbing throughout the pleural area and right across the dorsal area, a characteristic that heretofore has been considered the most marked distinguishing feature of *I. australis*, Sby. This ribbed character is shown in one of the Port Arthur shells only 63 mm. long, and one collected by Dr. Torr at Stanley, North Tasmania, only 55 mm. long, while a Port Arthur shell 80 mm. long is typical *evanida*.

Then, again, while the form in which the pleural area is ribbed right across is rare in South Australia, Dr. Torr has a specimen he informs me that he collected at Tungkallilla, on the South Australian coast open to the ocean, which is 45 mm. long, but is as strongly ribbed as the Port Jackson specimens of *I. australis*, and from the same locality a shell 33 mm. long showing as extensive ribbing in proportion to its age and size.

But none of these strongly-ribbed variants from type from South Australia, Tasmania, and Victoria that I have examined, show the widely-spaced, prominent ribbing in the lateral area that is present in the Port Jackson shells. On the other hand, shells from Bulli, N.S.W., a good way south of Port Jackson, show a departure from the typical shell from that port in that the anterior valve is similar to the form occurring in the southern States, the ribbing being less pronounced and closer together.

To sum up the evidence before us in regard to specimens from the States of South Australia, Tasmania, and Victoria:—

(1) No really adult shells are absolutely smooth in the pleural area as described by Reeve.

(2) That the age at which the shells from any of the localities referred to begins to show partial ribbing varies very much.

(3) That living alongside with *I. evanida*, Sby., in some parts of each of the three States named are shells in which the ribbing is as extensive, and closely approximates to, the Port Jackson, N.S.W., *I. australis*, Sby.

(4) That all the adult shells from the southern States show a similar sculpture in the lateral area, *viz.*, ribbing nearer together and less pronounced than is the case with the Port Jackson shell, but vary as regards the sculpture of the pleural area, from faint, broken ribbing over a portion of the area, to, in a limited number of cases, the area completely covered with strong ribbing, as in *I. australis*, Sby.

Conclusion.—On first commencing this inquiry I expected that the conclusions come to by Mr. Hedley in his very suggestive paper on "The Effect of the Bassian Isthmus upon the existing Marine Fauna," Proc. Linn. Soc. N.S. Wales, xxviii., 1903 (1904), would be amply supported by the distribution of the genus under review. That *I. australis*, Sby., would probably extend down from New South Wales to the Gippsland coast, and as the western side of the lost isthmus is reached, say the west side of Wilson Promontory, be replaced more or less abruptly by *I. evanida*, Sby. But in view of the fact that juvenile shells of both are equally smooth and inseparable, and the extreme variability of the southern form, we must conclude that all Australian representatives of this genus have a common ancestry, that the southern shells only represent a race, and do not warrant more than subspecific rank, and may be even relegated, as a result of future investigation, to the subordinate place of a mere variety. I conclude that the strongly-ribbed shells that occur (although but rarely) with the smoother forms in the south, are the progenitors of that section of the species that spread northward; while the more variable but smoother form spreads westward. The evidence points to the distribution of this genus in Australian waters having taken place since the breaking down of the Bassian Isthmus and the existence of the present straits. We must, therefore, conclude that the known Australian representatives of the genus *Ischnoradsia* are limited to one species and one subspecies, *Ischnoradsia australis*, Sowerby (1840), and *Ischnoradsia australis evanida*, Sowerby (1840), the former inhabiting New South Wales, and the latter the States of Victoria, Tasmania, and South Australia.

NOTE BY W. L. MAY, SANDFORD, TASMANIA.

Having been more or less associated with my friend Edwin Ashby in his investigation into *Ischnoradsia*, I am thoroughly in accord with his treatment in the present communication. From a superficial glance at specimens from the various Australasian localities, they appear as one species, in shape, size, and colour, and this impression is confirmed by an examination of the girdle, which is practically the same in all.

To maintain the several separate species, *viz.*, *australis*, *evanida*, and *novae-hollandiae*, we have to rely solely on the absence or presence, in varying degrees, of the longitudinal sculpture; and as this can be shown to be quite inconstant in the southern and western shells, and as some of these approximate rather nearly to the Port Jackson form, it seems necessary to treat them all as members of one variable species, but for convenience to maintain *evanida* for the southern and generally smoother form either as a subspecies, which is perhaps preferable, or as a variety.

Monograph on the Genus Stenochiton (Order Polyplacophora), with Descriptions of Two New Species.

By Edwin Ashby.

[Read May 9, 1918.]

Plates XIII. and XIV.

The genus *Stenochiton* was formed by Adams and Angas in 1864 (Ad. and Ang., P.Z.S., 1864, p. 193) for the reception of the South Australian shell described by the same workers under the specific name of *juloides*.

The characteristics of the genus of which *S. juloides* was the type are enumerated by Adams and [illegible]

[illegible] the following as the distinguishing characteristics of the subgenus:—"Shell very much elongated, roundly arched, valves ischnoid, the central valves having several slits; girdle having minute, smooth, imbricating scales." As will be shown later, some species that evidently should be placed in this genus only show one slit in the central valves, and in one the scales are minutely striated.

Since Pilsbry wrote the above, two additional species have been described. One by W. T. Bednall in 1897 (Proc. Mal. Soc., vol. ii., pt. 4), under the specific name of *pilsbryanus*. The habitat is given as Troubridge Shoal, Gulf St. Vincent, "on seaweed (?) *Zostera*." A third species was described by myself under the name of *pallens* in 1900 (Trans. Roy. Soc. of S.A., 1900). While I have every reason to believe that one or other of the two species described in this paper as new under the respective names of *posidonialis* and *cymodocealis* must have been the form described by Mr. Bednall, his description will not coincide with either of these very distinct forms. Either his figures and descriptions are at fault, or he described a fifth species that I have not yet been able to identify.

Conclusion.—On first commencing this inquiry I expected that the conclusions come to by Mr. Hedley in his very suggestive paper on "The Effect of the Bassian Isthmus upon the existing Marine Fauna," Proc. Linn. Soc. N.S. Wales, xxviii., 1903 (1904), would be amply supported by the distribution of the genus under review. That *I. australis*, Sby., would probably extend down from New South Wales to the Gippsland coast, and as the western side of the lost isthmus is reached, say the west side of Wilson Promontory, be replaced more or less abruptly by *I. evanida*, Sby. But in view of the fact that juvenile shells of both are equally smooth and inseparable, and the extreme variability of the southern form, we must conclude that all Australian representatives of this genus have a common ancestry, that the southern shells only represent a race, and do not warrant more than subspecific rank, and may be even relegated, as a result of future investigation, to the subordinate ... I conclude that the strongly-ribbed

ERRORS AND CORRECTIONS.

Page 68, fifth line from bottom:—For *S. posidonia* read *S. posidonialis.*

Page 80, eleventh line from bottom, should read:—Australian waters." I have a specimen collected by myself

Page 85, first line of table:—For CALLOCHITON read CALLISTOCHITON.

Sowerby (1840), the former inhabiting ... the latter the States of Victoria, Tasmania, and South Australia.

NOTE BY W. L. MAY, SANDFORD, TASMANIA.

Having been more or less associated with my friend Edwin Ashby in his investigation into *Ischnoradsia*, I am thoroughly in accord with his treatment in the present communication. From a superficial glance at specimens from the various Australasian localities, they appear as one species, in shape, size, and colour, and this impression is confirmed by an examination of the girdle, which is practically the same in all.

To maintain the several separate species, *viz.*, *australis*, *evanida*, and *novae-hollandiae*, we have to rely solely on the absence or presence, in varying degrees, of the longitudinal sculpture; and as this can be shown to be quite inconstant in the southern and western shells, and as some of these approximate rather nearly to the Port Jackson form, it seems necessary to treat them all as members of one variable species, but for convenience to maintain *evanida* for the southern and generally smoother form either as a subspecies, which is perhaps preferable, or as a variety.

Monograph on the Genus Stenochiton (Order Polyplacophora), with Descriptions of Two New Species.

By Edwin Ashby.

[Read May 9, 1918.]

Plates XIII. and XIV.

The genus *Stenochiton* was formed by Adams and Angas in 1864 (Ad. and Ang., P.Z.S., 1864, p. 193) for the reception of the South Australian shell described by the same workers under the specific name of *juloides*.

The characteristics of the genus of which *S. juloides* was the type are enumerated by Adams and Angas as follows:—"Shell elongated, narrow, convex; valves longer than wide, not carinated; apex of the posterior valve subcentral; plates of insertion multifissate in the end valves, the intermediate valves having 5 fissures on each side; girdle covered with very minute, polished, imbricating scales." Carpenter (MS.) refers the then only species known to his own later group *Stenoradsia*, but Pilsbry (in Man. of Con., vol. xiv., p. 55) says:—"*Stenochiton*, however, seems to have as much individuality as most of the divisions *Ischnochiton*, and may be allowed to stand as a subgenus." He somewhat modifies Adams and Angas' characteristics, retaining the following as the distinguishing characteristics of the subgenus:—"Shell very much elongated, roundly arched, valves ischnoid, the central valves having several slits; girdle having minute, smooth, imbricating scales." As will be shown later, some species that evidently should be placed in this genus only show one slit in the central valves, and in one the scales are minutely striated.

Since Pilsbry wrote the above, two additional species have been described. One by W. T. Bednall in 1897 (Proc. Mal. Soc., vol. ii., pt. 4), under the specific name of *pilsbryanus*. The habitat is given as Troubridge Shoal, Gulf St. Vincent, "on seaweed (?) *Zostera*." A third species was described by myself under the name of *pallens* in 1900 (Trans. Roy. Soc. of S.A., 1900). While I have every reason to believe that one or other of the two species described in this paper as new under the respective names of *posidonialis* and *cymodocealis* must have been the form described by Mr. Bednall, his description will not coincide with either of these very distinct forms. Either his figures and descriptions are at fault, or he described a fifth species that I have not yet been able to identify.

Every effort has been made to get a sight of the type. Mr. E. H. Matthews writes me, February 28, 1918, that he sent all his own and the late Mr. Bednall's types to Mr. Tom Iredale in London. The larger parcel reached London safely; the smaller one, which may have contained the type of this species under review, went down.

Mr. Matthews was good enough to send me some nice specimens that he refers to Bednall's *pilsbryanus*. These are the same species I am describing herein as *S. posidonialis*, and differ materially from Bednall's description in that the anterior valve is concave and not convex, as stated by Bednall, and the posterior valve is very flat and not strongly elevated and arched, as shown in Bednall's drawing, also the mucro is differently placed.

On the other hand, the figure of the posterior valve in Mr. Bednall's paper well illustrates the same valve herein described and figured under the name of *S. cymodocealis*, and his statement that the anterior valve is convex also corresponds, but the figure marked (1) in Mr. Bednall's description does not show the distinctive tapering characteristics in that species, and his statement that the "raised character of the lateral area does not extend to the outer anterior angle of tegmentum" does not correspond.

We are, therefore, with the material available, quite unable to determine which, if either, of these very distinct species was described by Mr. Bednall. Part of the description appears to refer to one and the balance to the other. Personally, in spite of the fact that Mr. Matthews, in common with all other South Australian collectors, has in the past referred the species hereunder described under the name of *S. posidonialis*, to Mr. Bednall's shell, and it is well known in all Australian collections of *Polyplacophora* under that name, I am strongly inclined to think that the other species herein described as *S. cymodocealis*, or one nearly allied to it, is the species described by Bednall. Unless the type is still in existence it will be impossible to satisfactorily determine this question, so for the time being we shall have to add the two species herein described to our list of *Stenochitons*. Iredale and May, in their paper on "Mis-named Tasmanian Chitons" (Mal. Soc. vol. xii., pts. ii. and iii., p. 105, Nov., 1916), think they recognize in Blainville's *Chiton longicymba* (1825) from King Island a member, though not yet identified, of the genus *Stenochiton*. I cannot concur with this opinion, and think that Blainville's shell was more likely either *Ischnochiton virgatus*, Reeve, or a near ally. The blue spots he speaks of are very marked in that species, and the shell is comparatively smooth.

Distribution.—It is remarkable that the whole of the known species of this interesting genus have been described from South Australia. Up to the present I believe there are only two records of the occurrence of members of this genus in the other States. *Stenochiton pallens*, Ashby, from Port Phillip Heads, Victoria, wrongly identified by Sykes (Proc. Mal. Soc., vol. ii., pt. 2, July, 1896) as *S. juloides*, Ad. and Ang., and correctly identified by Gatliffe and Gabriel (Proc. Soc. Vict., 30 (N.S.), pt. i., 1917, p. 26), one specimen only. And *S. juloides* three valves only in shell-sand, Albany, W.A. (Torr: Trans. Roy. Soc., S. Austr., xxxv., 1911, p. 96). The other localities given by Hedley (in Jour. Roy. Soc. W. Austr., vol. viii., 1914-1915, p. 23) have probably been copied in error from the records of the next species in Torr's paper. We have, therefore, the remarkable fact that outside of the two occurrences above referred to, no representatives of this interesting genus have so far been found outside of South Australian waters.

Habits.—Bednall (in Proc. Mal. Soc., vol. 88, pt. 4, April, 1897, p. 142) gives the habitat of the few specimens of *S. juloides* that had then come under his notice, "found living on Pinna shells below low-water mark." And on the same page he records the fact that the specimens he describes under the name of *S. pilsbryanus* were found on "seaweed *(Zostera)*, Troubridge Shoal, St. Vincent Gulf." Dr. Torr (Trans. Roy. Soc., S. Austr., vol. xxxvi., 1912) states that he had collected *S. juloides* by dredging and in shell-sand, and quotes Mr. Riddle as having found specimens on "old boots and bottles, and especially near the roots of *Zostera*, by dredging or with grappling iron—they are rarely found in shallow water." And on the same page he records having taken specimens of *Stenochiton pilsbryanus*, Bednall, "on *Zostera* (sea-weed)." And again, "Two large specimens by Mr. F. L. Saunders on seaweed at Aldinga," and "near the roots of *Zostera* at Wool Bay and other places by Mr. Riddle." I am now able to throw a good deal of light on the habits of members of this genus. The discovery of *Stenochiton juloides*, Ad. and Ang., on bottles, boots, etc., is evidently purely accidental. They live on the marine plant belonging to the order Fluviales known as *Posidonia australis*. I have found them in many localities at the base of the long ribbon-like leaves of this well-known plant. During the last week of December last, at Normanville, in this State, in company with Mr. F. L. Saunders, who with his brother had taken them in the same locality in numbers before, I was able by means of a strong digging hook to get well down into the roots of the *Posidonia*, and found enclosed in the brown sheaths of past leaves which enwrap the underground stems of that plant a large number of this *Stenochiton*. The spots that seemed to be especially attractive were beds of old, vigorous plants of *Posidonia* growing in sheltered pools (at low water), with a coarse sand or shell-grit bottom. The *Stenochitons* were usually about 3 inches deep in the shell grit, buried in the brown sheaths of *Posidonia*, but in a few cases odd specimens were found on the bases of the leaves outside the sand. Until recently most of the specimens that have been collected were these odd ones that had not worked their way down in the grit. The species hereunder described under the name of *S. posidonialis* also lives on the same plant, *Posidonia australis*, and I have found it in every locality I have visited in this State where this plant is growing. It is almost always found on the white or near the white bases of the leaves, just above the sand, and does not seem to bury itself in it. The best way to obtain it is to pull up bunches of *Posidonia* from as low down as possible, and search the white bases of the leaves for the *Stenochiton.* If held up to the sunlight they are easily perceived, even when on the reverse side of the leaf. The species hereinafter described as *Stenochiton cymodocealis* is found on the cylindrical stems of the marine plant *Cymodocea antarctica*, which belongs to the same order as the preceding. I am indebted to Mr. F. L. Saunders for pointing out this plant to me, he having on a previous occasion taken this *Stenochiton* at Normanville on this plant, but had wrongly identified it as *Stenochiton pallens*, Ashby. I was able to obtain a nice series at that locality, and on searching the same plant afterwards at Cape Jervis, Encounter Bay, and still more recently at Marino, I have been able to find it at all these localities. The favourite spots seem to be the sheltered or shore side of beds of *Cymodocea*, growing in situations more or less sheltered. They are to be found usually only an inch or two above the point where the plant stems enter the sand. In no case have I found them on the short, flat leaves of this plant. The girdle of this *Stenochiton* is in nature strongly incurved, almost reaching right round the cylindrical stems of the plant. The fourth species, *Stenochiton pallens*, Ashby, has up to the present only been found by dredging, and the plant it lives upon has not, therefore, been identified.

Colour protection.—There is surely some connection between the habits of these four species and the markings and colouration that is peculiar to them. *S. juloides* is dark brown in colour, of the same tone as the brown sheath of *Posidonia. S. posidonia* is normally yellowish-green, and shell is very transparent, so that it blends remarkably well with the leaf it is on. It is nearly always found on the basal portions of the leaf that are either very pale green or whitish. The markings are suggestive of dashes of darker green on the leaf. In some case the ground-colour of this species is white, or nearly so, harmonizing well with the lower parts of the leaves. *S. cymodocealis*, while often in colour and markings resembling the darker-green form of the former species, is usually variegated by darker markings, and the dorsal area often shows pinkish shades, thus harmonizing to a striking degree with the various growths that so often encrust the stems of *Cymodocea*. Of the plant which is the host of *Stenochiton pallens* we have, as before stated, no actual knowledge, but we are surely justified in deducing from the habits of its congeners that it lives on a plant probably belonging to the same order Fluviales, that the portions of the plant it affects are probably pale brown, buff, or cream in colour, and also that as only dredged specimens have been found, the plant is either a deep-water species or a pale and colourless variety growing in deeper waters; or perhaps it lives upon the dying or dead leaves, with which undoubtedly its colour would well harmonize.

Food.—I have attempted to keep the three first-named species in an aquarium, supplied with their respective host plants, but although care was taken to keep the temperature cool, they all died, and no results were obtained. Possibly these plants do not throw off sufficient oxygen. I think there is little doubt that *Stenochitons* live on the plants of the order Fluviales, are nocturnal, in common with most of the Polyplacophora. I have seen portions of the stems of *Cymodocea* eaten in a way that would suggest that it had been done by the *Stenochiton*. Further, the *Posidonia* which is frequented by two of the genus is almost invariably clean, no small encrusting growths being present, and therefore it is doubtful whether they would find any other food than the leaves of *Posidonia*. I am indebted to Mr. J. M. Black for the indentification of the two marine plants referred to. There is a close outward resemblance between *Posidonia australis* and *Zostera tasmanica*, and therefore, owing to my inability to find specimens of the "sea grass" I have referred to as *Posidonia australis* in flower or fruit, it is possible that Mr. J. M. Black, who has been good enough to examine and identify for me the specimens I sent him, may not have had sufficient data for accurate determination. He says, "Judging only by the breadth of the leaves and the nervation, the specimen sent is *Posidonia australis*, and not a *Zostera*." I think it not unlikely that the two species of *Stenochiton* I have referred to as living on *Posidonia* may live on *Zostera tasmanica* just as freely.

Classification.—The partial elucidation of the life history of members of the genus *Stenochiton* recorded in the foregoing, which supplies strong circumstantial evidence that not only in habits but also in food they are very distinct from any other of our Australian forms of the Polyplacophora, together with the external characteristics that differentiate them from other genera of the Ischnochitonidae, suggests that further investigation will reveal other differences, possibly internal ones, and warrants the elevation of the subgenus *Stenochiton* to the rank of a genus. I therefore propose to revive Adams and Angas' genus *Stenochiton*, of which *Stenochiton juloides*, Ad. and Ang., is the type. In some respects it is unfortunate that this species should have to stand as the type of the genus, because it exhibits several peculiarities that are not common to those I consider its congeners. For the present we must deem these specific distinctions only. The discovery of three or four new species that show several striking characteristics in common with *Stenochiton juloides*, that differentiate them from other members of the Ischnochitonidae, makes it desirable to retain only a portion of the characteristics cited by Adams and Angas as distinguishing the genus and the adding of others.

Generic description.—Shell usually elongated, highly polished, almost unsculptured, convex, *i.e.*, rounded or arched as distinct from carinated, plates of insertion small, multifissate in the end valves, girdle clothed with very minute, polished, imbricating scales. Living on plants of the order Fluviales. *Stenochiton (sensu stricto)* will then be a subgenus of the genus *Stenochiton*, distinguished by the elongated character of the shell. A second subgenus will have to be formed to receive a broad-shelled species that was collected by the late Professor Tate on plants belonging to the order Fluviales. This specimen has been placed in my hands by Dr. Torr to be dealt with in a future paper.

Conclusion.—I am hopeful that the investigations of future workers, not only in the other States of Australia, but also throughout the world, wherever plants belonging to the order *Fluviales* are found, will, now we know where and how to search, reveal many new forms of this genus. As *Posidonia oceanica*, an allied form to the Australian member, occurs extensively in the Mediterranean Sea and the European shores of the Atlantic, it seems only reasonable to conclude that there will be forms of Polyplacophora living on it that will exhibit some of the modifications peculiar to the *Stenochitons* of Australia.

Stenochiton cymodocealis, n. sp.

Pls. xiii. and xiv., figs. 1, 4, 5, 11, and 12 *(a, b, c, d, e)*.

General appearance.—Shell long, sides almost straight for $\frac{2}{3}$ of lateral, and then curving rapidly over dorsal area, width of shell less than $\frac{1}{3}$ of total length, dorsal area rounded, shell exceptionally highly arched; the whole shell is very polished.

Colour.—The general colour is green, the dorsal area ornamented with a number of longitudinal pale-green lines, closely packed, and only discernible under lens. The rest of shell decorated with a number of broad, dark-green longitudinal dashes. The megalopores, in the form of pale-green dots, are under a compound microscope visible on the anterior and posterior valves and on the lateral areas, but not as marked as in *S. posidonialis*. Inside of valves green.

Anterior valve.—Slope very steep, without sculpture, convex. In one specimen I counted 24 slits or grooves; the interior in this is irregularly fluted, each flute ending in a blunt rounded tooth, a feature very distinct from any other known member of this genus, or any other member of the Ischnochitonidae, I believe. The slits are continued in shallow grooves, indistinctly pitted. After photographing the interior of this valve it met with a mishap, and is lost, and therefore I have had to replace it with another from a specimen of considerably larger size, which shows considerable differences; the slits are 12 or 13, the teeth are blunt and irregular knobs, the fluted appearance so much in evidence in the former valve is hardly perceptible in this one; perhaps with increased age the fluting is filled in.

Posterior valve.—Highly arched, mucro central, prominent, posterior slope steep, nearly straight, but in type becoming slightly convex as it nears the girdle, shell highly polished, slits 13 to 15, a broad notch in the sutural laminae of this valve.

Median valve.—Uniformly smooth and glossy, the lateral area strongly raised, and if looked at longitudinally with lens, the anterior margin of this area is seen to be uneven, due to shallow sulci following the growth lines; so polished is the shell that this undulating character of the margin of this area is indiscernible unless the shell is held at a considerable angle.

Median and dorsal areas.—Smooth and dorsal area in some valves slightly beaked, 1 slit.

Girdle.—Clothed with small, closely-packed, smooth, imbricating scales, circular in shape, and thick in proportion to their diameter, reminding one of opalescent, flattened pebbles. The dark line showing in plate follows the contour of each valve. In life when looked at from above the only portion of the girdle showing is the narrow strip between this line and the shell. A darkish blotch extends across the girdle opposite each suture and at irregular intervals round the anterior valve.

Measurements.—Total length of type, 10 mm. (shown in plate with girdle flattened out); breadth, 3·5 mm.; the specimen shown in plate with recurved girdle as in nature measures, length 8 mm., breadth 2 mm. I have specimens that measure 12 mm. by 2·75 mm., girdle recurved.

Locality.—I have found this species on the cylindrical stems of *Cymodocea antarctica* at Marino, Normanville, Cape Jervis, and Encounter Bay, all in South Australia, and Dr. Torr has specimens found in shell-sand at Aldinga.

Specific name.—I have designated this species under the specific name of *cymodocealis*, after the generic name of the plant that is its host, and probably its food plant also. The plant was named after a sea nymph.

Variation.—While the type is green all over, the decoration being due to either lighter or darker shades of the same green, the species is subject to considerable variation both in colour and markings. In one from Normanville, the apex of the anterior valve and the blunt beak of the next four valves is bright pink, also the ground-colour of pale olive that is present in most is in this specimen replaced with silvery-green, the markings mottled instead of striped, and the posterior margins of each valve decorated with 1 to 3 blackish dots, which without the aid of a lens look like pits. One other specimen from this locality has a dark-pink line the whole length of the dorsal area.

Remarks.—This shell is easily distinguished from any other known *Stenochiton* by its highly arched character. The general appearance is that of a canoe turned bottom upwards. This effect is added to by the incurved girdle. In life, with the exception of the anterior and posterior portions, the whole of the girdle curves round clasping the hard cylindrical stem of the host plant, sometimes meeting on the other side. While the animal is able to flatten out the girdle enough to creep about on the surface of a bottle, it is evidently an abnormal position. In endeavouring to flatten out the girdles for figuring purposes I spoilt several specimens, and have, I fear, expanded the valves somewhat, giving a total width beyond what is true to nature.

I am indebted to Mr. F. L. Saunders for pointing out to me the host plant. He had previously found specimens at Normanville, and wrongly identified the shell as *Stenochiton pallens*, Ashby.

I am presenting the type and other specimens figured to the South Australian Museum.

Stenochiton posidonialis, n. sp.

Pls. xiii. and xiv., figs. 2, 6, and 13 *(a, b, c, d)*.

General appearance.—Shell long, flat, rounded, smooth, and highly polished. The whole shell is exceptionally flat as compared with other members of this genus.

Colour and markings.—General colour olive-green; pleural area white; dorsal area largely white, suggestive of a white streak down the full length of the back. Lateral areas olive-green, with two dark spots on the posterior margins on either side, and a darker olive-green blotch near the apex. All the areas are ornamented more or less with brown or dark olive-green colour streaks. Under compound microscope the megalopores are very pronounced on the anterior and posterior valves and lateral areas of median valves, the surface being apparently peppered all over with white spots. The pleural and dorsal areas under the same power are decorated with a number of white confluent streaks, which in the dorsal area form a complete network or mesh. Inside of shell, pale olive-green and white.

Anterior valve.—Very distinct from others of this genus, in that this valve is distinctly concave, broad, and flat, nearly as long as wide, without sculpture. Under microscope (2-inch objective and eye-piece) this valve is covered with white dots. Inside of valve has 18 slits at fairly regular intervals, each slit continued as a groove, irregularly and deeply pitted, to the apex of the shell. The teeth are sharp, square edged; colour, pale olive-green and white.

Posterior valve.—Longer than wide, mucro anterior, hardly distinguishable, but in large shell from Cape Jervis the mucro is practically median; posterior slope very flat, almost straight, but slightly concave. This feature is nothing like so noticeable as in the anterior valve. Slits 19, each continued in a groove to mucro; margin of teeth between slits slightly crenulate under 2-inch objective.

Median valves.—Uniformly smooth and glossy. The lateral area is raised, but not as strongly so as in *S. cymodocealis*. Slits 2 (in one case a suggestion of a third); the slits are continued in grooves deeply pitted for their whole length. The dorsal area is not beaked in some valves, but in others slight beaking is perceptible.

Note.—In a large specimen 20 mm. long, breadth just under 5 mm. collected by myself at Cape Jervis, the lateral area is distinctly raised, the line of demarcation between it and the pleural area being clearly defined from the dorsal area to the girdle. Two or three strong concentric sulci, following the growth lines in the lateral areas, are present, giving a slightly corrugated appearance to that area. Similar shells to these large Cape Jervis ones were obtained by Dr. Torr at Corny Point, Yorke Peninsula. Pleural and dorsal areas smooth, highly polished. Under 2-inch objective and eye-piece both these areas are apparently thickly grooved with shallow wavy grooves that coalesce in places, but by holding the shell sideways a good lens reveals the fact that the shell is absolutely unsculptured. Dorsal area is not beaked.

Girdle.—Less than ·5 mm. in width. A dark blotch extends across the girdle at each suture and irregularly in front of the anterior valve. Is covered with small, closely-imbricating scales, only a portion of their rounded ends being visible, but which are when exposed found to be flattened, elliptical, rounded at ends, straight-sided, about twice as long as wide. The outer two or three rows are drawn out into coarse, transparent hairs or spicules, forming a distinct fringe.

Measurements.—Type (flat view in figure in plate): length, 9·5 mm.; width, including girdle, 3·5 mm.

Localities.—I have found it on the eastern side of Gulf St. Vincent wherever I have searched for it on *Posidonia australis;* also at Port Lincoln; and Dr. Torr has found the large form exceedingly plentiful at Corny Point on Spencer Gulf.

Specific name.—I have designated this species under the specific name of *posidonialis,* after the generic name of the plant which is its host, and probably its food plant. It is always, as far as my experience goes, found near the whitish base of the ribbon-like green leaves of *Posidonia australis*, just above where the leaves enter the sand. The plant was named after Poseidon, a god of the sea.

Variation.—While the normal colouration is transparent green to olive-green, flecked or streaked with dark-green markings, in some specimens obtained by myself at Marino, and others collected by Dr. Torr at Corny Point, up to 15 mm. in length, the ground-colour is almost white, ornamented with a V-shaped, dark-brown blotch in anterior and posterior valves, and a V-shaped brown marking covering each dorsal area; the whole of the 4th valve and lateral area of the 3rd valve also dark brown. In a specimen, 17 mm. long, from Largs, sent me by Mr. E. H. Matthews, the ground-colour is dingy buff, with a V-shaped brown blotch on 1st and last valves, and a brown streak continuing through all the dorsal areas. Dr. Torr has also a similar specimen. In another of Dr. Torr's, the shell is orange colour.

Remarks.—This shell is easily distinguished from any other known *Stenochiton* by the shape of the anterior valve, which is distinctly concave, the general flat character of the shell, and the exceptionally flat posterior valve, the mucro being hardly perceptible. The figure in plate showing side view will sufficiently demonstrate these differences.

I am presenting the type to the South Australian Museum.

Stenochiton pallens, Ashby
(Trans. Roy. Soc. S. Austr., vol. xxiv, p. 86, 1900).
Pl. xiv., fig. 14 *(a, b)*.

General appearance.—Shell glossy, elongated, evenly arched and rounded, side slope curved. *Colour*—Cream, mottled with pink and pale brown.

Anterior valve.—Smooth and glossy, except for several growth-lines, that nearer the outer margin being the deeper. This valve is longitudinally very short, being twice as wide as long (see measurements). Slits 13, at very irregular distances apart.

Posterior valve.—Shield-shape, tapering rapidly; mucro posterior, only slightly raised. A deep sulcus traverses the valve a short distance from the margin, preserving the shield-like outline of the shell. A shallow diagonal depression crosses the valve from the mucro to the suture. Surface of shell glossy and smooth, slight growth-lines visible under the microscope. Slits six; the teeth are very irregular in contour.

Median valves.—Uniformly smooth and glossy, showing numerous growth lines, which are continued right across the dorsal area. The three areas are hardly distinguishable, except that the lateral area is slightly raised. The posterior margin is finely serrated like a file where the valves are not worn; this sculpture is very shallow. Four of the median valves have one broad wedge-shaped slit on each side; two valves have two slits on each side. *Inside of shell* glossy white, sinus broad and shallow, sutural laminae only slightly produced.

Girdle.—Under pocket lens appears whitish and felt-like. The margin fringed with white spicules, but under 1-inch objective the girdle is seen to be crowded with masses of small, irregular, imbricating scales, which are finely striated. Owing to the condition of girdle I have been unable to determine the exact shape of scales or verify the statement that they are finely striated. In the foregoing I have where possible followed the original description.

Measurements.—Anterior valve of disarticulated type, longitudinal length 1·75 mm., breadth 3·5 mm. Anterior valve of co-type, longitudinal length 2·5 mm., breadth 5·5 mm. Posterior valve about the same width at anterior margin as valve is long. Width 5 mm., tapering evenly to 2 mm., then rounded off abruptly. Length of valve, 4·5 mm. Valves 2 to 6 are all 6 mm. wide and about 3 mm. in length at the dorsal area, and are therefore twice as broad as long. Valve 7 tapers a little.

Habitat.—I think the statement in the original description, Gulf St. Vincent, is probably correct, but one of the three original specimens dredged by Dr. J. C. Verco, now in Dr. Torr's collection, is labelled "Spencer Gulf." Messrs. Gatliff and Gabriel have now added Port Phillip Heads, Victoria, as a locality (see previous reference). At present our knowledge of this species is limited to four specimens.

Remarks.—Under this heading in the original description the statement in the second line, "the first valve being the broadest," should have read "the first median valve being the broadest." A reference to the measurements given above will clear this up.

The great breadth, in proportion to its short longitudinal length, of the anterior valve easily distinguishes this species from any other known form.

I am presenting type to the South Australian Museum.

Stenochiton juloides, Adams and Angas (Proc. Zool. Soc., 1864, p. 193; *op. cit.*, 1865, pl. ii., fig. 15).

Pls. xiii. and xiv., figs. 3, 8, 9, and 10.

As no description, I believe, of this species occurs in any Australian literature, it may be well to redescribe it here.

General appearance.—Shell very solid and elongated, sides much curved, the arch being continued evenly from the girdle right over the dorsal area. Width of shell, one-seventh of total length. The whole shell highly polished.

Colour and markings.—Colour dark chocolate, merging in the pleural areas into maroon. (Col. Plates Soc. Française des Chrysanthémistes, 343, No. 4, and 341, No. 3). Many specimens are much flecked and streaked with grey dashes, giving a grey-chocolate effect.

Inside colour.—Anterior valve bluish-grey, others whitish-grey with the brown of outer shell showing through.

Anterior valve.—Strongly convex, considerably longer than wide, unsculptured except for several shallow sulci following the growth-lines, highly polished, inside many slits, counted 17, which are continued in grooves to the apex; the pitting of these grooves is only just discernable under a 2-inch objective and eye piece.

Posterior valve.—Mucro posterior (Carpenter states median), the anterior portion of valve quite smooth and rounded longitudinally, forming a V-shaped area the full width of the valve at the suture (in the specimen described 5·5 mm. wide and a length to the mucro of 5 mm.). The posterior portion is highly polished and unsculptured, except for a number of concentric sulci following the growth-lines. The posterior area where it abuts on the anterior V-shaped portion is highly raised, the anterior margin forming a rounded diagonal ridge; this ridge is formed by a deep sulci commencing quite shallow at mucro and increasing in depth until the anterior margin of valve is reached at the girdle. The slope behind mucro almost straight but slightly concave near girdle.

Median valves.—Lateral area more strongly raised than is the case in any other known species of *Stenochiton.* This area is, in common with the rest of the shell, highly polished, the only sculpture being several concentric grooves following the growth-lines. The strong diagonal ridge which divides this area from the pleural area is formed by a rapid drop from the anterior margin to the pleural area, and not by any definite raising of the lateral area.

Pleural and dorsal areas.—Indistinguishable from one another, except that the latter is usually outlined by a dark V-shaped mark. Both areas are smooth and highly polished, but the pleural area, where it abuts on the lateral, has the appearance of being broadly hollowed out, thus adding to the abruptness of the separating ridge that forms the anterior margin of the lateral area. Slits 3 to 4 very narrow (Carpenter gives central valve 3 slits, Adams and Angas 5 slits). This character seems rather specific than generic. Girdle narrow, clothed with small, closely-packed, imbricating scales, which are more flattened than in *Stenochiton cymodocea*, and although straight-sided are almost as broad as long. The scales in the outer row are lengthened and pointed, under 1-inch objective resembling short blunt spicules. The effect of a fringed edge is hardly perceptible.

Measurements.—Total length of dried specimen not disarticulated, 40 mm. Length of valves taken longitudinally at suture: (1) 5 mm., (2) 3 mm., (3) 4 mm., (4) 4·25 mm., (5) 5·5 mm., (6) 6 mm., (7) 5·5 mm., (8) 5·5 mm. Breadth of valves: (6) 6·5 mm., anterior valve 4 mm., posterior valve nearly 6 mm. It will be seen that the shell is widest at the sixth valve, and tapers forward to the anterior valve. The tapering of the posterior valve is rapid, as has been before alluded to.

Remarks.—The shape of the anterior valve, great length of the shell, and the raised lateral area with its abrupt ridge, easily distinguish this species. They are rather specific differences than generic characters.

Note.—While I have in the choice of distinguishing names departed somewhat from the fashion that has mostly been followed heretofore by workers in *Polyplacophora*, I deem no apology is necessary. The striking habits of the group dealt with suggest that their names should be chosen with reference to them, rather than to their valvular structure.

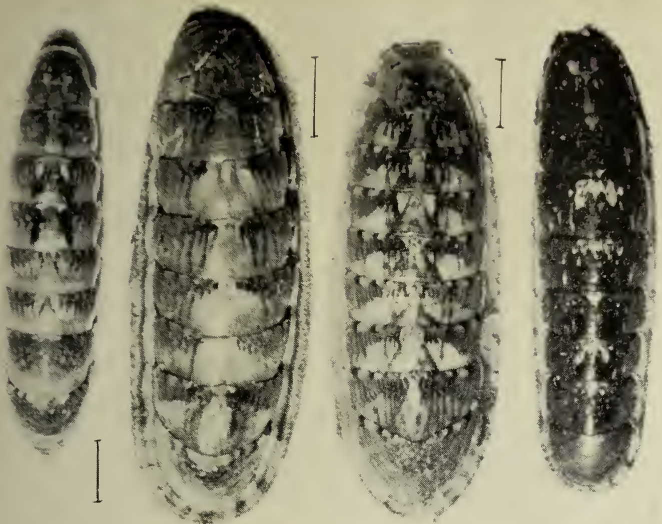
EXPLANATION OF PLATES.

Plate XIII.

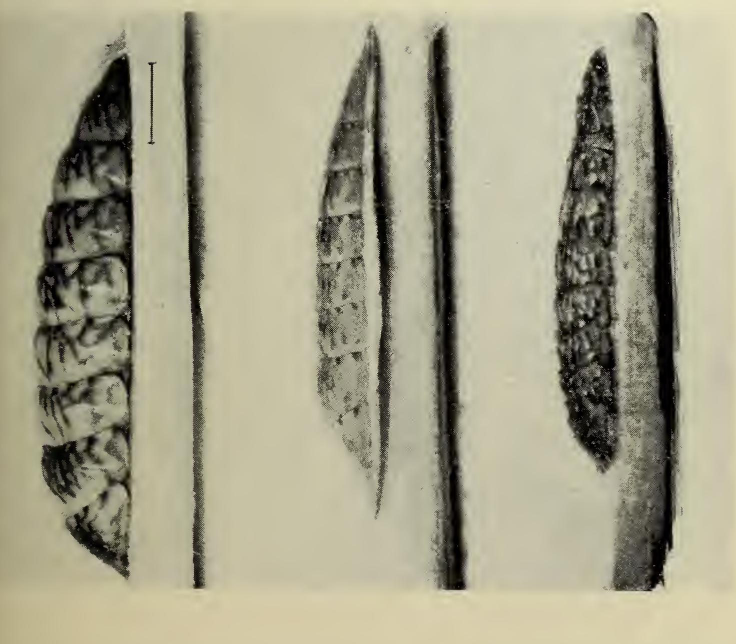
Fig. 1. *Stenochiton cymodocealis*, n. sp., side view.
,, 2. ,, *posidonialis*, n. sp., side view.
,, 3. ,, *juloides*, Ad. and Ang., side view.
,, 4. ,, *cymodocealis*, n. sp., from above, natural position.
,, 5. ,, ,, n. sp., from above, flattened-out girdle.
,, 6. ,, *posidonialis*, n. sp., from above.
,, 7. ,, *juloides*, Ad. and Ang., from above.

Plate XIV.

Fig. 8. *Stenochiton juliodes*, Ad. and Ang., posterior valve.
,, 9. ,, ,, Ad. and Ang., median valve.
,, 10. ,, ,, Ad. and Ang., anterior valve.
,, 11. ,, *cymodocealis*, n. sp., *in situ*, on stem of *cymodocea*.
,, 12. ,, ,, *(a)* anterior valve.
(b) median valve.
(c) median, showing arch.
(d) posterior valve.
(e) inside of anterior valve, showing teeth.
,, 13. ,, *posidonialis*, n. sp., *(a)* anterior valve.
(b) median valve.
(c) posterior valve.
(d) inside of anterior valve, showing teeth.
,, 14. ,, *pallens*, Ashby, *(a)* anterior valve.
(b) median valve.



Figs. 4, 5, 6, and 7.



Figs. 1, 2, and 3.

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Fig. 8. Fig. 9. Fig. 10.

Fig. 11.

Fig. 12*a*. Fig. 13*a*. Fig. 14*a*.
Fig. 12*b*. Fig. 13*b*. Fig. 14*b*.
Fig. 12*c*. Fig. 12*e*.
Fig, 12*d*. Fig. 13*c*. Fig. 13*d*.

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Notes on South Australian Polyplacophora, with Additions to the Fauna; together with a List of Australian Polyplacophora, showing their Distribution in the Australian States.

By Edwin Ashby.

[Read June 13, 1918.]

In presenting this list of Australian Polyplacophora the writer is conscious of many imperfections. It was prepared originally for his personal use, as an aid to the further study of the very interesting order of mollusca dealt with. But on submitting the rough draft to his friends, Mr. W. L. May and Dr. W. G. Torr, he has been encouraged to offer it for publication at once. As far as possible the latest classification has been adopted and the list kept as concise as possible, the writer contenting himself with giving a bibliography of the various works and papers consulted.

The list presents many peculiarities of distribution, but comments thereon are beyond the limits of this paper.

While lists of the Polyplacophora recorded from several of the individual States have from time to time been presented, no complete list for the whole of Australia appears to have been compiled previously. Mr. T. Iredale's list (Proc. Mal. Soc., vol. ix., pt. iii., p. 158, Sept. 1910) is incomplete, and intended only to illustrate his very interesting paper.

I have with some misgivings included the fauna of Norfolk Island and Lord Howe Island in the New South Wales list, thereby increasing the number of species credited to that State.

The number of species and subspecies recorded from the respective States are as follows:—Western Australia, 40; South Australia, 70; Victoria, 36; Tasmania, 44; New South Wales, 41; Queensland, 30. The total for Australia is 147, a few of which are doubtful. South Australia has the honour of holding easily the first place as to number of species, and, in fact, about half the total known Australian species have now been recorded from that State. (I have in my collection a specimen of *Acanthochiton zealandicus*, Quoy. and Gaim., labelled "New South Wales," but no further data. I have not felt justified in placing it on the Australian list until further data are forthcoming.)

NOTES AND ADDITIONS TO SOUTH AUSTRALIAN FAUNA.

Lepidopleurus liratus, Ad. and Ang., 1864 (*Terenochiton*, Iredale). This shell has heretofore been labelled in our collections. "*L. inquinatus*, Reeve, 1847." Many years ago I pointed out to my friends that it did not agree with the New Zealand shell. We are indebted to Mr. Iredale for its identification with *L. liratus*, Ad. and Ang.

Lepidopleurus badius, Hed. and Hull (*Terenochiton*, Iredale). (Rec. Aust. Mus., vol. vii., No. 4, 1909.) I am glad to be able to place this interesting *Lepidopleurus* on our South Australian list. On December 28, 1917, Mr. F. L. Saunders and I visited Cape Jervis, when Mr. Saunders was successful in finding two nice specimens. (Unfortunately my bottle of *Lepidopleurus* was washed out of my pocket, so to Mr. Saunders belongs the honour of finding the first fully-identified specimen.) On March 14, 1918, I again visited Cape Jervis, and was successful in getting another. In February, 1917, I found a carinated *Lepidopleurus*, which I put aside for identification. It approaches *L. badius* very closely, but shows some differences, and will need further investigation to accurately determine the question. Mr. Saunders kindly lent me his specimen to send over to Messrs. Gatliff and Gabriel, and later to Mr. Hull, who all have stated that it is certainly a typical *L. badius*, previously only recorded from New South Wales.

Lepidopleurus columnarius, Hed. and May, 1918 (*Terenochiton*, Iredale). Messrs. Gatliff and Gabriel (Roy. Soc. Vic., vol. xxx., N.S., pt. i., p. 24) have identified Dr. Torr's *L. pelagicus* (Torr: Trans. Roy. Soc. S. Austr., vol. xxxvi., p. 165) with the latter species, and so *L. columnarius* must be added to our South Australian list.

Ischnochiton wilsoni, Sykes, 1896 (Proc. Mal. Soc., vol. ii., pt. 2, July, 1896, p. 89). In addition to the two specimens recorded by Dr. Torr in his valuable paper on South Australian *Polyplacophora* (Trans. Roy. Soc. S. Austr., vol. xxxvi., 1912) "as probably all that have been found in South Australian Polyplacophora (Trans. Roy. Soc. S. Austr., vol. at Aldinga Bay about seventeen years ago.

Ischnochiton atkinsoni, Iredale and May, 1916 (Proc. Mal. Soc., vol. xxii., pts. 2 and 3, Nov., 1916). This is another addition to our South Australian fauna. In January, 1917, Dr. Torr and I spent some time at Port Lincoln, and we both collected a nice series of a shell we at the time referred to a variety of *I. crispus*, Reeve. Mr. Gatliff suggested at the time that our shell might possibly be Iredale and May's *I. atkinsoni*. Recently I have been able to pay more attention to this group, and Mr. May has kindly lent me his co-types, so I am able to say that the Port Lincoln shells are undoubtedly referable to that species, although showing some slight variations. It is easily differentiated from *I. crispus* by its small finely-striated scales.

Ischnochiton falcatus, Hull, 1912 (Proc. Roy. Soc. Vict., vol. xxv., N.S., pt. 1, Aug., 1912). I have a specimen of this shell marked Gulf St. Vincent, and have found amongst my papers the commencement of a written description in my own handwriting dated 1900, so the shell must have been collected prior to that year. The strong ribbing in the pleural area, and the coarse toothing of the posterior margin of the lateral areas, easily distinguishes it from its congeners. It is an interesting addition to the South Australian fauna.

Ischnochiton milligani, Iredale and May, 1916 (Proc. Mal. Soc., vol. xii., pts. 2 and 3, p. 109, Nov., 1916). This shell, which is a subspecies of the well-known New South Wales shell *I. proteus*, Reeve, for many years was wrongly labelled in Australian collections "*I. divergens.*" We are indebted to Dr. Torr, who has collected Polyplacophora throughout the Australian States more extensively than any other worker, for the addition to the South Australian fauna of this very fine form. He obtained a single but splendid specimen at Cape Northumberland in January, 1914. The measurements are, 45 mm. × 21 mm.

Haploplax pura, Sykes, 1896 (Proc. Mal. Soc., vol. ii., pt. 2, July, 1896). I am glad to be able to record this as a South Australian shell, having collected a single specimen at Marino on February 12, 1917. I am indebted to Messrs. Gatliff and Gabriel for its identification, they having compared it with typical specimens in their collection.

Heterozona subviridis, Iredale and May, 1916 (Proc. Mal. Soc., vol. xii., pts. 2 and 3, p. 105, Nov., 1916). I am able to include this shell in the list of Victorian shells, as in looking through with Mr. W. L. May a fine series of *Ischnochiton crispus* sent me some years ago by Mr. Gabriel from Back Beach, Phillip Island, Victoria, we were able to pick out four specimens of Messrs. Iredale and May's shell.

Rhyssoplax calliozona, Pilsbry, 1894, Torr in Trans. Roy. Soc. S. Austr., vol. xxxvi., 1912, gives measurement of largest dried specimen as 55 mm. × 25 mm. I have one collected at Cape Jervis on December 28, 1917, measuring 65 mm. × 35 mm., in splendid condition. It was accompanied by others of exceptional size.

Rhyssoplax bednalli, Pilsbry, 1895. In addition to the localities given by Dr. Torr (Trans. Roy. Soc. S. Austr., vol. xxxvi., p. 154, 1912), I can add that of Warrenben, in South Australia, from which I have one valve.

Loricella angasi, Ad. and Ang., 1864. I have taken at different times three large specimens alive at Marino in deep holes at lowest tide measuring 67 mm. × 40 mm., and one at Aldinga Bay measuring 67 mm. × 47 mm.

Onithochiton ashbyi, Bed. and Matt., 1906. Torr (Trans. Roy. Soc. S. Austr., vol. xxxvi., p. 151, 1912) refers to only one specimen having been taken. The type was collected by me at Aldinga Bay prior to 1898 and placed in Mr. Bednall's hands for description. Several years later I took a second specimen from the same spot about a quarter of a mile south of Aldinga jetty in a large sheltered pool. This is the one referred to in Torr's paper, and is still in my possession. When alive its girdle and valves were brilliant green and pink harmonizing with the calcareous growths on the rock upon which it was found. In January, 1918, Dr. Torr was successful in finding a third specimen at Corny Point, Yorke Peninsula.

Acanthochiton maughani, Torr and Ashby, 1898. In Torr's paper (Trans. Roy. Soc. S. Austr., vol. xxxvi., p. 162, 1912) only one locality is given for South Australia. I collected it at Aldinga Bay in 1897 and at Port Noarlunga and Marino in 1899. It is, as far as my experience goes, always a rare species in this State.

Acanthochiton cornutus, Torr and Ashby, 1898 (Trans. Roy. Soc. S. Austr., vol. xxii., pt. 2, p. 217, Torr and Ashby). The type locality is given as Marino at low tide. It was taken by me on the reef which at low water is quite shallow, many rocks being exposed. In Torr's paper (Trans. Roy. Soc. S. Austr., vol. xxxvi., p. 161, 1912) he says, "This is evidently a deep-water species." I think it doubtful whether the occurrences he refers to have been correctly identified. I have not myself seen a second specimen. The existence of eyes in the dorsal area, as referred to in the addendum to the original paper by Torr and Ashby, should make it easy of identification. I should be exceedingly grateful to any collector who may meet with this shell if he would kindly place a specimen or specimens at my disposal, in order that the remarkable discovery of eyes in an *Acanthochiton* may receive further elucidation.

Anisoradsia mawlei, Iredale and May, 1916 (Proc. Mal. Soc., vol. xii., pts. 2 and 3, p. 108, Nov., 1916). Subspecies *saundersi*, n. subsp. When at Port Lincoln in January, 1917, with Dr. Torr, I collected several specimens of an *Ischnochiton* evidently new to this State. On comparing it with Iredale and May's Tasmanian shell *mawlei*, for which they formed a new subgenus *Anisoradsia*, a close general resemblance was discernable, but it differs in several respects.

It is certainly deserving of subspecific rank. My material is rather limited, so that it may on further examination and comparison with a more extended series be found to deserve full specific rank. *Anterior valve.*—The radial ribbing in this valve is in straight lines, somewhat broken, giving a shallow, nodulose appearance to these ribs, whereas the sculpture of the dominant form *(mawlei)* is wavy. *Median valves.*—The broken concentric ribbing of the lateral area easily distinguishes it from typical *mawlei*. In this subspecies the sculpture is very coarse. The concentric ribs are better described as exceptionally coarse nodules, more or less running into one another; this feature is especially marked towards the posterior margin of this area. *Posterior valve.*—The sculpture of this valve behind the mucro is much coarser than is the case in the dominant form *(mawlei)*. In other respects the characteristics seem to accord. I am naming it in honour of Mr. F. L. Saunders, who is an earnest South Australian collector, and to whom belongs the credit of having first noticed the "host plant" of *Stenochiton cymodocealis*, Ashby.

Distribution of Australian Polyplacophora.

Order POLYPLACOPHORA.

Suborder LEPIDOPLEURINA.

Family Lepidopleuridae, Pilsbry.

	.	S.A.	W.A.	Vic.	N.S.W.	Tas.
Genus Lepidopleurus.						
Subgen. Terenochiton, Iredale.						
liratus, Ad. and Ang., 1864		x				x
matthewsianus, Bednall, 1906 ...		x				x
badius, Hedley and Hull, 1906 ...		x			x	
norfolcensis, Hedley and Hull, 1912					x	
catenatus, Hedley and Hull, 1912					x	
columnarius, Hedley and May, 1908		x				x
niger, Torr, 1911			x			
Subgen. Choriplax.						
grayi, Ad. and Ang.					x	

Suborder CHITONINA.

Family Callochitonidae, Thiele.

	.	S.A.	W.A.	Vic.	N.S.W.	Tas.
Genus Callochiton.						
platessa, Gould, 1846	x	x	x	x	x	x
rufus, Ashby, 1900		x	x			
mayi, Torr, 1912		x				x
elongatus, May, 1918						x
Genus Eudoxochiton.						
Subgen. Eudoxoplax, Iredale and May ...						
inornatus, Ten. Woods						x
Subgen. Chaetopleura.						
biarmata, Rochebrune, 1882			x			

Family Ischnochitonidae, Pilsbry.

	Q.	S.A.	W.A.	Vic	N.S.W.	Tas.
Genus Stenochiton.						
Subgen. Stenochiton.						
juloides, Ad. and Ang., 1865 ...		x	x			
pilsbryanus, Bednall, 1896		x				
posidonialis, Ashby, 1918		x				
cymodocealis, Ashby, 1918		x				
pallens, Ashby, 1900		x				
Subgen. Zostericola, MS., Ashby, 1918 ...		x				
Genus Ischnochiton.						
Subgen. Ischnochiton.						
pilsbryi, Bednall, 1896		x				
torri, Iredale and May, 1916 ...		x		x		
crispus, Reeve, 1847	x				x	
subsp. *decoratus*, Sykes, 1896 ...		x	x	x		x
atkinsoni, Iredale and May, 1916		x		x		x
ptychius, Pilsbry, 1894		x	x	x		
tateanus, Bednall, 1897		x	x	x		x
falcatus, Hull, 1912		x		x		x
wilsoni, Sykes, 1896=*levis*, Torr ...		x		x		
proteus, Reeve, 1847	x				x	
subsp. *milligani*, Iredale and May, 1916		x		x		x
gabrieli, Hull, 1912				x		
albinus, Thiele, 1911		x				
indifferens, Thiele, 1911			x			
intermedius, Hedley and Hull, 1912					x	
bednalli, Torr, 1912		x				
contractus, Reeve, 1847 *(decussatus)*		x	x			
lineolatus, Blain., 1825 *(contractus)*		x	x	x		x
fruticosus, Gould, 1846		x			x	
virgatus, Reeve, 1848		x		x		x
Subgen. Haploplax.						
thomasi, Bednall, 1896		x				
smaragdinus, Angas, 1867	x				x	
var. *picturatus*, Pilsbry	x				x	
subsp. *resplendens*, Bed. and Matt.		x	x	x		x
lentiginosa, Sowerby					x	
pura, Sykes, 1896		x		x		
mayi, Pilsbry, 1895						x
Doubtful Ischnochitons.						
adelaidensis, Reeve						
variegatus, Ad. and Ang., 1864 ...						
cancellatus, Sowerby						
carinculatus, Reeve						
arbutum, Reeve						
sculptus, Sowerby						
longicymba, Blain., 1825						
ustulatus, Reeve, 1847						
Subgen. Anisoradsia, Iredale and May.						
mawlei, Iredale and May, 1916 ...						x
subsp. *saundersi*, Ashby, 1918 ...		x				
Subgen. Ischnoradsia, Shuttl.						
australis, Sowerby, 1840			x		x	
subsp. *evanida*, Sowerby, 1840 ...		x		x		x
Subgen. Heterozona, Carp., MS., Pilsbry.						
cariosus, Carp. and Pils., 1873 ...		x	x	x		x
sub-viridis, Iredale and May, 1916				x		x

	Q.	S.A.	W.A.	Vic.	N.S.W.	Tas.
Family Callistoplacinae.						
Genus Callochiton, Pilsbry.						
antiquus, Reeve, 1847	x				x	
subsp. *mawlei*, Iredale and May		x	x	x		x
recons, Thiele, 1911			x			
Family Mopaliidae.						
Genus Plaxiphora, Gray.						
Subgen. Plaxiphora.						
albida, Blain., 1825		x		x	x	x
paeteliana, Thiele, 1911					x	
hedleyi, Torr, 1911			x			
pustulosa, Torr, 1911			x			
zebra, Torr, 1911			x			
Subgen. Poneroplax, Iredale.						
costata, Blain.	x	x	x	x		x
Subgen. Frembleya, H. and A. Ad.						
conspersa, Ad. and Ang., 1864 ...		x				
matthewsi, Iredale, 1901 (?), var.		x				
Family Cryptoconchidae, (Burrow, 1815) Iredale.						
Genus Acanthochiton, Gray, 1821.						
Subgen. Acanthochiton.						
sueri, Blain., syn. *asbestoides*, Smith	x	x	x	x	x	x
granostriatus, Pilsbry, 1894		x		x	x	x
crocodilus, Torr and Ashby, 1898		x				
cornutus, Torr and Ashby, 1898 ...		x				
maughani, Torr and Ashby, 1898		x			x	
exilis, Torr and Ashby, 1898 ...		x				
pilsbryi, Sykes, 1896				x		
lachrymosa, May and Torr, 1912 ...						x
brevispinosa, Sowerby, 1843			x			
deliciosus, Thiele, 1911			x			
sub-viridis, Torr, 1911			x			
verconis, Torr and Ashby, 1898 ...		x	x			
retrojectus, Pilsbry, 1894	x				x	
(?) subsp. *rufus*, Torr, 1912 ...		x				
variabilis, Ad. and Ang., 1864 ...	x	x			x	x
kimberi, Torr, 1912		x				x
leuconotus, Hed. and Hull, 1912 ...					x	
approximans, Hed. and Hull, 1912					x	
coxi, Pilsbry, 1894					x	
Subgen. Notoplax, Adams.						
matthewsi, Bed. and Pils., 1894 ...		x		x		
speciosus, H. Adams, 1861		x	x	x		x
wilsoni, Sykes, 1896		x		x		x
glyptus, Sykes, 1896				x		
Subgen. Macandrellus, Dall., 1878 = Loboplax, Pilsbry.						
costatus, Ad. and Ang., 1864 ...	x	x			x	x
rubrostratus, Torr, 1912		x				x
Doubtful Acanthochitons.						
tatei, Torr and Ashby, 1898, (?) *granostriatus*, Pilsbry						
bakeri, Torr, 1912, impossible of identification						

Family Cryptoplacidae, Dall.

	Q.	S.A.	W.A.	Vic.	N.S.W.	Tas.
Genus Cryptoplax.						
burrowi, Smith, 1884	x					
gunni, Reeve, 1847		x	x	x		
striatus, Lam., 1819		x		x	x	x
oculatus, Quoy and Gaim., 1834	x					
hartmeyeri, Thiele, 1911			x			
michaelseni, Thiele, 1911			x			

Family Chitonidae.

	Q.	S.A.	W.A.	Vic.	N.S.W.	Tas.
Genus Rhyssoplax, Thiele, 1893.						
jugosus, Gould, 1846					x	
subsp. *diaphora*, Ire. and May, 1916		x		x		x
coxi, Pilsbry, 1894	x				x	
torrianus, Hed. and Hull, 1909		x	x			x
calliozona, Pilsbry, 1894		x				x
exoptanda, Bednall, 1897		x	x	x		
bednalli, Pilsbry, 1895		x	x			
tricostalis, Pilsbry, 1894		x	x	x		x
limans, Sykes, 1896	x	x		x	x	
corypheus, Hed. and Hull, 1912					x	
verconis, Torr and Ashby, 1898		x		x		
oruktus, Maughan, 1900		x				x
aureo-maculata, Bed. and Matt.		x				x
vauclusensis, Hed. and Hull, 1909	x				x	
translucens, Hed. and Hull, 1909	x				x	
coccus, Menke, 1844			x			
howensis, Hed. and Hull, 1912					x	
Genus Amaurochiton, Thiele, 1893.						
glaucus, Gray, 1828						x
Genus Sypharochiton, Thiele, 1893.						
pelli-serpentis, Q. and Gaim., 1835					x	
subsp. *maugenaus*, Ire. and May, 1916						x
funereus, Hed. and Hull, 1912					x	
Genus Sclerochiton, Cpr.						
miles, Pilsbry, 1892	x					
curtisianus, Smith, 1884	x					
Doubtful Chitons.						
exiguus, Sowerby, 1843						
pulcherrimus, Sowerby, 1841						
Genus Tonicia, Gray.						
carpenteri, Ang.					x	
hullianus, Torr, 1911			x			
picta, Reeve, 1847	x					
fortilirata, Reeve, 1847	x					
Subgen. Lucilina, Dall.						
confossa, Gould, 1846	x					
delecta, Thiele, 1911			x			
Genus Acanthopleura.						
spinosa, Bruge., 1792	x		x			
Subgen. Amphitomura, Pilsbry.						
gemmata, Blain., 1825=*spiniger*, Sowerby			x			
aculeata, Linne., 1758	x					

	Q.	S.A.	W.A.	Vic.	N.S.W.	Tas.
Genus LORICA.						
volvox, Reeve, 1847					x	
subsp. *cimolia*, Reeve, 1847 ...		x	x	x		x
Genus LORICELLA.						
angasi, Ad. and Ang., 1864		x		x	x	x
Genus SCHIZOCHITON.						
incisus, Sowerby, 1841	x					
Genus ONITHOCHITON, Gray.						
scholvieni, Thiele, 1910	x		x			
ashbyi, Bed. and Matt., 1906 ...		x				
quercinus, Gould	x				x	
rugulosus, Angas					x	
discrepans, Hed. and Hull, 1912 ...					x	
Genus LIOLOPHURA.						
gaimardi, Blain.	x				x	
subsp. *queenslandica*, Pils., 1894	x					
georgiana, Quoy and Gaim., 1835...			x			

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AUSTRALIAN FUNGI: NOTES AND DESCRIPTIONS. No. 1.

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[Read July 11, 1918.]

Plates IX. to XII.

In submitting these notes and descriptions of some of the higher Australian fungi, we would like to point out the difficulties surrounding the identification of our species. The individuals of most species vary considerably amongst themselves, and, unless there is some outstanding common feature, extremes may not be recognized. Most of the fleshy species alter vastly in drying, the spores being frequently the only constant feature. To study a species properly it is therefore necessary to know it in the field, to write a full description of it when fresh, to have it figured in colours, to preserve specimens by drying as quickly as possibly and in formalin, and to measure the spores. It is very often exceptionally hard to say whether Australian species, which resemble extra-Australian ones, are or are not the same. Coloured plates of European species may be compared with our fresh plants or with coloured drawings of them, the dry plants of both may be examined sometimes side by side and their spores may be compared, and the descriptions of fresh plants of each considered. In these cases, if essentials agree, the diagnosis may be considered reasonably sound. We have adopted the plan of referring Australian plants to European species if there seems reasonable ground for considering them the same, even in the absence of authentically identified dry European plants with which to compare them. We, however, also add to such identifications our own descriptions of the Australian plants. If later the latter are found to be distinct, the error is thus easily rectified, and meanwhile we prevent undue multiplication of specific names. For the Australian higher fungi to be adequately known, it is essential that coloured drawings should be prepared and published of each. We have already over 150 of these, and hope that means may sometime be found to make them available to the scientific public.

We are deeply grateful to a generous benefactor of this Society for enabling those in this series to be reproduced.

The references to plates, under "colour tints noted," are to those by Henri Dauthenay in "Répertoire de Couleurs

. . . publié par la Société Française des Chrysanthémistes et René Oberthür"—the only colour index at present available to us.

The species considered are numbered consecutively for the convenience of possible reference in future papers.

Summary of Contents.

Brown-spored Agarics.

Rozites: 1—*R. australiensis*, n. sp.

Pholiota: 2—*P. disrupta*, Cke. and Mass. 3—*P. pudica*, Fries. 4—*P. recedens*, Cke. and Mass. 5—*P. eriogena*, Fries. 6—*P. unicolor*, Fl. Dan. 7—*P. marginata*, Batsch. 8—*P. pumila*, Fries.

Cortinarius: 9—*C. (Phlegmacium) variicolor*, var. *nemorensis*, Fries. 10—*C. (P.) corrosus*, Fries. 11—*C. (P.) decoloratus*, Fries. 12—*C. (P.) largus*, Fries. 13—*C. (P.[?]) rotundisporus*, n. sp. 14—*C. (Myxamicium) archeri*, Berk. 15—*C. (Myx.) vibratilis*, Fries. 16—*C. (Dermocybe) camurus*, Fries. 17—*C. (D.) miltinus*, Fries. 18—*C. (D.) venetus*, Fries. 19—*C. (Telamonia) austro-evernius*, n. sp.

Paxillus: 20—*P. aureus*. 21—*P. paradoxus*, Kalchb. *(Phylloporus rhodozanthus*, Schw.). 22—*P. crassus*, Fries. 23—*P. sp.* 24—*P. involutus*, Fries.

Hebeloma: 25—*H. crustuliniforme*, Bull. 26—*H. subcollariatum*, Berk. and Br. 27—*H. montanum*, n. sp.

Inocybe: 28—*I. asterospora*, Quel. 29—*I. subasterospora*, n. sp. 30—*I. gomphodes*, Kalch. 31—*I. albidipes*, n. sp. 32—*I. obscura*, Pers. 33—*I. flocculosa*, Berk. 34—*I. australiensis*, n. sp.

Flammula: 35—*F. carbonaria*, Fries. 36—*F. californica*, Earle. 36a—*F. californica*, var. *communis*, var. nov. 37—*F. fusa*, Batsch. 38—*F. liomonia*, Cke. and Mass. 39—*F. radicata*, n. sp. 40—*F. filicea*, Cooke. 41—*F. purpureo-nitens*, Cke. and Mass. 42—*F. purpurata*, Cke. and Mass. 43—*F. excentrica*, n. sp.

Bolbitius: 44—*B. flavidus*, Bolton.

Naucoria: 45—*N. horizontalis*, Bull. 46—*N. semiflexa*, Berk. and Br.

Galera: 47—*G. tenera*, Schaeff. 48—*G. campanulata*, Mass. 49—*G. rubiginosa*, Pers. 50—*G. hypnorum*, Batsch.

Tubaria: 51—*T. furfuracea*, Pers. 52—*T. inquilina*, Fries.

Crepidotus: 53—*C. mollis*, Schaeff. 54—*C. globigerus*, Berk. 55—*C. salmonicolor*, n. sp.

Purple or Porphyry-spored Agarics.

Psalliota: 56—*Ps. campestris (L.)*. 56a—*Ps. campestris*, var. *hortensis*, Cke. 56b—*Ps. campestris*, var. *sylvicola*, Vittad. 57—*Ps. arvensis*, var. *villaticus*, Brond. 57a—*Ps. arvensis*, var. *iodoformis*, var. nov. 57b—*Ps. arvensis*, var. *fragrans*, var. nov. 58—*Ps. pratensis*, Schaeff. 59—*Ps. elatior*, Cke. and Mass.

Stropharia: 60—*S. obturata*, Fries. 61—*S. stercoraria*, Fries. 62—*S. umbonatescens*, Peck.

Hpyholoma: 63—*H. fasciculare*, Huds. 64—*H. elaeodes*, Fries. 65—*H. sublateritium*, Schaeff. 66—*H. perplexum*, Peck. 67—*H. fragile*, Peck.

Psilocybe: 68—*Ps. sarcocephala*, Fries. 69—*Ps. bullacea*, Bull. 70—*Ps. musci*, n. sp. 71—*Ps. foenisecii*, Pers. 72—*Ps. atomatoides*, Peck. 73—*Ps. ceres*, Cke. and Mass. 74—*Ps. aggregata*, n. sp.

Black-spored Agarics.

Panaeolus: 75—*P. ovatus*, Cke. and Mass. 76—*P. retirugis*, Fries. 77—*P. campanulatus (L.)*. 78—*P. sub-balteatus*, Berk. and Br. 79—*P. semilanceatus*, Peck.

Psathyrella: 80—*P. disseminata*, Pers.

BROWN-SPORED AGARICS.

Rozites.

According to Massee (Brit. Fung. Flora, ii., p. 232, 1893), though "the genus *Locellinia*, Gillet, founded for the reception of a rusty-spored species having a universal veil that remains at the base of the stem as a volva, differs from *Acetabularia*, Berk., in having a secondary veil and adnate gills, nevertheless Saccardo has made the mistake of sinking Berkeley's genus, and placing the species in *Locellinia*." Cooke, in his Handbook of Australian Fungi, 1892, follows Saccardo, as does Hennings in Engler and Prantl's Die Natürlichen Pflanzenfamilien. On the other hand, the latter author, under the genus *Rozites*, Karst., defines this as having a ring on the stem and with the young plant enveloped in a universal veil, which later on remains as fragments on the surface of the cap and as a sheath at the base of the stem. The Australian plant we have found has when young such a universal veil, rupturing in the way indicated, a marked secondary veil forming later ragged fragments of a ring, and adnate and later nearly free gills. It is obviously *Rozites* as defined by Hennings, but also, we take it, the *Locellinia* of Gillet referred to by Massee. At present we adopt *Rozites* as being less liable to cause confusion.

1. *Rozites australiensis*, n. sp.—The young plant with a subglobose or pear-shaped head up to 3 inches across, on a broad stem 3 inches high and 2½ inches broad, which contracts into a conical root; adherent to the upper part of the stem and separated from the cap are large ragged fragments of a universal veil (=volva) disclosing beneath the secondary veil; viscid when moist; pure white or with a slight brownish tint. When adult, pileus up to 11 inches across, expanding to convex and then nearly plane and usually broadly gibbous, sometimes with a depression in the umbo, smooth, white with a slight brownish tint, sometimes cracking, with fragments of the veil at the edge. Gills when very young pale

straw and adnate, finally slightly sinuate and nearly free (S.A.), in the New South Wales specimens adnate with a trace of decurrence, moderately close, rather narrow, pale salmony-brown becoming more cinnamony, finally rich rusty brown. Stem when adult up to 6 inches high, 1½ to 2 inches broad, becoming bulbous below and then contracting into a conical root, white, slightly fibrous, solid, with large ragged fragments of a rather superior ring, and below this the remains of the universal veil (volva) are usually distinguishable (S.A.). The New South Wales (1918) specimens show a sheathing base to the lower two-thirds of the stem, comprised of superimposed split layers of the universal veil seen in the young plant, surmounted by a broad upwardly-concave persistent ring. Stem (N.S.W.) attached to white mycelial threads traversing the ground and forming indefinite masses. Flesh tough, white. No smell. Spores in the mass rich ferruginous brown, microscopically yellow-brown, oblique, with pointed ends, 8·5 to 10·5 × 5 to 6 μ.

On the ground under trees, sometimes subcaespitose. Found in exactly the same spot, forming a colony some 20 yards in diameter, about 1½ miles due west of Mount Lofty, South Australia, in May, 1910, and April, 1917. We also have a specimen, locality not noted, from New South Wales, and in May, 1918, at Wauchope and Kendall found several colonies in forests.

Pileus ad 20 cm. latus, convexus, plerumque late gibbosus, interdum in umbone depressus, aliquanto glaber, albidus sed fuscum tinctus. Lamellae juventute substramineae, adnatae, demum minime sinuatae et stipite paene disjunctae, modice confertae, subfulvae, mox cinnamoneae, demum ferrugineae. Stipes ad 15 cm. altus, 2·5 cm. crassus, basi sensim bulbosus, albidus, subfibratus, annulo subsuperiore. Volva imperfecta. Sporae perferrugineae, obliquae, 8·5-10·5 × 5-6 μ.

Colour tints noted: New South Wales—Pileus shows tints of pale-yellowish flesh, No. 68; gills near snuff-brown (deep bistre), No. 303, at first Ton 1, then Ton 3. South Australia—Spore mass and dried gills near bistre, No. 328, Ton 4.

Pholiota.

2. *Pholiota disrupta*, Cooke and Massee: Grev., xix., 89; Cooke: Handb. Austr. Fungi, No. 220. Previously recorded, Victoria.—The following description of a plant collected by us agrees fairly well with that of *P. disrupta* given by Cooke in his Handb. of Austr. Fungi (No. 220):—"Stout. Pileus 4½ inches across, slightly convex, smooth or

finely rough, whitish with a dirty-brownish tint. Gills moderately crowded, adnate, whitish with a brown tint in certain lights, later becoming coffee coloured, and finally cinnamon-brown. Stem $3\frac{1}{2}$ inches high, $\frac{7}{8}$ inch in diameter above, expanding below to a somewhat bulbous base $1\frac{1}{4}$ inch thick, with a conical almost fusiform root, mealy white and somewhat silky fibrous. Ring $\frac{5}{8}$ inch from the gills, pendulous, torn, a rich reddish-brown from fallen spores. Spores brown, 11 to 11·5 × 5·5 μ, oblique, with one or both ends pointed."

On the ground under a rock, Milson Island, Hawkesbury River, May, 1913. In the description given by Cooke, the cap is said to be at first smooth, then cracked deeply into large areolae. Our specimen was smooth when gathered, but is irregularly wrinkled when dry. The spore measurements given by Cooke are larger than ours, *viz.*, 14 × 9 μ. Our spores are perhaps rather bright to be called "dusky ferruginous"—*P. disrupta* is placed in the section *Phaeotae* by Cooke—but the tint "tawny-brown," applied to the colour of the spores in the description, could be applied to those of our specimen. Cooke records the species for Victoria.

3. *Pholiota pudica*, Fries.: Hymen. Eur., p. 118; Sacc.: Syll., v., 3065; Cooke: Illustrs., pl. 362; Cooke: Handb. Austr. Fungi, No. 221. Previous Australian record, Victoria.—We refer to this species a pure-white *Pholiota* with a slightly hollow stem found growing in caespitose fashion amongst bark at the base of a Eucalyptus on Milson Island, Hawkesbury River, in March, 1912. Spores oval, brownish, 7·2 to 9 × 5·5 μ.

4. *Pholiota recedens*, Cooke and Massee: Grev., xviii., 25; Cooke: Handb. Austr. Fungi, No. 217. Previous Australian record, Victoria.—We refer, with some hesitation, the following common plant in the Sydney district to *P. recedens*. Pileus $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter, hemispherical or conico-campanulate, then expanded, sometimes slightly umbonate, smooth, brownish-tan, edge becoming dark brown on drying and striate, slightly hygrophanous, when young sometimes showing some lighter yellow shreds on the pileus the colour of the ring. Gills adnate but slightly sinuate and with a slight decurrent tooth or adnexed and seceding, moderately distant, ferruginous tan. Stem 2 inches high, slightly striate, hollow, slightly thickened below, ferruginous tan. Ring marked, distant, reflexed, striate above, yellowish-brown. Spores yellow-brown, obliquely flask-shaped, 9 to 13 × 6 to 7 μ.

On the ground, Neutral Bay and Mosman, Sydney, May, June, and August (D. I. C., Watercolour No. 21; Miss Clarke, Watercolour No. 136.)

Colour tints noted:—Pileus at the periphery when moist near brownish-terracotta, No. 322, Ton 2, with darker lines, in the centre darker than mineral brown, No. 339, Ton 4. Gills near hazel, No. 324, Ton 4. Ring, yellowish-buff, No. 310, Ton 2. Spore mass rather browner than yellow ochre, No. 326, Ton 2.

5. *Pholiota eriogena*, Fries.: Pl. Preiss, ii., 132; Sacc.: Syll., v., 3128; Cooke: Handb. Austr. Fungi, No. 230. Previously recorded, Western Australia.—The description given by Cooke of *P. eriogena*, Fr., in Pl. Preiss., is very short and will probably fit a number of species. As it is based on Australian plants, we refer the following species to it to avoid multiplication of specific names. Our plants agree well with the description and plates of *P. discolor* of Peck. Pileus ½ to 1 inch in diameter, convex, sometimes irregular, dark brown or reddish-brown becoming pale tan or reddish-tan, slightly viscid and not striate (one collection; Blue Mountains), edge at first turned in. Gills adnate, moderately crowded, light or reddish-brown. Stems 1 to 1½ inch high, pallid becoming brownish or brown, at first mealy, slightly striate, slightly hollow, base slightly enlarged with a white mycelial attachment. Superior ring not very marked and evanescent. Spores pear-shaped, 7 to 7·8 × 5 μ.

On wood, single, Blue Mountains, May, 1914; Terrigal, June, 1914; Bulli, May, 1914—all in New South Wales.

6. *Pholiota unicolor*, Flora Danica, t. 1071, fig. 1; Cooke: Handb. Brit. Fungi, p. 149; Cooke: Illustrs., pl. 356B.—We place the following species under *P. unicolor*, though it has resemblances to *P. marginata*. In Cooke's Illustrations of the former, the small specimens show umbonation, whilst in ours even large ones show prominent umbos. Our specimens also seem to be larger than *P. unicolor*, whilst the gills cannot be called triangular. The plants grow singly, whilst in *P. unicolor* they are said to be subcaespitose and in *P. marginata* solitary or gregarious. Pileus up to 1¼ inch in diameter, convex, at first deep reddish-tan to watery yellow-brown, drying to a pale brown, edge finely striate when moist, smooth, umbonate, sometimes acutely so. Gills adnate or with a decurrent tooth, reddish-brown to pallid cinnamon becoming dingy cinnamon, moderately close. Stem 1½ inch high, slightly attenuated upwards, base a little swollen, covered with whitish-mealy fibrils, brownish below, solid. Ring moderately distant, marked or sometimes slight. Spores 7·5 to 10·4 × 4 to 5·2 μ.

Scattered on fallen trunks. Mount Wilson, June, 1915 (Miss Clarke, Watercolour No. 85); Leura, June, 1916; Lisarow, August, 1916—all in New South Wales.

7. *Pholiota marginata*, Batsch.: Elench. Fung., f. 207; Cooke: Illustrs., pl. 372; Sacc.: Syll., v., 3130; Cooke: Handb. Austr. Fungi, No. 229. Previous Australian record, Victoria.—We refer the following to this species:—Pileus 1 inch in diameter, convex, slightly distorted, smooth, pale tanny-white to tan, sometimes a pale centre and darker periphery. Gills adnate, moderately crowded, cinnamon. Stem $1\frac{1}{4}$ inch high, moderately slender, attenuated upwards, with a central brownish ring, sometimes brownish above the ring and whitish below, sometimes brownish or pallid brown or brown with white streaks throughout, hollow. Caespitose amongst or on old wood and sawdust. Spores 6 to 7 × 4·5 to 5 μ.

Milson Island, Hawkesbury River, July, 1912 (Miss Clarke, Watercolour No. 8).

8. *Pholiota pumila*, Fries.: Mon., i., p. 321; Fries.: Icones, ii., p. 5, pl. 105; Cooke: Illustrs., pl. 503A; Sacc.: Syll., v., 3135; Cooke: Handb. Austr. Fungi, No. 231. Previous Australian records, New South Wales, Victoria.—We describe our specimens thus:—Pileus up to $\frac{3}{8}$ inch in diameter, broadly conical or convex, then nearly plane, trace of an umbo or apex somewhat pointed, faintly striate near the edge, dark reddish-brown to yellow-brown and waxy looking when moist, finely granular with a lens, hygrophanous, opaque and pallid brown when dry. Gills adnate, with a trace of decurrence, moderately close to rather distant, pallid brown to reddish-brown. Stem 1 inch high, pallid brown to dark brown, somewhat silvery-mealy, solid or slightly hollow. Ring superior to rather distant, filmy, later disappearing. Spores oblique, one end acute, yellow-brown, 7 to 8 × 4 to 4·5 μ.

Amongst moss. The Spit, Sydney, July, 1916 (Herb., J. B. C., Form. Sp., No. 216); Mosman, Sydney, August, 1914 (several acuminate cystidia, 34 × 8 μ); Neutral Bay, April, 1918.

Colour tints noted:—Pileus when moist near brown-pink, No. 297, Ton 3; gills near Ton 2.

Cortinarius.

9. *Cortinarius (Phlegmacium) variicolor*, var. *nemorensis*, Fries.: Hymen. Eur., p. 339; Cooke: Illustrs., pl. 863; Massee: Brit. Fung. Flora, ii., p. 99.—Specimens which we think may be this variety we describe as follows:—Pileus $1\frac{3}{4}$ inch across, convex, very irregular, dark brown with perhaps a tinge of purple, viscid. Gills moderately close, dingy

violet, then yellow-cinnamon, from distortion of the cap variously attached being sometimes slightly decurrent, at others adnate or deeply ventricose and slightly cut out. Stem $1\frac{3}{4}$ inch high, stout, a little swollen at the base ($\frac{3}{4}$ inch in diameter), conical below this, finely striate, yellowish with tinges of violet. Superior veil. Flesh of stem turning violet. Caespitose. Spores 7·5 to 8·2 × 5·2 μ.

National Park (N.S.W.), July, 1916; (?) this species, Milson Island, Hawkesbury River (N.S.W.), July, 1912.

The following, with intensely glutinous caps, seem to belong to the same species as the above:—Pileus up to $2\frac{1}{2}$ inches high, at first convex and rather irregular, then more expanded, fibrously streaked, pale tan with a stony tint and then deeper tan and the edge pallid with a lavendar tinge, or dark brown with a voilet tinge and paler edge. Gills sinuately adnexed or adnate, moderately crowded, at first brown with a voilet tinge, finally cinnamon. Stem up to 2 inches high and $\frac{5}{8}$ inch thick, stoutish, often flattened, fibrously streaked, whitish, sometimes voilet tinted when damaged. Flesh of cap with a faint brownish tint, of stem faint voilet. Cobweb veil when young; superior ring. Spores flask-shaped, 8 to 8·5 × 5·2 μ.

Mosman, Sydney, April, 1915 (Herb., J. B. C., Form. Sp., 64); Hornsby (N.S.W.), June, 1916 (no violet tint noticed in gills; stem violet; veil violet; spores finely rough).

10. *Cortinarius (Phlegmacium) corrosus*, Fries.: Epicr., p. 266; Cooke: Illustrs., pl. 715; Massee: Brit. Fung. Flora, ii., p. 108.—We refer the following to this species:—Pileus $1\frac{1}{2}$ inch in diameter, convex, irregular, rather fibrously streaked, apparently sticky, dark tan. Gills moderately close, adnate with a slight decurrent tooth, dark cinnamon, drying bright ferruginous with a pale edge. Stem stout, whitish, slightly streaked, solid, base slightly bulbous with a free edge, doubtful remains of the cobweb veil. Spores with one end more pointed, 8·2 × 5·2 μ.

On the ground. Mosman, June, 1915.

11. *Cortinarius (Phleg.) decoloratus*, Fries.: Monogr., ii., p. 30; Cooke: Illustrs., pl. 729; Massee: Brit. Fung. Flora, ii., p. 113; Cooke: Handb. Austr. Fungi, No. 360 (Vict.).—We place the following under this species:—Pileus up to $2\frac{1}{2}$ inches in diameter, plane or irregular and a little depressed, very viscid, wax coloured. Gills adnate, slightly ventricose, pallid cream with a brownish tint, then a little browner, moderately close. Stem up to $2\frac{1}{2}$ inches high, slightly attenuated downwards, silky fibrous, hollow, white. Spores yellow-brown, oblique, 7 to 8 × 5·2 μ.

Lane Cove River, Sydney, June, 1916.

12. *Cortinarius (Phleg.) largus*, Fries.: Monogr., ii., p. 10; Cooke: Illustrs., pl. 701; Massee: Brit. Fung. Flora, ii. p. 99.—The following appears to be this species, though the spores are a little narrower. Pileus finally up to 9 inches across, convex, then irregular, then irregularly upturned, viscid when moist, dark tan, finally becoming scorched brown, very slightly fibrous when young, then smooth. Gills deeply sinuately adnexed, close, pallid brownish-white with a faint violet tinge, soon losing the violet to become pale brown, then more cinnamon, finally dark reddish-brown. Stem $3\frac{1}{2}$ inches high, $1\frac{1}{2}$ inch broad above, at first very stout with a non-marginate bulb of 2 inches, when adult the bulb not noticeable, root conical, solid, white tinged with the brown spores. Remains of a cobweb veil when young. Tough. Flesh white, $1\frac{1}{2}$ inch thick. No smell. Spores microscopically yellow-brown, oblique, one end pointed, 10·4 to 12 × 5 μ.

Caespitose on the ground. Mount Lofty (S.A.), April, 1917.

13. *Cortinarius (Phleg.* [?]*) rotundisporus*, n.sp. (pl. ix., figs. 3 and 4).—Pileus up to 1 inch in diameter, slightly viscid when moist, surface dull, convex with a trace of an umbo, the edge a little turned in when young, occasionally of a beautiful mauve colour, becoming pallid with a greyish-blue tint and traces of brown when dry. Gills adnate or with a trace of decurrence and slightly sinuate and ventricose, moderately close, dingy flesh-tinted drying pale yellow-brown then browner. Stem up to 2 inches high, attenuated upwards, rather bulbous below, slightly striate, slender to moderately slender or rather stout, white tinged with the colour of the cap, with remains of a superior cobweb veil (bluish when young), hollow. Flesh of the stem and cap pallid watery or turning yellowish in the stem, no blue. Spores smooth, nearly subspherical, 6·8 to 7·4 × 5·5 to 6 μ.

Subcaespitose under trees, Bradley Head and Mosman, Sydney, May, 1917, and April, 1918 (Miss Clarke, Water-colour No. 152).

Colour tints noted:—Pileus when dry becoming creamy-yellow, No. 30, Tons 2 and 3, tinged more or less with eucalyptus green, No. 248, Ton. 2. Stem tinted with the colours of the pileus. Gills when dry yellow-ochre, No. 326, Ton 1. Spore mass near snuff brown (deep bistre), No. 303, Ton 3. Pileus and stem of one specimen tinged with lavender-blue (violet-blue), No. 204, paler than Ton 1.

It is probable that this species should be placed under *Myxamicium*. In one specimen the stem seemed to be viscid as well as the cap. The specific name *rotundisporus* is given on account of the subspherical spores.

Pileus ad 3·5 cm. latus, paulo viscidus, convexus, paulo umbonatus, margine initio paulo involuto, pallido-flavus et glauco-violaceus coloratus. Lamellae adnate et minime sinuatae, subventricosae, paulo confertae, fusco-carneae, deinde flavo-ochraceae. Stipes ad 6 cm. altus, sursum attenuatus, paulo bulbosus, minime striatus, albidus et ad pileum similiter coloratus. Velum initio coeruleus. Caro pallida. Sporae glabrae, subsphericae, 6·8-7·4 × 5·5-6 μ.

14. *Cortinarius (Myxacium) archeri*, Berk.: Fl. Tas., t. 181, f. 7; Sacc.: Syll., 3763; Cooke: No. 361.—This species, recorded for Tasmania, is not rare in the Sydney district. Our description is as follows:—Pileus 2 to 5 inches in diameter, convex, then sometimes slightly depressed, intensely glutinous, rich brownish-violet, later becoming dry and shining and tan-brown with a deep violet streaky edge or light to dark chestnut only, edge turned in when young. Gills adnate or with a very slight sinus, or with a decurrent tooth, moderately close, pallid earthy with a violet tinge, then cinnamon or snuff-brown. Stem up to 3 or 4 inches high, glutinous, base bulbous and up to more than 1 inch thick, attenuating upwards to $\frac{5}{8}$ inch thick, conical below the bulb and ending in mycelial threads, hollow, pallid with a marked violet tint below the fugacious ring. Ring sometimes marked and persistent. Veil cobwebby, reddish-brown. Spores yellow-brown, ends rather pointed, rather elongated, very finely rough, 12 to 14·5 × 7 to 7·5 μ.

Hawkesbury River, June, 1912; locality not stated; Neutral Bay, Sydney, April, May, and June; Gladesville, Sydney (M. Flockton), May, 1910; Cheltenham, Sydney (A. A. Hamilton), May, 1910; Penshurst, Sydney, June, 1907.

Colour tints noted:—Edge of pileus when half-grown tinted with lavender-blue (violet-blue), No. 204, Tons 1 to 3; later the peripheral third of the pileus raw umber, No. 301, and the centre near brown-pink, No. 297, Ton 1. Lamellae when mature near snuff-brown (deep bistre), No. 303, Ton 2, with a slight lavender tint. Stem when very young lavender-blue (violet-blue), No. 204, Ton 4. Spore mass brown-pink, No. 297, Ton 4.

15. *Cortinarius (Myx.) vibratilis*, Fries.: Monogr., ii., p. 43; Cooke: Illustrs., pl. 744; Massee: Brit. Fung. Flora, ii., p. 92.—We give the following description of the specimens we thus refer:—Pileus up to $1\frac{1}{2}$ inch in diameter, glutinous, convex then plane, subgibbous in one collection,

rich tan to dark yellow-brown. Gills sinuately adnexed or as if adnate and then seceding, moderately close, pale salmon or pallid cinnamon. Stem $1\frac{1}{2}$ inch high, moderately stout, somewhat swollen below, viscid below the brown median remains of the veil, solid or hollow, white, sometimes fibrously streaked. Taste bitter. Spores yellow-brown, 8·5 to, occasionally, 10·5 × 5·2 μ.

On the ground. The Spit, Sydney, July, 1916; Sydney, July; Mount Lofty (S.A.), July, 1914 (cap 2 inches in diameter, stem not noted as sticky, spores distinctly larger and usually 10·5 μ long; this may be a distinct species).

16. *Cortinarius (Dermocybe) camurus*, Fries.: Epicr., p. 285; Cooke: Illustrs., pl. 784; Massee: Brit. Fung. Flora, ii., p. 61.—The following resembles the description of this species and also Cooke's illustration of it, save that the umbo may be acute and not obtuse. Pileus 1 to $1\frac{1}{2}$ inch broad, $\frac{3}{4}$ inch high, conico-convex with an acute, sometimes obtuse, umbo, edge slightly incurved, finely fibrously striate, not viscid, dark tan or with the apex nearly black, succeeded by chestnut-tan or reddish-brown with the periphery lighter, drying rather shiny and striate. Gills adnate or slightly sinuate, moderately close, edge crenate, slightly ventricose, reddish-cinnamon. Stem 3 inches high, rigid, moderately slender, attenuated upwards, slightly fibrillose or silky striate, slightly hollow, white or pallid whitish. Ring imperfect. Brown(?) or whitish cobwebby universal veil. Flesh thin, attenuated towards the edge. Slight seminal smell. When young with the edge turned in and the cap conico-acute. Caepitose at the base of tree-trunks. Spores yellow-brown, sometimes slightly warted, 8·5 to 10·4 × 5 to 6 μ.

Neutral Bay, Sydney, April and May, 1915 (Miss Clarke, Watercolour No. 74; Herb., J. B. C., Form. Sp., 102); at base of tree, Mosman, Sydney, July, 1916 (spores finely warted); Hawkesbury River, May, 1915 (cap $\frac{1}{2}$ inch in diameter, reddish-brown; gills adnexed; stem 1 inch high, moderately stout, solid; flesh pale reddish-brown; spores smooth). Bradley Head, Sydney, May, 1917; Kendall (N.S.W.), May, 1917.

Colour tints noted:—Pileus tan colour, No. 317, Tons 2-4, apex very dark; gills cinnamon, No. 323, Ton 3; spore mass near Ru ochre, No. 314, Ton 1.

17. *Cortinarius (Dermocybe) miltinus*, Fries.: Epicr., p. 287; Cooke: Illustrs., pl. 785A; Massee: Brit. Fung. Flora, ii., p. 65.—We describe specimens collected at Bradley Head, Sydney, in April, 1918, thus:—Pileus up to 2 inches (5 cm.) in diameter, convex, finally upturned and rather wavy, subgibbous, dry, matt, reddish-brown, paler when old. Gills

sinuate, rather ventricose, moderately close, blood-red brown, later more rusty. Stem up to $1\frac{3}{4}$ inches (4·5 cm.) high, moderately slender, sometimes flattened, slightly fibrously streaked, blood-reddish-brown, hollow. Veil reddish-brown. Flesh of cap white over the stem attachment, very thin elsewhere; flesh of the stem reddish-brown peripherally. Spores 7 to $8 \times 4{\cdot}2\ \mu$.

Colour tints noted:—Pileus in places red ochre (red-brown terracotta), No. 332, Ton 1; with tinges in the centre rather more purplish than blood-red brown, No. 337, Ton 2; other parts of the pileus (peripherally) approaching tan colour, No. 317, Ton. 1. Stem at the base approaching garnet brown, No. 164, Ton 1, and also the blood-red brown of the pileus, No. 337, Ton 2. Gills near dark Indian red (red-brown), No. 338, Ton 4; later, from the spores, turning more to mineral brown, No. 339, Ton 2, with touches of cinnamon. Spore mass near hazel, No. 324, Ton 4.

The following appear to be smaller specimens of this species:—Pileus $\frac{5}{8}$ to $1\frac{1}{4}$ inch in diameter, convex, then upturned, sometimes umbonate, dark tanny or yellow-brown, with a lens finely fibrillose, edge turned in. Gills adnate, moderately close or moderately distant, pallid cinnamon to reddish-brown. Remains of a yellow-brown cobweb veil. Stem 1 to 2 inches high, slender, finely striate, white at the top but very soon blood-red from the fibres of the universal veil seen in very young plants covering the cap and stem with blood-red, solid. Spores yellow-brown, (?) finely rough, $8{\cdot}5 \times 5{\cdot}2\ \mu$.

On the ground, North Bridge, Sydney, July, 1916 (Herb., J. B. C., Form. Sp., 211); National Park (N.S.W.), July, 1916.

18. *Cortinarius (Dermocybe) venetus*, Fries.: Epicr., p. 291; Cooke: Illustrs., pl. 833B; Massee: Brit. Fung. Flora, ii., p. 73.—We place the following under *C. venetus*:—Pileus up to 2 inches or more in diameter, convex, usually gibbous, edge turned in, then expanding and irregular, smooth, bright yellow-green to olive-green or brownish-green. Gills broadly adnexed and slightly sinuate, sometimes with a decurrent tooth, moderately close, pale yellow-brown, then cinnamony-yellow, later dark yellow-brown. Stem up to 3 inches high and $\frac{5}{8}$ inch broad, wavy, pallid yellowish or whitish, sometimes reddish-brown below ([?]from veil), fibrillose, solid or with a tendency to be hollow. Flesh white with a pale yellow tint, thin except in the centre; when injured by insects turning reddish-brown. Remains of cobweb veil on the upper part of the stem. Spores smooth, oblique, rather elongated, 8 to $11 \times 5{\cdot}2$ to $7\ \mu$.

Usually in clumps. Under *Casuarina*, Milson Island, Hawkesbury River, June, 1913 (cap noted as slightly sticky when moist, sometimes when old with fibrous dark-brown scales forming a solid patch in the centre; D. I. C., Watercolour No. 27); Mount Wilson (N.S.W.), June, 1915; Lane Cove River, Sydney, June, 1916; Mount Lofty (S.A.), July, 1914 (cap up to $3\frac{1}{4}$ inches in diameter, uniform dark green or olive-green or green-tinged shades of brown, somewhat striate, spores 8·5 to 9 × 5·2 μ).

19. *Cortinarius (Telamonia) austro-evernius*, n. sp. (pl. ix., figs. 5 and 6).—The following seems to be the Australian representative of *C. evernius*:—Pileus up to 2 inches in diameter, convex, then expanded and wavy, finally sometimes upturned and splitting, dull violet with the periphery paler, drying to a pale brown with a slight violet tint or tanny-brown, obscurely striate, not viscid, smooth. Gills adnate, moderately close, not connected by veins, violet-cinnamon becoming browner, drying to a ferruginous brown. Stem up to 3 inches high, slender, solid or slightly hollow above, silky fibrillose, shining, the light being reflected so as to give a somewhat banded appearance, voilet tinted or pallid whitish with traces of violet. Flesh thick in the centre of the cap, then becoming almost suddenly thin, white or violet tinted. Spores very finely rough, 7 to 8·5 × 5·2 to 6 μ. Smell pleasant. Slightly caespitose.

Under bushes. Lane Cove River, Sydney, June, 1916 (Miss P. Clarke, Watercolour No. 110; Herb., J. B. C., Form. Sp., 194); North Bridge, Sydney, June, 1916; National Park (N.S.W.), July, 1916; Bradley Head, Sydney, May, 1917.

The following description of another collection shows the variation in the species:—Pileus $\frac{3}{4}$ inch in diameter, conico-campanulate and broadly and obtusely umbonate, then expanding to $1\frac{1}{2}$ inch in diameter with a slight umbo, not viscid, dull brownish-violet, paler at the periphery. Gills adnate, moderately distant, at first pallid brown with a violet tint, then rusty-cinnamon without violet. Stem 1 inch high, stout, then more slender, white with a pale lilac tint. Whitish fibrillose veil. Flesh of the cap solid in the centre, then thin, violet tinted. No smell. Spores 8·5 × 5·2 to 6·6 μ, occasionally much larger.

Under bushes, Lane Cove River, Sydney, June, 1916 (Miss P. Clarke, Watercolour No. 111; Herb., J. B. C., Form. Sp., 195).

Pileus ad 5 cm. latus, convexus deinde expansus, obscuro-violaceus, exsiccatus pallido-fuscus et leviter violaceus, promiscue striatus, non viscidus, glaber. Lamellae adnatae, aliquanto confertae, violaceo-cinnamoneae, deinde fuscae, exsiccatae ferrugineo-fuscae. Stipes ad 7·5 cm. longus, gracilis, sericeo-fibrillosus, candidus, violaceus aut pallido-violaceo-albidus. Caro albido- et violaceo-colorata. Sporae 7-8·5 × 5·2-6 μ.

Paxillus.

20. *Paxillus aureus, auct.* (?).—Specimens of this species have been kindly identified for us by C. G. Lloyd. Plants collected at Somersby Falls, near Gosford, New South Wales, in May, 1915, we describe as follows:—At first small, orbicular, attached by the back, hymenial surface slightly concave and saucer-like, pale yellow, the gills thick and honeycomb-like, upper-surface white. Finally somewhat flabelliform, 1 inch broad and ¾ inch high, the upper-surface white and matt, laterally attached; gills rather thick, radiating, dividing, connected by numerous wrinkles, buff coloured; on rotten log; spores pale yellowish, elliptical but often irregular, 4 to 4·8 × 3 μ.

Large and handsome specimens (those identified by Lloyd) were found under a fallen log at Wiseman Ferry (N.S.W.) in August, 1915; the spores, borne on tetrasporous basidia, were pale yellowish (?), rod-shaped, 3·5 × 1·5 μ; the dried plants show radiating gills connected by wrinkles, the gills being a rich golden-brown near their bases and dark brown at the distal ends.

21. *Phylloporus rhodozanthus*, (Schw.) Bres.; *Paxillus paradoxus*, (Kalchb.); Cooke: Illustrs., pl. 884; Cooke: Handb. Austr. Fungi, No. 369, fig. 38 (Vict., Q'land.).—From Petch's account (New York State Museum, Rep. of State Botanist, 1908, p. 40) this is a variable species and has been referred to various genera and described under different specific names. The species as met with by us also seems rather variable. The usual form has a relatively short, stout stem and adnato-decurrent gills, but occasional specimens are met with exhibiting longer and more slender stems and deeply decurrent gills. The stems usually show only a trace of brown or reddish-brown. Our usual specimens agree well with Petch's description and the spore measurements with his. Massee, in his British Fungus Flora, gives the spore measurements as 20 to 22 × 7 to 8 μ, which must either be an error or our plants and the American ones belong to a different species.

A composite description of our plant is as follows:—Pileus 2 inches or more in diameter, convex, sometimes distorted, tomentose or villose matt, dark umber to brownish, reddish-brown, pale yellowish-brown or stony-brown. Flesh thick. Gills almost adnate to decurrent, moderately close, sometimes branching and anastomosing, a little wrinkled, apparently not easily separable from the hymenophore, bright canary-yellow to greenish-yellow, often becoming darker spotted when old, with a hand lens seen to be bristling with cystidia. Stem 2 inches, occasionally more, high by ½ inch in diameter above, occasionally long and slender, slightly attenuated downwards, usually stout, rarely flexous, usually central, slightly fibrillose and villous, not scaly, solid, brittle, pale brown and yellowish or reddish-brown just below the gills, sometimes whitish or pallid with a faint brown tint due to punctate points. Spores in the mass greenish-brown, microscopically pale yellowish-green, elongated, somewhat twisted, rather "mummy-shaped" like typical *Boletus* spores, 7·8 to 16 × 3·8 to 5·5 μ, usually about 12 × 5·2 μ. Cystidia acuminate, blunt-topped, 70 × 10·4 to 15 μ. In young specimens, the edge is markedly turned in and the gills may be crenulate and show forking and irregular buttressing folds.

Milson Island, Hawkesbury River, June, 1912, and November, 1914, also April, 1915 (apparently a young specimen with adnate yellow gills, stem 1 inch long, white, attenuated upwards); Neutral Bay, Sydney, April, 1915 (young specimen: pileus 1½ inch across, viscid, dark brown, edge markedly turned in, gills decurrent, vivid pale yellow), and February, 1917 (Miss Clarke, Watercolour No. 145), and March, 1917; Hill Top, Southern Line, February, 1911 and 1917 (E. C.); Leura, Blue Mountains, February, 1911 (T. Steel); Lane Cove River, Sydney, April, 1913 (stem long and slender, gills deeply decurrent, spores 7·8 to 10·4 × 4 μ, the spores distinctly smaller and perhaps paler than in the stouter forms; Miss Clarke, Watercolour No. 144)—all in New South Wales; under bushes, Morphett Vale (S.A.), July, 1914 (a much stouter form).

Colour tints noted:—Pileus hazel, No. 324, Tons 1-4; snuff-brown (deep bistre), No. 303, Ton 2. Gills canary-yellow (yellow-green), No. 17, Ton 4; primrose-yellow, No. 19, Ton 2. Stem snow-white, No. 2 (J. B. C.).

Pileus when fresh snuff-brown, No. 303, Ton 3, shading to dark fawn, No. 307, Ton 3, when dry—also a tendency towards tints of mineral-brown, No. 339, Ton 1. Gills yellow-lake (old gold), No. 33, Ton 1, to yellow-tan colour, No. 315, Ton 1, or yolk-yellow, No. 24, Ton 3; in certain stages approaching yellow cadmium, No. 47, Ton 3. Upper part of stem cream-yellow, No. 30, Ton 2, to amber-yellow, No. 28, Tons, 2, 3 (E. C.).

22. *Paxillus crassus*, Fries.: Epicr., p. 318; Cooke: Illustrs., pl. 877; Massee: Brit. Fung. Flora, ii., p. 11;

Cooke: Handb. Austr. Fungi, No. 370 (Q'land).—We have specimens collected at Port Hacking, near Sydney, in August, 1915, that very closely resemble Cooke's illustration of *P. crassus*, which has been recorded for Queensland. The gills, however, seem more "crowded" than "rather distant." The spores were elongated, of the same shape as in *P. paradoxus*, microscopically greenish-yellow, and 11 to 14 × 4·2 to 5 μ in size (as against 15 to 18 × 7 to 8 μ given by Massee).

23. *Paxillus*, sp.—These specimens, collected by one of us (J. B. C.) at Mount Lofty, South Australia, in May, 1900, resemble the preceding, save that the stem is stouter and they have dried darker. The plants were often very large, with the caps orange-brown to yellow-brown when fresh, the decurrent gills brownish, and the stems solid and whitish. The spores were elongated, "mummy-shaped," like those of *P. paradoxus*, greenish-yellow microscopically, and 12 to 15·5 × 5 μ in size.

24. *Paxillus involutus*, Fries.: Epicr., p. 317; Cooke: Illustrs., pl. 875; Massee: Brit. Fung. Flora, ii., p. 9.—The following resembles a dried specimen of this species from England kindly sent to us by Miss Wakefield, save that the gills have dried a darker brown. The spores also agree. Pileus 3 inches in diameter, slightly convex with the centre slightly depressed, dark brown, matt. Gills dark earthy-brown, moderately close, decurrent. Stem $\frac{3}{4}$ inch high, stout, brownish with fine punctate spots, solid. Flesh turning a little brownish. Spores yellow-brown, not "mummy-shaped," 8 to 9 × 5 μ (English specimens, 7·5 to 10·5 × 5 μ).

Under a tree, National Park, South Australia, April, 1917.

Hebeloma.

25. *Hebeloma crustuliniforme*, Bulliard; Cooke: Illustrs., pl. 507; Massee: Brit. Fung. Flora, ii., p. 176.—The following species, evidently introduced, agrees best with the description of *H. crustuliniforme*:—Pileus up to 3 inches across, irregular, convex then nearly plane, often shiny, biscuit colour or sometimes mouse-brown in the centre, paler towards the periphery, the brown in the centre sometimes appearing as if seen through a fine whitish film. Gills sinuately adnexed, moderately close, pallid fleshy-brown becoming browner, edge finely serrate. Stem up to $2\frac{1}{2}$ inches high, usually stout, sometimes slender, white, somewhat fibrillose, mealy above, stuffed. Spores microscopically dull brown, oblique, one end finely pointed, apparently finely rough ([?]from drying), 11 to 12 × 6 to 7 μ.

Caespitose in large clumps under English oak, chestnut, and other introduced trees, National Park (S.A.), April, 1917.

Hitherto not found under any native trees *(e.g., Eugenia, Eucalyptus)* planted or growing in the neighbourhood. This seems to be the same species that, about twenty years ago, grew in great abundance under *Pinus insignis* at the Parkside Mental Home. It has died out from this situation for many years, in spite of no alteration having occurred in its surroundings. Perhaps the soil became exhausted for it, as is the case in some of the fairy-ring species. The plants have a slight resemblance to the common mushroom, accentuated by the gills having a somewhat flesh-coloured tint, and they have been mistaken for this by persons of little observation. The species is obviously an introduced one, as is evidenced by its clinging to the neighbourhood of introduced trees, but it is remarkable that these should be of several species.

26. *Hebeloma subcollariatum*, Berk. and Br.: Ann. Nat. Hist., n. 1942; Cooke: Illustrs., pl. 506; Massee: Brit. Fung. Flora, ii., p. 175.—We describe our Australian specimens as follows:—Pileus up to 1 inch or more in diameter, hemispherical, then convex, sometimes finally upturned, slightly viscid, pale yellow-brown, sometimes browner on top, when very young edge turned in and closed in by the veil, later with a few mealy flakes, the remains of the veil, and with fragments of the veil round the edge, veil rarely forming an imperfect ring. Gills sinuate-adnate, discoloured a greyish-brown, when dry reddish-brown, $\frac{1}{4}$ inch deep. Flesh of cap white, $\frac{1}{8}$ inch deep. Stem up to $1\frac{3}{4}$ inch high, attenuated downwards, base a little swollen and with abundant fine rooting mycelium, hollow or stuffed, pale brownish, but almost white, finely mealy, when young shaggy from the universal veil. Spores in the mass dark brown, not purplish-brown, microscopically yellowish-brown, usually 12 to 14 × 8·5 μ, sometimes 11 to 17 × 7 to 10·4 μ, occasionally (Manildra specimens) 15·5 to 19 × 10 to 12 μ.

On dung or by roadsides, usually near horse-dung. Sydney, February, March, April; Narrabeen, February, December; Milson Island, Hawkesbury River, June; Orange, November; Manildra, October; Wellington, November; Narromine, May; Narrabri, November; Hill Top, December; Cooma (C. C. Settar), January; Mummulgum, near Casino, December; Byron Bay and Murwillumbah, April—all in New South Wales. Adelaide, July and September.

Colour tints noted:—Pileus honey-yellow, No. 35, Tons 1, 2. Gills in certain lights near otter-brown, No. 354, Ton 1. Spore mass between snuff-brown, No. 303, Ton 1, and chocolate, No. 343, Ton 1.

27. *Hebeloma montanum*, n. sp. (pl. ix., figs. 1 and 2).—Pileus $1\frac{1}{2}$ inch or more in diameter when expanded, convex,

edge at first a little turned in, broadly gibbous, sometimes with a depression around the umbo, rather sticky, yellowish-brown, apex often darker, with scattered brown scales. Veil evident when young, remaining for a while as an appendiculate margin to the pileus. Gills slightly sinuately adnate, moderately crowded, dark cinnamon. Stem up to $2\frac{1}{2}$ inches high, firm, later hollow, fibrously streaked with brown fibrils below, brownish below, paler and mealy above, base a little swollen. Spores dull brown, $7 \times 3{\cdot}6\ \mu$, occasionally $8{\cdot}5 \times 4\ \mu$.

Amongst grass in damp forest, Mount Wilson, Blue Mountains, June, 1915 (Miss Clarke, Watercolour No. 82; Herb., J. B. C., Form. Sp., 127).

Pileus 3 vel 3 + cm. latus, convexus, margine initio paulo involuto, lato-gibbosus, paulo viscidus, flavo-fuscus, apice saepe atro-fusco, squamis dispersis fuscis. Velum initio evidens, deinde appendiculatum. Lamellae minime sinuato-adnatae, paulo confertae, atro-cinnamoneae. Stipes ad 6 cm. altus, firmus, demum tubulosus, deorsum fibrillis fuscis, sursum pallido-fuscus et farinosus, base paulo bulbosus. Sporae fuscae, $7\text{-}8{\cdot}5 \times 3{\cdot}6$ to $4\ \mu$.

Inocybe.

Spores rough or irregular. Cystidia present.

28. *Inocybe asterospora*, Quelet: Bull. Soc. Bot. France, xxvi., p. 50; Cooke: Illustrs., pl. 385; Massee: Brit. Fung. Flora, ii., p. 194.—The following appears to be typical *I. asterospora*, and is a distinctly larger plant than the next species:—Pileus $1\frac{1}{4}$ inch in diameter, convex with a large conical umbo, somewhat golden-brown, fibrillose. Gills adnexed, nearly free, moderately close, cinnamon-brown. Stem $1\frac{1}{4}$ inch high, moderately stout, slightly attenuated upwards, striate, pallid-brown tinted, solid, fibrous. Spores irregularly nodular, $7,\ 8{\cdot}5,\ 8{\cdot}5 \times 7\ \mu$. Cystidia 40×12 to $14\ \mu$.

Mount Lofty, South Australia, April, 1917. We have also collected typical specimens at Bradley Head, Sydney, in April, 1918. In these, the pileus was up to $1\frac{3}{4}$ inch in diameter, the gills were at first dingy pallid-brown and were sinuately adnexed, the stem was $2\frac{1}{2}$ inches high and $\frac{1}{4}$ inch thick and was pallid fleshy-brownish and had a slightly swollen base, whilst the spores measured $8{\cdot}5$ to $10{\cdot}4\ \mu$, and cystidia were present. On crushing, there was a strong seminal smell. We have also collected specimens at Mosman (December and May; formalin specimen) and Suspension Bridge, Sydney, April. (Miss Clarke, Watercolour No. 182.)

The following colour tints were noted:—Pileus near dark chocolate-brown (carob-brown), No. 342, Ton. 1. Stem buff, No. 309, Ton 1. Spore mass chocolate, No. 343, Ton 2.

29. *Inocybe subasterospora*, n. sp. (pl. x., figs. 4 and 5).—The following common species in the Sydney district agrees fairly well with Cooke's illustrations of *I. asterospora*, save that the plants are smaller. It also resembles somewhat Cooke's figures of *I. maritima*. As it seems clearly distinct from the South Australian specimens, we give it a new name which indicates its affinity:—Pileus occasionally up to 1¼ inch in diameter, slightly convex, sometimes depressed, subgibbous to occasionally papillately umbonate, dark brown, occasionally lighter or rusty-brown and often more chestnut at the periphery, usually fibrously streaked and splitting, occasionally more scaly. Gills adnate to adnexed, separating from the stem, moderately crowded, pale milk-coffee coloured, then cinnamon, sometimes with a white edge. Stem up to 1½ inch high, moderately stout, solid, slightly fibrillose, pale brownish, slightly mealy above, base sometimes a little swollen. Spores irregularly knobby, 7 to 9 × 5·2 to 7 μ. Cystidia numerous, ventricose, apices usually knobby, 42 × 17, 47 × 15·5, 50 × 14, 55 × 21·5, 70 × 17 μ, etc.

Sydney district, March to July, October, December; Pittwater, April; Parramatta, July; Milson Island, Hawkesbury River, July, November; Hill Top (E. C.), May; localities not noted (several); locality not stated (stem white but cap dark). (Miss Clarke, Watercolour No. 33; D. I. C., Watercolour No. 63; Herb., J. B. C., Form. Sp., November, 1914).

Pileus interdum ad 3 cm. latus, aliquanto convexus, interdum depressus, subgibbosus, interdum papilloso-umbonatus, fuscus, interdum pallido-fuscus aut ferrugineo-fuscus, vulgo fibratus et fissus, interdum aliquanto squamosus. Lamellae adnatae aut adnexae, stipite secedentes, aliquanto confertae, pallido-cinereo-fuscae, deinde cinnamoneae, interdum marginibus albidis. Stipes ad 3·75 cm. altus, aliquanto crassus, non cavus, aliquanto fibrillosus, pallido-fuscus, in parte superiore aliquanto farinosus, base interdum aliquanto inflato. Sporae nodis irregularibus, 7-9 × 5·2-7 μ. Cystidia ventricosa, apicibus vulgo nodosis, 42 × 17, 47 × 15.5, 50 × 14, 55 × 21·5, 70 × 17 μ, etc.

30. *Inocybe gomphodes*, Kalchb.: Grev., viii., 152, tab. 142, f. 8; Sacc.: Syll., v., 3235; Cooke: Handb. Austr. Fungi, No. 237 (N.S.W.).—The following we believe to be Kalchbrenner's *I. gomphodes*, his figure of which it resembles. In the original description, there is no reference

to the character of the spores or the presence or absence of cystidia:—Pileus up to $1\frac{1}{4}$ inch in diameter, conico-campanulate with the edge turned in, gradually expanding to convex with a large obtuse umbo, then nearly plane on top with an umbo and convex edge, fibrously streaked, cap sometimes splitting when old or the fibres separating and curling up, light brownish-tan. Gills deeply sinuately adnexed, nearly reaching the stem and then ascending so as to be nearly free. Stem 2 inches high, moderately stout, solid, whitish, somewhat mealy. Spores irregular and knobby, 7 to 9 × 4·4 to 5·2 μ. Cystidia ventricose or clavate, apices rough, 52 × 10·4, 42 × 14 μ.

On the ground, Milson Island, Hawkesbury River, November, 1914 (Herb., J. B. C., Form. Sp., 22), and May, 1915.

31. *Inocybe albidipes*, n. sp. (pl. x., fig. 3).—Pileus up to 1 inch in diameter, when young acutely umbonate, later gibbous and nearly plane, light to yellowish-brown, apex darker, silky fibrous or radiately fibrillosely rimose or striate and cracking. Gills moderately close, adnate to adnexed or nearly free, dingy greyish-brown becoming dark cinnamon, edge not white. Stem up to $1\frac{1}{2}$ inch high, rather stout, slightly fibrillose, base swollen or with a marginate bulb, solid, white, or occasionally with a slight yellowish tint. Spores knobby, 7 to 8·5 × 5 μ, 7 μ. Cystidia ventricose with rough apices, 42 to 60 × 14 to 20 μ.

Neutral Bay, May, 1915 (Herb., J. B. C., Form. Sp., 109) and 1916; North Sydney, April, 1915 and 1918; Chatswood, May, 1916 (Miss Clarke, Watercolour No. 97); Mosman, June, 1915, and December, 1916 (Herb., J. B. C., Form. Sp., 262); Lane Cove River, May, 1916—all in the Sydney district.

Colour tints noted:—Pileus dark fawn, No. 307, Ton 1 or paler, apex darker and browner than Ton 4.

Pileus ad 2·5 cm. latus, acute umbonatus, deinde gibbosus et subplanus, fusco-cervinus, apice fuscus, sericeo-fibrosus aut fibrilloso-rimosus. Lamellae subconfertae, adnatae aut adnexae, cinereo-albidae, deinde pallido-fuscae, denique fusco-cinnamoneae. Stipes ad 3·75 cm. altus, subfibrillosus, ad basem bulbosus, solidus, albus aut stramineo-albidus. Sporae verrucosae, 7 to 8·5 × 5 μ, 7 μ. Cystidia ventricosa, apicibus aspris, 42-60 × 14-20 μ.

Spores smooth. Cystidia present.

32. *Inocybe obscura*, Pers.: Syn., p. 347; Cooke: Illustrs., pl. 427; Massee: Brit. Fung. Flora, ii., p. 190.—

We refer the following to this species:—Pileus up to $1\frac{1}{4}$ inch in diameter, slightly convex, slightly umbonate, somewhat streaked to fibrillosely scaly, brownish with a violet tinge to violet-brown. Gills moderately crowded, slightly sinuate to adnexed, pallid smoky-brown, edges finely serrate. Stem $1\frac{1}{2}$ inch high, violet tinted, paler above, base slightly bulbous, solid, stringy. Strong scented, when dry a strong mousey smell; one specimen with a seminal smell when fresh. Spores smooth, brown, 7 to 8·5 × 5·2 μ. Cystidia elongated flask-shaped, rough at the apices, 50 × 12 to 17 μ.

Hawkesbury River, under rocks, November, 1914; Sydney, May, 1915.

33. *Inocybe flocculosa*, Berk.: Engl. Fl., v., p. 97; Cooke: Illustrs., pl. 393; Massee: Brit. Fung. Flora, ii., p. 188; Cooke: Handb. Austr. Fungi, No. 236 (Vict.).—The following descriptions are composite pictures of two groups of specimens, which we at first thought comprised two species, but on careful comparison think should both be referred to *I. flocculosa*. They indicate the variations in individuals of a species which may easily lead to an undue multiplication of specific names.

(a) Pileus up to $\frac{1}{2}$ inch in diameter, conico-campanulate to conico-expanded, slightly umbonate, a tendency to striation, pale straw-brown to dull dark cinnamon-brown, apex sometimes dark reddish-brown and periphery pale yellowish-brown, interwoven fibres round the edge usually forming a just discernible whitish line. Gills slightly sinuately adnexed to just adnexed, moderately close to moderately distant, cinnamon. Stem up to $1\frac{1}{4}$ inch high, slender, slightly bulbous at the base, slightly hollow, stringy, pale brown or the colour of the cap, covered with mealy fibres which often form a white base. Spores smooth, pointed, oblique, sometimes rather triangular, 7 to 9 × 4·5 to 6·6 μ. Cystidia somewhat fusiform, or elongated fusiform, or elongated diamond-shaped or flask-shaped, thick walled, apices rough, 42 to 70 × 8·5 μ, 42 to 63 × 11 to 14·5 μ.

On the ground, often under rocks, shrubs, or banks. Milson Island, Hawkesbury River, May, 1915 (D. I. C., Watercolour No. 52; Herb., J. B. C., Form. Sp., 116); Neutral Bay, Sydney, April, 1915, and May, 1913 and 1916; Lane Cove River, Sydney, May 1915; North Bridge, Sydney, June, 1916.

(b) Pileus $\frac{1}{2}$ inch or a little more in diameter, convex then nearly plane, gibbous or with an acute umbo, fibrously striate, splitting, bistre brown to dark brown. Gills moderately close to moderately distant, adnate, reddish-brown to brown. Stem $\frac{3}{4}$ to 1 inch high, slender, solid, pallid brown

and fibrously streaked and mealy, sometimes with whitish fibrillose scales at the base. Spores pale brown, smooth, oblique, sometimes rather triangular, 6·8 to 8·5 × 5·2 μ. Cystidia numerous, thick walled, ventricose or fusiform, often elongated, 25 to 70 × 8·5 to 17 μ.

Gregarious on the ground. Mount Irvine (N.S.W.), June, 1915; Bumberry (N.S.W.), October, 1916; Mount Lofty (S.A.), July, 1914; Neutral Bay, Sydney, May, 1915 (gills just adnexed, dingy cinnamon, edges white and very finely serrate; Herb., J. B. C., Form. Sp., 105).

Colour tints noted:—Pileus near snuff-brown (deep bistre), No. 303, Ton 1; apex of cap near raw umber, No. 301, Ton 4, periphery shading to pallid.

34. *Inocybe australiensis*, n. sp. (pl. x., fig. 2).—Pileus up to ½ inch in diameter, convex, sometimes somewhat umbonate, covered in a rather echinulate way with dark brown, almost black, projecting fibrous scales, which are wart-like above and more imbricate below. Gills adnexed, crowded, cinnamon or dark brown. Stem 1¼ inch high, pallid brown to dark brown, mealy above, solid, base a little swollen. Spores brown, smooth, oblique, 6 to 7 × 4 to 5 μ. Cystidia numerous, ventricose or narrow ventricose, 42 to 70 × 8·5 to 10·5 μ.

Neutral Bay, Sydney, May, 1915 (Herb., J. B. C., Form. Sp., 106; Chatswood, Sydney, May, 1916 (Miss Clarke, Watercolour No. 96); Sydney.

Pileus ad 1·5 cm. latus, convexus, interdum paulo umbonatus, squamis subnigris fibrosis vestitus. Lamellae adnexae, confertae, cinnamoneae vel atro-fuscae. Stipes 3 cm. altus, pallido-fuscus aut fuscus, sursum farinosus, non tubulosus, base minime bulbosa. Sporae fuscae, glabrae, obliquae, 6-7 × 4-5 μ. Cystidia ventricosa vel angusto-ventricosa, 50-70 × 10·5, 42 × 8·5 μ.

Flammula.

35. *Flammula carbonaria*, Fries.: Syst. Myc., i., p. 252; Cooke: Illustrs., pl. 442; Massee: Brit. Fung. Flora, ii., p. 133.—The following seems best referable to this species, though it is smaller, and has cystidia which are not mentioned in descriptions of the species:—Pileus ½ to 1 inch in diameter, convex, edge turned in when young, dark tan to chestnut, periphery paler, in one collection with a teat-like umbo. Gills adnate, moderately crowded, pallid then dark cinnamon, edge noted as finely toothed in the Dubbo specimens. Stem 1 inch high, whitish to pallid, sometimes with brownish fibrils, stuffed. Taste not bitter. Spores yellow-brown, 6·8 to 8·2 × 3·5 to 5 μ; cystidia fringing the edge of

the gills, acuminate or clavate with rough apices and swollen bases, 43 to 48 × 8·5 to 10·4 μ.

Usually densely caespitose with rooting mycelial strands amongst or near the charcoal of burnt logs. Milson Island, Hawkesbury River, May, 1913, and October and November, 1914; Spring Vale, near Dubbo, July, 1915; Suspension Bridge, Sydney, April, 1915 (cap viscid).

36. *Flammula californica*, Earle.—The following is the original description (the reference we do not know) of this species found in California:—"Gregarious or caespitose, under trees, probably from buried rotten wood; pileus 4-7 cm., expanded, subumbonate, pale ochre-brown, umbo often darker, glabrous, subhygrophanous, margin entire; lamellae subsinuate-decurrent, heterophyllous, crowded, subventricose, pale ochraceous to fusco-ferruginous; spores ferruginous, elliptic, 6-7 × 4 μ; stalk 5-6 cm. × 3-4 mm., subequal, slightly enlarged at apex and base, glabrous above, brown fibrillose below, base white mycelioid, bringing up attached sand and fragments, pale brown, apex yellowish-white, solid; flesh cream coloured, unchanging, taste and smell mild. The glabrous subhygrophanous pileus places this species in the section Udae." The fact that this species was described from America as being found in plantations of Eucalyptus directed our attention specially to it. The form which we refer to a new variety, var. *communis*, we at first thought might be it. Compared with specimens of *F. californica*, kindly forwarded to the National Herbarium by C. F. Baker, and identified by Earle, however, the spores are distinctly larger. Though the spores of the specimens under consideration are somewhat broader and rounder than those of the American *F. californica*, they resemble them closely, and the dry plants appear very similar. Cystidia are common on our species and its varieties, and we found a few in the American plants.

We describe our collection as follows:—Pileus ½ inch in diameter, convex, gibbous, not definitely viscid, centre brown, rest yellowish. Gills adnate, moderately crowded, dull greenish-yellowish. Stem 1 inch high, slender, hollow, fibrillosely striate, pallid yellowish. No taste. Spores almost subspherical or triangular, pale brownish microscopically, 5·2 to 6 × 4 μ. Cystidia ventricose, 40 × 10 μ.

On the ground, Lane Cove River, Sydney, May, 1916.

36A. *Flammula californica*, var. *communis*, var. nov. (pl. xi., figs. 3 and 4).—The following differs, more especially in the distinctly larger spores. It is relatively common in the Sydney district and somewhat variable. Pileus up to 2 inches in diameter, convex, then flattened or upturned, gibbous, viscid when moist, sometimes slightly streaky with fibrils or with a few widely separated scales, dark tan or reddish-brown with a pale yellow-brown periphery, in a very young plant the edge turned in and a fibrillose veil. Gills adnate or sinuate with a slight decurrent tooth, moderately close, yellowish-green or pale yellow-brown, drying dark cinnamon. Stem $\frac{7}{8}$ to 2 inches high, slender, slightly attenuated upwards, slightly hollow, base a little bulbous, fibrous, apex not mealy, clad below with brownish fibrillose scales with white mycelium at the base, yellowish-brown above. Flesh white, becoming yellow (?). No taste. Sometimes gregarious. Spores elliptical, dingy brown microscopically, 7·8 to 9 × 5 to 6·3 μ. Cystidia ventricose with acuminate apices, 50 × 10·5 to 13·8 μ.

Milson Island, Hawkesbury River, July, 1912, and May, 1913 (D. I. C., Watercolour No. 12); Neutral Bay, Sydney, April, 1915 (Miss Clarke, Watercolour No. 58), June, 1914 and 1916, July, 1916; other localities, near Sydney, April to July; Lane Cove River, Sydney, June, 1916 (spores yellow-brown); Brookvale, July, 1916; Terrigal, June, 1914; Hill Top, April, May; Lilyvale (A. A. Hamilton), April, 1912; The Oaks, June, 1914; Leura (T. Steel), February, 1911, and (J. B. C.) June, 1916; Kendall, May, 1917—all in New South Wales. The following are larger forms usually found amongst fallen leaves:—North Bridge, Sydney, June, 1916 (cystidia 42 × 13·8 μ); Sydney, March, 1914, and June, 1916; Lane Cove River, June, 1916; on a stump, Mosman, May, 1916 (cap up to 3 inches across, cystidia 35 to 60 × 14 μ); Lisarow, August, 1916—all in New South Wales.

Colour tints noted:—Centre of pileus madder brown (brownish-terracotta), No. 334, Ton 4, periphery paler. Lamellae straw-yellow, No. 31, Tons 2, 3. When drying, pileus near fawn, No. 308, Ton 1, the centre near Ton 4. The lower part of the stem the same tint but paler, the scales about Ton 3. Lamellae golden-bronze-green, No. 298, Ton 2 (J. B. C.).

Pileus brown-pink, No. 297, Tons 3, 4, to burnt umber, No. 304, Ton 1. Gills snuff-brown, No. 303, Ton 1, to mineral-brown, No. 339, Tons 1, 2. Upper part of stem cream-yellow, No. 30, Ton 2, to amber-yellow, No. 28, Tons 2, 3 (E. C.).

Pileus ad 5 cm. latus, convexus, mox planus aut repandus, gibbosus, interdum viscidus, fuscus, margine pallido-fusco. Lamellae adnatae vel sinuatae et minime decurrentes, paulo confertae, flavo-viridae deinde pallido-flavo-fuscae, exsiccatae cinnamoneae. Stipes ad 5 cm. altus, gracilis, sursum paulo attenuatus, paulo tubulosus, base paulo bulboso, fibrillosus, deorsum squamis fibrillosis fuscis, sursum flavo-fuscus. Sporae ellipticae, fuscae, 7·8-9 × 5-6·3 μ. Cystidia ventricosa, apicibus acuminatis, 50 × 10·5-13·5 μ.

The following form of *Flammula californica*, var. *communis*, seems worthy of separate mention. Pileus up to 1 inch in diameter, convex, then more expanded, slightly umbonate, tanny-brown becoming darker, slightly viscid when young and moist. Gills at first adnate, then slightly adnexed, moderately close, pallid dingy yellowish-brown becoming dingy cinnamon. Stem up to 1 inch high, slender, slightly hollow, slightly striate, whitish flecked with small brownish scales from the veil, which are also seen on the edge of the cap when young. Flesh somewhat dingy. Rather caespitose. Spores tawny, 7 × 4·8 μ. A few flask-shaped cystidia with rough apices, 25 × 12 μ.

On the ground, Mosman, December, 1916 (Herb., J. B. C., Form. Sp., 265).

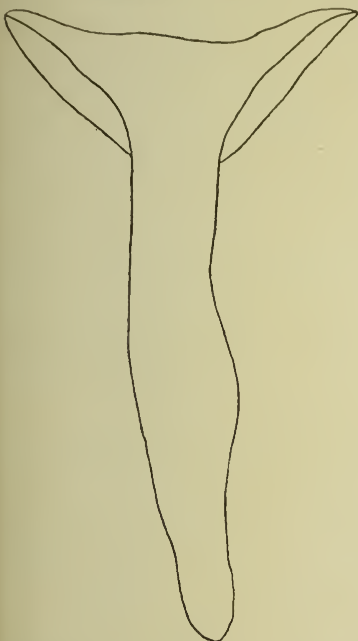
37. *Flammula fusa*, Batsch: f. 189; Cooke: Illustrs., pl. 433; Massee: Brit. Fung. Flora, ii., p. 134; Cooke: Handb. Austr. Fungi, No. 257 (Vict.).—The following seems to be this species. It has a strong resemblance to a large form of our *F. filicea*, but grows on the ground:—Pileus 4 inches in diameter, nearly plane, a little rugose, tanny-brown. Gills adnate with a decurrent tooth, moderately close, bright ferruginous. Stem 2½ inches high, moderately stout, apparently solid, fibrously striate, pallid brownish, with a fusiform root. Flesh yellowish. Spores ferruginous, finely rough (1/12-inch lens), 7 × 5 μ.

On the ground, Lisarow (N.S.W.), December, 1916.

38. *Flammula limonia*, Cke. and Massee: Grev., xv., 94; Sacc.: Syll., v., 3379; Cooke: Handb. Austr. Fungi, No. 259.—This species is recorded by Cooke for "Victoria, Cudgegong River, and Lake Bonney." The following, collected on rich soil at Beaumont, near Adelaide, in September, 1913, and on road-sweepings, Adelaide, in July, 1914, appear to be it:—Pileus up to 4 inches in diameter, hemispherical, then gradually expanded, finally with the edge upturned, when young brownish-yellow, glutinous, finally a pale lemon-yellow, edge sometimes obscurely striate. Gills adnate, ventricose, rather crowded, pallid white becoming greyish with a brown tint, finally when old a dark greyish or earthy brown. Stem up to 3 inches high, whitish or pale yellow, attenuated slightly downwards, sometimes shaggy-scaly towards the base, fibrously rooting below, stuffed in one collection, markedly hollow in another. Veil in one collection leaving ragged remains on the edge of the pileus and on the stem, absent in the other. Occasionally slightly caespitose.

Spores oval, rather elongated, light brown, 14 to 16·5 × 8 to 8·5 μ.

39. *Flammula radicata*, n. sp. (pl. x., fig. 1).—Pileus about 4 inches in diameter, occasionally as much as 9, slightly convex to plane or slightly depressed with irregular depressions and bumps, pallid white to yellowish-tan or dark chestnut, apparently not viscid. Gills adnate to decurrent, moderately crowded, narrow, many short, not branched, easily separating from the hymenophore, pale cinnamon to rich reddish-brown. Stem up to $4\frac{1}{2}$ inches high, stout, $\frac{3}{4}$ to $1\frac{1}{4}$ inch thick, slightly attenuated upwards, slightly bulbous, extending downwards as a long tapering root up to $1\frac{1}{4}$ inch in length or more in large specimens, stuffed, mealy-white with brownish stains or streaky brownish fibrillose. Spores elongated, oblique, 7 to 11 × 5·2 to 6·3 μ, in one specimen 6 to 7 × 3·5 μ.


Flammula radicata, n. sp. Section.

Bursting through the ground and often partly covered with the sandy soil in which the plants are found. Milson Island, Hawkesbury River, under trees amongst leaves, July, 1912; Hawkesbury River, May, 1913 (Miss Clarke, Watercolour No. 16); Bulli Pass, April; The Oaks, June, 1914—all in New South Wales.

Pileus circum 10 cm. interdum ad 23 cm. latus, convexus ad planus aut minime depressus, irregularibus cavis et verrucis, pallido-albus ad fulvo-helvolus aut gilvo-fuscens, non ut videtur viscidus. Lamellae adnatae ad decurrentes, mediocriter confertae, angustae, multae breves, non ramosae, facile ab hymenophora secedentes, pallide cinnamoneae ad vivo-rufofuscae. Stipes ad 12 cm. longus, crassus, 2 ad 3 cm. latus, minime attenuatus sursum, subbulbosus, descendens deorsum radice longe attenuato ad 3 cm. longo vel ultra in magnis specimentibus, farctus, farinoso-albus cum fuscis maculis aut striatulo-fusco-fibrillosus. Sporae elongatae, obliquae, 7 to 11 × 5·2 to 6·3 μ.

40. *Flammula filicea*, Cooke: Seem. Journ. Bot., i., p. 66, pl. iii., fig. 1; Cooke: Illustrs., pl. 450; Massee: Brit. Fung. Flora, ii., p. 142.—We have recorded this species for various localities in New South Wales and South Australia in the Journ. Roy. Soc. N.S. Wales, 1914, p. 434. Further experience emphasizes its variability, and we are inclined to think that it is really only an extreme form of *F. sapinea*, and that many of our specimens might be classified as the latter. Our specimens vary from slender small forms to large stout ones, and the cap from squamulose to villous or nearly smooth. In specimens found at Neutral Bay, Sydney, in February, 1917, the cap had in places a greenish hue, the rest being yellowish-brown with punctate scales, whilst the base of the stem was rather purplish-brown. This type, which is not uncommon, seems to merge into *F. purpurata*, which, we think, may be only a variety of *F. filicea* (or *F. sapinea).* We have the following additional records and dates of *F. filicea*:—Sydney, several localities; Tuggerah; National Park; Kew—all in New South Wales. January, March to July, October.

Colour tints noted:—Pileus sometimes Mars yellow, No. 316, Tons 1, 2. Spores in thick masses very near bistre, No. 328, Ton 4; in thin masses, redder than Ton 1.

Since these notes were written we have had a letter, in answer to enquiries as to the possible relationship of *F. filicea*, *F. purpurata*, and *F. purpureo-nitens* to *F. sapinea*, from Miss E. M. Wakefield, of Kew Herbarium. She has very kindly looked into the matter as far as possible, and writes as follows:—"I think it quite likely that *F. filicea* is only a form of *F. sapinea. F. purpureo-nitens*, however, apart from the difference of colour, seems to have had a perfectly smooth, shining pileus, and also has broader and browner spores. We have no specimen of *F. purpurata*, and I have never seen it; but I have never seen any trace of purple on British specimens of *F. sapinea*."

41. *Flammula purpureo-nitens*, Cooke and Massee: Grev., xv., 94; Sacc.: Syll., v., 3393; Cooke: Handb. Austr. Fungi, No. 266 (Vict., Q'land, W. Austr.).—We have previously recorded from New South Wales *(loc. cit.*, p. 436) what we believe to be this species. It may be only a dark form of *F. filicea*. We have the following from Somersby Falls, near Gosford, New South Wales (May, 1915):—Pileus $\frac{3}{4}$ inch in diameter, convex, slightly fibrous, dark reddish-brown becoming blackish. Gills sinuately adnexed, moderately crowded, reddish-gold, edges darker and

usually finely serrate. Stem $1\frac{1}{4}$ inch high, slightly striate, hollow, dark reddish-brown. Spores finely warty, 8 to $8 \cdot 2 \times 5 \cdot 2\ \mu$. On a fallen log.

42. *Flammula purpurata*, Cooke and Massee: Grev., xviii., p. 73; Cooke: Illustrs., p. 964; Massee: Brit. Fung. Flora, ii., p. 143.—The following *Flammula* (pl. ix., fig. 7) is evidently very close to, if it is not actually, *F. purpurata*. It closely resembles Cooke's illustration. It is also evidently near *F. filicea*, and perhaps the latter and *F. purpurata* are forms of one species:—Pileus $\frac{3}{4}$ inch across, convex, edge turned in when young with remains of the veil, dark madder brown with a tinge of purple, strongly villoso-fibro-scaly, in one specimen the edge of the cap beyond the gills when viewed from the underside against a strong light showing a greenish tinge. Gills close, adnate with a decurrent tooth, pale yellowish drying to a bright ferruginous. Stem 1 inch high, slender to moderately stout, pallid, fibrously striate, no definite trace of a ring. Spores 7 to $8 \times 5 \cdot 2\ \mu$, finely rough under a 1/12-inch lens.

On a rotten stump, Mosman, Sydney, July, 1916 (Miss Clarke, Watercolour No. 130).

43. *Flammula excentrica*, n. sp. (pl. xi., figs. 1 and 2).—The following species, in its bright ferruginous spores and general appearance resembling a *Flammula* but with an excentric stem, has been met with on several occasions:—Pileus up to 4 inches broad and 3 inches from before backwards, convex to nearly plane, rather wavy, at first yellowish-tan and sometimes flecked with minute fibrous scales, finally rich reddish-brown or dark reddish-tan (very dark brown when dry in one specimen), sometimes paler in the centre, surface dull or somewhat villous, moist looking when old. Gills very crowded, at first pale yellowish-cinnamon, finally rich ochreous-brown, almost auburn, reflecting the light, adnate or slightly sinuate with a decurrent tooth. Stem up to 2 inches long, often much less, short, excentric, attenuated downwards, firm, sometimes hollow, brownish or reddish-brown or pale yellowish-brown, fibrous or striate, no collar or ring. Flesh reddish-brown. Spores bright ferruginous, finely rough, 6 to $7 \times 4 \cdot 2$ to $5 \cdot 5\ \mu$, occasionally $8 \cdot 5$ to $12 \times 5 \cdot 2$ to $6\ \mu$.

On fallen logs or attached to buried wood. Neutral Bay, July, 1912 (Miss Clarke, Watercolour No. 1); Terrigal, June, 1914; Milson Island, Hawkesbury River, April, 1915; Ryde, May, 1916; Mosman, October, 1916; attached 3 feet up a *Melaleuca* stump, Lane Cove River, Sydney, June, 1916; Kendall, May, 1917—all in New South Wales.

Colour tints noted:—Pileus when drying approaching Mars yellow, No. 316, Tons 1 and 2, scales darker approaching Ton 3; sometimes neutral orange, No. 319, Ton 1. Lamellae near Roman ochre, No. 327, Ton 1; then raw sienna, No. 329, Tons 2 and 3, in the high lights with darker reflections; in certain lights approaching orange cadmium, No. 49, Tons 1 to 3.

Pileus 10 × 7·5 cm., convexus aut aliquanto planus, flavo-ferrugineus, aliquanto villosus. Lamellae confertae, nitido-flavo-ferrugineae, adnatae aut minime sinuatae. Stipes ad 5 cm. altus vel minus, excentricus, deorsum attenuatus, firmus, fibrillosus, ferrugineo-fuscus. Caro fuscida. Sporae ferrugineae, 6-7, interdum 8·5-12 × 5·2-6 μ.

Bolbitius.

44. *Bolbitius flavidus*, Bolton; *Agaricus flavidus*, Bolton: p. 149, pl. 149; Cooke: Illustrs., p. 689; Massee: Brit. Fung. Flora, ii., p. 204.—We refer the following to this species:—Pileus 1½ inches in diameter, occasionally up to 2¼ inches, when young obliquely conical, then conico-campanulate, finally slightly convex, viscid, when moist sometimes semi-transparent and greyish and apparently striate from the gills showing through, bright yellow with a greenish tint or pale canary-yellow or creamy-white with a suspicion of yellow or pallid brown when old, sometimes almost white. Gills nearly or just free, moderately close, pale becoming brown. Stem 1½ inch high, occasionally up to 3¼ inches, slender, attenuated upwards or slightly attenuated in the middle, hollow, slightly mealy, whitish, sometimes very pale yellowish-white. Partially deliquescing. Spores bright brown, oval with one end slightly flattened, thick walled, 10 to 13·5 × 7 to 10 μ.

On dung and manured ground. Milson Island, Hawkesbury River, April, May, and June, 1913 (D. I. C., Watercolour No. 28); Neutral Bay, Sydney, October and November, 1913, and May, 1914 (D. I. C., Watercolour No. 30); Manly, January, 1915; Mummulgum, near Casino, October, 1916; Adelaide, July, 1914 (cap whitish).

Naucoria.

45. *Naucoria horizontalis*, Bull.: t. 324; Cooke: Illustrs., pl. 601B; Massee: Brit. Fung. Flora, ii., p. 155.—We have recorded this species for New South Wales in Journ. Roy. Soc. N.S. Wales, 1914, p. 436. We describe our Australian specimens as follows:—Pileus usually ¼ to ⅓ inch, occasionally up to ¾ inch, in diameter, convex, sometimes flabelliform

or kidney-shaped, centre sometimes a little depressed or sometimes with a slight acute umbo, later more flattened, faintly striate, villous looking, pale brownish-straw to orangey-brown. Gills adnexed, almost free, moderately distant, crenulate, colour of cap. Stem $\frac{1}{4}$ to $\frac{1}{2}$ inch long, slender, central or a little excentric or sometimes nearly lateral, attenuated downwards, sometimes with some whitish mycelium at the base, slightly brownish. Spores yellow-brown microscopically, oval, 7 to 9 × 5 to 6·5 μ.

On fallen logs or bark of dying Eucalyptus *(E. piperita)*. Neutral Bay, Sydney, March, April, May, July (D. I. C., Watercolour No. 17).

Colour tints noted:—Pileus and gills near brown-pink, No. 297, Ton 1, the gills warmer.

46. *Naucoria semiflexa*, Berk. and Broome: Ann. Nat. Hist., n. 1246; Cooke: Illustrs., pl. 509A; Massee: Brit. Fung. Flora, ii., p. 156.—We refer the following to this species, with Cooke's illustration of which it agrees:—Pileus $\frac{1}{2}$ inch in diameter, convex, waxy-brown flecked with white scales, drying to a pale yellowish-brown. At first the whole plant is covered with a whitish meal and the edge of the pileus is a little turned in; later the meal is left covering the cap and stem. Gills pallid brownish and adnate when very young; then becoming somewhat ventricose and adnexed and reddish-brown to dingy cinnamon, edge finely serrate. Stem about $\frac{1}{2}$ inch long, central, curved from its situation on upright trunks, mealy-white, solid. Spores pale yellow-brown, 8 to 8·5 × 4·5 to 5 μ.

On trunk of a living eucalypt. Bingham Springs, near Bumberry (N.S.W.), September, 1916 (Herb., J. B. C., Form. Sp., 237).

GALERA.

47. *Galera tenera*, Schaeff.: t. 70, f. 6-8; Cooke: Illustrs., pl. 461; Massee: Brit. Fung. Flora, ii., p. 144; Cooke: Handb. Austr. Fungi, No. 284, fig. 26 (Vict., Tas.).—The spores of our specimens are distinctly larger than the measurements given by Massee (12 to 13 × 7 μ) for this species. The stem also seems paler than the descriptions would lead one to infer. We have found the spores of specimens of *G. tenera* from California, identified by Prof. Peck, to measure 13·8 to 15·5 × 8·5 to 10 μ. These seem identical in size and colour with spores from two collections found on or near horse-dung at Adelaide in July, 1914. In these two collections, however, our notes state that the stems are "pallid whitish," and the formalin specimens show likewise stems a little paler than our other specimens. Possibly the Adelaide species is not the same as the New South Wales one,

but if so it is probably the true *G. tenera*. For the present, however, we leave them all under *G. tenera*. We thus describe our specimens:—Pileus $\frac{3}{4}$ to 1 inch broad by $\frac{5}{8}$ inch high, conical, then conico-campanulate, when moist dark watery brown to ferruginous and finely striate, drying from the centre to a pale yellowish-brown or fawny-white and becoming atomate, apex sometimes more rufous when dry, edge not turned in when young, in one collection the cap noted as slightly viscid when young. Gills adnate to just free, ascending, narrow, moderately close, reddish-brown to yellowish-cinnamon. Stem up to 3 inches or more high, slender, wavy, polished, sometimes finely striate, pallid with a rufous tinge to pale brownish with a darker base, sometimes hollow, not rooting. No smell. Spores yellowish-brown, oval, thick walled, 12·5 to 20 × 8 to 11·5 μ.

On dung, occasionally on manured soil or grassy ground. Mosman, Sydney, May; Milson Island, Hawkesbury River, February, April, May, June; Ryde, Sydney, May; Orange, October—all in New South Wales (Miss Clarke, Watercolour No. 23). Adelaide, July.

48. *Galera campanulata*, Massee: Brit. Fung. Flora, ii., p. 145; *G. siligenea*, Fr., in Cooke's Illustrs., pl. 1156.—We refer the following with some doubt to this species. It has been found coming up in grass and lawns, whilst *G. tenera* appears chiefly on dung:—Pileus $\frac{3}{8}$ inch × $\frac{3}{8}$ inch to $\frac{3}{4}$ inch × $\frac{3}{4}$ inch, conical, then expanding to become broadly conical, pale brownish-fawn or pale tan or very pale fawnish-white, apex acute or obtuse, sometimes with a dark-tan umbo, finely striate, in one collection slightly sticky. Gills just adnexed to adnate (one collection), close, narrow, yellowish to reddish-brown or pale fawn. Stem $1\frac{3}{4}$ to 2 inches high, white to whitish, silky, finely striate, base slightly bulbous, attenuated upwards, hollow. Spores 10·5 to (occasionally) 13·8 or 15·5 × 7·3 to 8·5 μ.

Sydney, February and March, 1914; Hawkesbury River, November, 1914 (Miss Clarke, Watercolour No. 40); Adelaide, September, 1913; Neutral Bay, Sydney, December, 1916 (cap apparently not hygrophanous).

The spores of our specimens referred to *G. tenera* are usually distinctly larger than those of this species, whilst in formalin specimens of the two the tinted stem of the former can be easily recognized when compared with the white one of this species.

49. *Galera rubiginosa*, Pers.: Syn., p. 385; Cooke: Illustrs., pl. 464B; Massee: Brit. Fung. Flora, ii. p. 148.—Though the following species (pl. xi., fig. 7) has spores a little broader and, from Cooke's illustration, gills more

broadly attached, it seems undoubtedly to be the Australian representative of *G. rubiginosa*:—Pileus $\frac{3}{8}$ inch broad and high, conico-campanulate, obtusely umbonate, dark chestnut when moist, tan coloured when dry, coarsely ribbed to the umbo. Gills adnate, broad, moderately distant, dark reddish-brown. Stem $1\frac{1}{4}$ inch high, slender, dark brown, slightly hollow. Spores yellow-brown, finely rough under 1-12-inch lens, obliquely oval, 10·5 to 11 × 7·5 μ.

Amongst moss on rocks, Mosman, July, 1916 (Miss Clarke, Watercolour No. 132).

50. *Galera hypnorum*, Batsch: f. 26; Cooke: Illustrs., pl. 465A; Massee: Brit. Fung. Flora, ii., p. 149; Cooke: Handb. Austr. Fungi, No. 286 (Vict., S. Austr.).—Though the following species (pl. xi., fig. 8) has the edge somewhat turned in when young, we nevertheless believe it to be a *Galera* and the Australian representative of *G. hypnorum*:—Pileus $\frac{1}{4}$ inch broad and 5/16 inch high, conico-campanulate, without a definite umbo, dark yellow-brown drying to a pallid tan, striate, edge a little turned in when young so that the cap is nearly globular. Gills moderately distant, ascending, adnate, not ventricose, yellow-brown. Stem up to 1 inch high, slender, yellow-brown. Spores yellow-brown, oval, oblique, showing apparently a narrow flange on each side towards one end, giving the spores a winged appearance, 8 to 9 × 5·2 to 6 μ.

Amongst moss on flat rocks, Mosman, Sydney, July, 1916; amongst moss on fallen trunks, Lisarow (N.S.W.), August, 1916 (Miss Clarke, Watercolour No. 133).

In the Sydney district there are three fairly common species—*G. rubiginosa*, the above *G. hypnorum*, and *Psilocybe musci*—found growing amongst moss, which all somewhat resemble each other and are all hygrophanous. They may be readily distinguished, however, as follows:—*G. rubiginosa* has a darker reddish-brown cap and reddish-brown gills; *G. hypnorum* has a yellow-brown cap, ascending gills less broadly attached than the preceding and yellowish, and the characteristic slightly "winged" spores; *Ps. musci* has a cap of a darker tint than *G. rubiginosa* and usually definitely obtusely umbonate, the darker gills are so broadly attached as to be sometimes slightly decurrent, whilst the spores are a pale porphyry-slate colour under the microscope.

Tubaria.

51. *Tubaria furfuracea*, Pers.: Syn., p. 454; Cooke: Illustrs., pl. 603; Massee: Brit. Fung. Flora, ii., p. 122; Cooke: Handb. Aust. Fungi, No. 288, fig. 20 (Vict., Q'land, Tas., Lake Bonney).—We refer the following to this

species:—Pileus up to 1 inch in diameter, hemispherical or rather campanulate, then convex, centre deeply dimpled, brown or reddish-brown, drying pallid, rugose striate. Gills adnate when quite young, then definitely but slightly decurrent, rather distant, deep, cinnamon to reddish-brown. Stem up to $1\frac{1}{4}$ inch high, slender, a little wavy, dark brown or reddish-brown above and darker below, granular, often with whitish down at the base, slightly hollow. Spores microscopically yellow-brown, 8 to 8·5, occasionally 10 × 5·2 μ.

On the ground, Orange, October, 1916; Manildra, October, 1916—both in New South Wales.

52. *Tubaria inquilina*, Fries.: Syst. Myc., i., p. 264; Cooke: Illustrs., pl. 497; Massee: Brit. Fung. Flora, ii., p. 126; Cooke: Handb. Austr. Fungi, No. 289 (N.S. Wales).—We have some doubt in placing the following under this species:—Pileus up to ½ inch in diameter, convex, flattened atop and slightly umbilicate, coarsely striate, dingy tan, edge not turned in when young. Flesh thin. Gills arcuate, slightly decurrent, deep, moderately distant, many short, pinkish-tan, when dry earthy-brown. Stem a little over 1 inch high, finely mealy, darker brown than the cap. Spores microscopically a very pale dirty dull brown, 8·5 to, occasionally, 10·4 × 5 to 5·5 μ.

On clay soil, Adelaide, July, 1914.

Crepidotus.

53. *Crepidotus mollis*, Schaeffer: t. 213; Cooke: Illustrs., pl. 498; Massee: Brit. Fung. Flora, ii., p. 117; Cooke: Handb. Austr. Fungi, No. 293.—This species has been recorded by Cooke for Victoria and Western Australia, and by ourselves (Journ. Roy. Soc. N.S. Wales, 1914, p. 436) for New South Wales. We describe our Australian specimens as follows:—Pileus up to 1 inch across, occasionally more, convex, fan-shaped, sometimes striate, smooth, white then dingy watery brownish, somewhat hygrophanous, smooth, edge turned in when young. Gills thin to rather thick, moderately close to rather distant, at first pallid and then pale brownish. Laterally attached by a very short almost obsolete downy stem. Spores in the mass snuff-brown (deep bistre), No. 303, Ton 3, obliquely oval, 7 to 8·5 × 4 to 5·2 μ.

On rotten stumps and trunks, Mosman, June, July, October; Terrigal, June (spores 8·5 to 10·4 × 5·5 μ); Lisarow, June, August, December—all in New South Wales.

54. *Crepidotus globigerus*, Berk.: Linn. J., xiii., p. 158; Sacc.: Syll., v., 3610; Cooke: Handb. Austr. Fungi, No. 294 (Vict.).—Our plants agree with the description of this species, to which we refer them. They also, however,

agree perfectly with Peck's dscription of *C. malachius*, B. and C., and with his figure of it (N. York State Mus., Rep. of State Botanist, 1907, p. 139, pl. 112, figs. 1-4). Our plants we thus describe:—Pileus about 1 inch in diameter, occasionally 2 inches broad by 1½ inch from before backwards, edge slightly striate, at first pure white or whitish, then pallid white becoming greyish translucent. Gills pallid becoming dirty greyish-brown, edge finely serrate, moderately distant. Attached by a fluffy white base. Spores dingy brown, thick walled, noted as very finely warted with an oil-immersion lens in one case, spherical, 5·5 to 9 μ.

On fallen logs, Tuggerah, October, 1914; Narrabeen, April, 1915 (Herb., J. B. C., Form. Sp., 61); National Park, July, 1916—all in New South Wales.

55. *Crepidotus salmonicolor*, n. sp.—Pileus up to 2 inches broad and 1¼ inch deep, convex, dull, pale pinkish, laterally attached. Gills moderately distant, many short, rich pinky-salmon becoming more ferruginous. Spores in the mass salmony-brown, microscopically pale brown, pear-shaped, 6·6 × 4·8 μ. On rotten fallen trunk in brush forest. Mummulgum, near Casino (N.S.W.), December, 1916. The colour of the gills and of the shed spores suggests that the plants might belong to *Claudopus*, but the tint in the mass is much browner than, for instance, that of *Pluteus cervinus*, so we refer the species to *Crepidotus*.

Pileus ad 5 cm. latus, 30 mm. crassus, convexus, siccus, pallido-carnosus, a latere adjunctus. Lamellae paulo distantes, multae breves, ferventer incarnatae, mox magis ferrugineae. Sporae in toto salmoni-coloribus-fuscae, per amplificationem pallido-fuscae, piriformes, 6·6 × 4·8 μ.

PURPLE OR PORPHYRY-SPORED AGARICS.

Psalliota.

56. *Psalliota campestris*, (L.); Cooke: Illustrs., pl. 526; Massee: Brit. Fung. Flora, i., p. 410; Cooke: Handb. Austr. Fungi, No. 307 (Vict., Q'land, N.S. Wales, S. Austr., Tas.). —We consider as the typical form of this species, the common variety having when young a smooth pure white cap, pink gills, and a pleasant but not scented smell. It seems widely distributed in pastures throughout Australia, and may be found at almost any period of the year provided weather conditions are favourable. Spores 6·3 to 9 × 4·2 to 5·5 μ, usually 7 to 8 × 5 μ.

We have noted specimens as follows:—Sydney district, January, April; Hawkesbury River, March; Dubbo, June;

Kew, January, May—all in New South Wales; Adelaide, autumn.

Occasionally, especially in shady places, this pure white form has a definite pink tinge in the cap, which is also finely fibrillose. Wet conditions seem to favour this. We have noted this feature several times, and have a specimen collected at Sydney in June—gills rich pink, just reaching the stem, ring distant and single, spores 7·2 × 5 μ.

56A. *Psalliota campestris*, var. *hortensis*, Cooke: Illustrs., pl. 527.—Mushrooms with brownish fibrillose scales on the cap are not uncommon in the Sydney district. The following is the most marked form we have met with. It had not been cultivated:—Pileus up to 4 inches in diameter, densely covered with reddish-brown fibrillose scales. Gills rounded near the stem and just free, pink then purplish-brown. Flesh white, somewhat tinted brownish. Stem 3 inches high, up to ¾ inch thick, with a small cavity, base slightly bulbous. Ring ample, moderately distant. Spores 5·2 × 3·4 μ.

Neutral Bay, Sydney, April, 1915 (Miss Clarke, Watercolour No. 67). Specimens obtained at Milson Island, Hawkesbury River, in January, 1915, had the scales more numerous in the centre and a moderately slender, solid stem; spores usually 5·5 × 3·4 μ, occasionally 6·8 × 3·4 μ.

56B. *Psalliota campestris*, var. *sylvicola*, Vittad.; Cooke: Illustrs., pl. 529; Cooke: Handb. Austr. Fungi, No. 307 (Vict.).—We have several collections of specimens which we believe belong to this variety. The pilei are comparatively smooth and white or pallid whitish, and the stems more or less elongated and bulbous at their bases. The smell is also rather strong. Spores 4·5 to 8 × 2·5 to 5 μ.

Sydney district, various collectors, February, March, June, July, October.

57. *Psalliota arvensis*, var. *villaticus*, Brond; Cooke: Illustrs., pl. 585; Massee: Brit. Fung. Flora, i., p. 413.—We refer the following to this variety, with Cooke's illustration of which it agrees. It appears also to agree fairly well with the description and Cooke's plate of *P. augustus*, Fr., so we may be mistaken in our reference:—Pileus up to 4 inches in diameter, at first rather campanulate, finally slightly convex and wavy, when young covered with small brown scales so as to appear uniformly brown, when adult the brown scales more separated. Gills just about reaching the stem, at first nearly white, then very pale pink, then purplish. Stem 3 inches high, stout, white, mealy, solid. Ring thick, ample. Flesh turning yellowish or reddish-brown when bruised. Smell slightly fragrant and unlike that of *P. campestris*. Spores usually 5·8 × 4 μ, occasionally

$6{\cdot}8 \times 5\ \mu$. Plants when cooked were found to be less palatable than those of *P. campestris*, and had a definite but slight fragrant taste.

On manured soil, Botanic Gardens, Sydney, November, 1916 (Miss Clarke, Watercolour No. 139), July, 1907, and February and March, 1917; Heathcote (E. Lower), May, 1912.

57A. *Psalliota arvensis*, var. *iodoformis*, var. nov. (pl. xii., figs. 1 and 2).—This variety, to which we can find no reference, is characterized by its very strong iodoform smell. When brought into a house, the whole building is filled with this smell, which persists after drying. One of us has eaten specimens without any ill-effects, though the taste was rather unpleasant owing to the partial persistence of the smell. On the other hand, the following experience, for the notes of which we are indebted to Miss C. M. le Plastrier, of Sydney, indicates the need for great caution in tasting such plants:—"*Re* the iodoform-odour agarics. Three of us ate some. The odour was attributed by us not to the mushroom, but to the nurse who was with us at the time (it was during my father's last illness). As soon as we tasted iodoform, we stopped eating, and so did not partake heavily. The effects were a burning in the throat and restlessness. It was at the evening meal they were served, and not one of us (three in all) slept that night, falling off only towards morning. There was in my own case a certain amount of nausea (probably due to imagination). The agarics grew in great abundance in the shade of a large *Schinus molle*, and though they were close to the wire fence of a fowl-yard, and even grew on the other side of the wire, the fowls never touched them, though when I gave them an ordinary agaric they ate it readily."

Pileus 4 inches or more in diameter, campanulate, then convex, sometimes with the centre depressed, smooth, pure white, sometimes with a faint brown tint in places. Gills nearly reaching the stem, rounded, white to pallid, remaining pale for long, then becoming pinkish, finally purplish-brown. Stem up to 5 inches high, slender, often flexuous, base not bulbous but rooting, slightly attenuated downwards, with spongy pith or hollow, silky-white. Ring very marked, not definitely double. Flesh of the stem showing reddish to yellow-orange stains when cut. Strong iodoform smell. Spores 5 to $6{\cdot}3 \times 3{\cdot}5\ \mu$.

Densely caespitose, often in depressions amongst grass. Neutral Bay, Sydney, April, 1913 (Miss C. le Plastrier), March, 1914, and April, 1915 and 1916; Mosman, Sydney, March, 1916; Milson Island, Hawkesbury River, May, 1913; Gordon, Sydney, April, 1916 (C. Wickham). (Miss Clarke, Watercolour No. 77.)

Pileus 10 cm. aut plura latus, campanulatus, mox convexus, interdum centro depresso, levis, clare albus aut umbrinus maculatus. Lamellae confertae, stipiti adnatae, obtusae, albae ad pallidae, diu lividae, mox carnosae, demum purpureo-umbrinae. Stipes ad 12 cm. longus, gracilis, saepe flexuosus, non bulbosus sed radiciformis, sensim attenuatus deorsum, annulo amplo non plane duplici. Sporae 5 to 6·3 × 3·5 μ.

57B. *Psalliota arvensis*, var. *fragrans*, var. nov. (pl. xii., figs. 3 and 4).—We have met with this distinct variety on a number of occasions. It may be readily distinguished from the common field mushroom by slight yellowish stains on the cap, by the pallid colour of the gills when young, and by the definite though slight fragrant smell. Pileus up to 3½ inches in diameter, usually much less, at first hemispherical, then convex, sometimes conical with a depressed centre, sometimes gibbous, smooth, shining, pure white, later with faint rusty or yellowish stains, when bruised turning yellowish. Gills close, free or just reaching the stem, whitish for long, then pallid greyish or pale creamy-pink, finally purplish-brown. Stem 3½ inches high or less, sometimes up to ½ inch thick, slender or stout, slightly hollow or solid, with a pointed root, white, sometimes later with a reddish tint. Texture sometimes tougher than that of *P. campestris*. Slight but definite fragrant smell. Spores sometimes 7 to 8·5 × 4·2 to 5·2 μ, sometimes 5·2 × 3·4 μ; of 11 collections in which the spores were measured, 5 gave the larger size and 5 the smaller, whilst one varied from the higher to the lower: there seem to be no other essential differences between the two.

Milson Island, Hawkesbury River, January, April, May; Sydney, April, December; locality(?), September; Forbes, August; Lisarow, April, May; Bumberry, near Manildra, October; Kendall, May (Miss Clarke, Watercolour No. 158); Byron Bay, April (cap flecked with minute brown scales)—all in New South Wales.

Colour tints noted:—Pileus showing stains of yellow ochre, No. 326, Ton 2. Gills when mature approaching but paler than purple-black, No. 345, Ton 1.

Pileus ad 9 cm. latus, primo hemisphericus mox convexus, levis candidus clare-albus, demum quasi ferrugineus aut flavus maculatus, si contusus flavescens. Lamellae confertae, solutae aut paene solutae, albidae, deinde pallidae, denique pupureo-fuscae. Stipes ad 8·75 cm. latus, albus, tenuis aut crassus, aliquanto cavus aut solidus. Odor aliquanto fragrans. Sporae 7-8 × 4·2-5·2 μ.

58. *Psalliota pratensis*, Schaeff.; *Agaricus pratensis*, Schaeff.: Icon., t. 96; Cooke: Illustrs., pl. 525; Massee: Brit. Fung. Flora, i., p. 414.—We refer the following to this species, though the gills are not rounded behind and the stem is not hollow. Our plants agree well with Cooke's Illustrations:—Pileus up to 4 inches in diameter when mature, at first rather globose and with the centre depressed, finally convex and somewhat umbonate, creamy coloured, clad with fibrillose dark-brown concentric scales, very thick at the disc, giving with the ground-colour a dark grey-scaled appearance to the cap. Gills just reaching the stem, then free, not rounded behind, crowded, narrow, whitish for a long time, then passing through pale pinkish to brown and dark purple-brown. Stem up to $4\frac{1}{2}$ inches high, $\frac{1}{2}$ inch thick, base usually bulbous, smooth or scurfily squamous to the ring, white or tinged faintly reddish, stuffed with downy fibrils. Flesh $\frac{3}{8}$ inch thick. Veil long persistent, finally rupturing to leave a voluminous dependent ragged ring at the junction of the upper $\frac{1}{3}$ or $\frac{1}{4}$ of the stem with the remainder. Spores 5·2 to 5·5 × 3·4 μ, occasionally 6·8 × 3·4 μ. When cooked, the taste resembles that of *P. campestris*.

Milson Island, Hawkesbury River (N.S.W.), January and April, 1915 (Miss Clarke, Watercolour No. 65).

59. *Psalliota elatior*, Cooke and Mass.: Grev. viii., 3; Cooke: Handb. Austr. Fungi, No. 310, fig. 28.—This species is recorded by Cooke (No. 310) for Victoria. We describe our specimens as follows:—Pileus 1 inch or more in diameter, at first convex, then more expanded and covered with pinky-fawn squamules, becoming darker at the gibbous umbo, later reddish-brown from fibrous scales, especially over the umbo, finally slightly upturned and gibbous, blackish-brown and slightly fibrous. Gills free, close, at first pinky-white, then rich pink, finally purplish-brown. Stem up to 2 inches high, slightly attenuated upwards, whitish, fibrillosely streaked, then pinkish-white and smoother, slightly bulbous, slightly hollow. Ring rather distant. Flesh white. The colour partly dissolves in formalin solution to a reddish-brown tint. Spores 5·2 to 5·5 × 3·4 μ.

In a wood, Narrabeen, near Sydney, April, 1915 (Miss Clarke, Watercolour No. 48; Herb., J. B. C., Form. Sp., 48); under *Casuarina*, Suspension Bridge, Sydney, April, 1915; Mosman, Sydney, April, 1915.

Stropharia.

60. *Stropharia obturata*, Fr.; Harper: Trans. Wisc. Acad. of Sci., Arts, etc., xvii., pt. ii., No. 3, plate; Massee:

Brit. Fung. Flora, i., p. 400.—The following, from the decided smaller size of the spores, seems not to be *S. coronilla*, Bull.; *S. melasperma*, Bull.; or *S. bilamellata*, Peck, all of which it somewhat resembles. On its general likeness to the photograph of *S. obturata* given by Harper, and from the description of this species quoted by this author, we at present place it here. The cap is not noted as being "rimosely-squamulose" when fresh, but some of our dried specimens suggest that this was the case:—Pileus up to $2\frac{1}{2}$ inches in diameter, eventually plane or a little upturned, edge turned in, slightly sticky, finely woolly or fibrous, with white fragments of the veil at the edge, reddish-tan or pale brownish with a violet tinge in one collection. Gills slightly sinuately adnate or simply adnate, broad, moderately close, greyish-brown, then browner, purplish-brown when dry. Stem up to $1\frac{3}{4}$ inch high, silky-white, slightly curved, stout, solid, attenuated downwards, with long ramifying white mycelial threads at the base. A marked whitish ring, marked by the gills on its upper-surface, sometimes fragmentary, close to the cap, the stem below the ring with scattered fibrous scales as if from remnants of the veil. Flesh thick, white. Spores dark purplish-brown or purple porphyry, slightly flattened on one side, 6 to 7·5 × 3·4 to 4·8 μ.

On the ground, Neutral Bay, Sydney, May, 1915, and June, 1916 (D. I. C., Watercolour No. 67); Wahroonga (W. B. Stokes), May, 1915; Lisarow, June, 1916—all in New South Wales.

61. *Stropharia stercoraria*, Fries.: Syst. Myc., i., p. 291; Cooke: Illustrs., pl. 538; Massee: Brit. Fung. Flora, i., p. 404.—The chief differences between *S. stercoraria* and *S. semiglobata* seem to consist in the former being larger, having a distinct pith in the stem and having larger spores, whilst *S. semiglobata* has a "persistently hemispherical" cap. Harper (Trans. Wisconsin Acad. of Sc., Arts, and Letters, vol. xvii., 1914, p. 1022) says that *S. stercoraria* is distinguished from *S. semiglobata* by "the more expanded pileus, the stuffed and more floccose stem, the larger size, larger spores, and plane not clouded gills." He adds, however, that these distinctions do not always hold good, and that he has found the spores of *S. semiglobata* as large as any described for *S. stercoraria*. He gives the spores of the former as 13 to 14 × 8 to 9 μ or larger, and of the latter as 16 × 10 μ. The common dung *Stropharia* of Australia seems to be *S. stercoraria*, inasmuch as it is not "persistently hemispherical," but expands, and has spores measuring up to 20 μ or more. The stems, however, are hollow, a characteristic apparently of *S. semiglobata* as compared with "stuffed with

a distinct pith." The gills are also often clouded. We believe that all the specimens we have met with belong to one species, and that this is the *S. semiglobata* recorded in Cooke's Handbook (No. 313) for all the States. Taking everything into consideration, we prefer to place the plants for the present under *S. stercoraria*.

Stems up to 4 inches high, hollow, with whitish pith. Pileus sometimes becoming brown. Spores 14 to 24 × 7 to 12 μ, usually about 16 to 19 × 9 to 10 μ.

On dung. Sydney district, January, March, May, June, July, September, December; Liverpool; Parramatta, March; Milson Island, Hawkesbury River, November; The Oaks, June; Hill Top, July; Leura, February; Bumberry, October; Coonamble; Orange, October, November—all in New South Wales. Adelaide, September.

In the following, the spores are rather smaller:—Narrabeen, December (spores 13 to 14 × 8·5 μ); locality not stated (spores 13·5 to 14·5 × 9 μ); Cowra, June (spores 14·5 to 16 × 9 μ); Mummulgum, near Casino, December (spores 12 to 15·5 × 8 to 8·5 μ, pileus expanding); Gladesville, Sydney (spores 11 to 12 × 7 to 9 μ).

62. *Stropharia umbonatescens*, Peck: N. York State Mus. Rep., 30, p. 41; Harper: Trans. Wisc. Acad., etc., xviii., p. 1023.—The following is the original description by Peck, as quoted by E. T. Harper:—"Pileus at first conical, subacute, then expanded and umbonate, smooth, viscid, yellow, the umbo inclining to reddish. Lamellae plane, broad, at length ventricose, blackish-brown with a slight olivaceous tint. Stem equal, slender, hollow, generally a little paler than the pileus. Spores purplish-brown, almost black, 10 × 15 to 18½ μ. Plant 3 to 4 inches high, pileus 6 to 12 lines broad, dung in pastures." Harper, in reference to his specimens, adds to the above description:—"The plants are very close to *Stropharia mammillata*, Kalch., and probably belong to that species, but the pileus is rather umbonate than papillate, and the spores are elliptical rather than ovate or pyramidal, as in the description of *Stropharia mammillata*."

We refer the following (pl. ix., fig. 8) to *S. umbonatescens*:—Pileus ⅜ to ¾ inch in diameter, conico-convex, then plane, acutely umbonate or papillate, yellowish-brown with apex dark chestnut, very viscid. Gills adnate, moderately distant, dark grey. Stem 3 to 4½ inches high, slender, fibrillosely squamulose below, hollow or partly filled with spongy pith. Ring superior, evanescent. Marked mouldy smell. Spores purplish, elliptical and somewhat oblique or a little flattened on one side, 15·5 to 20 × 8·5 to 11·2 μ.

On horse-dung probably, collected on three occasions in April, May, and June, 1915, Neutral Bay, Sydney (Miss Clarke, Watercolour No. 78; Herb., J. B. C., Form. Sp., 113). Numerous plants were collected on dung on the hills near Beaumont, Adelaide, in April, 1917—these were at first acutely conical and viscid, with the edge of the pileus a little inturned, then convex with an acute umbo, then expanding and reaching $1\frac{1}{4}$ inch in diameter; gills adnate, later with very slight decurrence or seceding, clouded grey, then dingy sooty-brown; the stem was pallid with a slight brown tinge, markedly hollow, with a slight moderately distant black ring; mouldy smell marked; spores 16·5 to 20·5 × 10·5 to 12 μ.

Hypholoma.

63. *Hypholoma fasciculare*, Huds.: Fl. Anglica, p. 615; Cooke: Illustrs., pl. 561; Massee: Brit. Fung. Flora, i., p. 382; Cooke: Handb. Austr. Fungi, No. 315 (Vict., S. Austr., Tas.).—This is a common and characteristic species in the neighbourhood of Sydney, growing in dense clusters at or near the base of old stumps, posts, etc., and frequently emerging from the ground in clumps near buried rotting timber. The yellowish tinge of the edge of the cap and the dull yellowish-green gills with the clustered habit and bitter taste render it easily recognizable.

Sydney district, Parramatta, Hawkesbury River, April to July; Hill Top, March and April; Berowra, June; Kendall, May; Mount Lofty Ranges (S.A.), June. Spores purplish, 6·5 to 8 × 3·5 to 5·2 μ. A few slightly ventricose acuminate cystidia, 35 × 10·5 μ, have occasionally been seen. Several clusters show evidence of a ring on the stem, whilst a collection obtained at Mosman in July, 1915, shows specimens with a very marked persistent ring, technically placing them in the genus *Stropharia*.

64. *Hypholoma elaeodes*, Fries.: Epicr., p. 222; Massee: Brit. Fung. Flora, i., p. 383.—The following, collected on one occasion only, seems to be this species. It agrees with Cooke's Illustrations (which, however, Massee places under *H. fascicularis*):—Pileus up to 1 inch in diameter, convex, slightly gibbous, tanny-yellow, remains of veil at the edge. Gills slightly sinuate, close, colour of cap, then becoming more umber. Stem 1 inch high, slender, mealy-white with tinges of brown shining through, fibrously streaked. Flesh yellow. Taste bitter. Spores porphyry coloured, 7 × 3·8 μ. No cystidia seen.

Caespitose at the root of a stump. Leura, Blue Mountains, June, 1916 (Miss Clarke, Watercolour No. 119).

65. *Hypholoma sublateritium*, Schaeff.: t. 49; Cooke: Illustrs., pl. 557; Massee: Brit. Fung. Flora, i., p. 380.—The following plants, collected on a fallen log at Mount Wilson, Blue Mountains, in June, 1915, seem to belong to this species rather than to *H. fasciculare*:—Pileus 2½ inches in diameter, orange-brown, yellowish towards the edge, convex, then expanded. Gills dirty yellowish-green, sinuate. Stem up to 4 inches long, markedly attenuated downwards, white above, then stained reddish-brown, shining, slightly striate, hollow. Caespitose. Bitter. Spores purplish, 6 to 8·5 × 3·8 to 4·2 μ. No cystidia seen.

66. *Hypholoma perplexum*, Peck; Harper: Trans. Wisc. Acad. of Sciences, Arts, etc., xvii., p. 1148, plate. E. T. Harper quotes Peck's original description as follows:—"Pileus convex or nearly plane, sometimes umbonate, glabrous, reddish or brownish-red, usually yellowish on the margin. Flesh white or whitish. Taste mild. Lamellae thin, close, slightly rounded behind, adnexed, pale yellow becoming tinged with green, finally purplish-brown. Stem rather slender, equal or nearly so, firm, hollow, slightly fibrillose, whitish or yellowish above, reddish-brown below. Spores 3 to 4 × 6 to 8 μ. Pileus, 2·5 to 7 cm. broad. Stem 5 to 7 cm. long, 4 to 8 mm. thick. Generally caespitose. On or about stumps or prostrate trunks of trees in woods or open places. Edible." Harper adds that Peck says that it differs from *Hypholoma sublateritium* in its "smaller size, paler margin of the pileus, somewhat umbonate pileus, mild taste, and paler and more slender stem, which is always hollow, even when young." Harper also states that this plant has usually been considered a form of *H. sublateritium*. From the descriptions Harper gives, it would appear that the gills in *H. perplexum* are "slightly rounded behind, adnexed," whilst in *H. sublateritium* they are "adnate."

The following, collected at Mount Wilson, Blue Mountains, in June, 1915, seems to belong to this species:—Pileus 2 inches in diameter, convex, dark tanny-brown, slightly gibbous. Gills rather sinuately adnexed, moderately close, brown with a greenish tinge. Stem brownish, white mealy fibrils below, base a little swollen, slightly hollow. Flesh yellow. Taste mild. Densely caespitose on a fallen log. Spores purplish-brown, 7 to 7·6 × 3·4 to 4·2 μ. No cystidia seen.

67. *Hypholoma fragile*, Peck: N. York State Mus., Mus. Bull., 131, 1909, p. 22 (pl. v., figs. 1-7).—This species has given us considerable trouble. Though closely resembling the descriptions of *H. appendiculatum* and *H. candolleanum*, it did not seem to be either. Miss E. M. Wakefield, of Kew,

has kindly forwarded us dried specimens of *H. appendiculatum (=H. candolleanum)*, from London. The spores of these are distinctly smaller than those of our plants, being 6 to 7 × 3·5 to 4 μ, whilst our plants in the dry state have less pale caps and a warm brownish tinge in the gills. The spores of plants identified as *H. candolleanum* by G. H. Robinson, and given to us by Mr. C. Brittlebank, of Melbourne, are distinctly much darker microscopically than those of our plants or Miss Wakefield's. The description and figures given by Peck of *H. fragile* seem to fit exactly our species. We quote here Peck's description:—"Pileus thin, fragile, conic or subcampanulate, becoming convex, obtuse or subumbonate, floccose-squamulose when young, with the margin slightly appendiculate with fragments of the veil, glabrous when mature, yellowish, greyish or subochraceous, the centre sometimes a little darker; lamellae thin, narrow, close, adnate, whitish or pallid becoming purplish-brown; stem slender, stuffed or hollow, glabrous or minutely floccose, white; spores 8 to 10 × 4 to 5 μ."

Our species (pl. xi., fig. 5) is common in the neighbourhood of Sydney and at Milson Island, Hawkesbury River, occurring in gardens or on rich soil, sometimes singly and sometimes in large patches. The presence of appendiculate remains of the veil round the edge of the pileus is marked in some specimens, but as a rule is very evanescent. When very young, the plants are convex, pale fawn, margin slightly incurved, showing appendiculate remains of the veil, the surface being covered occasionally with scattered whitish friable warts, also due to the remains of the universal veil. The cap soon expands, remaining somewhat convex and slightly umbonate or being wavy, still showing in some cases scattered punctate granules, and reaches a diameter of 1 to $1\frac{3}{4}$ inches. The centre is brownish-fawn or pallid clay colour, the edge pale fawn, striate. Gills moderately crowded, adnate, whitish then purplish-brown. Stem $1\frac{1}{2}$ to 2 inches high, rather fragile, slender, pure white, silky striate, perhaps slightly mealy above, hollow. Spores purplish-brown, oval, slightly oblique, 6·8 to 9 × 4 to 5·4 μ.

On the ground, somtimes caespitose. Sydney and Hawkesbury River, February to May, November; Hill Top (N.S.W.), May, 1915. (Miss Clarke, Watercolour No. 34; Herb., J. B. C., Form. Sp., 21).

Psilocybe.

68. *Psilocybe sarcocephala*, Fries.: Monogr., i., p. 429; Cooke: Illustrs., pls. 567 and 520; Massee: Brit. Fung. Flora, i., p. 364.—We consider that the following is this

species:—Pileus up to 3 inches in diameter, at first almost hemispherical, when adult convex and a little irregular or slightly dimpled, finally sometimes with the edge upturned and slightly gibbous, reddish-brown to brownish-tan or yellowish-tan on top, paler towards the periphery, sometimes pallid with a brownish tint all over, slightly viscid when moist, smooth to slightly fibrillose. Occasionally a fibrous veil is seen when young, leaving fibres on the lower part of the stem. Gills slightly but definitely sinuate, broadly adnexed, occasionally adnate, moderately close, at first nearly white, then pallid salmony, then almost a mushroom tint but not so bright, finally browny-salmon, sometimes spotted brown. Stem 3 inches high, $\frac{1}{4}$ to $\frac{1}{2}$ inch thick, stout to slender, white, mealy above, slightly fibrillose, base a little thickened, solid (noted as hollow in one collection). Flesh white, moist looking. Slight mushroomy smell. Caespitose or gregarious. Spores in the mass dull vinus brown, microscopically dull brown with a vinous tinge, oblique, one end more pointed, 8·5 to 9 × 4 to 5·5 μ, occasionally 13·5 × 5·5 μ.

On the ground. Hawkesbury River, July, 1912 (Miss Clarke, Watercolour No. 6), and May, 1913; Terrigal, June, 1914; on an old camp site under bushes, Lane Cove River, Sydney, June, 1916; The Spit, Sydney, July, 1916; Brookvale, July, 1916; National Park, July, 1916—all in New South Wales.

69. *Psilocybe bullacea*, Bulliard; Champ.: t. 566, f. 2; Cooke: Illustrs., pl. 608B; Massee: Brit. Fung. Flora, i., 370.—We have previously recorded this species for New South Wales and Adelaide (Journ. Roy. Soc. N.S. Wales, 1914, p. 438). We have the following additional localities or dates:—Orange, November; Sydney, March, June, July; Milson Island, Hawkesbury River, May; (?) this species, Walcha, July—all in New South Wales. Adelaide, September.

70. *Psilocybe musci*, n. sp. (pl. x., fig. 7).—Pileus $\frac{1}{4}$ inch across and $\frac{1}{4}$ inch high, conical or convex with a marked obtuse umbo, becoming nearly plane and $\frac{3}{8}$ inch across, hygrophanous, umbo a waxy yellow-brown, the rest dark brownish and striate or rugose, drying from the apex to a pallid brownish-white or tan, slightly viscid when moist, edge turned in when very young and closed with a veil, which occasionally leaves a slight ring on the stems in older specimens. Gills rather distant, broad, greyish-brown to dingy dark brown, adnate to slightly decurrent. Stem up to $1\frac{1}{4}$ inch high, slender, pallid brownish, somewhat silky striate, hollow. Plant rather tough, not fragile. Spores porphyry tinted, 7·5 to 9, and occasionally 10·5, × 5 to occasionally 6 μ.

Gregarious amongst moss on rocks in shady places. Sackville Reach, Hawkesbury River, August, 1915; Mosman, North Bridge, and The Spit, Sydney, June and July, 1916 (Miss Clarke, Watercolour No. 134; Herb., J. B. C., Form. Sps., 157, 230). This species appears to be allied to *P. bullacea*.

Pileus ·6 cm. latus, conicus aut convexus, obtuse umbonatus, deinde paene planus, hygrophanus, fuscus, postquam sicco pallido-fuscus, striatus aut rugosus. Lamellae aliquanto distantes, fuscae, adnatae aut aliquanto decurrentes. Stipes ad 3 cm. longus, tenuis, pallido-fuscus, aliquanto sericeo-striatus, aliquanto cavus. Sporae porphyraceo-coloratae, 7·5-9, interdum 10·5 × 5-6 μ.

71. *Psilocybe foenisecii*, Persoon: Icon. Descr., t. 11, f. 1; Cooke: Illustrs., pl. 590; Massee: Brit. Fung. Flora, i., p. 377; Cooke: Handb. Austr. Fungi, No. 323 (Lake Bonney).—The following, which is found growing on dung in Australia, resembles Cooke's illustration of this species and the description of it. Compared with identified specimens kindly sent to us from England by Miss Wakefield, though the size of the spores of our plants agree with that (13·8 to 15·5 × 7·5 μ) of the European species, the latter are more of a dark sooty-brown and ours of a purplish or porphyry brown. For the present at least we leave our plants under *P. foenisecii*:—Pileus up to 1½ inch in diameter, usually less, convex to campanulate, then nearly plane, with a small acute umbo, dark brown and striate when moist, drying to a pallid yellowish or brown. Gills moderately crowded, narrow, adnate, sometimes ventricose, greyish-purple to brownish-purple when dry, edges white. Stem 1¾ to 3½ inches high, slender, fibrously striate or finely striate below and mealy above, hollow, pallid brownish or pallid with a rufous tinge, mycelium at the base. Spores in the mass very dark purplish-black, microscopically dark purple-brown or porphyry brown, oblique, elongated, 13 to 15·5 × 7 to 8·5 μ.

On dung. National Park (N.S.W.), July, 1916; The Spit, Sydney, July, 1916; cap not noted as umbonate, gills greyish-brown, sinuate and moderately distant, stem pallid whitish, spores 12 to 13·2 × 7 μ, The Oaks (N.S.W.), June, 1914; cap not noted as umbonate, gills ascending and nearly free, stem whitish, spores 12·5 to 13·8 × 7·5 μ, Terrigal (N.S.W.), June, 1914; Ararat, Victoria, May, 1917 (E. J. Semmens).

72. *Psilocybe atomatoides*, Peck: N. York State Mus., Mus. Bull., 157, 1912, p. 96.—The following is evidently not *Psathyrella atomata*, to which with much doubt we at first referred it. It resembles more the description of Peck's

Psilocybe atomatoides, with which for the present we place it. Peck's description is as follows:—"Pileus thin, fragile, convex or subcampanulate becoming nearly plane, rugosely wrinkled, atomate, slightly and evanescently white floccose, slightly hygrophanous, greyish or ochreous-brown, sometimes with a pinkish tinge, flesh cinereous; lamellae moderately broad, subventricose, rounded behind, adnexed, cinereous becoming dark brown; stem equal, hollow, minutely flocculent when young, pruinose at the top, whitish; spores blackish-brown, 7 to 8 × 4 to 5 μ. Pileus 1·6 to 2·4 mm. broad; stem 3 to 5 cm. long, 2 mm. thick." Our species appears to differ in the gills being more adnate and the stem solid. When young the edge of the cap was "not definitely turned in," which should be the case in *Psilocybe*. We describe our plants as follows:—Pileus $\frac{1}{2}$ to $1\frac{1}{4}$ inch in diameter, conico-campanulate or broadly conical, then campanulate, then more expanded, almost membranaceous, apex pale yellowish-fawn, the rest coarsely plicate and dark umber drying to a pallid brownish, the gills showing through, some shining particles; when young, pale fawny-yellow with glistening particles, striate, edge not definitely turned in. Gills adnate, ascending, broad, moderately distant, grey then purplish-brown, clouded with the spores. Stem $1\frac{1}{2}$ to $2\frac{1}{4}$ inches high, slender, solid, shining, white, slightly brownish below, at first mealy. Tending to dissolve. Spores in the mass very dark purplish-brown (dark neutral tint, No. 346, Tons 1-4), microscopically dark brown, 6·5 to 9 × 4·4 to 5·5 μ.

On the ground amongst leaves, Mosman, Sydney, May.

73. *Psilocybe ceres*, Cooke and Massee: Grev., xvi., 72; Cooke: Handb. Austr. Fungi., No. 324, fig. 31. Previously recorded for Victoria.—This is recorded in Cooke (No. 324) for Victoria. In this work, the spore measurements given are 14 to 16 × 6 to 8 μ. The following is the description of our specimens, whose spores are a little smaller:—Pileus up to $1\frac{1}{4}$ inches broad, convex, then expanded and slightly umbonate, smooth not striate, not viscid, rich orange brick-red or rich scarlet-brick or even approaching the tint of tomatoes, veil separating early and remaining slightly attached to the edge of the pileus. Gills sinuate adnexed, moderately crowded, greyish brown becoming purplish-brown. Stem up to 4 inches long, wavy, slender, reddish-brown below and pale above or colour of the cap but paler, shining, faintly striate, firm and cartilaginous, slightly swollen below and attenuated upwards, strigose at the base, solid, later hollow, when old the flesh of the stem reddish-brown, with mycelium rooting amongst dead leaves. Spores purple-brown, thick-walled, elliptical, 10 to 12 × 5·6 to 7 μ. Occasionally caespitose.

Blue Mountains, May, 1914 (Herb., J. B. C., Form. Sp.); Mosman, Sydney, May, June, amongst fallen leaves (Miss Clarke, Watercolour No. 27); Parramatta, June, 1916 (Miss Clarke, Watercolour No. 118; Herb., J. B. C., Form. Sp., 208).

74. *Psilocybe aggregata*, n. sp. (pl. xii., figs. 5 and 6).—Pileus up to 1 inch across, usually $\frac{3}{4}$ inch, slightly convex becoming flattened, very dark chocolate-brown when moist, drying from the centre to a pale brown, faintly striate. Gills close, adnexed, slightly ventricose, colour of the moist cap. Stem short, $\frac{3}{4}$ inch long, curved, pale brown, semi-transulcent, slightly greyish, silky-fibrous, hollow. Spores in the mass dark purplish, microscopically a dark bronzy-brown, 5·5 × 3·4 μ. Numerous ventricose cystidia, the apices rough, 35 to 40 × 10·5 μ.

In dense masses covering a fallen log. Leura, Blue Mountains, June, 1916 (Miss Clarke, Watercolour No. 122; Herb., J. B. C., Form. Sp., 209).

Pileus ad 2·5 cm. vulgo 1·9 cm. latus, aliquanto convexus, deinde aliquanto planus, nigro-fuscus, postquam sicco pallido-fuscus, aliquanto striatus. Lamellae confertae, adnexae, aliquanto ventricosae, nigro-fuscae. Stipes brevis, 1·9 cm. longus, curvatus, pallido-fuscus, semi-translucidus, aliquanto cinereo-pallidus et sericeo-fibratus, cavus. Sporae nigro-purpureae, 5·5 × 3·4 μ. Cystidia ventricosa, apicibus asperis, 30 to 40 × 10·5 μ.

BLACK-SPORED AGARICS.

Panaeolus.

75. *Panaeolus ovatus*, Cooke and Massee: Grev., xviii., 4; Cooke: Handb. Austr. Fungi, No. 332; Cleland and Cheel: Journ. Roy. Soc. N.S. Wales, xlviii., p. 439. Previously reported for Victoria and New South Wales.—We have the following additional New South Wales records of this species. We have notes also that, when old, the cap may have a brownish tint and crack into scales.

Sydney district, including Manly and Parramatta, January to April, December; Milson Island, Hawkesbury River, January to March; Goulburn, February; Cobar (L. Abrahams), June; Baan Baa, January; Kew, January. On dung, near Adelaide, April, 1917 (stem very slightly hollow).

76. *Panaeolus retirugis*, Fries.: Epicr., p. 235; Cooke: Illustrs., pl. 627; Massee: Brit. Fung. Flora, i., p. 334; Cooke: Handb. Austr. Fungi, No. 336 (Vict.); Cleland and Cheel: Journ. Roy. Soc. N.S. Wales, 1914, p. 439 (N.S.

Wales).—Further specimens have been collected at Neutral Bay, Sydney, in May, 1916; Botanic Gardens, Sydney, April, 1915; and Penshurst, Sydney, January and July, 1910. On dung, National Park (S.A.), April, 1917 (spores 14 to 17 × 8·5 to 10·4 μ).

77. *Panaeolus campanulatus*, (L.) Fries.: Hym. Eur., p. 311; Cooke: Illustrs., pl. 629; Massee: Brit. Fung. Flora, i., p. 336; Cooke: Handb. Austr. Fungi, No. 328 (Vict.); Cleland and Cheel: Journ. Roy. Soc. N.S. Wales, 1914, p. 440 (N.S. Wales).—As indicated in our previous notes, we refer our common dung *Panaeolus* that exhibits a shining cap to this species (probably). We are not sure if, at present, we are not confusing two species under this heading. The following is a composite description of our collections:—When very small pileus cylindrical and closed by the veil, later conical or sugar-loaf, then convex and up to 1 inch broad and ¼ inch high, sometimes somewhat gibbous, when moist pale brownish with a darker edge or pale pinky-fawn or velvety-grey with a fine whitish edge, when dry shining and smooth and smoky-white or brownish. Gills adnate, ascending, narrow, crowded, dark grey. Stem 3 inches high, dirty rufous or brownish, powdery white above, somewhat striate. Spores black or dark neutral tint [Dauthenay, pl. 346 (2)], ventricose with the ends drawn in, 10·4 to 16 (occasionally) × 7 to 10·8 μ.

On dung or manured soil. Sydney district, including Manly, February to July, November; Milson Island, Hawkesbury River, May, July; Hill Top, May, July; Orange, October; The Oaks, June (edges of gills pale); Murwillumbah, April (spores rotund, 10·5 × 7 to 7·5 μ, cap not shining when dry); Terrigal, June; Tuggerah, October; Bumberry, September, 1916 (spores 13·8 × 8·5 μ, pileus not shining when dry, edge markedly turned in when young, edges of gills whitish, stem slightly hollow)—all in New South Wales. Adelaide, September, 1913 (pileus silky pale brown breaking into brownish scaly patches with silky greyish-white between or with cobweb-like brownish speckling).

78. *Panaeolus sub-balteatus*, Berk. and Br.: Ann. Nat. Hist., n. 923; Cooke: Illustrs., pl. 631B; Massee: Brit. Fung. Flora, i., p. 337.—The following we refer to this species:—Pileus 1 inch broad, ½ inch high, broadly conico-convex, then convex, obscurely umbonate, mealy, when moist mouse greyish-brown and slightly striate at the edge, when drying a dirty pale brownish-white or stone-white with a dark ring near to but within the edge that fades as drying becomes complete. Gills adnate to adnexed, moderately close, ascending, ventricose, narrow, many short, dark grey or pinkish-brown, edges paler. Stem up to 3 inches high, hollow or

solid, mealy, stringy, slightly silky striate above, pale tanny-brown or pallid flesh colour. Single or subcaespitose, on rich soil or dung or amongst grass. Spores black, the ends constricted, very variable, many swollen, 10·4 to 12, occasionally 13·8 × 7 to 8·5 μ.

Milson Island, Hawkesbury River, November, 1914 (Herb., J. B. C., Form. Sps., 2, 29), and February, 1915; Neutral Bay, Sydney, December, 1914; Botanic Gardens, Sydney; Mummulgum, near Casino, December, 1916—all in New South Wales.

79. *Panaeolus semilanceatus*, Peck: N. York State Mus., Mus. Bull. 131, p. 37.—Peck's description of this species is as follows:—"Pileus thin, conic-ovate, umbonate, greyish-brown; lamellae ascending, black when mature; stem slender, glabrous, hollow, brown: spores ellipsoid, compressed variable in size, black, 12 to 18 × 8 to 12 μ. Similar to *Psilocybe semilanceata*, Fr., in size and shape, but differing in colour and spore character." We have a common species, growing amongst grass in the Sydney district, that resembles closely dried specimens of *Psilocybe semilanceatus*, kindly sent to us by Miss E. M. Wakefield from England, but differing in the spores being black. It appears to be Peck's species. We describe specimens (pl. xi., fig. 6) as follows:—Pileus about $\frac{3}{8}$ inch high and $\frac{1}{4}$ inch wide or larger, conico-ovate, somewhat acuminate, constricted below and inturned so as sometimes to almost completely hide the gills, always showing some degree of inturning, occasionally slightly sticky, edge slightly striate, pallid greyish-straw, somewhat browner on top, pallid silky when dry, sometimes, according to moisture, showing a greyish band near the edge. Flesh whitish, thick in the centre. Gills ascending, adnate, about $\frac{1}{8}$ inch deep, greyish-black, edge white and very finely toothed. Stem up to $2\frac{3}{4}$ inches high, silky shining, hollow, twisting on section, somewhat cartilaginous and stringy, slightly attenuated downwards, pale brown. Spores dark brown to black, oval, ends pointed, 12 to occasionally 13·8 or 15·5 × 7 to 8·5 μ.

Amongst grass. Cook River, Sydney, March, 1911 (A. A. Hamilton); Botanic Gardens, Sydney. March 1914 (D. I. C., Watercolour No. 35); locality not noted, March, 1916 (Miss Clarke, Watercolour No. 39); Cremorne, Sydney, March, 1914; Milson Island, Hawkesbury River, November, 1914; Narrabeen, February, 1917; Mummulgum, near Casino, December, 1916—all in New South Wales.

Psathyrella.

80. *Psathyrella disseminata*, Pers.: Syn., p. 403; Cooke: Illustrs., pl. 657B; Massee: Brit. Fung. Flora, i., p. 345;

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Cooke: Handb. Austr. Fungi, No. 344 (Vict., Q'land, Tas., W. Austr.).—We describe Australian specimens (pl. x., fig. 6) as follows:—Pileus up to ½ inch broad, conico-campanulate, greyish-brown, ribbed to the top, which is flattened and pallid white, a few shining particles, edge not turned in when young. Gills adnate, moderately distant, dark brown with a purplish tint. Stem 1 inch high or a little more, pure white, silky shining, hollow. Densely gregarious. Spore mass near dark neutral tint, No. 346, Ton 4. Spores dark bronzy-brown microscopically, one end truncate, $7 \times 3{\cdot}8$ to $4{\cdot}2\ \mu$.

At the foot of a fence-post, Murwillumbah, April, 1916 (Herb., J. B. C., Form. Sp., 175); on ground near trunks, Lisarow, June, 1916 (spores 8 to $9 \times 5\ \mu$); Mosman, Sydney, August, 1916 (spores in the mass black, perhaps with a tinge of purple; thin spore-prints greyish-black—Miss Clarke, Watercolour No. 131; Herb., J. B. C., Form. Sp., 247); round stump, Orange, October, 1916 (spores $8{\cdot}5 \times 4\ \mu$); on trunks of *Erythrina*, sp., Botanic Gardens, Sydney; Bexley, Sydney—all in New South Wales. Waterfall Gully, near Adelaide, and National Park (S.A.), April and June, 1917 (spores $7{\cdot}2$ to $9 \times 4{\cdot}2$ to $4{\cdot}8\ \mu$).

DESCRIPTION OF PLATES.

Plate IX.

Fig. 1. *Hebeloma montanum*, n. sp.
,, 2. ,, ,, ,, and spores.
,, 3. *Cortinarius rotundisporus*, n. sp., with spore.
,, 4. ,, ,, ,, section.
,, 5. ,, *austro-evernius*, n. sp., with section and spore.
,, 6. ,, ,,
,, 7. *Flammula purpurata*, Cke. and Massee, with spores.
,, 8. *Stropharia umbonatescens*, Peck, and spore.

Plate X.

Fig. 1. *Flammula radicata*, n. sp., with spore and spore mass.
,, 2. *Inocybe australiensis*, n. sp., with section, cystidium, and spore.
,, 3. ,, *albidipes*, n. sp., with section, cystidium, and spore.
,, 4. ,, *subasterospora*, n. sp., with section, cystidium, and spores.
,, 5. ,, ,, n. sp.
,, 6. *Psathyrella disseminata*, Pers., and spore.
,, 7. *Psilocybe musci*, n. sp., showing moist pileus (dark brown), dry pileus (pallid), section, and spores.

Plate XI.

Fig. 1. *Flammula excentrica*, n. sp.
,, 2. ,, ,, ,, cross section, spores, and spore mass.
,, 3. ,, *californica*, var. *communis*, var. nov.
,, 4. ,, ,, ,, var. nov., cross section, cystidia, and spore.
,, 5. *Hypholoma fragile*, Peck, and spore.
,, 6. *Panaeolus semilanceatus*, Peck.
,, 7. *Galera rubiginosa*, Pers., with section and spore.
,, 8. ,, *hypnorum*, Batsch, with section and spore.

Plate XII.

Fig. 1. *Psalliota arvensis*, var. *iodoformis*, var. nov., with spore and spore mass.
,, 2. ,, ,, ,, ,, var. nov., section.
,, 3. ,, ,, ,, *fragrans*, var. nov.
,, 4. ,, ,, ,, ,, var. nov., section and spore.
,, 5. *Psilocybe aggregata*, n. sp., showing moist pileus (dark), dry pileus (pale), section, spore, and spore mass.
,, 6. ,, ,, n. sp., showing gills and cystidium.

Notes on South Australian Marine Mollusca, with Descriptions of New Species.—Part XVI.

By Jos. C. Verco, M.D. (Lond.), F.R.C.S. (Eng.).

[Read August 8, 1918.]

This paper is a continuation of the series from page 201, of vol. xxxvi., of 1912, and deals with the genera *Cypraea*, *Trivia*, and *Erato*. After enumerating for a species its localities in South Australia, those in Western Australia are given as far north as Fremantle, where I may have taken it. Further, where in the same area I have obtained species not found in South Australia, they have been listed, so as to indicate which pass round Cape Leuwin and which do not.

Cypraea reevei, Sowerby.

Cypraea reevei, Gray: Sowerby's Conch. Illus., 1832, fig. 52, Cat. Cypraeidae, 1837, No. 15; Adcock: Handlist Aquatic Moll. S. Austr., 1893, p. 5, No. 153; Shaw: Proc. Mal. Soc., 1909, vol. viii., p. 302; Verco: Trans. Roy. Soc. S. Austr., 1912, vol. xxxvi., p. 210; Hedley: Jour. Roy. Soc. W. Austr., 1916 (1915), p. 199.

Habitat.—Sowerby (1837) gives Garden Island, mouth of the Swan River, Western Australia.

Taken off Newland Head, Encounter Bay, 20 fathoms, 1 dead; in Backstairs Passage, 20 fathoms, 1 dead; Yankalilla beach (Adcock); Cape Spencer beach (Tate); Corny Point beach, Spencer Gulf; St. Francis Island beach, 1 perfect; 100 fathoms, 90 miles west of Eucla, 3 alive; 72 to 120 fathoms, 120 miles west of Eucla, 1 dead; Hopetoun beach, 2 (A. Parkinson); Esperance beach, 4; Albany beach, 3; Rottnest Island, 3.

When mature the length may be 40 mm. or only 28 mm. The relative width may vary, being 25 mm., with lengths of 36 and 39 mm. Of three taken alive in 100 fathoms one is of a uniform delicate cream colour, one a lavender-grey, and one of a rather deeper tint with four obscure darker transverse bands. The beautiful example from St. Francis Island is of a dark slate colour, with close set antero-posterior lighter lines, 4 faint broad transverse darker bands, and the whole surface finely malleated. Some more solid older specimens are of a light chestnut colour with darker chestnut bands. All have the pink tips front and back.

It is a rare shell in South Australia, and appears not to reach the Victorian boundary, is distinctly more common at the western end of the South Australian coast, and is found as far north as Rottnest. It is taken alive on the beach at Albany, and also in 100 fathoms, so that it has a wide range of depth.

Cypraea angustata, Gmelin.

Cypraea angustata, Gmelin: Syst. Nat., 1790, p. 3421, No. 40; Sowerby: Conch. Illus., 1836, fig. 105; Cat. Cyp., 1837, p. 10, No. 99; Kiener: Coq. Viv., vol. 1, 1845, p. 43, No. 36, pl. xxxv., figs. 2, 2*a*; Reeve: Conch. Icon., vol. iii., 1846, pl. xvii., fig. 91; Angas: Proc. Zool. Soc., 1865, p. 170; Sowerby: Thes. Conch., 1870, p. 30, No. 101, pl. xxviii., figs. 296, 297; Ten. Woods: Proc. Roy. Soc. Tas., 1878 (1877), p. 35; Brazier: Proc. Linn. Soc. N.S. Wales, vol. v., 1881 (1880), p. 499; Adcock: Handlist Aq. Moll. S. Austr., 1893, p. 5, No. 156; Beddome: Proc. Linn. Soc. N.S. Wales, vol. xxii., 1898, p. 568, pl. xxi., figs. 1-3; Pritchard and Gatliff: Proc. Roy. Soc. Vic., vol. xii. (N.S.), 1900 (1899), p. 181; Hedley and May: Records Austr. Mus., vol. vii., No. 2, 1908, p. 111; Hedley: Austr. Assoc. Adv. Sci., 1909, p. 361; Shaw: Proc. Mal. Soc. Lond., vol. viii., 1909, p. 306.

Gmelin gives *hab.* (?); Sowerby, in 1837, South Africa; Kiener, Indian seas and shores of New Holland; Angas gives Guichen Bay, South Australia, and adds, "It is a Tasmanian species, not extending into the South Australian gulfs, where several allied species have their habitat"; Ten. Woods gives "common" in Tasmania; Brazier questions the locality of a specimen from Moreton Bay, or the identification of the shell. But Hedley cites it from Queensland; and Hedley and May record it from 100 fathoms off Cape Pillar, Tasmania.

Sowerby, in his Thesaurus, ventures the opinion that *comptoni*, *declivis*, *piperita*, and *bicolor* are all varieties of *angustata;* while Beddome creates the varieties *subcarnea*, Ancey, *mayi*, and *albata*. Pritchard and Gatliff discuss this question fully, and declare all to be varieties. I have no hesitation in supporting these authors and in confirming Sowerby's further suspicion as to the varietal position of *C. pulicaria*, Reeve. *C. angustata*, Gmelin, the typical ventricose form, is not very common in South Australia, but is most so in the eastern part, as MacDonnell Bay, where occurs the very elegant form figured by Reeve, pl. xvii., fig. 91, covered with a bluish-white enamel. It is found, however, along the whole coastline of South Australia to the west, as far as explored, and at Albany up to 24·5 mm. in length. Like all its varieties it may have several transverse ridges.

C. angustata, Gmelin, var. **comptoni**, Gray.

Cypraea comptoni, Gray: Voy. "Fly," ii., App., 1847, p. 356, pl. i., f. 3; Angas: Proc. Zool. Soc., 1865, p. 170; Brazier: Proc. Zool. Soc., 1872, p. 85; Ten. Woods: Proc. Roy. Soc. Tas., 1878 (1877), p. 35; Adcock: Handlist Aq. Moll. S. Austr., 1893, p. 5, No. 157; Henn: Proc. Linn. Soc. N.S. Wales, vol. xx., 1896, p. 520; Beddome: Proc. Linn. Soc. N.S. Wales, vol. xxii., 1898, p. 568, pl. xxi., figs. 15, 16; Hedley: Journ. Roy. Soc. N.S. Wales, vol. li. (1917), 1918, M. 70.

Habitat.—Gray gives Port Essington; Angas, Port Lincoln, Gulf St. Vincent, and Port Adelaide Creek; Brazier, Twofold Bay, New South Wales, Cape Riche, King George Sound, and north coast of Tasmania; Pritchard and Gatliff, Victoria. It is more common along the South Australian coast than the typical *C. angustata*. It is found alive in rock pools, and has been dredged alive up to 14 fathoms. It may be 21 mm. × 12·5 × 9·5, or reach 27 × 16·5, as at St. Francis Island. Several have been taken at Albany up to 20 mm., but none on the western coast of Western Australia.

C. angustata, Gmelin, var. **declivis,** Sowerby.

Cypraea declivis, Sowerby: Thes. Conch., vol. iv., 1870, p. 31, No. 103, figs. 287, 328*, 329*; Bedodme: Proc. Linn. Soc. N.S. Wales, vol. xxii., 1898, p. 571, pl. xxi., figs. 12-14; Pritchard and Gatliff: Proc. Roy. Soc. Vict., vol. xii. (N.S.), (1899), 1900, p. 184.

Habitat.—Sowerby gives Tasmania; Pritchard and Gatliff, Victoria. The plump ventricose form, with crowded large dark-brown spots along the columellar side, smaller lighter peppered spots all over the dorsum, is found at MacDonnell Bay, 2, 25 mm. × 18 × 13·5; the narrow form, Esperance Bay, 1.

Cypraea angustata, Gm., var. *mayi*, C. E. Beddome: Proc. Linn. Soc. N.S. Wales, vol. xxii., 1898, p. 570, pl. xxi., figs. 4, 5, 6, 7.

Taken at MacDonnell Bay; at Sleaford Bay, 5, up to 26 mm. × 17 × 13·5, and down to 16·5 mm. × 12 × 8·25; also at Venus Bay, up to 29 mm. × 19 × 14·5; at Albany, 7, up to 25 mm.

Cypraea angustata, Gm., var. *subcarnea*, Ancey, C. E. Beddome: Proc. Linn. Soc. N.S. Wales, vol. xxi., 1896, part 3, p. 467; also *op. cit.*, vol. xxii., 1898, p. 571, pl. xxi., figs. 8, 9, 10.

Habitat.—Tasmania (Beddome); Victoria (Pritchard and Gatliff). This is quite rare in South Australia, but is taken in MacDonnell Bay and Lacepede Bay; and one was found at Esperance, in Western Australia.

Cypraea angustata, Gm., var. *albata*, C. E. Beddome: Proc. Linn. Soc. N.S. Wales, vol. xxii., 1898, p. 571, pl. xxi., figs. 11, 11*a*.

His type locality is Derwent River, Tasmania; but he reports a specimen from South Australia. There is a narrow pure white form like an albino—*C. comptoni*, Gray—from MacDonnell Bay and Gulf St. Vincent; also a cream-coloured plumper form without spots or dorsal bands. Others may have small reddish-brown spots on each margin, and others in addition may be dusted with very minute brownish specks. Some have the cream colour slightly tinged with brown, and yet without dots or bands, or have dots only, or faint transverse brown bands in addition. Others may be browner still, with faint brown bands, marginal dots fairly many and distinct or absent, and so merge into *C. subcarnea*.

Cypraea angustata, Gmelin, var. **piperita,** Gray.

Cypraea piperita, Gray: Zool. Journ., vol. i, 1825, p. 498; Sowerby: Conch. Illus., Cyp. Cat., 1837, No. 100, fig. 24, 1832; Menke: Moll. Nov.-Holl., 1843, p. 30; Reeve: Conch. Icon., vol. iii., 1846, pl. xvii., Sp. 87; Angas: Proc. Zool. Soc., 1865, p. 170, and 1867, p. 206; Sowerby: Thes. Conch., vol. iv., 1870, p. 31, No. 104, figs. 285, 286; Ten. Woods: Proc. Roy Soc. Tas., 1878 (1877), p. 35; Tryon: Man. Conch., vol. vii., 1885, p. 189; Adcock: Handlist Aq. Moll. S. Austr., 1893, p. 5, No. 158; Beddome: Proc. Linn. Soc. N.S. Wales, vol. xxii., 1898, p. 574, pl. xxi., figs. 17, 18; Pritchard and Gatliff: Proc. Roy. Soc. Vict. (N.S.), vol. xii., 1900 (1899), p. 184; Tate and May: Proc. Linn. Soc. N.S. Wales, vol. xxvi., 1901, p. 374; Hedley: Proc. Roy. Soc. W. Austr., vol. i., p. 199; Hedley: Proc. Roy. Soc. N.S. Wales, vol. li., Supp., 1918, p. M. 70.

Sowerby, in 1870, first suggested its conspecifity with *C. angustata*, and Pritchard and Gatliff supported him. Woods, Beddome, and Tate and May kept them separate. Hedley unites them, and my examples completely intergrade.

Gray gives its habitat as New Holland; Sowerby as New South Wales; Menke as Western Australia; Angas as Port Lincoln and Port Jackson; Ten. Woods as Tasmania; Pritchard and Gatliff as Victoria.

Taken on the beach at Normanville and American River, Kangaroo Island. Dredged alive in Backstairs Passage in 13, 15, 18, 20, and 23 fathoms; in Gulf St. Vincent in 5 fathoms; in Investigator Strait, 13, 15, and 17 fathoms; and dead but fresh in 25 fathoms off Beachport; also on the beach at Esperance 1, and at Albany 4.

Cypraea angustata, Gmelin, var. **bicolor,** Gaskoin.

Cypraea bicolor, Gaskoin: Proc. Zool. Soc., 1848, p. 91, 92; Angas: Proc. Zool. Soc., 1865, p. 170; Sowerby: Thes. Conch., vol. iv., 1870, p. 31, No. 104, figs. 288, 289, 533; Tryon: Man. Conch., vol. vii., 1885, p. 189; Adcock: Handlist Aq. Moll. S. Austr., 1893, p. 5, No. 159; Beddome: Proc. Linn. Soc. N.S. Wales, vol. xxii., 1898, p. 576; Pritchard and Gatliff: Proc. Roy. Soc. Vict. (N.S.), vol. xii., 1900 (1899), p. 184; Tate and May: Proc. Linn. Soc. N.S. Wales, vol. xxvi., 1901, p. 374.

Sowerby, in 1870, made it a variety of *C. piperita*, Gray; Tryon, Pritchard and Gatliff, and Tate and May correctly concur.

Its habitat was given by Gaskoin as Australia; Angas localized it more definitely at Kangaroo Island and Port Adelaide Creek; Beddome extended it to Tasmania; and Pritchard and Gatliff recorded it from Victoria.

Taken on the beach, Kangaroo Island, Gulf St. Vincent and Spencer Gulf, Fowler Bay (Tate), and Albany 3. Dredged alive in Gulf St. Vincent, 7 fathoms 6, 17 fathoms 3. One is a *facsimile* of Sowerby's fig. 289, a small ventricose form from Miss Saul's collection; others match fig. 533, "Mr Hugh Owen's beautiful shell from South Australia."

Cypraea angustata, Gmelin, var. **pulicaria**, Reeve.

Cypraea pulicaria, Reeve: Proc. Zool. Soc., 1845, p. 23; Conch. Icon., vol. iii., 1846, pl. xvii., Sp. 84; Gaskoin: Proc. Zool. Soc., 1848, p. 97; Sowerby: Thes. Conch., 1870, p. 31, No. 105, pl. xxviii., figs. 290, 291; Tryon: Man. Conch., vol. vii., 1885, p. 189, pl. xvi., figs. 59, 60; Tate and May: Proc. Linn. Soc., vol. xxvi., 1901, p. 445; Hidalgo: Mon. Cyp. Viv., 1907, p. 480; Verco: Trans. Roy. Soc. S. Austr., vol. xxxvi., 1912, p. 210; Hedley: Journ. Roy. Soc. W. Austr., vol. i., 1916, p. 199.

Its habitat was unknown to Reeve and Gaskoin; Sowerby and Tryon give it as Australia; Tate and May deny Tasmania, as affirmed by Paetel; Hidalgo rightly cites Geographe Bay. It has not been recorded from Victoria. E. H. Matthews has 5 worn examples from Corny Point.

Dredged in Gulf St. Vincent or Spencer Gulf, 3; one has the articulated cross bands, and sparse large dots along the sides and over the dorsum; a second has the sparse large dots on the sides and dorsum, and the articulated bands on the left base and side, but on the dorsum the middle two bands have their spots joined by narrow brown bars, while the spots of the anterior and posterior bands become blotches, and the whole surface is finely peppered and reticulated brown. Forty miles west of Eucla, in 100 to 116 fathoms, 1 was dredged alive; 80 miles west, in 80 fathoms, 1 alive, and in 100 fathoms, 2 alive, up to 20 mm.; and 90 miles west, in 100 fathoms, 4 alive, the largest 23·5 mm. long without spots of any kind, one 21 mm. with many spots on the thickened outer lip alone, one of 19 mm. with spots scattered sparsely over the dorsum and sides, none on the base or outer lip, one 19 mm. with spots scattered sparsely over the dorsum, sides, and thickened outer lip.

Esperance 3, one with the middle two rows of spots joined by a brown bar and so grading into *C. bicolor*, but with the numerous side dots coming well over the dorsum. Albany 2, up to 21·5 mm. × 12 × 9·5, typical in shape and ornament, with four equidistant cross bands of articulated squarish brown spots, and numerous smaller rounded dots on both sides, crowded towards the base, and becoming more discrete on the dorsum. Another also typical in shape with spots at both margins, also sparsely scattered over the dorsum; but these are nearly obscured by a very fine general brown reticulation, in which are faintly visible four slightly browner cross lines, due to greater thickness of the reticulation at these places.

Ellensbrook beach 16, ranging from 14·5 mm. × 8 × 6·25 to 20 mm. × 11 × 8·5, yellowish-brown. These all have transverse rows of square spots on the dorsum forming four interrupted or articulated narrow bands, of which the front one is often obsolete or absent, less frequently the back one is obsolete. Besides these there are many rather large brown dots, most numerous and deeply coloured on the thickened outer lip, numerous but more discrete on the left side of the shell, extending upwards to the centre of the dorsum. These are mostly roundish and irregularly scattered, but some tend to be squarish, and even to run in transverse lines between the bands of squarish spots. Rottnest (Mrs. Simpson) 2, up to 16·25 mm.

C. pulicaria seems to be the extreme western variant of *C. angustata*, which is the extreme eastern form, while *comptoni* and *piperita* and *bicolor* are most abundant in the middle southern Australian area. *C. angustata* is more common in Tasmania than elsewhere, and becomes gradually scarcer to the west, while *C. pulicaria* is common on the western coast of Western Australia, is rare on its southern coast, becomes very rare further east, and disappears beyond Kangaroo Island. Shaw says *C. pulicaria*, "on account of its narrower and more elongate form and finer teeth, should be regarded as a good species, and not a variety of *C. angustata*." But in well-marked *C. pulicaria* the teeth vary from 22 to 30 in shells of the same size, and in well-marked *C. angustata-comptoni* they may be just as numerous and as fine, and the shape may be as narrow and long in the latter as in the former. The colour ornament in typically shaped *C. pulicaria* also varies from uniform white through all gradations of the flea-bitten dots, and through the articulated bands and very fine pepperings and fine reticulations into *piperita* and *bicolor*, and so through *comptoni* into *declivis* and *angustata*.

Cypraea friendii, Gray.

Cypraea friendii, Gray: Zool. Miscel., 1831, vol. viii., p. 29; Gray: Descrip. Cat. of Shells, Cyp., 1832, p. 5, No. 32; Menke: Moll. Nov.-Holl., 1843, p. 29; Shaw: Proc. Mal. Journ. Lond., 1909, vol. viii., p. 303; Hedley: Journ. Roy. Soc. W. Austr., vol. i., 1916, p. 199.

Cypraea scottii, Broderip: Zool. Journ., vol. v., 1831, p. 330, pl. xiv., figs. 1-3; Sowerby: Conch. Illus., Cat. Cyp., 1837, Sp. 33, fig. 44, 1832; Kiener: Coq. Viv., vol. i., p. 110, No. 99, 1845, pl. xiv., fig. i., 1843; Reeve: Conch. Icon., vol. iii., 1845, pl. iv., fig. 10; Ten. Woods: Proc. Roy. Soc. Tas., 1878 (1877), p. 35; Tryon: Man. Conch., vol. vii., 1885, p. 176, pl. ix., figs. 29, 30; Adcock: Handlist Aq. Moll. S. Austr., p. 5, No. 154; Tate and May: Proc. Linn. Soc. N.S. Wales, vol. xxvi., 1901, p. 445; Sowerby: Thes. Conch. vol. v., 1870, p. 18, No. 54, figs. 47, 48; Shaw: Proc. Mal. Soc., vol. viii., 1909, p. 303 (gives Gaskoin, not Broderip, as the author).

This shell has generally been referred to as *C. scottii*, Brod., but Gray has priority of publication. Broderip gives as the habitat the Strait of Sunda, near Angia, Java, and Kiener the Moluccas; but Sowerby, in 1837, Garden Island, Swan River. Menke in 1843 confirms this in his "Western Coast of New Holland." Reeve cites not only Swan River for the typical shell, but Port Lincoln for his variety B, which is evidently *C. thersites*, Gaskoin. Ten. Woods writes, "In more than one work it is spoken of as Tasmanian, but I cannot find any trace of this species among cellections." So also Tate and May reject it for Tasmania. It was listed by Adcock for South Australia. Mr. E. H. Matthews has a shell from Yorke Peninsula which was regarded as *C. scottii;* it is a somewhat elongated example of *C. thersites.*

I took it on Bunbury beach. Captain Irvine, of Fremantle, told me that several specimens may somtimes be obtained from the piers of the jetty, apparently feeding on the coral-like incrustations. Tate's collection contained 5 examples ranging up to 81 mm. × 40 × 34 mm. from Geographe Bay. At Esperance Captain Douglas gave me 4 individuals said to have been gathered locally. These were much longer, wider, and higher.

Cypraea friendii, Gray, var. **thersites,** Gaskoin.

Cypraea thersites, Gaskoin: Zool. Proc., 1848, p. 90; Angas (Aricia): Proc. Zool. Soc., 1865, p. 170; Sowerby: Thes. Conch., vol. iv., 1870, p. 18, No. 55, pl. viii., figs. 49, 50; Tryon: Man. Conch., vol. vii., 1885, p. 176, pl. ix., figs. 31. 32; Adcock: Handlist Aq. Moll. S. Austr., 1893, p. 5, No. 155; Verco: Trans. Roy. Soc. S. Austr., vol. xxxvi., 1912, p. 209; Hedley: Journ. Roy. Soc. W. Austr., 1916 (1915), p. 200.

Gaskoin's habitat is "Salt Creek, Yorke Peninsula, South Australia, on clusters of zoophytes at 2-3 fathoms." Angas cites this as "the only place where it has hitherto been found." But Reeve's variety B of *C. scottii* from Port Lincoln is almost certainly this species. It has since been taken in numbers at Black Point, Gulf St. Vincent, and in Hardwicke Bay, Spencer Gulf. One was dredged by me full grown at the entrance to American River, Kangaroo Island, and 2 fragments eroded, in 40 fathoms off Beachport; also in the Great Australian Bight, alive, in 72 and 100 fathoms.

When quite young, up to 25 mm. in length, the shell is thin, pyriform, with a depressed exsert spire, and unicoloured yellow, the spire tinged with brown. Then dark brown spots and splashes up to 2 or 3 mm. in size appear over the anterior third or from the spire to the notch. At 30 mm. the colour becomes light purplish-brown, with two obscure yellowish-white transverse bands about 2 mm. wide, with about two-fourths of the shell between them. At 40 mm. the purplish tint is deeper and the spots are still discrete, or the whole dorsum may be clouded with spots of irregular shape and obscure margins running into or superimposed on one another. At 50 mm. the spots may be nearly effaced, and besides the two pale cross bands the indistinct spots may be seen to form obscure interrupted dark mahogany transverse bands. At 65 mm. the shell has grown more globular, being 50 mm. wide and 40 mm. high; it is still very thin; the outer lip is inflected, slightly convex, 14 mm. wide, and edentulous; the dorsum may have about 6 transverse dark rusty mahogany bands. After this the labrum flattens through callous deposits at the latero-labral margin, and teeth appear along the labral edge and the opposite columellar margin. The labral teeth become more valid and extend slightly over the inferior surface. They seem very often to extend to the extreme outer border, but this is an illusion due to blackish-brown rays, which extend from the border, and become narrow as they approach the teeth. These rays are absent from the columellar side, where round or oval spots are found. The teeth on both sides of the aperture are white or nearly so; also the central part of the base as well, but this varies greatly in degree, in some cases the base is almost wholly dark brown. As a rule the bordering latero-basal callus is nearly black. It may extend in varying degrees over the dorsum, and in some examples the whole dorsal surface may be very dark, producing what is popularly known as "the black cowry."

Reeve's variety B of *C. scottii* from Port Lincoln was evidently the form which Gaskoin subsequently described as *C. thersites*. It is now degraded to a varietal position.

C. friendii from Geographe Bay is a much narrower and lower shell than the South Australian *C. thersites*, and might properly be regarded as a different species, but for the Esperance shells, which relatively are broader and higher than the former, but not proportionately so broad and high as the latter.

The relative measurements are as follow:—

Western Australian Shells.

From Geographe Bay:—

1. 81 mm. × 40 × 34 = 100 × 49·4 × 42.
2. 59 mm. × 33 × 26·5 = 100 × 56 × 45.
3. 73 mm. × 41 × 33 = 100 × 56·2 × 45·2.

From Esperance:— .

4. 94 mm. × 53 × 40 = 100 × 56·4 × 45·75.
5. 86 mm. × 53 × 40 = 100 × 61 × 46·5.
6. 81 mm. × 50 × 40 = 100 × 63 × 50.

South Australian Shells.

1. 75 mm. × 47 × 38 = 100 × 62·66 × 50·66.
2. 69 mm. × 44 × 35·5 = 100 × 63·77 × 51·3.
3. 80 mm. × 52 × 41·5 = 100 × 65 × 51·9.
4. 76 mm. × 50 × 41 = 100 × 66 × 54.
5. 72 mm. × 50 × 41 = 100 × 69·45 × 56·95.
6. 75 mm. × 55 × 42·5 = 100 × 73·3 × 56·6.

From these data it is plain that there is an uninterrupted gradation between the narrow and low form of *C. friendii* to the broadest and highest example of *C. thersites;* and while the narrowest of the former kind and the broadest of the latter are very unlike, the intermediate examples are too alike to be separable, although the author of the Monograph Cyp, in Thes. Conch., vol. iv., 1870, p. 18, writes in reference to them, "The two . . . although curiously allied, differ so much in proportions that they run no risk of being confounded with each other."

No distinctive feature can be found in the number or character of the *teeth*. The labral teeth in *C. thersites* vary from 23 to 28, and in *C. friendii* from 21 to 28; the columellar from 9 to 15, and from 6 to 13. The *spire* in the Geographe Bay specimens is much longer than in South Australian *C. thersites*, but in the Esperance Bay examples it is intermediate. Looking at the shell from above and behind, the ascending posterior *channel* in the Geographe Bay specimen lies well to the right of the spire, and rising above it turns to the left over the spire, whereas in some of the South Australian shells it ascends directly to, and only to the point of the spire. In other examples, however, it turns to the right of the very short spire, while in one of the Esperance shells it goes directly to its apex. So with the *lateral compression* of the shell base in front and its angular deviation to the right, there is the same gradation. The *width of the aperture* is no diagnostic. This is as narrow in the extreme western form as in the extreme eastern, while in the Esperance specimens it is wider. The base is usually very darkly and completely *coloured* in *C. friendii*, while in *C. thersites* it is generally in large part white; but sometimes it is no more completely or darkly coloured in that than in this. Usually the lateral borders are less *callous*, and less deeply blackish-brown in *C. friendii*, but this is not sufficient to specifically separate them. Their specific identity seems certain.

Cypraea armeniaca, Verco. *Cypraea umbilicata*, Sowerby: var. *armeniaca*, n. v.; Verco: Trans. Roy. Soc. S. Austr., vol. xxxvi., 1912, p. 211; Iredale: Proc. Mal. Journ., vol. xi., parts ii. and iii., 1916, p. 93; Hedley: Journ. Roy. Soc. N.S. Wales, vol. li., (1917) 1918, Suppl., p. M. 70.

Iredale proves the name *C. umbilicata*, Sowerby, to be preoccupied by Dillwyn, and renames it *C. hesitata;* so *C. armeniaca* becomes the species name, and *hesitata* the varietal. Though the latter is found to the east of Australia as far north as New South Wales, and is not very uncommon in Tasmania, yet it has not been taken along the southern coast of Victoria or South Australia, nor in my dredging off this coast up to 300 fathoms. *C. armeniaca* was dredged in the Great Australian Bight, somewhere west of Eucla, and therefore in Western Australian waters.

Cypraea caput serpentis, Linne: Syst. Nat., 1758, p. 720; Hedley: Journ. Roy. Soc. W. Austr., vol. i., 1916 (1915), p. 198; Hedley: Proc. Roy. Soc. N.S. Wales, vol. li, Suppl., 1918, p. M. 70.

This is recorded from New South Wales and Queensland, and has been sent to me from Cape Banks, Byron Bay, and Moreton Bay; from Cambridge Gulf, Broome, Carnarvon, Geraldton, and Pelsart Island. I have taken it at Rottnest Island and at Ellensbrook. It was given to me as from Albany, but I did not find it myself when collecting there, and am disposed to think it does not occur there, nor elsewhere along the southern coast of Australia.

Cypraea vitellus, Linne: Syst. Nat., x., 1758, p. 721; Angas: Proc. Zool. Soc., 1867, p. 205; Brazier: Proc. Zool. Soc., 1872, p. 83; Hedley: Journ. Roy. Soc. W. Austr., 1916 (1915), p. 200.

Menke localizes it on the western shore of New Holland; Angas in Port Jackson, Brazier makes Botany Bay its southern limit; Gross' collection has examples from Moreton Bay and North Queensland; Tate's North-west Australia; and I have taken it at Ellensbrook, south of Cape Naturaliste. Two fine specimens were given to me by a gentleman, who had them given to him at Albany, but this locality is probably incorrect; I found none there.

Cypraea helvola, Linne: Syst. Nat., 1758, p. 724; Brazier: Proc. Zool. Soc., 1872, p. 84; Hedley: Austr. Assocn. Adv. Sci., 1909, p. 362; also Journ. Roy. Soc. W. Austr., 1916 (1915), p. 199.

Brazier records it from Bellinger River beaches, New South Wales; Hedley from Queensland. It has been sent to me from Carnarvon, North-west Australia. Brazier cites it from Rowley Shoals, and I have taken it at Ellensbrook. It has not been found on the southern shores.

Cypraea cribraria, Linne: Syst. Nat., 1767, p. 1178; also Gmelin's Edition, Tom. i., pars. vi., 1789, p. 3414, No. 80; Gray: Zool. Journ., vol. iv., 1828, p. 79; Shirley: Proc. Roy. Soc. Q'land, vol. xxiii., 1911 (1910), p. 99.

Gray gives New Holland as its habitat; Shirley cites Moreton Bay. Ellensbrook, west coast of Western Australia, one beach specimen in good condition, colour slightly faded. Hedley, in Jour. Roy. Soc. W. Austr., vol. i., 1916 (1914-1915), p. 199, records *C. fallax*, Smith, Ann. Mag. Nat. Hist. (5), viii., 1881, p. 441, W. Austr.; Tryon, in Man. Conch. 1885, vol. vii., p. 190, writes:—"*C. fallax*, E. A. Smith, is an unfigured variety, credited to Western Australia. It differs from the normal shell in being larger, more pyriform, white spots smaller and less clearly defined; they appear to blend into the fawn colour of the dorsum, which is paler than in *C. cribraria*." My shell is rather less than 1·1 inch, the maximum of *C. cribraria* given by Tryon, and less still than my cabinet specimens of this species, which reach 1·25 inch. The relative sizes of my example, and the largest of these are 27 mm. × 16 × 13 and 30 mm. × 18 × 14·5. Its dimensions, therefore, do not suggest *C. fallax*, nor does the colour ornament, for the spots are typically large, and allowing for some fading of the yellow-brown foundation tint are typically distinct. It seems, therefore, to be a typical *C. cribraria*. It has not been found on the southern shore of Australia.

Trivia australis, Lamarck.

Cypraea australis, Lamarck: Anim. s. Vert., 1822, vol. vii., p. 404; Verco: Trans. Roy. Soc. S. Austr., vol. xxxvi., 1912, p. 215; Hedley: Journ. Roy. Soc. W. Austr., 1916 (1915), p. 200.

It has been taken along the shore of South Australia from MacDonnell Bay to Fowler Bay and on St. Francis Island. It reaches 16 mm. in length, and is well and typically coloured. Dredged off Beachport, 2 in 40 fathoms, up to 11·5 mm., 2 in 110 fathoms, and in 200 fathoms 1 showing colour spots; off Cape Jaffa, in 90 fathoms 1 eroded; off Cape Borda, Kangaroo Island, in 55 fathoms 2 very poor, in 62 fathoms 2 dead, up to 11·5 mm., typically coloured.

In the Great Australian Bight, Federal trawler "Endeavour," 40 miles west of Eucla in 110 to 116 fathoms, 1 recent, translucent, uncoloured; 80 miles west of Eucla in 80 fathoms 2 dead, up to 11 mm., showing colour at the ends; in 81 fathoms 3 recent, coloured on back and ends; 90 miles west of Eucla in 100 fathoms, 1 eroded. Taken on beach at Esperance up to 13·5 mm.; at Albany up to 12 mm.; at Ellensbrook, very many brilliantly coloured; on Rottnest Island up to 11 mm.; Cottesloe beach up to 14 mm.

Trivia globosa, Sowerby. (*Cypraea globosa*, Gray: M.S.S. Descrip. Cat. of Cyp., p. 14, No. 121). Sowerby: Conch. Illus. Cat., Sp. 117, 1837, fig. 34, 1832; Sowerby: Thes. Conch., vol. iv., 1870, p. 47, No. 167, pl. xxxv., figs. 466, 467; Angas: Proc. Zool. Soc., 1871, p. 94; Hedley: Austr. Assoc. Adv. Sci., 1909, p. 362; Shaw: Proc. Mal. Soc., vol. viii., 1909, p. 308.

Dredged by Federal trawler "Endeavour" 40 miles west of Eucla, in Great Australian Bight, in 72 fathoms 1; at 80 miles west in 81 fathoms 1. In King George Sound in 12 to 14 fathoms 3 dead, but in perfect condition, 4 mm., 3 mm., and 2·5 mm. long (Dr. Verco).

Erato bimaculata, Tate

Erato bimaculata, Tate: Adelaide Philos. Soc., 1878, vol. i., p. 88; Tate and May: Proc. Linn. Soc. N.S. Wales, vol. xxvi., 1901, p. 375, pl. xxiii., fig. 6.

Recorded by Tate on the east and west coast of Gulf St. Vincent and on the east coast of Spencer Gulf. Dredged 4 alive in 5 fathoms Gulf St. Vincent; in Backstairs Passage in 17 fathoms 11, in 22 fathoms many dead, 10 quite fresh; off Corny Point, Spencer Gulf, in 30 fathoms 1 dead.

Albany beach 1; off Bunbury, dredged, in 15 fathoms 1 dead; Rottnest Island beach 2, typical (Dr. Verco).

Erato lachryma, Sowerby.

Erato lachryma, Gray: Descrip. Cat., 1832, p. 17; Sowerby: Conch. Illus. Erato, p. 15, Sp. 5, 1837, fig. 48, 1832 (*Lachryma trifasciata*, Humphrey, M.S.S.); Sowerby: Thes. Conch., vol. iii., 1866, p. 82, Sp. 5, figs. 4, 5, 6; Reeve: Conch. Icon., 1865, fig. 9; Tate: Trans. Roy. Soc. S. Austr., 1881, vol. iv., p. 140; Tate and May: Proc. Linn. Soc. N.S. Wales, vol. xxvi., 1901, p. 375; Hedley: Austr. Assoc. Adv. Sci., 1909, p. 362.

Erato denticulata, Pritchard and Gatliff: Proc. Roy. Soc. Vict., vol. xii. (N.S.), 1900, p. 133.

Sowerby's type of 1832 was from New South Wales; in the Thes. Conch. the species was recorded from Japan in 1866. Tate identified it from Fowler Bay (Mrs.

Richards) and Tasmania (Petterd); Pritchard and Gatliff described it as a new species from Victoria; and Hedley listed it for Queensland.

Taken on the beach at Venus Bay, Port Le Hunte, and St. Francis Island, up to 7 mm. long. Dredged dead in Encounter Bay, Backstairs Passage, Gulf St. Vincent and Spencer Gulf, Investigator Strait, from 6 to 22 fathoms, alive in 17, 20, and 22 fathoms Backstairs Passage. Dredged off Beachport in 40 fathoms 4 poor and 3 moderate almost bleached, in 49 fathoms 1 large and quite fresh, in 110 fathoms 13 very poor up to 7 mm., in 150 fathoms 1 very poor, in 200 fathoms 2 poor; off Cape Jaffa in 130 fathoms 2 dead; off Cape Borda in 55 fathoms 33 nearly bleached up to 6·25 mm., 1 dead but fresh; off Neptune Islands in 45 fathoms 3 poor.

Taken on Esperance beach 2; dredged in 35 fathoms off Hopetoun 8 dead; on Albany beach 1; dredged in King George Sound in 12 to 14 fathoms 1 immature dead, and in 35 fathoms 1 broken; on Ellensbrook beach 1 of 7 mm. and 1 of 4·5 mm. in length; on Yallingup beach 6; at Bunbury on the beach 1 of 5·75 mm. length, in 5 fathoms 1 dead, in 22 fathoms 3 dead but fresh (1 immature); Rottnest Island 17 up to 7 mm. long, and typically coloured.

Aborigines of the West Coast of South Australia. Vocabularies and Ethnographical Notes.

By Daisy M. Bates.
(Communicated by J. M. Black).(1)

[Read September 12, 1918.]

The alphabet used to express native words is that of the International Phonetic Association, with slight modifications, and the characters which require explanation are as follow:—

[a] when long [a :] is the English *a* in father; when short the Scottish *a* in "man."
[e] as in "they."
[ɛ] as in bed; when long [ɛ :] as in "there."
[i] as in "pity" [piti]; when long [i :] as in "marine."
[ɔ] as English *o* in "not."
[u] as *oo* in foot; [u :] as in boot.
[ə] as *u* in "turn" or *e* in "wanderer."
[au] and [ai] nearly as *ow* in "now" and *ai* in "aisle."
A long vowel is indicated by the sign [:] placed after it.
[j] = *y* in young. [tj] and [dj] are the sounds heard in English "tune" [tju :n] and "duty" [dju :ti], and must not be confused with English *ch* or *j*, two sounds which are quite unknown in Australian languages.
[η] = *ng* in "singer."
[θ] = *th* in "thin."
[δ] = *th* in "other."
[g] is always pronounced as in "go."

(1) This paper has been entrusted to me by Mrs. Bates, who has been doing philanthropic work among the aborigines at the Wîrilya native camp, near Yalata, and at other places on the West Coast, and has thus had exceptional opportunities for continuing, among natives of South Australia, the valuable observations on language and customs which she has already made with regard to those of Western Australia. My share of the work has been almost wholly confined to transliterating the native words and arranging the vocabulary alphabetically. The language dealt with here is essentially the same as that spoken at Murat Bay, of which I published a short vocabulary in these Transactions, xli., 3-8.—J. M. Black.

The stressed or accented syllable is indicated by the sign [ʹ] placed *before* it, but in order to avoid the necessity of accenting every word, it must be understood that all words which have no mark of stress are accented on the *first* syllable, whether they contain two or more syllables.

Letters and single words in the phonetic alphabet occurring in the ordinary text are placed within square brackets.

Vocabulary of the Wîrongu Language
[wi : roŋu woŋga].

alindjira, north.
aŋgari, eye-brow.
baba, native dog.
bala, baʹlardu, he she. bala ŋarbi, he is lying down.
balʹdjindjir, coachwhip bird.
balgərda, seal.
bandji warlbu, ribs.
bani uldi, come here!
bardjərda, native cat.
barna, long-tailed iguana.
baru, animal food.
bərnbərn bu : lala, bell bird.
bərnda (banda), stone.
bi : larl, pied bell magpie.
bilda, hip; also opossum.
bildabi (contraction of bilda gabi, opossum water), name of a waterhole in the Wookata district.
bi : na, ear.
bi : ra, moon, month.
bi : ri, fingernail.
bi : ria, heat (of sun).
bi : riŋ warlba, sandhill.
birli, water-bearing roots of mallee.
bi : ru bi : run, sacred kingfisher (this is also a sacred bird with the aborigines).
bogun bogun, bell bird.
bu : ka (bu : ga), stinking.
bu : kabi (contraction of bu : ka gabi, stinking water), name of settlement (Bookabie), about 26 miles from Fowler Bay.
bu : kati, boot (from the English word).
bu : lgara, sandalwood tree.
bu : ndi, species of *Acacia*.
bu : ndja, mouse.
bundjin, white-shafted fantail.

bu:ni, bird's nest.
bu:ŋgara, to smell, to stink.
burgu, fog in the upper air.
bu:rəru, small quail.
bu:ri, white stone; also white man's money.
burli, parrot (in general).
burn burn, fruit of native peach.
dalja, to spit.
dauw, edible gum of walduri, a species of *Acacia*.
djaljir, white cutting flint.
djarda, stomach.
djarda u:ndan (ŋu:ndan), empty stomach.
djarlbu, ant-eater.
dje:gi, edible grub.
djilbi, old, grey-headed man.
dji:da, bird (in general).
djildja, calf of leg.
djildjil, warbler (bird).
djilga'mərda, scorpion.
djilɔŋ, grey bell-magpie.
djina, foot, road, track.
djina'arbil, murderer's slippers.
djina'arda, evil spirit, devil.
djina'mildjarn, instep.
djina'djarda, sole of foot (lit. foot-stomach).
djina'bi:ri, toe-nail.
djindu, sun; also a species of mallee.
djindidji, species of *Myoporum*.
djiŋga, evil spirit; spirit of dead native.
djinti, rump.
djindir-djindir, wagtail, shepherd's companion.
djirbə, restless fly-catcher.
dji:rigi, grub of wattle.
dju:dilu, brush kangaroo.
dju:in dju:in, grey-crowned babbler (bird).
dju:li dju:li, bat.
djuŋgu djuŋgu (ðuŋgu ðuŋgu), an edible root.
durdur, soft red ochre.
ðalbundjir, martin, swallow.
ðan ðain, female caterpillar-eater (bird).
ðɛrba, inside, within.
ðu:ban ða, to cover up, bury. ŋaiju ðu'banðana, I have covered it up.
ðu:gur, to dream; long ago, in "dream" or "ancestral times."
ðu:la (du:la), cutting flints of various colours (not white).

δu : lea, little blue penguin.
gabi, water.
gabi ŋal, to drink (lit. to eat water).
garbidji (karbidji), species of wallaby.
garuraŋ, gully.
gibər, gibəra, wild turkey.
gibəra ma ("turkey food"), *Anguillaria dioica* (a small Liliaceous plant).
girgiru, hawk (in general).
gu : balu, club.
gu : dji gu : dji, dust storm.
gu : jana, "native gooseberry."
gu : ma, one.
gu : mba'lɛ : ra, whirlwind, duststorm.
gu : mbu, to urinate.
gu : mbaru, urinating.
gu : na, to void excrement.
gu : nan, elbow.
gu : njaru, thirsty.
gu : ndji, fly; gu : ndji gu : ndji, lots of flies.
gu : rarduŋal, to drink plenty.
gwa, yes.
i : rbil, hail.
jadu, good.
jalgundu, edible grub.
jagala, red mallee.
jailbuiŋ, cloud.
jambadu, far away.
janguna, white cockatoo.
jaŋgu u : ldin, going to sleep.
jara, tooth.
jari, arm.
jau, seagull.
ji : bi, breasts.
jilgi, bed (made of leaves, grass, etc.).
jini, name.
ji : ra, mouth.
ji : rgili, genuine name of Eucla.
joo, bough of a tree.
ju : ldilŋa, genuine name of Ooldea.
ju : jan (nju : jan), spear made from tree root and bartered from the district where it was obtained (north-east of Laverton, W.A.), along the edge of the Nullarbor Plains, towards Penong.
ju : ŋgu, to give.
ju : ri, to hear.
kabulu, kidney.

kadji, spear (in general).
kagalɔŋ (kɔgalɔg), cockatoo (in general).
kagu, white edible root.
kala, fire.
kala'warda, firewood.
kala'djirdjir, black-breasted plover.
'kalaia (kalia), emu.
'kalaia 'malδara, murderer's slippers, made of emu feathers and hairstring.
'kalbərdi, to break.
kalbin, mallee hen.
kalda, stumpy-tailed lizard.
kalga, Venus (star).
kalgula, an edible fruit.
kali, boomerang.
kali'gali, bow-legged (lit. boomerang-legged).
kalɔŋ, heat (of fire).
kalɔŋga. burnt.
kandi, gum of sandalwood used to fasten flints on spears, etc.
kandil, ribs.
kanu, frilled lizard.
ka : ŋga, crow.
kaŋgo, shade.
kara, spider; also sandplain.
ka'rambi, an edible fruit.
karar, pearlshell ornament (article and name come from the coast of Western Australia).
kararu, light-coloured people.
karba, to dig.
kardia, myall (*Acacia* sp.).
kardidi, teeth.
kardjul, ankle.
kargala, pig-face (*Mesembryanthemum*).
kargu, yellow pipeclay.
kari, immediately, presently.
karidjal, heel.
karu, teatree (*Melaleuca*).
kata (= wana), woman's digging-stick.
kɔga, head.
kɔga lidja (liδa), sea-shells.
kɔga ŋu : rar, hair of head.
kɔgarara, east.
kɔŋu, mallee, the bark on the roots of which is eaten.
ku : δara (ku : djara), two.
ku : ga, animal food.
ku : lardi, butcher bird.

ku:lgari, fat.
ku:liba, masked wood-swallow.
kumba, fruit of *Solanum* sp.
kundəlu, *Pittosporum phillyraeoides* (tree).
ku:ndi, club.
kuŋgara, sparrow hawk.
ku:ra, magpie.
ku':rabi (contraction of kura gabi, magpie-water), native name of township near Fowler Bay (Coorabie).
ku'raiŋ (kri:ŋ), long-tailed iguana.
ku'raiŋ gabi, settlement on West Coast (Kooringibbie); name of waterhole in vicinity.
kurdi, native peach tree (*Fusanus acuminatus*).
kurdu, vein; also hole.
kurda'guδa, crimson-breasted chat.
kurdudu, heart.
kurgu, boobook owl.
kurli (gurli), species of sheoak.
ma, vegetable food.
madji, husband.
maδεri, dark people.
malδulu, tomorrow.
malda, neck.
ma:lu, silvery-grey or white kangaroo.
ma:mu, stillborn baby.
mambulu, saltbush.
maŋiri, throat.
mara, hand.
mara'djarda, palm of hand (lit. hand stomach).
mara'bi:ri, finger-nail.
marailja, sorcerer, medicine man.
mardarba, hard red ochre.
marngu:r, three (also used in the Murchison and Gascoyne areas, Western Australia).
mε:l, eye.
mε:lgalba, eyelash.
mənarn, bittern.
məka, no.
mərdərn (matn), wife.
mərnda, clay, ground.
mi:di, mi:rdi, back.
milbi, shoulders.
mi:rdiŋaŋga, mi:rdi bi:li:, back-bone.
mildjin, skin.
miljiliŋ, parasite on sandalwood (*Loranthus*[?]) with edible fruit.
mindara, an edible fruit.

minja, little, small.
minjiaŋ, miŋari, mindjin, mountain devil *(Moloch horridus)*.
minjaru, cold.
miŋga, sick, ill.
mi:rikata, morning star.
mi:riljilji (miljil'ji:ri), superb warbler.
mi:ru (mi:la), spear-thrower.
mɔmbaingin, to sneeze.
mo:gu, edible grub.
mu:di, fish (in general).
mu:dundu, cloud.
mu:ga, voice, speech.
mu-gu, ankle.
mu:la, mu:lδa, nose.
mu:la'mambarn, moustache.
mu:liŋga, mouse.
mu:lδu, red fungus growing on dead sandalwood.
mu:lai'ɔŋu, an edible snake.
mu:ndu, diarrhoea.
mu:nduŋ, covered up with earth.
mu: ŋiri, kidney.
mu:na, head-covering, hat.
mu:na'ardu, heavy, big, strong.
mu:rdi, knee.
mu:rgu, noise.
mu:rliŋa, small lizard.
murŋu iŋgu, evening star.
nala, name of the [kɔŋu] mallee in the Eucla district and totem of a local group who call themselves [nala um] (um is a contraction of [wamu] camp).
nanθa, bad.
naruri, orphaned waterholes and country whose owners are all dead.
njanji'dji:ra, black-faced cuckoo shrike (also black-shouldered kite).
nji:ari, mountain devil *(Moloch horridus)*.
njilba, fruit of a creeping plant.
njildi ju:lan, to cry.
nji:mi, lip.
njinagain, to sit down.
nju:di, netted bag of hairstring in which a child is carried.
nju:ri (nju:ni), you.
nju:rilu (nju:nigu), yours.
ŋabarli, fringed lizard.
ŋaiju (ŋaidju), I.

ŋaijugu, my.
ŋa:in, to breathe, to pant.
ŋal, to eat.
ŋalara, our, ours.
ŋaldi, liver.
ŋanana, what?
ŋanana jini, what (is your) name?
ŋanuŋga, what is it?
ŋambu garbil, evil spirit.
ŋana, me.
ŋanba (nanba), belt.
ŋaŋga, bone.
ŋagali, cloud.
ŋaŋi, frog.
ŋarbi, lying down (to sleep).
ŋarnuiŋ, chin.
ŋarga ru:ŋuni, quivering of upper part of body in the dance.
ŋaru, water-bearing roots of mallee.
ŋau, bird's egg.
ŋo:gorn, bird's egg.
ŋu:du, cheek.
ŋu:gu, temple.
ŋu:ldi, tears.
ŋu:ldu, plenty, abundance.
ŋu:lu, skin.
ŋu:lu'bu:nji, frightened.
ŋu:ŋi, bittern.
ŋu:ra, wurley, native hut of boughs and saplings.
ŋu:rar, hair.
ŋu:rar bi:rbarn, hair-cutting.
paldjari, enough.
talin, tongue.
tju:garn, a parsnip-like root.
tjurguin, a small white fruit.
θala, where? θala wen, where are you going?
θamuna, greenish edible mushroom.
θardu ini, go away, go back.
θarndu, whistling eagle.
ulba'reri, south.
undugu, thunder.
undugu wɔŋgan, a thunderstorm ("thunder talking").
wa, face, forehead.
wadji, yes, true.
waidjirda, bandicoot.
waiərda, opossum.
wailbɛla, whitefellow (from English word).

wala, angry, sulky.
waldja, eagle or eaglehawk. [waldja] is always the bird who brought the first fresh water to the natives in [δu:gur] or "dream times."
walduldu, cloud.
walga, ground fog; also fruit of small prickly plant (*Solanum* sp.[?]).
walgala, *Pholidia scoparia* (shrub).
walu (walδu), wallaby.
wana, woman's digging-stick.
wanbərdi, cool south-west winds (Eucla).
wanjiri, "native currant."
warda, shrub.
warda δadi, scrub country.
war'dargəna, Boundary Dam.
wardriŋ, wild turkey (ju:lbari dialect).
wardu, wombat.
wari (wɔri), native road leading to the principal permanent waters.
warlba, hill.
warlilja, bandicoot.
warna, sea.
waru, kangaroo (in general).
waru gu:liŋ, kangaroo in pouch.
wɛn, go.
wi:a, mother.
wi:ana, woman.
wi:ba, ant (in general).
widji widji, large ceremonial boomerang.
wi:ldjará, a long time ago.
wi:lu, curlew.
wi:lurara, west.
wi:na, white pipeclay.
wi:naga, wind.
winda, pigeon (in general).
windu, hooked twig for picking out grubs from roots.
wi:nidja, grassbird; also fantail warbler.
wi:ra, sky, clouds.
wirbiŋ, spotted ground-bird.
wi:rɔŋu wɔŋga, the native language given in this vocabulary.
wɔlindji, chest.
wɔmariŋ, spear-thrower, wommera.
wɔŋala, crow.
wɔŋga, speech, language.
wɔŋgan, speak!
wɔŋunu, small seed (nardoo[?]) pounded and made into damper.

Personal Names.

Names are often given from some circumstance attendant on birth, such as [ŋ·ŋgali] "raincloud," given to a girl child. A soft rain was falling when she was born. [dju:ndal] "summer cloud," was also the name of a little girl. Sea clouds hung over the coast and someone drew attention to them. The child's grandmother [kabarli] caught the word mentioned and gave it as a name to the newborn baby. If a bird, animal, insect, etc., is seen near the spot where the child is born, it will receive the name of such object. In the case of boy children their birth-name may be dropped after initiation, when they will be called by the name of the place where their initiation was carried out. A boy initiated in 1913 at a creek called [dji:gala], 16 miles east of Eucla, received the name of the creek. His birth-name was [gu:rardu], his mother's brother's name. Names of men:—[θarnduriŋ] and [θarnduriri], from [θarndu], the whistling eaglehawk; [bi:ra δu:gur], "dream moon"; [wɔŋala], "crow." Names of dead relatives—grandparents usually—are frequently given to children.

Tribal or Local Group Names.

wi:rɔŋu wɔŋga (from wi:ra, cloud and wɔŋga, speech). Tarcoola Road.
ku:gurda wɔŋga (ku:ga, meat). Ooldea (ju:ldilŋa) area.
ju:lbari wɔŋga (ju:lbari, south). Fowler Bay, Great Bight, and towards Eucla.
jagarga wɔŋga (jaga, woman). Eucla area.
wadi wɔŋga (wadi, man). Near Boundary Dam.
ba:du wɔŋga (ba:du, man). Near Boundary Dam.
wɔŋgai'i: wɔŋga. Boundary Dam area.
ŋalia wɔŋga (ŋalia, our). North of Boundary Dam, in the (Musgrave[?]) ranges.
ŋaδa wɔŋga (ŋaδa, I, me). Near the wi:rɔŋu(?).
ŋandja wɔŋga (ŋandja, forbidden[?]). North of Boundary Dam area.
marda wɔŋga (marda, yes). Near Western Australian border.
jaga ŋu:ri (jaga, mother[?]). North-west of Ooldea.
bi:dju wɔŋga. Boundary Dam area.
kuŋgu (kundu) wɔŋga (kuŋgu or kundu, woman). North of wɔŋgai'i: wɔŋga.
andingiri. North of ŋalia wɔŋga.
njunŋa wɔŋga. North-west of wadi wɔŋga.
ku:gara wɔŋga. North of wadi wɔŋga.
djidji wɔŋga. West of Boundary Dam.

wanbiri wɔŋga. Boundary Dam area, West.
minma wɔŋga. Boundary Dam area, North.
waia wɔŋga (waia, woman). Boundary Dam area.
warbail wɔŋga (warbail, woman). Boundary Dam area.
mandjindji wɔŋga. West of border and east of Western Australian goldfields.
rabuna (Spencer's "Urabunna" [?]). Near Coward and Hergott Springs (Marree).
jairunda (Spencer's "Arunta" [?]). Towards Oodnadatta (wudnadat).
jul'u:ridja (Spencer's "Luritcha"). Finke River to Lake Amadeus, Northern Territory.

Relationship.

The following terms are used by the [wi:rɔŋu] and [ju:lbari] people, from about Tarcoola to the Western Australian border:—

ŋalara, θarburda, our own family group, who cannot intermarry.
marria, older brother (kurdana in jagaŋu:ri dialect).
baŋanu, younger brother (malaiŋ in jagaŋu:ri).
mama, father and father's brother.
ŋunduna, ŋundjub, wi:a, mother. The two first names appear to be applied to one's own mother.
wi:a, mother's sister.
kaŋgea, older sister (kaŋgəru in jagaŋu:ri dialect).
bu:jalu, younger sister (malaiŋ in jagaŋu:ri).
wandi, kaδa, son; kaδuna, sons.
wanji, u:ndal, daughter; u:ndalŋa, daughters; also son's wife's sisters.
θamu, paternal and maternal grandfather and grand-uncle.
kabarli, paternal and maternal grandmother; also son's daughter and daughter's daughter; also wife's mother's mother and husband's mother's mother.
bɔgali, paternal and maternal granduncle; also wife's father's father and husband's father's father.
kundili, father's sister.
ka:iŋ, ka:inja, kɔmuru, mother's brother.
mərdərn (matn), own wife.
walidji, wife's sister; also husband's brother.
maruδu, wife's brother; also husband's sister.
ju:mari, u:mari, wife's mother; also husband's father.
ju:mari ka:iŋ, u:mari kɔmuru, wife's father.
madji, husband.
ju:mari wi:a, husband's mother.

gidjara, brother's son (male speaking).
gidjara, sister's son (female speaking).
wanji, u:ndalŋa, sister's daughters (male speaking).
u:ndal ju:mari, son's wife (male speaking).
ju:mari, daughter's husband (female speaking).
iŋgilji, son's wife's mother and father; also daughter's husband's mother and father.
bərda'mi:ra, two brothers who exchange wives with each other.
ŋandara, straight marriage.
njurgarda, wrong marriage (when ŋalara or θarburda intermarry).
bu:liliŋ, pu:lulin, nardugu, betrothed in infancy.
kaia'ni:a, strangers (Eucla district).
wi:riŋ'ima, strangers (about Ooldea).
kardi, karda, fully initiated man.
kala bu'rai, uninitiated young man (kala, penis).

Other terms for "our own people" are:—
ŋananidja, ŋarumba, δu:naδa, walδaδa, ŋanderga.

The term for "great-grandmother" and "great-grandfather" is the same as that for "son" and "daughter." In all tribes I have found that the fourth generation begins thus, and if a fifth generation should arise, with a member of each living, the term for "great-great-grandfather" will be mama, and for "great-great-grandmother" wi:a. The sequence of generations runs thus:—

Daughter, u:ndal.	Son, wandi, kaδa.
Mother: wi:a.	Father, mama.
Grandmother, kabarli.	Grandfather, θamu, bɔgali.
Great-grandmother, u:ndal.	Great-grandfather, kaδa.
Great - great - grandmother, wi:a.	Great - great - grandfather, mama.
Great - great - great - grandmother, kabarli.	Great - great - great - grandfather, θamu.

I have known two families of four generations—one in the Eucla area and the other in the Nor'-west—and in each family the great-grandmother was called by the name for "daughter."

Several of the relationship terms given above are identical or almost so with those of the Luritcha Tribe recorded in Messrs. Spencer and Gillen's work, "Native Tribes of Central Australia." This tribe is shown in the map (p. 3) as occupying the country between the Finke and its north-west tributaries and Lake Amadeus. [ju'lu:ridja] is the name applied to the Luritcha [lu:ritja] by the [jaga'ŋu:ri].

[jaga] is the Eucla area word for "mother" and is the south-west Australian word for "woman" [jaga, jɔga, jɔg].

Place-names near Eucla.

[ku:lbari], the last male native of Ilgamba Water, properly [ji:lga'amba], name of permanent water at the head of the Bight, stated that, besides Ilgamba, the following were landing-places on the cliffs between Ilgamba and Eucla [ji:rgili]:—

δu:landa (Sponge Cove, about 3 miles west of Ilgamba).
ŋo:bərnda.
kardulba or kardu'ulba.
bi:na.
burdin'jɛrba or burdin'gɛrba.
mərdi'e:rəŋ (about 14 miles east of Eucla).

Fishing for seal [balgərda] and little penguin [δu:lea] took place at certain seasons, the Ilgamba and Eucla natives often joining in these fishing expeditions. Descent was extremely dangerous at some of the landing places; [mərdi'e:rəŋ] is easy of access and is often visited by the Eucla telegraphists. At [kaldiljɛra], about six miles from Eucla, Eyre noticed the "cutting-flint quarry" on the top of the cliff. The white cutting-flints [djaljir] from [kaldiljɛra] were bartered by the Eucla natives to tribes west and east of them.

Class Systems.

I can find no class system, such as obtains among the Dieri, Urabunna, Luritcha, and other tribes mentioned by Howitt and Spencer and Gillen, amongst these tribes of the West Coast and the tribes of the Border and Eucla areas. The two-class system, similar to that of the Dieri, but with different bird names, obtains in the south-west of Western Australia, and also bears on colours—white cockatoo and crow, light and dark purple. The four-class system obtains amongst the circumcized tribes bordering the south-west of Western Australia and up to West Kimberley; in the north-east Kimberley has a sixteen-class system. Somewhere south-east of Kalgoorlie the four-class system dies out, and as the natives of the south-east areas say, "Marriages and relationships go by faces" (probably light and dark colour). I have not previously visited the south-east Kalgoorlie area, where the class system dies out. It would be interesting to know where Spencer and Gillen's northern class systems stop, and by what system they are replaced. The Eucla area system was one of small totemic groups, and apparently the

West Coast system is somewhat similar; but whatever system obtained on the West Coast in the early days, there is no system whatever at present. Most of the [ju:lbari] people are dead, and the numerous natives at present frequenting the West Coast come from districts far north and east of the Great Western Railway, and, as will be seen by the tribal names, are hopelessly mixed. One man has had as wife a woman, her own mother (his mother-in-law), and his wife's own daughter (by another father). The man became blind, "because he did this thing" the natives say. Cross-cousin, or first-cousin marriages, apparently did not obtain amongst the West Coast tribes. West of Eucla area, near Twilight Cove, I found one tribe where cross-cousin marriages was the law or rule.

Ceremonial Dances.

An interesting circumstance happened during my residence in the camps of the Eucla and West Coast natives, and that was the meeting of two "corroborees," whose starting points were in North-eastern Queensland and North-western Australia respectively. The travels of these two ceremonies occupied many years. Dr. Roth mentions having seen the north-eastern ceremony called [mu:luŋga] in the Diamantina district in 1904 (see Roth's "Bulletin"). The [mu:luŋga] arrived at Penong, on the West Coast, in 1915, taking thus eleven years to travel down from the Diamantina. Shortly before the [mu:luŋga] reached Penong the [wandjiwandji] had arrived from the Nor'-west and had been performed at that place. I have only been able to trace the [wandjiwandji] beyond Laverton, Western Australia, as yet; but I feel sure the ceremony had not its origin there. Most probably it started in the Kimberley area, where I have known the natives to "compose" new dances and send them along certian routes, to be bartered to those to whom they are shown and taught, and who in their turn barter them to other tribes. These two ceremonies represent in their travels a broad V, and, coupled with other circumstances, I assume that there has been a highway along this great distance for many generations. For instance, a turtle (sea turtle) ceremony was composed by an ancestor of one of the Broome district tribes. I saw the "dance" when I was in Broome, and noted the names of certain important objects that played their part in this special "dance." I have discovered that this "dance," with the same names, attached to similar objects, was known to the [ba:du, wadi] and other groups living in the Boundary Dam area. And if I add to this the numerous dialectic words similar in the Boundary Dam and Nor'-west areas, I think it quite possible that the route by which the present dances travelled and are travelling (the [mu:luŋga] is taking the route north-westward now, and the [wandjiwandji] north-eastward) is a very old one, and it also shows that the circumcised tribes—amongst whom only these ceremonies travel—were a horde in themselves, and that they arrived after the uncircumcised aborigines, who were the first-comers. Outside this great V the tribes—certainly of Western Australia and probably of the Eastern States—were uncircumcised, and a most important fact in connection with this is that the circumcised people were gradually encroaching upon and circumcising the tribes outside their borders. I have proved this from Point Malcolm (South Coast, Western Australia) to Ballaballa (beyond Cossack, North-western Australia). Among the groups along the line of demarcation between these two places boys had been given over to the circumcised group adjoining for initiation, but no son of a circumcised father was found to have been given to the uncircumcised tribes for initiation. With the most patient enquiry I could not find one instance of this, but of the other (where the uncircumcised boys are handed over) I found many instances.

When Sir John Forrest made his journey along the South Coast he noticed that the circumcised groups were east of Cape Arid, which was then their western boundary. They have reached Point Malcolm in the years that have passed since that journey was taken. When white settlement first took place at Geraldton, Western Australia (about the fifties), the circumcised tribes were within 20 miles of the coast. When I visited the Geraldton area in 1905 they had reached the coast, but their progress was rendered easy by white settlement. They have, therefore, the whole northern seaboard of Western Australia, down to Ballaballa in the Nor'-west, thence inland until they reach the Murchison area, where they touch the coast at Geraldton; from whence they go inland south-east until Point Malcolm is reached. From Point Malcolm they occupy the southern coast to some point in South Australia or Victoria, whence they again turn inland.

Another most interesting point in this connection is that the Kabi tribes in Queensland, described by the Rev. J. Mathew, have much in common with the south-western (Western Australian) tribes. I fully believe that were these routes followed, which the corroborees are now travelling, much important light would be thrown on the origin of the aborigines, their routes, and their dialects.

I may add that I attended two performances of the [wandjiwandji], each of which lasted a fortnight, there being three performances every twenty-four hours—at 3 p.m., 7 p.m., and when the morning star rose, just before the false dawn. Each ceremony was conducted by a different [bu:nəri] or master of ceremonies—in Eucla by [ku:lea'gara], who brought it from some point south-east from Kalgoorlie; the second was in the West Coast district, the [bu:nori] of the second being the learner at the Eucla performance. Each of these men had the [kalaia] (emu) as their totem, the [wandjiwandji] being an "emu totem" ceremony. The totemic portion of the ceremony was strictly confined to the men, but at every portion or phase I was present. Unfortunately I was unable to get to the district where the [mu:luŋga] was performed, and so cannot compare it with Dr. Roth's account. The two performances of the [wandjiwandji] showed clearly the remarkably retentive memory of the learners, the songs in both cases were exact in every detail, also the tunes and actions of the performers.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA. NO. 14.

By J. M. Black.

[Read October 10, 1918.]

Plates XV. to XVIII.

Many of the specimens dealt with in this paper were collected during an excursion along the Great Northern Railway as far as Marree (Hergott) in October, 1917, and also at Yunta, on the Broken Hill line.

Species believed to be new to science, in the genera *Frankenia*, *Muehlenbeckia*, *Atriplex*, *Acacia*, and *Minuria*, are described and figured.

The following Australian species are recorded for the first time for this State:—*Solanum Oldfieldii*, *Eucalyptus vitellina*, *Stipa eremophila*, *Vittadinia scabra*, *Pimelea ammocharis*.

Alien species are distinguished in the body of the text by an asterisk. Those recorded here for the first time are:—*Mesembryanthemum angulatum*, *Sutherlandia frutescens*.

New records for Professor Tate's districts are enclosed in brackets after the name of the locality.

Juncaginaceae.

Triglochin calcitrapa, Hook. (*T. centrocarpa*, Hook., var. *calcitrapa*, Benth.). Mount Gunson (Mrs. Beckwith).

Gramineae.

Panicum prolutum, F. v. M. Railway reservoir, Hawker (Dist. S). Panicle 12-20 cm. long, lowest branches scattered, central ones verticillate or opposite; spikelets becoming purple.

Stipa eremophila, Reader. Largs Bay; Brighton; Marino; Murray Bridge; Keith; Orroroo; Yunta; Hawker; Murat Bay; Nullarbor Plain. It will be seen that this grass, here recorded for the first time for South Australia, is widely distributed in our State. The type came from Lowan, Western Victoria. Near *S. flavescens*, Labill., it is distinguished by its short ciliate ligule, longer outer glumes (the lower one 15-20 mm. long and 3-nerved, and the upper one 12-14 long and 5-nerved), and larger flowering glume

(8-10 mm. long with the stipes), clothed with rich golden or dark-brown hairs, and usually with a small "neck" or "collar" at the summit, owing to the hairs being much shorter at that spot. The panicle appears to be always embraced at base by the swollen sheath of the uppermost leaf. The northern specimens are slender and about 40 cm. high, with glabrous nodes; those from Keith and the sea-coast are stouter, with pubescent nodes. The determination of the Yunta specimens was kindly confirmed by Mr. J. W. Audas, of the National Herbarium of Victoria.

S. scabra, Lindl., nov. var. **auriculata.** *Variat ligulâ unilateraliter auriculatâ.* Laura; Yunta; Mount Gunson; Minnipa. The orifice of the leaf-sheath has on one side a long erect lobe or auricle, which is continuous with the short ciliate ligule. The lower sheaths are often pubescent with spreading hairs, and the panicle is loose and clasped by the base of the uppermost sheath. It is a less slender grass than the type, and the leaf-blades are always scabrous.

S. setacea, R. Br. Leigh Creek. Stems slender but stiff, to 70 cm. high; ligule short, glabrous; leaf-sheath silky at the orifice.

Calamagrostis aemula, Steud. Yunta (border of Dists. S and M).

Glyceria ramigera, F. v M. Frome River, Marree. Mr. E. H. Russell, the well-known pastoralist, called this "Cane-grass," so apparently that name is applied in our Far North both to *G. ramigera* and *Spinifex paradoxus*.

**Schismus fasciculatus*, Beauv. Yunta.

**Avena fatua*, L. "Wild Oat." Flowering on the plains at Marree in October.

Cyperaceae.

Scirpus pungens, Vahl. Growing round a mound spring, Marree (Dist. C).

Juncaceae.

Juncus pauciflorus, R. Br. Beetaloo; Wirrabara (Dist. N).

Casuarinaceae.

Casuarina lepidophloia, F. v. M. Moolooloo (S. A. White); along Windy Creek, near Leigh Creek (Dist. S). Locally called "Black Oak." Tree about 5 m. high, with dark bark; branches mostly erect-spreading, only a few of the lowest drooping; male trees far exceeding the females in number; sheathing teeth 9-11.

PROTEACEAE.

Hakea leucoptera, R. Br., var. *Kippistiana*. Leigh Creek. Small tree or large shrub; flowers white, not scented.

H. Ednieana, Tate. Leigh Creek.

SANTALACEAE.

Fusanus spicatus, R. Br. Leigh Creek. A small tree 3-4 m. high, locally known as the "Quandong," and much smaller than *F. acuminatus*, R. Br., which is distinguished as the "Native Peach." The leaves of *F. spicatus* are thicker, broader, of a darker green, and the fruit is inedible.

POLYGONACEAE.

Muehlenbeckia coccoloboides, *nov. sp. (tab. xv.). Suffrutex circiter metralis, caulibus ramosis glaucis diffusis flexilibus basi lignosis, foliis lineari-lanceolatis margine recurvis 1-2 cm. longis caducis, floribus dioicis in fasciculos subaphyllos 3-10-floros ad nodis dispositis, bracteis calyptriformibus ocreisque tenerrimis caducissimis, perianthio masculo breviter pedicellato 5 mm. longo octandro, lobis 5 obtusis patentibus tubo paulo longioribus (rarius perianthio sexlobo enneandro), pistilli rudimento minuto, perianthio femineo ovoideo vel globoso carnoso subsessili circiter 3 mm. diametro, lobis 5 (rarius 6) erectis obtusis minutis (vix 1 mm. longis), styli ramis margine crenato-dentatis, stigmate decurrente, staminibus sterilibus connatisque vesiculam simulantibus, perianthio fructifero aucto carnoso ovoideo vel subgloboso plus minus angulato rubro vel rubescente 6-7 mm. longo fructum omnino involvente, nuce trigonâ nigrâ nitente, seminis testâ rubellâ verruculosâ, embryone laterali curvo.*

Lake Blanche; fruiting September, 1916; S. A. White. In the fleshy enlarged fruiting perianth, tipped by the minute lobes and completely enclosing the fruit, this species comes very near to the genus *Coccoloba*, but differs in its habit, which is quite that of *Muehlenbeckia*, in the dioecious flowers, narrow cotyledons, and non-ruminate albumen. It stands nearest to *M. Cunninghamii*, F. v. M., from which it is distinguished by the peculiar female perianth, the flowers in separate clusters and never in spikes, the stigmas not terminal but decurrent on the style-branches, etc.

This interesting desert plant was found by Captain White during the Museum Expedition to Cooper Creek in 1916, but his specimens were only in fruit. The seed germinated readily, and I was able to cultivate several plants in North Adelaide, but they did not produce flowers until June, 1918.

In the original specimens the fruiting perianths were all ovoid, but some of the plants which I grew developed globose perianths.

CHENOPODIACEAE.

Bassia divaricata, (R. Br.) F. v. M. Marree; Nilpena; Leigh Creek. Spines slender, yellow, divaricate, the 2 longest 6-16 mm. long; leaves cylindrical or subcompressed, glaucous, fascicled, broad and persistent at base, hairy in the axil.

B. enchylaenoides, F. v. M. Loxton, Mannum (Dist. M); Gawler Ranges (S. A. White), Yalata (Mrs. D. M. Bates; Dist. W).

B. tricornis, (Benth.) F. v. M. Marree (Dist. C).

Atriplex angulatum, Benth. Marree; Hookina; Hawker. In the large-leaved form the male clusters form an interrupted terminal spike 2-4 cm. long, with a few males accompanying the females in the upper axils; in the small-leaved form there are no spikes, the males accompanying the females in the upper clusters, the fruiting bracteoles are smaller and narrower, and the petioles much shorter. Both these forms seem to be indicated by Bentham, but further investigation may show the advisability of treating them as distinct species. The narrow bracteoles show an approach to *A. leptocarpum*, but the leaves are different.

Atriplex crassipes, *nov. sp. (tab. xvi.). Herba canofarinosa (specimine meo 17 cm. alto), caule ramisque erectis rigidis, foliis ovato-lanceolatis integris 4-8 mm. longis brevissime petiolatis, floribus monoicis, glomerulis confertis axillaribus, masculis in apice brevium ramulorum sitis et aliquot floribus femineis circumdatis, glomerulis inferioribus omnino femineis, bracteolis fructiferis parvis (circiter 2 mm. longis) rhomboideo-subtrilobis reticulatis fere ad medium usque connatis in stipite crasso cylindrico fere aequilongo stantibus semine orbiculari nigro, radiculâ supera.*

Marree (Hergott). Near *A. humile*, F. v. M., but the male flowers are not spicate, the fruiting bracteoles are smaller, distinctly stipitate, and more or less 3-lobed. It is, perhaps, nearer to the small-leaved form of *A. angulatum*, but the bracteoles are differently shaped and the stipes longer and thicker.

Atriplex nummularium, Lindl. "Oldman Saltbush." On plains at Marree and near the bed of the Frome River. The drifting sand often forms small hillocks around each shrub or cluster of shrubs. Fruiting bracteoles sometimes 10 mm. long by 15 mm. broad.

A. halimoides, Lindl., var. *conduplicatum*, F. v. M. et Tate. Marree. Fruiting bracteoles 2-edged in the connate portion then forming 2 spreading erect wings.

A. campanulatum, Benth. Yunta. Nov. var. **adnatum.** *Variat appendiculis bracteolarum linearibus non solum tubo affixis sed etiam usque ad apicem bracteolae anticae adnatis.* —Near Lyndhurst Railway Station; Marree.

Kochia humillima, F. v. M. Carrieton (Dist. N). A very puzzling form of *Kochia* was found at Leigh Creek, with the minute, soft leaves of *K. pyramidata*, but with the broad, flat-topped fruit of *K. villosa*.

Osteocarpum acropterum, F. v. M. et Tate. Marree; Willochra. Leaves green, succulent, plano-convex.

Amarantaceae.

Alternanthera nodiflora, R. Br. Marree.

Aizoaceae.

Gunniopsis zygophylloides, (F. v. M.) Maid. et Betche (*Aizoon zygophylloides*, F. v. M.). Marree. The capsule is 4-lobed and much depressed in the centre of the summit. It begins to open septicidally, but almost at the same time it splits loculicidally also, so that it finally separates into 8 valves. The placentas remain united in the centre, and the lower half of the column, which bears no placentas, is 4-winged, because the lower parts of the septa break away from the valves and remain attached to the central column. The dehiscence is therefore partly septifragal.

**Mesembryanthemum angulatum*, Thunb. Port Lincoln (H. Griffith); swamp near Port Adelaide (H. W. Andrew). South Africa. First record for this State; already recorded for Victoria.

Caryophyllaceae.

Spergularia rubra, Pers. Marree (Dist. C). Small specimens growing at waterhole.

**Herniaria hirsuta*, L. Leigh Creek. After re-examining the specimens in the Tate Herbarium labelled "*H. incana*, Lamk.," and collected on the Murray and in the North, I have no doubt they are the same plant as the above, now widely distributed throughout South Australia, and that *H. incana* should be deleted from our flora until we have better proof of its introduction.

Cruciferae.

Lepidium hyssopifolium, Desv. Waterfall Gully; Findon; Grange Road; Gladstone. Fruits arranged in long racemes.

L. fasciculatum, Thell. Gladstone; Yunta; Renmark; also Broken Hill, New South Wales. Fruits densely clustered at the ends of the branches. Both these species were placed by Bentham in the Fl. Aust. under *L. ruderale*, L., a European and Asiatic species which Dr. Thellung, in his monograph of the genus, considers does not exist in Australia. The determinations were made by Mr. J. H. Maiden.

Stenopetalum sphaerocarpum, F. v. M. Cultivated specimens show that the white petals are, when the circinnate blade is unrolled, quite twice as long as the sepals (4 mm. as against 2 mm.).

S. lineare, R. Br. Mundowdna (Dist. C).

Blennodia canescens, R. Br., var. *pterosperma*, J. M. Black. Parachilna.

Alyssum linifolium, Steph. Marree (Dist. C).

Menkea sphaerocarpa, F. v. M. Waterhole near Marree. Already recorded from Arkaringa.

**Diplotaxis tenuifolia*, DC. Common and growing luxuriantly over 1 m. high in the sandy bed of the Yunta Creek, near the railway. This weed is said to have been introduced here from Port Lincoln some years ago under the mistaken impression that it was a useful fodder plant.

Leguminosae.

Acacia colletioides, A. Cunn. Dublin scrub (Dist. A); Yunta (border of Dists. S. and M).

A. hakeoides, A. Cunn. Dublin (Dist. A; H. Griffith); Halbury, Peterborough (Dist. N); Oodnadatta (Dist. C).

A. Oswaldii, F. v. M. Yunta (border of Dists. S and M).

A. Kempeana, F. v. M. Ooldea (Dist. W; S. A. White). Flowering December, 1917.

A. oxycedrus, Sieb. Between Mount Gambier and Glencoe (E. H. Alcock). Flowering at end of August, 1917. Calyx flat-based and saucer-shaped, hairy, ½ mm. long; petals free nearly to base, smooth and glabrous, 1½ mm. long.

A. brachystachya, Benth. Ooldea (S. A. White).

Acacia rivalis, *nov. sp. (tab. xviii.). Frutex glabrescens 3-4 m. altus in alveo rivi torridi crescens, ramulis angulatis, phyllodiis lineari-lanceolatis plus minus falcatis 4-7 cm. longis circiter 3 mm. latis obscure uninerviis et penninerviis oblique mucronulatis, glandulâ marginali pusillâ paulo infra medium phyllodii sitâ, pedunculis monocephalis solitariis pubescentibus 4-6 mm. longis, capitulis parvis globosis circiter 40-floris, floribus pentameris, calycis membranacei lobis brevibus obtusis pilosis, petalis distinctis uninerviis superne pilosis calyce fere semel longioribus,* *bracteolâ hypocrateriformi, ovario glabro, legumine planiusculo recto vel leviter falcato 7-10 cm. longo 4-5 mm. lato inter semina constricto, seminibus ovato-oblongis longitudinalibus nigris, funiculo longo semel complicato itaque majorem partem seminis circumcingente.*

Growing rather numerously in the bed of a dry creek at the foot of the ranges near Hawker; flowers in bud; fruit almost ripe (October 18, 1917). A specimen was submitted to Mr. J. H. Maiden, the leading authority on Australian Acacias. He agreed that this is probably a new species, and added:—"Its affinity appears to be with *A. leprosa*, Sieb., var. *tenuifolia*, Benth., in the flowers and bracts, and with the narrow forms of *A. stricta*, Willd., in the phyllodes and general appearance, but the flowers and pods are totally different. The pods are a good deal like those of *A. calamifolia* and its allies. Without flowers and pods it could easily be mistaken for *A. aestivalis*, Pritzel, a Western Australian species." *A. rivalis* is certainly well distinguished from any other South Australian species.

Swainsona Burkei, F. v. M. Yunta (border of Dists. S and M). Only one specimen found growing near a small watercourse beside the Broken Hill Railway. Stems prostrate; leaflets 7, grey-villous; standard red with yellow base (drying purple), wings red, shorter than the yellow incurved keel. The 2 longitudinal calli at the base of the standard are much more easily observed when the plant is dried than when it is fresh.

S. campylantha, F. v. M. Near waterhole at Marree. Erect perennial about 30 cm. high; leaflets 3-5; flowers purple; pod not quite ripe, becoming glabrous, 15-23 mm. long at this stage, oblong, swollen, deeply impressed along the upper suture, not really stalked but much contracted towards the base.

Indigofera australis, Willd., var. *minor*, Benth. Hawker (Dist. S).

**Sutherlandia frutescens*, R. Br. "Bladder Senna." A garden escape established near Leigh Creek. Native of South Africa.

**Medicago minima*, L. Numerous at Millicent. A form with the spines short, thick and not hooked, so that it has a very different appearance from the ordinary form which is found in our midland and northern districts. Determined at Kew.

Zygophyllaceae.

Zygophyllum prismatothecum, F. v. M. Marree (Dist. C). Leaf-lobes incurved at summit; petals 4, yellow, lanceolate, 2½ mm. long; seeds 2-3 in each cell (not solitary, as stated by Bentham), when soaked exuding a dense mucus and long spiral fibres. The specimen in the Tate Herbarium is from Idracowra, Northern Territory.

Z. crenatum, F. v. M. Mernmerna (Dist. C).

Z. Billardieri, DC., var. *ammophilum*. Farina. Stems procumbent; flowers drooping; petals 4, white, lanceolate, scarcely as long as the sepals; fruit 5-7 mm. long. This form, which is found in many parts of the North and in the Murray district, is the *Z. ammophilum*, F. v. M., except that the stamens number 8 instead of 4. I have only found 4 stamens in one specimen from Edithburgh, Yorke Peninsula. It seems to me to vary too little from the type to be considered a separate species.

Sapindaceae.

Dodonaea microzyga, F. v. M. Windy Creek, near Leigh Creek. A small shrub about 50 cm. high; leaves spreading, leaflets varnished, very sticky; fruits glossy, pink, 15-18 mm. long (with the wings), dissepiments remaining attached to the axis; seeds ovoid-compressed, black.

Malvaceae.

Sida intricata, F. v. M. Hawker; Leigh Creek; Yunta (Dist. S).

Plagianthus glomeratus. Marree; Leigh Creek. The petals, which dry yellow, are described in my field-note as "light green, recurved under the calyx and between its teeth; anthers yellow."

Cienfuegosia hakeifolia, Hook. Hills near Hawker (Miss Reed).

**Modiola caroliniana*, (L.) Don. (*M. multifida*, Moench). Clarendon (H. W. Andrew).

Dilleniaceae.

Hibbertia acicularis, F. v. M., var. *sessiliflora*, J. M. Black. Wirrabara Forest.

Frankeniaceae.

Frankenia, the only genus in this family, is a difficult one, owing to the external resemblance of several of the species and to the variation in the number of floral parts which may be often found on the same plant. Even in the usually regular *F. pauciflora* flowers can be found with 4 calyx-teeth and 4 petals. To the somewhat scanty literature of the genus a valuable contribution has been made this year by Dr. C. H. Ostenfeld in his revision of the Western Australian species (Contributions to Western Australian Botany, ii., 47-55, Dansk Botan. Arkiv, 1918). An effort is here made to do the same work for the species of this State.

KEY TO THE SOUTH AUSTRALIAN SPECIES OF *Frankenia*.

Section *Toichogonia*, Niedenzu. Placentas parietal, each bearing 1 or more ovules; funicles either ascending and the ovule with an inferior micropyle, or deflexed and the ovule with a superior micropyle.

A. Placentas 3, each bearing several ovules, funicles ascending, micropyle inferior.
  a. Leaves petiolate, subcylindrical, almost glabrous; ovules 3-6 to each placenta; diffuse plant, chiefly maritime ... ... *F. pauciflora*
  b. Leaves sessile, linear, ashy; inland plants.
    1. Leaves rather flat, several at the nodes, as long as or shorter than the internodes; ovules 8-9 to each placenta; erect plant ... ... *F. foliosa*
    2. Leaves subcylindrical, few at the nodes, small but much longer than the internodes; ovules about 5 to each placenta; creeping plant ... ... *F. muscosa*
B. Placentas 2-3, each bearing 1-2 ovules; funicles deflexed, micropyle superior; leaves sessile.
  1. Placentas 3, each bearing 2 ovules; leaves ovate-cordate, glabrous and pitted above ... ... *F. cordata*
  2. Placentas 2, each bearing 1, rarely 2 ovules; leaves small, subcylindrical, ashy ... ... *F. fruticulosa*

Section *Basigonia*, Niedenzu. Placentas basal, each bearing 1 ovule on a long funicle, erect in the lower part, deflexed and often twisted in the upper part; micropyle superior.

Placentas 3, rarely 2; leaves petiolate, subcylindrical or ovate and almost flat; hairy plant ... ... *F. serpyllifolia*

Frankenia pauciflora, DC. (pl. xvii.). A diffuse shrub, scarcely 30 cm. high, growing in intricate masses in salt ground, usually near the sea; branches pubescent; leaves subcylindrical, glabrous above but sometimes covered with a white incrustation, midrib usually concealed, but prominent below in transverse section; calyx almost glabrous, 5-6 mm. long by 1½ mm. broad; petals pink, usually 5, rarely 4, free; stamens 6; style-branches 3, stigmas decurrent on one side for ½ or ¾ of their length; ovules 3-6 to each placenta.—Patawalonga Creek and sandhills near Glenelg; salt swamps, Port Noarlunga; Port Elliot; Beachport; Robe; Pondalowie Bay (S. A. White); salt lagoon, Dudley Peninsula, K.I.;

Bay of Shoals, K.I. (Tate Herbarium); Lake Torrens (Victorian National Herbarium).

Frankenia foliosa, *nov. sp. (tab. xvii.). Fruticulus cinereus 7-15 cm. altus, caulibus erectis ramisque dense puberulis, foliis sessilibus 3-7 mm. longis late linearibus obtusis margine revolutis sed planiusculis pilis minutis conspersis et crustâ albâ obtectis inferioribus 6-16 ad nodis aggregatis et internodia aequantibus, nervo mediano infra lato prominente, vaginâ ciliolatâ, floribus in cymas densas dichotomas dispositis, calyce ovoideo-oblongo 5 mm. longo 2-2·5 mm. lato, petalis 5 roseis liberis, staminibus 6, styli ramis 3, stigmatibus crassis dimidium ramorum decurrentibus, placentis 3 parietalibus, ovulis 8-9 ad quamque placentam, funiculis ascendentibus, micropyle inferâ, seminibus papillosis.*

Marree; Farina. An erect, dwarf, ashy-grey shrub with bright pink flowers; flowering in October and November.

Frankenia muscosa, *nov. sp. (tab. xvii.). Fruticulus nanus cinereus vel ferrugineus, caulibus ascendentibus saepe ad nodis radicantibus, foliis sessilibus parvis (circiter 3 mm. longis) sed approximatis et internodiis multo longioribus lineari-subcylindricis margine revolutis parce puberulis et crustâ albâ obtectis, nervo mediano prominente, vaginâ ciliolatâ, calyce 5 mm. longo 2·5 mm. lato 5-dentato, petalis 5, staminibus non visis, placentis 3 parietalibus, ovulis circiter 5 ad quamque placentam.*

South Australia. Dalhousie Springs.

Northern Territory. Finke River, between Crown Point and Horseshoe Bend. Captain S. A. White, who collected the specimens at both places in August, 1913, says:—"This little prostrate plant is evidently very rare. It has a moss-like appearance." The condition of the specimens showed that they grew in damp soil. Flowering was over and only one or two withered calyxes remained. The flowers are apparently solitary.

Frankenia cordata, *nov. sp. (tab. xvii.). Fruticulus ramosus, ramis parce pilosis, foliis sessilibus ovatis vel oblongis basi plus minus cordatis margine revolutis 4-6 mm. longis supra glabris punctatis infra puberulis, nervo mediano inconspicuo, vaginâ ciliolatâ, floribus solitariis, calyce 6 mm. longo basin versus in costis piloso superne glabro 5-dentato, petalis 5 apice laceratis potius quam dentatis, staminibus 4-6, styli ramis 3, stigmatibus crassis dimidium ramorum decurrentibus, placentis 3 parietalibus, ovulis 2 ad quamque placentam, funiculis deflexis, micropyle superâ.*

South Australia. Between Everard Range and Wantapella Swamp (S. A. White, August, 1914).

Northern Territory. West of Lake Amadeus (Tate Herbarium; no collector named, but probably W. H. Tietkens in his journey of 1899). Both specimens are very small.

F. fruticulosa, DC. (pl. xvii.). A small maritime shrub with minutely puberubent branches and the straggling character of *F. pauciflora*, but with small sessile often white-incrusted leaves, glabrous above, linear-subcylindrical, 2-4 mm. long; midrib prominent below; sheath ciliate; flowers solitary, usually terminating short branchlets; calyx 3-4 mm. long, 4-5-toothed, petals 4-5, white; stamens 6; placentas 2, parietal; ovules 1, very rarely 2 to each placenta and, where there are 2 ovules, the corresponding style-branch is divided into 2 branches; funicles bent downwards.—Ardrossan, Yorke Peninsula (Tate Herbarium, coll. J. G. O. Tepper); Murat Bay. As regards the identity of this species, see these Transactions, xl., 68, and xli., 49. J. Vesque, in describing the leaf of *F. fruticulosa* (Ann. sci. nat. 6me sér. xv., 125), says:—"Nervure médiane fortement saillante en dessous, formant avec les bords de la feuille deux profondes gouttières." This description applies to the species here dealt with, although it is true that it also fits one or two other species.

F. serpyllifolia, Lindl. (pl. xvi.). Dwarf shrub, in South Australian specimens 15-30 cm. high, with erect branching stems rising from a woody base; branches, leaves, and calyx pubescent or hispid (often almost bristly) with spreading hairs; leaves stalked, 3-7 mm. long, usually much shorter than the internodes, revolute on the margin so as to appear almost linear-cylindrical, or almost flat and ovate or ovate-oblong, midrib inconspicuous below; flowers in loose or compact dichotomous cymes; calyx 5-8 mm. long, 2 mm. broad; petals 5, bright pink, free; stamens 6; style-branches 3; stigmas very shortly decurrent or descending half-way along the branch; placentas 3, basal; ovule 1 to each placenta on a long bent funicle; seeds papillose, 1-2 in capsule. I have examined specimens from the following localities:—

South Australia.—Frome River, near Marree; Hawker; Leigh Creek; Mount Parry; tableland north of Callana, Lake Eyre Basin; sandy soil near Ferdinand River (the last 3 from the Tate Herbarium); east of Everard Range; Murteree, Strzelecki Creek; Innamincka; west of Port Augusta; Eringa, Lindsay Creek (S. A. White); north of Goyder Lagoon (R. Cockburn).

Northern Territory.—Henbury, Finke River (S. A. White).

Queensland.—Roxburgh Downs (F. M. Bailey); Georgina River (E. W. Bick); Diamantina River (F. M. Bailey); Monkira Station, Diamantina River (S. L. Debney); "South-western Queensland" (T. Little); between Stokes Range and Cooper Creek (Dr. Wheeler).

This is the species accepted as *F. pauciflora*, DC., var. *serpyllifolia*, Benth., in the National Herbarium of New South Wales. In the Queensland Herbarium it is sometimes labelled "var. *serpyllifolia*" and sometimes "var. *thymoides*." The only specimen in Australia of the type, collected by Sir Thomas Mitchell on the Nive River, Queensland, and described by Lindley in 1848, appears to be in the National Herbarium of New South Wales. Mr. J. H. Maiden writes:—"Our specimen of the type is merely a fragment glued down on a sheet of paper, and has only about a couple of flowers, which seem to be immature. Mr. Cheel very carefully compared it with the specimen I sent you from the Diamantina River, Queensland, a locality in the same general lie of country as that where the type was originally collected." This is the specimen collected by the late Mr. F. M. Bailey and mentioned above. It belongs to the ovate-leaved, hispid form common in Queensland and in our Far North, and certainly to the section *Basigonia*. The Queensland specimens agree very well with Lindley's short original description (Mitchell, Exped. Trop. Aust., 305):—"Tomentosa hispida, foliis oblongis planis longe ciliatis, floribus solitariis subcapitulatis pentameris, calycibus patentim hispidis."

The species here dealt with is not the same as that described and figured by Dr. Ostenfeld (*l.c.*, 51, fig. 15) as *F. serpyllifolia*. The description and figure are there based on a Western Australian specimen presented by Baron von Mueller to the Berlin Herbarium and named "*F. serpyllifolia*" by W. J. Bray in Engler, Bot. Jahrb., xxiv. (not accessible here). It has (according to Ostenfeld) the ovary of *F. pauciflora* and leaves glabrous on both surfaces. It is true that Bentham made *F. serpyllifolia* a variety of *F. pauciflora* (Fl. Aust., i., 152), but it is noteworthy that he does not mention the number of ovules, although he does so in the case of *F. pauciflora* and of var. *thymoides*. The plant which I have here described must (at least in the form with rolled leaves) be very close to, if not identical with, *F. interioris*, Ostenfeld, *l.c.*, 53, fig. 17.

Var. **eremophila,** *nov. var. Variat omnibus foliis lineari-subcylindricis, ramis foliis calycibusque pilis brevissimis obtusis vestitis et plus minus crustâ albâ tectis, nervo mediano infra manifestiore, staminibus 5-6, styli ramis et placentis 2-3.*

South Australia.—Ooldea (Tietkins); head of Great Bight (T. Richards); Euria (Eucla [?], T. Richards); Yalata, near Fowler Bay (R. Tate). A very minutely pubescent greyish desert plant, which should perhaps be considered a distinct species, but the specimens (all from the Tate Herbarium) are small and incomplete.

Thymelaeaceae.

Pimelea ammocharis, F. v. M. Yaninee, Eyre Peninsula (border of Dists. W and L). Received from the local school teacher per E. G. Edquist. Quoted for Central Australia in Tate's Flora, but this appears to be the first record of this beautiful silver-leaved plant in South Australia.

Pimelea curviflora, R. Br., var. *micrantha*, Benth. Hawker (Dist. S); Melrose; Gladstone; Hundred of Pirie; Murray Scrub; Collinswood.

Myrtaceae.

Eucalyptus vitellina, Naud. Road between Mount Gambier and Glencoe. A tree 5-7 m. high, often with drooping branches; bark rough and brown or grey, except on the smaller branches, where it is smooth and light in colour. The glossy leaves vary much in size and shape, are 10-20 cm. long and 12-45 mm. broad, with the lateral nerves often almost parallel with the midnerve, after the manner of *E. pauciflora*, Sieb. Umbels 3-15-flowered, the operculum either almost flat, with a small umbo, as described by Naudin, or hemispherical and umbonate; fruits ovoid-truncate, 7-8 mm. in diameter and 6-7 mm. long, the rim broad and flat. This species, as far as South Australia is concerned, was placed by Bentham (Fl. Aust., iii., 202) under *E. virgata*, Sieb., with the locality "stringybark forests 15 miles north-west of Mount Gambier." It seems to me very probable that this is the same species as was described and figured by the late J. Ednie Brown (For. Fl. S. Austr., part 4) under the name of *E. pauciflora*, Sieb. The localities quoted are Dismal Swamp and Benara Estate. Although *E. pauciflora*, Sieb., and *E. Sieberiana*, F. v. M., are both recorded by Tate for the Mount Gambier district in his Fl. Extrâ-trop. S. Austr., the Tate Herbarium contains no specimens. There is, however, a specimen labelled "*E. amygdalina*, Labill., Nangwarry Forest and Tarpeena, J. E. Brown and R. Tate," in the Tate Herbarium. This also appears to be the same as my specimens, and some collected later by Mr. E. S. Alcock, on the road from Mount Gambier to Glencoe, which were submitted to Mr. J. H. Maiden and determined by him as

E. vitellina. The fruits of the specimen labelled "*E. amygdalina*" by Tate are a trifle smaller than those gathered between Mount Gambier and Glencoe (about 5 mm. long by 6 mm. diameter at the summit), but otherwise agree with them. All the localities mentioned lie near together, and are in the same class of country. Mr. Maiden considers *E. vitellina* to be a hybrid between *E. pauciflora*, Sieb. (*E. coriacea*, A. Cunn.) and *E. amygdalina*, Labill., which has become more or less fixed.

E. leucoxylon, F. v. M. Wirrabara Forest. "Blue Gum." The typical form, with smooth, white and bluish bark on the stem, is found here, but there are also many trees with similar flowers and fruits, but with a rough black bark. The dark-barked form also occurs at Bordertown, with the point of the operculum much shorter than usual. Maiden (Crit. Rev. Euc., ii., 82) points out that Bentham confused *E. leucoxylon*, F. v. M., with *E. sideroxylon*, A. Cunn. In distinguishing the two species Maiden says that *E. sideroxylon* has the bark "black, furrowed, and rugged." while *E. leucoxylon* has it "whitish or bluish, smooth." It appears, therefore, that we have in South Australia either a form of *E. leucoxylon* closely approaching *E. sideroxylon*, or else the latter species itself.

E. oleosa, F. v. M. Leigh Creek. Here a rather tall tree, with lanceolate black-dotted leaves like those of *E. calycogona*, Turcz., var. *gracilis*, Maid.

Melaleuca glomerata, F. v. M. Leigh Creek. This is a "paperbark teatree," the bark white on the outside, fibrous beneath, and pealing off in thin strips.

Umbelliferae.

Didiscus glaucifolius, F. v. M. Lyndhurst Railway Station. My field-note says, "Flowers white; leaves glaucous." In other northern specimens from Oodnadatta and Strzelecki Creek most of the dried petals are blue, so that probably both colours occur.

Convolvulaceae.

Convolvulus erubescens, Sims. Three forms of this variable species were found at Hawker:—1, limb of corolla pink, rotate, almost or quite lobeless, 15-20 mm. diameter when open; leaves narrow, entire in the upper part and with 2 spreading, emarginate auricles at base. 2, limb pink, 8-10 mm. diameter, spreading-erect, with prominent rounded lobes; leaves narrow, lobed, with lobed auricles at base. 3, limb white, 6-10 mm. diameter, spreading-erect, lobes subacute; leaves broadly ovate-cordate, bluntly lobed all round.

Cressa cretica, L. Marree (Dist. C). Although this species is described as having 2 distinct styles, it has frequently one bifid style, as in the genus *Wilsonia*.

Solanaceae.

Solanum oligacanthum, F. v. M. Plain near Marree. Shrub about 40 cm. high; corolla purple, sinus between lobes shallow; petioles of the lowest leaves 5 mm. long, of the uppermost about 1 mm.

S. Oldfieldii, F. v. M. Near Ooldea (B. S. Jobson). First record for South Australia of this species, hitherto found only in the Western State.

S. petrophilum, F. v. M. Woolshed Flat, Warren Gorge (Dist. N); Arno Bay (Dist. L).

Myoporaceae.

Eremophila Freelingii, F. v. M. Shrub growing on hillsides at Leigh Creek; flowers lilac, sometimes twin or even 3 in the axil.

E. Sturtii, R. Br. Yunta (Dist. S). Flowers lilac.

Rubiaceae.

Asperula scoparia, Hook. f. Hawker.

Compositae.

Erechthites quadridentata, DC. Hawker (Dist. S).

Calotis scabiosifolia, Sond. et F. v. M. Railway reservoir, Hawker. Rayflowers white; pappus-awns 4-5; achenes with narrow, ciliate wings; otherwise as described. Luxuriant specimens reach 30 cm. in height.

Leptorrhynchos pulchellus, F. v. M. Leigh Creek (Dist. S).

Pterigeron adscendens, Benth. Frome River, near Marree.

Minuria rigida, *nov. sp. (tab. xviii.). Fruticulus ramosus ascendens 20-30 cm. altus basi lignosus glaber absque flocculis lanosis axillaribus, foliis ovato-lanceolatis rigidulis acutissimis 5-10 mm. longis, supremis minoribus, involucris terminalibus hemisphaericis 5 mm. longis, bracteis oblongis margine scariosis acumine patente terminatis, floribus radii numerosis pallide lilacinis, disci circiter 30, achaenio radii compresso pilis biuncinatis vestito, pappi setis 15-20 achaenio maturo quadruplo brevioribus, achaenio disci abortivo, pappi setis barbellatis valde inaequalibus, longioribus 6-10 tubum corollae aequantibus cum aliquot brevioribus subpaleaceis alternantibus.*

Near waterholes and on the plains at Marree. Nearest to *M. integerrima*, Benth., but the leaves are broader, more acute (almost acuminate), and more rigid, the involucre larger and the bracts with a spreading point. The axils both of the leaves and branches are usually woolly. The leaves closely resemble those of *Ixiolaena leptolepis*, Benth. The new species differs from all previously described *Minurias* in the very short pappus of the rayflowers. The bristles only equal one-fourth of the ripe achene in length, whereas in the other species they are always longer than and often twice as long as the achene.

Helipterum uniflorum, J. M. Black. Marree. Numbers of the detached woolly fruiting heads were found clinging to the stellate-hairy under-surface of the leaves of *Solanum lacunarium*, F. v. M.

H. microglossum, (F. v. M.) Tate. Hawker.

Vittadinia scabra, DC. Marree. First record for South Australia, although it has already been found in the southern end of the Northern Territory. There is nothing to distinguish this species from forms of *V. australis* with thick, obovate, scabrous leaves except the pubescent ribless achenes.

V. australis, A. Rich., var. *pterochaeta*, F. v. M. Hawker (Miss Read).

**Sonchus asper*, Hill. "Rough Sowthistle." Hawker; Melrose; Keith; Nantabibbie. A stout plant, standing 50-150 cm. high, with prickly leaves. **S. oleraceus*, L., is also common on the plains at Hawker.

**Centaurea melitensis*, L. This weed ("Maltese Cock-spur") is very common near Leigh Creek.

**Onopordon acaule*, L. Yunta. Common on the flats subject to inundation from the creek.

DESCRIPTION OF PLATES.

Plate XV.

Muehlenbeckia coccoloboides, n. sp. 1, portion of male plant. 2, portion of female plant. 3, male flower (side view). 4, the same (viewed from above). 5, stamen (front). 6, stamen (back). 7 and 8, female flowers. 9, vertical section of No. 7: *a*, epidermis of perianth; *b*, fleshy layer of perianth; *c*, the connate sterile stamens surrounding the ovary; *d*, wall of ovary; *e*, erect ovule. 10, pistil. 11 and 12, fruiting perianths showing the ovoid and globular forms. 13, vertical section of nut and seed: *f*, pericarp; *g*, warted testa of seed; *h*, albumen; *i*, curved embryo; *j*, base of fruiting perianth. 14, nut. 15, transverse section of seed (lettering as in No. 13). 16, sketch showing habit of plant.

Plate XVI.

Atriplex crassipes, n. sp. 1, female flower. 2, vertical section of same. 3, male flower. 4, fruiting bracteoles and stipes. 5, vertical section of seed. 6, vertical section of No. 4.

Frankenia serpyllifolia, Lindl. 7, flowering branch of broad-leaved form. 8, transverse section of leaf of same. 9, flowering branch of narrow-leaved form. 10, transverse section of leaf of same. 11, pistil. 12, ovary spread open. 13, seed and one valve of capsule.

Plate XVII.

Frankenia pauciflora, DC. 1, pistil. 1*a*, upper part of style branch. 2, ovule and funicle. 3, ovary spread open. 4, transverse section of leaf. 5, seed: *rh*, rhaphe; *h*, hilum. 6, transverse section of seed: *a*, *a*, albumen; *c*, *c*, cotyledons; *rh*, rhaphe.

F. foliosa, n. sp. 7, transverse section of leaf. 8, pistil. 9, vertical section of seed.

F. fruticulosa, DC. 10, transverse section of leaf. 11 and 12, pistils. 13 and 14, ovaries spread open.

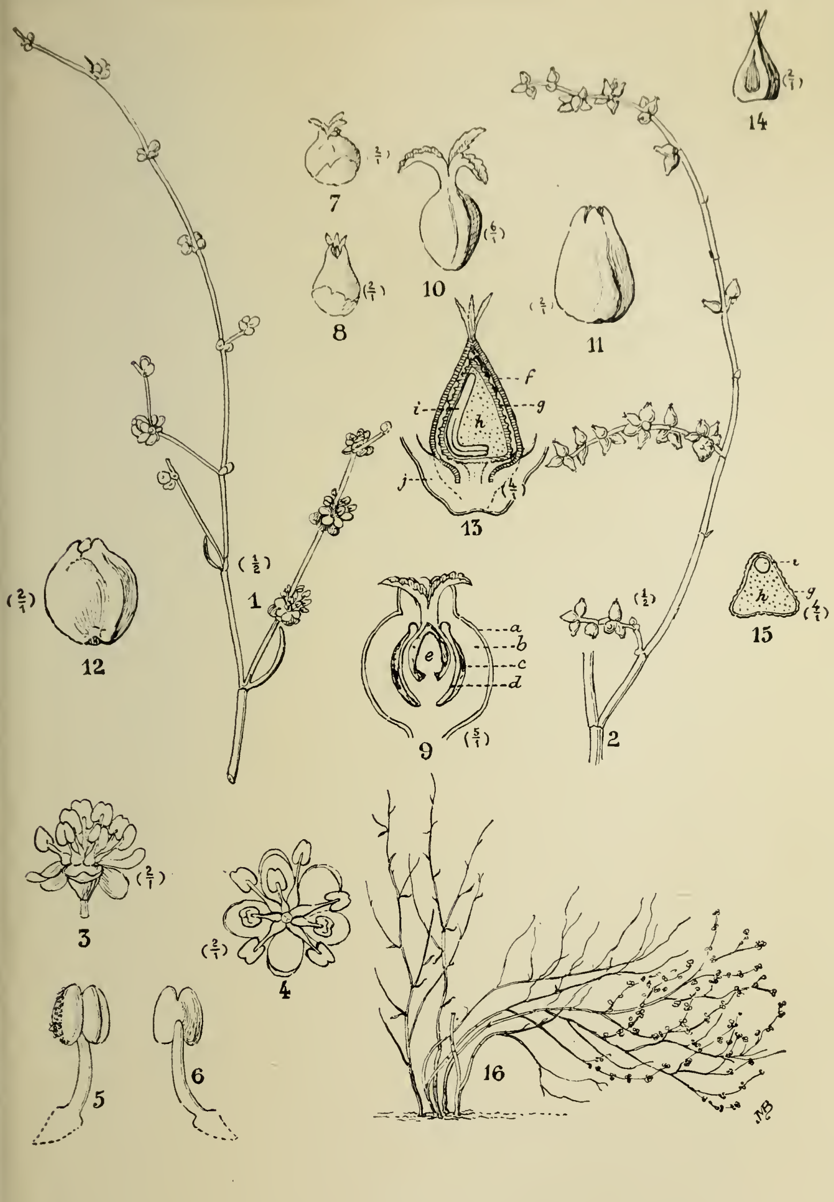
F. cordata, n. sp. 15, transverse section of leaf. 16, pistil. 17, calyx. 18, ovary spread open.

F. muscosa, n. sp. 19, pair of leaves. 20, transverse section of leaf.

Plate XVIII.

Minuria rigida, n. sp. 1, disk flower. 2, ripe achene of ray. 3, 2-hooked hair of achene. 4, upper part of style of disk flower.

Acacia rivalis, n. sp. 5, bud. 6, petal. 7, bracteole. 8, seed.



Muehlenbeckia coccoloboides *nov. sp.*

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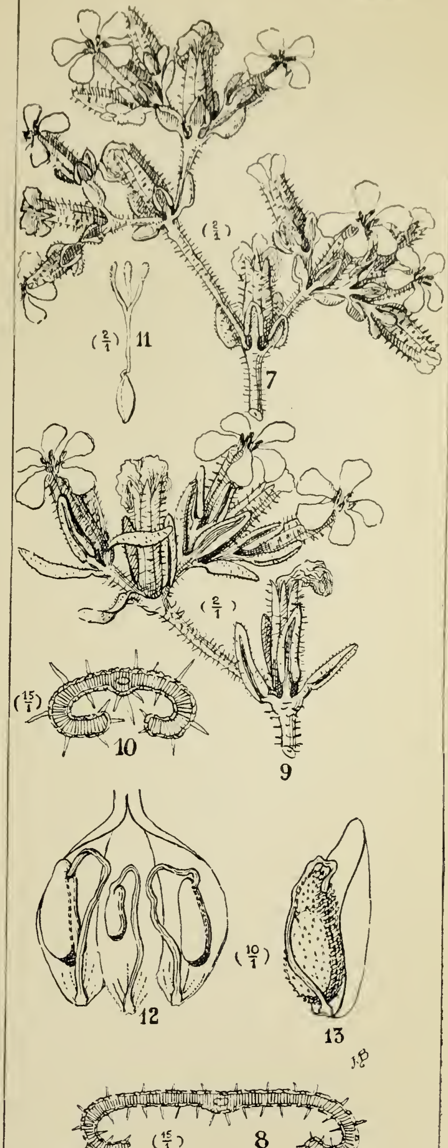

ıtriplex crassipes *n. sp.*

Frankenia serpyllifolia *Lindl.*

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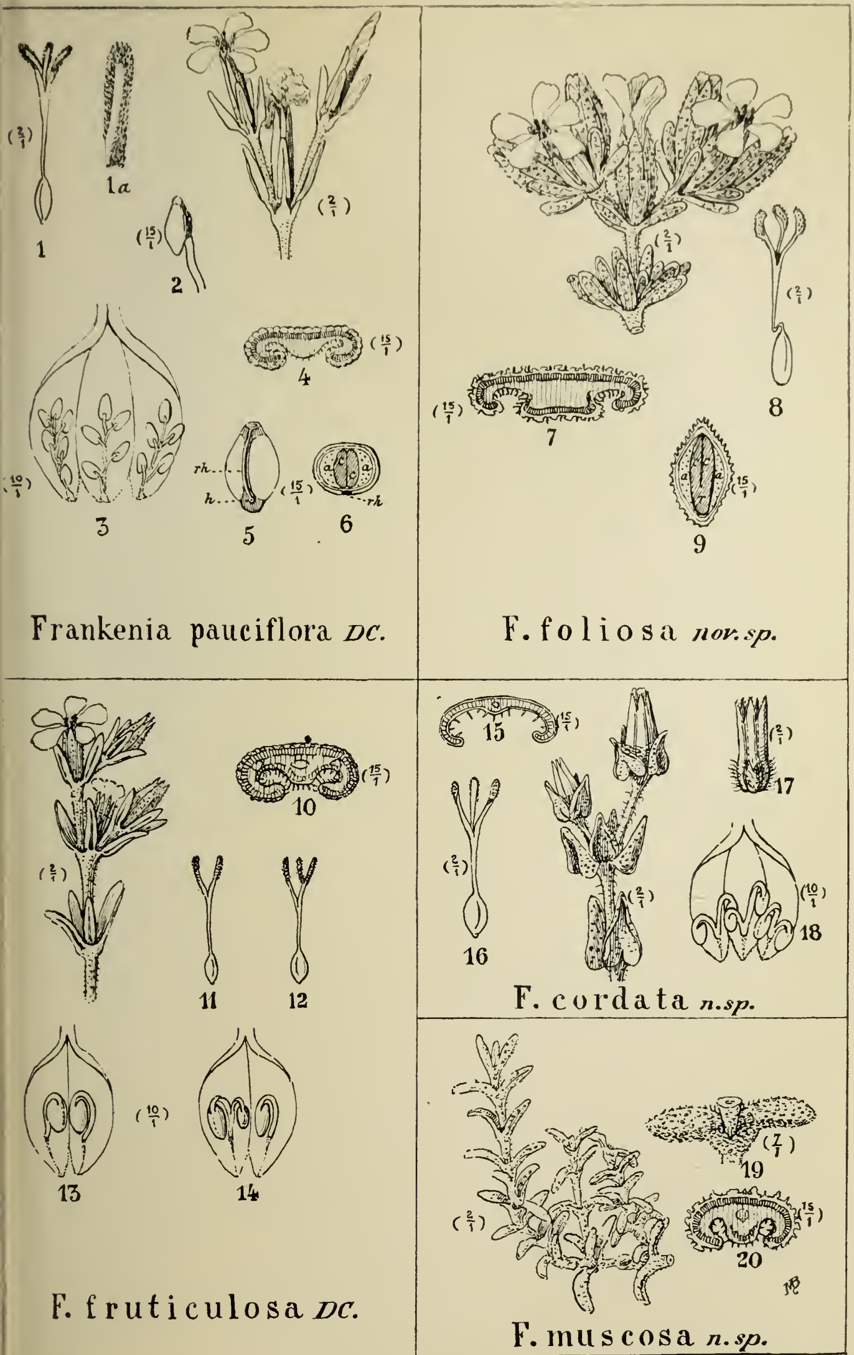

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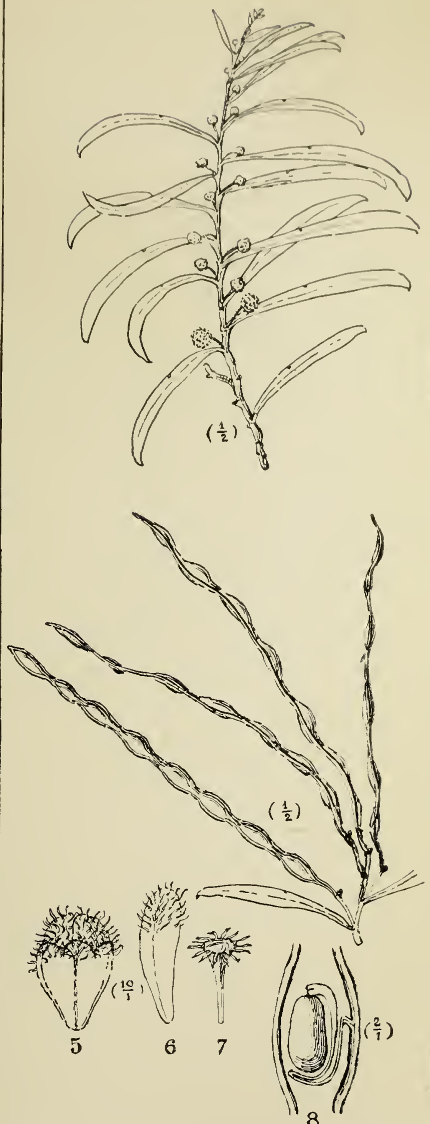
Minuria rigida *n.sp.*



Acacia rivalis *n.sp.*

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Notes on the Geology of Ardrossan and Neighbourhood.

By Walter Howchin, F.G.S., Lecturer in Geology and Palaeontology, University of Adelaide.

[Read October 10, 1918.]

Plates XIX. to XXIX.

CONTENTS.

Introduction.

Ardrossan, situated in the northern portions of Yorke Peninsula, was the first locality in South Australia from which Cambrian fossils were obtained. Mr. J. G. O. Tepper, who was for several years State school teacher at Ardrossan, obtained from the local limestones some trilobite remains as well as examples of fossil "coral" (Archaeocyathinae) in sea-worn pebbles of the same limestone on the beach. These remains Professor Tate referred, tentatively, to the Lower Silurian.(1) The so-called "corals" were handed to Mr. R. Etheridge, of Sydney, for description, who recognized their affinity with the Archaeocyathinae.(2).

Soon after the discovery of these interesting fossils Mr. Tepper published two papers on the geology of the district,(3) including a geological plan and section illustrating the occurrence and succession of the beds that had yielded the remains. These papers, as the work of a pioneer, formed a useful contribution to the subjects and, although subject to correction, indicate careful observation.

Yorke Peninsula contains many points of geological interest. The basement rocks, so far as they are exposed, form fragments of the old Pre-Cambrian peneplain and are representative of the oldest Australian terrain known to us, and although the covering, formed by subsequent deposits on this primordial floor, is patchy and of no great thickness, it carries the records of many strange vicissitudes in its geological history. It was submerged during the latter part of the Cambrian period, following which is a blank, extending through several geological periods, concerning which no records have survived. It was above sea level in Permo-Carboniferous times when a great ice-sheet covered the land, leaving behind it great thicknesses of boulder clay and gritty sandstones that have disappeared by denudation except where protected in the deep-seated valleys of the southern portions of the Peninsula. The Mesozoic Age has left no remains, but a few isolated patches of the older Tertiary marine beds prove that the land was again under sea level in middle Tertiary times, and has apparently been above sea level and subject to subaerial waste from that time to the present.

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(1) Trans. Philos. Soc. (Roy. Soc.) S. Austr., vol. ii., p. xxix. (1879); *ibid.*, vol. iii., p. xiii.

(2) Etheridge: Trans. Roy. Soc. S. Austr., vol. xiii., p. 10, with Editorial Note by Tate.

(3) Introduction to Cliffs and Rocks at Ardrossan, Trans. Philos. Soc. (Roy. Soc.) S. Austr., vol. ii., 1879, p. 71, Sketch of Geology and Physical His. of Hund. of Cunningham, *ibid.*, vol. iv., 1882, p. 61.

It is not a region that can be easily mapped in a geological sense. The sediments spread over its surface are relatively thin, when compared with those of a like age in other parts of the country, and have been entirely removed by denudation from many parts of the area, exposing the original Pre-Cambrian floor. Peneplanation has taken place during several successive periods which has reduced the various geological elements to a common level and has spread a covering mantle of sand, clay, and travertine limestone over the whole which effectually hides the underlying rocks from view. What makes the field work of the geologist still more difficult is the absence of eroding streams, prominent land forms, and railway cuttings, so that the only rock sections available are in the sea cliffs or in well sinkings.

Proterozoic.

PRE-CAMBRIAN.

Metamorphic and igneous rocks form the basement rocks of the district (fig. 1). So far as observed they have a north and south strike with a high angle of dip. The exposure of these beds is, for the most part, inconspicuous,

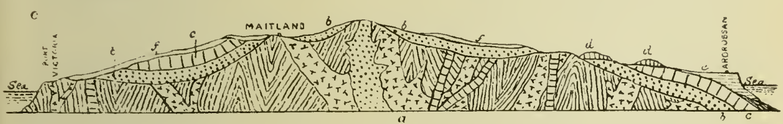

Fig. 1.

Section across Yorke Peninsula from Ardrossan to Port Victoria.

a, Pre-Cambrian Complex; *b*, Upper Cambrian Basal Grits; *c*, Upper Cambrian fossiliferous Limestone; *d*, Outliers of Lower Tertiary (Miocene) fossiliferous marine beds; *e*, Pleistocene Mottled Clay and Sandstone and silicified Grits and Conglomerates; *f*, mantle of soil and nodules of Travertine.—Howchin's "Geology of South Australia."

often occurring on cultivated land, and recognized by surface stones, or proved, at shallow depths, by borings and well sinkings, and it is certain that they cover a much greater extent of country than is represented on the official Geological Map of South Australia. In making the observations in the field, here recorded, no attempt was made to determine the extent of the Pre-Cambrian outcrops, so that the occurrences noted below are the result of casual observations met with in a general survey of the ground.

1. *Ardrossan.* At a mile and a half distance from Ardrossan, in a north-westerly direction, there is an extensive field of Pre-Cambrian outcrops, and includes the old Parara copper mine, which is on the northern side of the

main road to Arthurton. A conspicuous dyke of schorlaceous pegmatite is seen on the opposite side of the road running north and south. The country for some distance on both sides of the valley, and southwards to Dinham's quarries, is a continuous belt of igneous and metamorphic rocks, pegmatites alternating with gabbro and other basic dykes, penetrating micaceous, hornblendic, and schorlaceous schists, the latter being vertical, or nearly so.

(a) In a northerly direction the outcrops were traced through Sections 87 and 88.

(b) A costeen pit situated on, or about, Section 275, on south side of main road, showed talcose and schorlaceous schists to a depth of 4 feet, with a north and south strike, and dip 85° east; flanked on the western side by a strong dyke of pegmatite.

(c) Another costeen pit, situated on, or about, Section 277, 100 yards to the south-east of the preceding, gave a strike north-north-east and south-south-west, the beds being in vertical position.

(d) At old shaft, on Mr. Dinham's land, situated on south side of road, a little west of the Government Reservoir, the surface dumps showed talcose and chloritic schists passing into quartzite.

(e) At the back of Mr. Dinham's house a dyke of gabbro forms the bed of the road.

(f) At Mr. Allison's farmstead, situated on Section 97, a well, at the time of my visit, was being sunk near the district road, which gave the section—20 feet of red clay, 1 foot of coarse quartz grit with fossiliferous nodules from the Tertiary beds, and 4 feet of decomposing mica schist.

(g) Government bore, put down in Section 83, situated 5 miles west of Ardrossan, proved granite after passing through alternations of clay and gravel to a depth of 106 feet.

2. *Hart's Mine.* The mine is situated on the sea cliffs, a little further south than Muloowurtie Point, 8 miles from Ardrossan. The cliffs form a remarkable exposure of Pre-Cambrian rocks, mostly plutonic, and are highly coloured. The rocks are largely felspathic, large portions consisting exclusively of a massive pink felspar, which passes in places into a quartz-felspar rock, the quartz occurring in long crystals sporadically distributed through the felspar, and approaches a graphic granite. Much of the rock is coloured green, probably an epidote-syenite, and is also chloritic, in part. The syenite, in one place, was penetrated by a vein of ilmenite 2 inches in diameter. Crystals and nests of tourmaline occur, and a large rock consisting entirely of actinolite and tremolite lay upon the beach. These basement rocks are

immediately overlain by fossiliferous miocene beds, and many angular fragments of the granite, actinolite, and other of the Pre-Cambrian rocks are caught up into the base of the Tertiary beds forming a breccia of highly contrasted colours. On the north side of the exposure the beds have been greatly disturbed, and a most peculiar rock of flinty character with mammillary structure forms most of the sea cliff. There are also, in the same place, thick layers of ironstone which interpenetrate the granite rock both as sheets and as reticulations through the stone.

On the western side of Hart's mine, a little to the south, the granite is seen on the south road, and can be traced by surface stones into Section 43. The stone is a reddish, felspathic, and microcrystalline granite or granulite. On Mr. Rowe's land (Sections 103 and 104, Muloowurtie), 6 miles to the westward of Hart's mine, the surface of the ploughed land is covered with a similar fine-textured, granulitic granite, and also at the four cross roads that unite Sections 73, 74, 52, and 53 in the same neighbourhood. All these are evidently an extension of the granitic rocks seen on the beach near Hart's mine.

3. *Winulta Creek.* The Pre-Cambrian rocks are extensively developed on the border of the Hundreds of Cunningham and Tiparra, occupying, for the most part, the sides and bottom of the Winulta Valley. The features are chiefly those of a coarse pegmatite with graphic granite, in both coarse and fine varieties, and some schistose rocks. The bottom of the valley, near to the school-house, is occupied by a fine-grained pinkish syenite, which has much the appearance of a pinkish sandstone, with an exposed face that is 12 feet in thickness and 150 yards in length. Quartz veins, and a breccia included in a quartz matrix, were noticed. The rocks are usually much decomposed and in process of disintegration; granitic sand covers the sides of the hills and the valley bottom. The Pre-Cambrian rocks appear to extend for several miles in a westerly direction and, on the rises, are capped by the Cambrian basal grits and conglomerates.

4. *Weetulta.* A Government bore, put down on Section 342, Hundred of Tiparra, 16 miles almost due west of Winulta and 9 miles west of Arthurton, proved the granite, after passing through red clay and indurated gravel, at a depth of 36 feet.

5. *Arthurton.* Situated between Weetulta and Winulta. Mr. Cornish, of Maitland, forwarded to me a sample of rock from this locality which proved to be a fine-grained granite, or granulite, a common type of granite in the Ardrossan district.

6. *Maitland.* The township of Maitland is built on a floor of Pre-Cambrian rocks. Granite is seen in a shallow road-cutting on the eastern side of the township, but is masked at a slightly higher elevation by recent sediments. Two Government bores supply the following sections:—

(a) On the west park lands of the township the bore penetrated clay, limestone, and indurated sandy clay to a depth of 51 feet, when the granite was entered.

(b) Maitland "No. 1 Bore," situated at the north-eastern corner of Section 72, 1½ miles west of Maitland, passed through Recent and Cambrian beds to a depth of 199 feet before the granite was reached.

7. *Yorke Valley, Eastern Ridge.* About 14 miles west of Ardrossan and 2 miles east of Maitland, a low ridge, forming the eastern boundary of Yorke Valley, runs for many miles in a north and south direction. This ridge was examined on both sides of the main east and west road. Going in a northerly direction, by way of Sections 287 and 219, for about 2 miles, mostly over cultivated land, low outcrops and stony patches of the Pre-Cambrian rocks were observed, including pegmatite, graphic granite, felspathic, and schistose rocks. From the inconspicuousness of the outcrops the lie of the beds could not be very definitely determined, but the strike is apparently north and south, and the dip, averaging about 80°, is sometimes east and sometimes west. On the same side of the ridge, but at a lower level, a well was being sunk at the time of my visit in Mr. Wundersitz's yard (Section 214), which showed the following section:—Clay, 25 feet; decomposing mica-schist, 10 feet. This well is situated only slightly below a capping of Cambrian basal grits.

Retracing one's steps to the main road, the ridge was examined on the southern side of that boundary, through Section 212. Granite rocks were seen in patches as far as observations were carried out in that direction, and were of similar types to those seen on the northern side of the main road. From reports of the local residents this eastern ridge of the Yorke Valley carries outcrops of the granitic and metamorphic rocks for many miles.

8. *Yorke Valley, Western Ridge.* The main south road, between Maitland and Yorketown, passes along the Yorke Valley. On the western side of this road there is a low ridge, or scarp, corresponding to that on its eastern side. There is a greater cover of Cambrian rocks on the western ridge than on the eastern, but about 5 miles to the southward of Maitland, in Section 19E, an outcrop of granite was noted. The rock occurs *in situ* as well as in spheroidal lumps and

free stones of a like kind, extending north and south, with the Cambrian basal grits occurring on the rising ground.

9. *Port Victoria.* The township is situated on Spencer Gulf, in the Hundred of Wauraltee, about 14 miles to the south-west of Maitland. There is an extensive development of a Pre-Cambrian complex, on both sides of the jetty, on the beach as well as forming cliffs. The chief rock is a pinkish felsite, passing into syenite, often carrying layers and segregations of epidote; various schists (biotite schist and hornblende schist make strong contrasts of colour with the felsites and syenites), gneissic schist, and spotted schist, the last-named being very common. Close-grained felsitic veins penetrate the mass at all angles, and a gabbro, with coarse crystals of diallage and pinkish felspar, makes a striking feature. No typical granite was seen in outcrop, but one or two large coarse-grained granite boulders occurred on the south side of the jetty, indicating a local outcrop not far distant.

The angle of schistosity is high and the rock commonly weathers into strong ridges. The cliffs, which are of no great height, show vertical folia in relief. The rocks make no surface features beyond the edge of the cliffs, while the country behind is typical of the district, showing a light surface soil with much nodular travertine.

Palaeozoic.

UPPER CAMBRIAN.

Basal Grits and Conglomerates.

These beds may be briefly described as very siliceous, quartzose, gritty, passing into conglomerates, sometimes ferruginous, somewhat open in texture near the surface (probably from the loss of ingredients by weathering), and generally contain rounded or angular fragments of felspar which are weathered to an opaque white. These inclusions are most numerous where there are outcrops of pegmatite in close proximity, as at Wundersitz's quarry, near Maitland, and in the Winulta Creek.

The stratigraphical position of these grits is capable of proof. In several cases they are seen to rest directly upon the Pre-Cambrian rocks. Although in no case, to my knowledge, are their outcrops seen in close conjunction with the Cambrian limestones, yet the Maitland No. 1 Bore shows them interbedded between the Pre-Cambrian granite below and the grey crystalline limestone above, where they have a thickness of 51 feet; and on the western ridge of Yorke Valley the limestones are seen (as surface stones) in close proximity to the basal grits.

The bedding, so far as it can be tested in shallow workings, is approximately level, and the dip, when present, is slight, various, and local. It is the most characteristic formation on high ground throughout the district, but is recognized chiefly by angular stones scattered over the surface of the ground. It forms the principal building stone of the neighbourhood, but the quarries from which it is won are level with the ground. Its material undoubtedly represents the waste of the coarse pegmatites which form the dominant rocks of the crystalline series of the district.

The following outcrops, among others, were noted:—

1. *Dinham's Quarry* (pl. xix.). Situated within 2 miles of Ardrossan, towards the north-west angle of Section 77, behind Mr. Dinham's house. The stone is worked in two quarries that are parallel to each other, each quarry having a face of about 8 feet in height, with the stone dipping into the hill. The dip is south 10° east, at about 15°. The outcrop can be traced along the foot of the hill for at least half a mile to the westward of the quarries, where it passes into scrub country and is replaced by reddish sand, which is probably the decomposed remnants of the same rock. About one-eighth of a mile to the west of Dinham's quarries a small exposure of the rock is seen in a trial pit, and here the beds are apparently level.

The rock is bedded but differs greatly in the size of grain within short distances, from a fine siliceous sandstone to small gravel. The stone is much jointed, but no quartz veins were noticed. A thin slate-band occurs in one part of the quarry. Near the eastern end of the southern quarry there is a brecciated dyke which penetrates the bedding at right angles, caused by two parallel faults with displacement between the walls, which are smooth, and the pseudo-dyke is made up of broken fragments of the bed rock cemented together. The dyke has a thickness of 18 inches near the top, but widens in its downward extension. The quarrymen have left this dyke standing whilst removing the stone from either side, so that it projects 9 feet from the face of the wall of the quarry, and can be traced at surface for a distance of 32 yards.

On the northern side of the quarries the igneous and schistose rocks of the Pre-Cambrian, with discordant dip and strike, are seen to outcrop and come close up to the grits, the angular fragments of each class of rock blending in great numbers at the line of junction, but the intrusive rocks do not penetrate the grits. The rise at the back of the quarries is covered by fossiliferous Miocene cherts and travertine. The Cambrian limestones outcrop in a position 1½ miles to the southward, in the same direction as the dip seen in Dinham's quarry, and therefore should bring the grits below the limestones.

2. *Cane's Quarry.* Situated 3½ miles north of Ardrossan, in the north-west angle of Section 95 (Hundred of Cunningham). The quarry, which is worked for building stone, is on a low ridge that crosses the east and west district road from Tiddy Widdy. The outcrops can be seen on both sides of the road, and covering these, at a slightly higher level on the western side, the ground is strewn with nodular travertine. The quarry stone is very siliceous, variable in the grain, regularly bedded, sometimes cross-bedded, more or less laminated, especially near the surface. It is roughly jointed in vertical or slightly oblique directions. The exposed quarry face measures 10 feet in height and the bedding has a dip to north-east at 15°.

3. *Whittaker's Quarry.* This is situated 4 miles in a direct line to the north-west of the preceding example, in Section 151, on the northern side of the east and west district road and nearly opposite Mr. Whittaker's house, which was built from this quarry. The outcrop is on a slight rise in the ground. The stone exposed in the quarry is 5 feet in thickness, whitish in colour, and of a gritty texture, including fragments of felspar. No dip could be recognized.

4. *Winulta Creek.* There is a great development of the Cambrian basal grits on the borders of the Hundreds of Cunningham and Tiparra, the most extensive seen in the district. The Winulta Creek is a wide, open waterway, with the Pre-Cambrian rocks forming the floor and lower slopes, on either side, and the Cambrian grits forming cappings on the higher ground. On the southern side of the valley, not far from the public school, and about 30 feet from the bottom of the valley, a quarry (Short's) shows coarse grit passing into conglomerates having a 3-feet face of stone. Angular surface stones, of the same kind, mixed with travertine can be traced to the top of the rise.

On the north side of the valley, at the same place, a prominent spur marks a strong outcrop of the beds on that side, estimated to be 50 feet in thickness. Conglomerates are interbedded with the grits (pl. xx.). Almost all the included stones consist of quartz, which are rounded and reach a maximum size of hen's eggs. There is only a small proportion of cement between the stones, which, however, is strong. The beds continue as a capping to the ridge for a considerable distance and produce some very broken and rough ground. A very large block on the summit gives a dip of 20° to the south-south-west, but I doubt whether this is true dip, and may have arisen from a slide, or otherwise an uneven floor on which deposition took place.

The same remarkable conglomerate is seen on the next spur of the hills, about half a mile to the north-west, where it is of considerable thickness and makes a very rough and broken outcrop. Further up the rise is a quarry (also Short's) which is about 120 feet above the creek level. The stone is a gritty sandstone similar to that on the southern side of the valley, containing much felspathic material, and the dip in this quarry is apparently in the form of a shallow syncline. The stone used in the building of the Winulta school-house was obtained from the two quarries referred to.

The unconformity between the Pre-Cambrian complex and the overlying Cambrian grits in this neighbourhood is very distinct.

5. *East of Winulta.* The basal grits show again on the north and south road that divides the Hundreds of Tiparra and Clinton. At a point, little more than a mile to the northward of the south-east angle of the Hundred of Tiparra, the beds outcrop, close to the road, on Section 356.

6. *Weetulta.* A Government bore put down on Section 342 (Tiparra), situated about 16 miles to the westward of Winulta, gave the following section:—

	ft.	in.
Surface soil and limestone ...	4	0
Red clay	16	6
Indurated gravel (basal grits)	15	6
Granite	76	9 (not bottomed)

7. *Three miles west of Ardrossan, on the Maitland Road.* The basal grits outcrop in Sections 41 and 80 where they cross the Maitland road as a low ridge in a north-east and south-west direction. The outcrop is almost even with the surface of the ground, covers a wide area, and exposes stones of large size. The adjacent land carries a light soil more or less strewn with nodules of travertine limestone.

8. *Wundersitz's Quarry.* This is a well-known quarry, situated on the western flanks of the Yorke Valley (eastern) ridge, 14 miles west of Ardrossan and 2 miles east of Maitland. It is within about 200 yards of the well sunk in mica-schist (mentioned on page 190) near Mr. Wundersitz's house. The quarry has a wall-face of about 10 feet in height, and the beds have a gentle roll with a slight dip to the west. The stone is usually coarse and gritty with a considerable quantity of fragmental felspar, which sometimes gives colour to the stone, which is white to reddish. The grit is said to rest on a reddish, sandy, and kaolinized clay, which has been proved by boring to be at least 6 feet in thickness. This

clay is probably the decomposed covering which formed the Pre-Cambrian floor on which the basal grits were laid down.

9. *Maitland.* The Maitland No. 1 Bore, put down about a mile from the township on its western side, proved the basal grits at that place to have a thickness of 51 feet (see page 202).

10. *Yorke Valley, Western Ridge.* About 5 to 6 miles to the southward of Maitland there is an interesting series of outcrops of the Cambrian rocks along this ridge. The top of the ridge shows outcrops of the basal grits which have been quarried for building stones in Section 16 (Hundred of Maitland) and other places. It was followed in a continuous outcrop through the properties of Messrs. William Greenslade, Joseph Kelly, and A. W. Jarrett, in Sections 1, 16, 19W, 19E, etc. Within the area mentioned the granite is seen to underlie the grits on the one side, and the Cambrian limestones to overlie them on the other.

11. *Henderson's Quarry.* I am indebted to the Rev. J. R. Andrew for the information that a quarry (owned by Mr. Henderson), in the basal grits, occurs on the north side of Section 53, Hundred of Muloowurtie, about 3 miles due west from Rogues Point. The Pre-Cambrian igneous rocks occur a little to the south of this quarry.

12. *Port Hughes.* In October, 1905, a visit was paid to Port Hughes, near Moonta, where the basal grits of the Cambrian series were seen to outcrop on the beach, and the following observations were made. The beds consist of coarse conglomerates and silicious gritty quartzites. The included pebbles consist almost entirely of quartz, much worn and rounded, and the beds generally closely resemble the basal grits as they occur at Winulta Creek. In certain zones the rock has been much fractured and the cracks subsequently filled with quartz, forming veins that intersect the matrix and pebbles without distinction. (Dip N. 20° W. at 12°).(4)

Limestones.

The Cambrian limestones (in common with the other geological outcrops) of Yorke Peninsula make no very prominent features in the landscape and give only limited sections at the surface; it is, therefore, somewhat difficult to obtain an unquestionable order of succession for the respective members of the series. This defect is, in part,

(4) For further geological information on this part of Yorke Peninsula see the comprehensive and detailed descriptions given by the Assistant Government Geologist (Mr. R. Lockhart Jack) in The Geology of the Moonta and Wallaroo Mining District, Bull. No. 6, Department of Mines, 1917.

met by Government borings in the district which will be described below.

On the evidences obtained the limestones may be classed under three divisions:—

Upper — Dark-coloured, impure, pteropod-trilobite limestones.

Middle — White, yellow, and pinkish marbles (Archaeocyathine marbles in part).

Lower — White and yellow granular-crystalline Dolomites.

The following are brief descriptions of all the exposures of these beds which have come under my notice in the neighbourhood:—

UPPER AND MIDDLE (FOSSILIFEROUS) BEDS.

1. *Horse Gully.* The most complete and interesting section of the Cambrian limestones within the district occurs at Horse (or Pavey) Gully, situated a little to the southward of Parara Head Station and 3 miles southward of Ardrossan. It forms the deepest eroded valley in the district, with sloping sides and rocky terraces, that have a maximum height of about 200 feet. The gully, in its exit to the sea and lower portions, possesses clay banks, and these continue in an upstream direction for about a quarter of a mile to the westward of the main road, beyond which the limestones make a sudden appearance in the floor and sides of the valley. The gully intersects the limestones, in an east and west direction, for about a mile and a half. The beds roll by slight synclinal and anticlinal curves, at an average angle of about 12°, which increases somewhat as the beds pass eastwards before their disappearance below sea-level. The stronger beds make small scarp-faces on the sides of the valley, and in the case of one such prominent outcrop that encircles an isolated hill near its summit, there is a striking resemblance to a monk's tonsure. This feature illustrates the approximate horizontality of the beds.

The best section occurs soon after the appearance of the limestones in the lower part of the valley, where an anticline brings into view a great thickness of beds, and the following order can be observed on the northern side of the valley:—

	Thickness in feet.
(a) At the summit is a capping of Tertiary chert, crowded with the casts of *Turritella aldingae*, forming a hill that is conspicuous from its conical form and growth of sheaoaks	50

Unconformity.

(b)	An ironstone layer on top of Cambrian limestone, probably metasomatic	1
(c)	Bluish, somewhat earthy, pteropod limestone, containing numerous small pteropods and fragments of trilobites, which weather in relief ...	30
(d)	Rubbly impure limestone; the included earthy material weathers in relief, fossils scarce ...	40
(e)	Hard siliceous limestone with impurities, fossils scarce	15
(f)	White and yellow crypto-crystalline, marble-like rock, has a clean and smooth fracture, no fossils observed at this spot (lowest bed exposed)	50
		186

In ascending the gully the siliceous and marble-like limestones, shown in the lower portions of the above section, continue to occupy the bottom of the valley and contain, sparingly, small brachiopod and molluscan remains. The limestone is sometimes laminated and pseudo-brecciated. The Archaeocyathinae make their appearance near the head of the gully, where the valley opens out before reaching the north and south district road that makes the western boundary of Section 22, a little east of the phosphate mine. The fossiliferous beds are in outcrop on the hillsides, and also in patches on cultivated land, where the stones collected from the ploughed land are gathered into heaps and make good hunting ground for fossils. The stone carrying the Archaeocyathinae is a whitish and pinkish marble which has a freer fracture than the bluish pteropod limestone, and weathers to a smooth surface. With the exception of scattered sponge spicules, which sometimes appear in relief on the weathered surfaces, no fossils other than the Archaeocyathinae were found in the limestone. Lithologically, the matrix bears a close resemblance to the marble-like rock that forms the lowest member *(f)* of the series shown in the section given above, and in which no fossils were observed. They may possibly be on the same horizon. The western outcrop, so far as could be judged, forms the axis of an anticline, as is the case with the beds referred to in the detailed section. The Archaeocyathinae have a very local development, and in many cases the fossils merge into indistinctness, as though in course of absorption into the structureless matrix. It is possible that this process of absorption of fossiliferous structures has been effectively carried out in the case of the similar marble-like limestone lower down the gully, and accounts for its nonfossiliferous condition. Associated with the Archaeocyathinae limestones are layers and nodules of cherts of various colours—reddish, greenish, dark coloured, etc.

2. *Pebbles on Beach at Ardrossan.* One of the most remarkable features of the district is the occurrence of sea-worn pebbles of the fossiliferous Cambrian limestones that are strewn along the beach over a length of several miles. They occur mostly on the southern side of the jetty and for a distance of half a mile from the latter; the pebbles have been mainly derived from the grey and pinkish marbles that contain the remains of the Archaeocyathinae. The homogeneous nature of the rock causes it to wear with a smooth surface that shows up the structure of the included fossils to perfection. It was here that the occurrence of the Archaeocyathinae in our older rocks first attracted attention in South Australia. On a stony spit, exposed at low water, about three-quarters of a mile to the southward of the Ardrossan jetty, the stones are of a more earthy kind, having been derived from the pteropod-trilobite limestones that overlie the grey and yellow marbles. Unlike the Archaeocyathinae pebbles the former are deeply etched by the action of the sea water, and consequently present a very rough surface with the impurities in the limestone, as well as the fossils, standing out in strong relief. It is a curious feature that while the upper surfaces of these pebbles are deeply incised, the undersides, that have been sunken in the sand, are relatively smooth. At Parara, 2 miles to the southward of Ardrossan, there is a clay platform, uncovered at low water, that extends for a mile out to sea. Here again there are stony spits of shingle, resting on the clay floor, among which are numerous angular stones of Cambrian limestone, including the crystalline varieties as well as the impure bluish pteropod limestones, some examples of which measured 2 feet in diameter.

The origin of these fossiliferous beach stones raises an interesting question. To account for their presence on the beach one or two explanations appear to be possible:—*(a)* River transport, or *(b)* outcrops of Cambrian limestones below sea level but within the limits of wave action. In support of the first of these suggestions, the parent rock is in the neighbourhood, and, under ordinary circumstances, their presence on the beach could be easily explained by stream erosion carrying the land waste to the sea; but such a transporting force has no existence in the neighbourhood at the present time. Horse Gully is the deepest and longest gully in the locality, and has undoubtedly been excavated by running water, and further, it is equally certain that the transported material in the excavation of the gully must have found its way into the valley of the gulf. If the stones on the beach came from the head of this gully, where a similar rock is *in situ*, then the questions arise, When did this transport take place? and, Why is not a similar agency in operation at the present time?

At the present time there are no permanent streams on Yorke Peninsula and practically no land drainage reaches the sea. Horse Gully is grass grown, and at its mouth the only evidence of stream transportation is in the form of a narrow band, about 2 feet in width, containing small stones of less size than marbles, whilst the rest of the bottom is covered with grass. On the testimony of the oldest residents, covering fifty years of experience, there has never been sufficient water in the gully to transport the smallest stones within their knowledge. The Archaeocyathinae pebbles on the beach are usually from 6 to 9 inches in diameter, with larger stones of the impure variety, which would require a considerable body of water for transport.

The possibility of the pebbles having been derived from rocky reefs through wave action is at present incapable of proof. The sea cliffs consist of clay of unknown thickness, and no investigations for testing the presence of such reefs have been carried out along the littoral and shallow margins. The more plausible suggestion seems to be that of stream erosion and delivery at some past time, and the present relatively dry condition of Horse Gully, and others of a like kind in the neighbourhood, may arise from underground channels and caves in the limestones by which the existing drainage finds a passage downwards instead of to the sea.

3. *Dowlingville.* At Thompson's Hut, Section 128 (Hundred of Cunningham) strong exposures of Cambrian limestone occur in the bottom and sides of a shallow creek, close to the main road, near Dowlingville. The outcrop measures 160 yards in length by 40 yards in width; strike, north-north-west to south-south-east; dip, 25° easterly. The stone is a dark, bluish-grey limestone, exactly corresponding to the fossiliferous beds of Horse Gully, and is sparingly fossiliferous; the only other example than that of Horse Gully of a fossiliferous Cambrian limestone within the area under observation. Little time could be devoted to fossil hunting, but several fragments of trilobites were detected in the stone. The rise on the southern side of the valley, under which the limestone passes, is thickly strewn with travertine.

LOWER LIMESTONE (DOLOMITIC).

The lowest member of the Cambrian limestones in the neighbourhood of Ardrossan is a finely granular, white or yellowish dolomitic rock. Its position in the series is defined by the Maitland No. 1 Bore (see page 202), and from the following analysis, kindly undertaken by Mr. W. S. Chapman, of the Adelaide School of Mines, it is shown to be a true dolomite:—

	Per cent.
Insoluble matter	0·88
Ferric oxide	0·67
Alumina	0·45
Calcium carbonate	54·10
Magnesium carbonate	43·51
	99·61

This is the most widely distributed member of the Cambrian limestones throughout the district (the newer beds having aparently been removed by denudation), and preserves a general uniformity of chemical and physical characteristics in all its exposures. The following are the chief localities where its outcrops can be seen:—

1. *Eastern Scarp of Coastal Ridge.* A low range with its scarp facing the sea is continuous from Horse Gully to Ardrossan. The dolomitic rock rises from beneath the marble on the northern side of Horse Gully, and has been quarried on Cliff's farm (formerly Mrs. Naughton's land), almost in a direct line with Parara Head Station. It is here a white, crystalline dolomite, with a dip west at 38°, and a little further to the westward the dip changes to the southwest at 19°. Excellent exposures are seen in a small transverse gully, about half a mile to the northward of the quarry just referred to, where the stone is a yellowish, granular dolomite (penetrated by ferro-manganese stains), with a dip of 35° facing 40° east of south. In the next gully, a little further to the northward, the beds have a south-westerly dip at 30°, and continue in outcrop along the slopes of the ridge, until they cross the Maitland road, and disappear from sight on the western side of the Ardrossan Cemetery.

2. *Rogues Gully.* Situated 2½ miles to the southward of Horse Gully and about 6 miles from Ardrossan. Deep gullies, now permanently dry, have been excavated in the dolomite beds, but as the country is covered by dense scrub it is unfavourable for geological observations. The hillsides are covered with surface rubble, but no large faces of stone are exposed, and consequently no reading of dip could be taken. The stone is saccharoidal in texture, grey or yellowish in colour, and at surface often soft through partial decomposition. The base of the beds is not exposed, but as they occupy the whole of the main and lateral gullies to the top of the adjoining heights, their thickness is estimated at not less than 100 feet.

3. *"Sliding Rocks"* (pl. xxi.). These rocks occur as an isolated exposure on the beach, 1½ miles to the southward of Rogues Point (at the outlet of Rogues Gully), and a little to the north of Muloowurtie Point, in Section 49. The rocks make a bold ridge, 20 feet in thickness, with a strike almost due north and south and a dip east, 10° south, at 40°. The beach at this spot is narrow, and the Cambrian beds are overlain in the cliff face by horizontal strata of soft decomposing fossiliferous (Miocene) sandstones and arenaceous clays. The isolated character of the outcrop, the tabular form of the bedding, and the high dip of the beds as they pass below sea level have given rise to the descriptive name by which they are known as "sliding rocks." The beds are characteristic of the lower or granular-crystalline (dolomitic) portion of the Cambrian series.

4. *Montgomery's.* This area is situated 14 miles to the northward of Ardrossan, near the boundaries of the Hundreds of Cunningham and Clinton. A ridge of the Cambrian dolomites extends from Mr. Montgomery's farmstead (Section 172) northwards, through Section 182, into the Hundred of Clinton, and is said to occur at intervals in that direction for a good many miles. It was also traced in a westward direction, across the public road and in rises, still further to the west, in Section 173, giving a breadth of three-quarters of a mile.

In driving over the paddocks in a north-westerly direction the ground was spotted by numerous "swallows" (saucer shaped) with "crab holes," down which the water is said to rush freely in wet weather, a certain evidence of underlying limestones. If these "swallows" mark the presence of the Cambrian limestone it must have a breadth of not less than 2 miles over that country.

The stone, for the most part, is buff coloured and saccharoidal in texture, containing numerous cavities lined with crystals. It is much broken by joint planes, which are coated of a black colour, probably caused by a thin film of manganese oxide.

Over this extensive area no section could be seen sufficiently exposed to show the dip of the beds. The outcrops are marked either by flat, tabular patches, or otherwise by loose surface fragments. In Mr. Montgomery's yard, near the junction of roads (Section 172s), there is a limekiln that has been excavated in the beds and exposes about 4 feet of rock. So far as could be judged from this limited section the beds have a slight dip to the north-west.

5. *Yorke Valley.* The main road from Maitland to Yorketown follows this valley bordered by low ridges on

either side. The western ridge for several miles shows outcrops of the Pre-Cambrian basement and the Cambrian basal grits (see pages 190 and 195). At 6 miles from Maitland, in passing from Section 16 to Section 1 (Hundred of Maitland), a great change of surface features and soil occurs. In the first-named section there is little or no travertine visible, but a reddish, gritty soil, resulting from the breaking down of the basal grits; while in the latter section the ground is strewn with concretionary travertine, accompanied by a light and soft soil. On the northern side of Section 1, near Urania Head Station, evidences of the Cambrian limestone occur in the form of surface stones, often carrying a crust of travertine limestone. These are most numerous on the ground skirting the eastern side of the range, and in places are brought to the surface by the burrowing of rabbits. The rock is a characteristic brownish and yellowish saccharoidal dolomite, which apparently overlies the basal grits that outcrop along its borders.

6. *Maitland No. 1 Bore.* This bore was put down by the Government at the northern end of Section 72E, situated a little more than a mile to the westward of the township. The following is the official record of the beds passed through:—

	Thickness of strata.		Depth from surface.	
	ft.	in.	ft.	in.
Cainozoic—				
Surface soil red loam	3	6	3	6
Clay and limestone	32	0	35	6
Palaeozoic—				
Grey crystalline limestone	74	6	110	0
Grey crystalline limestone, with bands of light-blue micaceous clay rock ...	12	6	122	6
Grey crystalline limestone	5	6	128	0
Red argillaceous rock, with few specks of mica	20	0	148	0
Red crystalline limestone (see below) intermixed with quartz and felspar	51	0	199	0
Archaean—				
Red granite	41	0	240	0
Gneiss and granite	26	0	266	0

By the courtesy of the officer in charge I was permitted to examine the samples from this bore in the Engineer-in-Chief's Department, when it was found that "grey crystalline limestone," recorded from the depths 35 feet 6 inches to 128 feet (=92 feet 6 inches) represented the dolomite or lowest member of the Cambrian limestone series; the "red argillaceous rock" was a typical form of the purple slates series; while the so-called "red crystalline limestone, intermixed with quartz and felspar," contained *no limestone*, but was a typical example of the coarse basal grits found throughout the district as the lowest member of the Cambrian System.

This bore supplies important information on the geology of the district which is not otherwise available. Not only does it prove the existence of Cambrian beds in a locality where there is no surface indications of their presence, but it also supplies evidence in relation to *(a)* the position and thickness of the (basal) grits; *(b)* the dolomites as ocupying a position next to the basal grits in an ascending order of occurrence; *(c)* typical examples of purple slate interbedded with the dolomites; *(d)* the thickness of the dolomitic rocks to be something over 90 feet; none of which particulars can be definitely obtained at the surface in any part of the district. As the upper limits of the dolomite in the bore section is shown to be a surface of erosion, it is most likely that the original thickness of these beds exceeds the measurements given in the section.

Cainozoic.

No beds of an age between the Upper Cambrian and the Mid-Cainozoic, or Miocene, occur in that portion of Yorke Peninsula to which these notes refer. The Permo-Carboniferous glacial clays and erratics, which occur over wide areas in the southern portions of the Peninsula, have not been noted so far north as Ardrossan, while the geological formations that are newer than the Upper Cambrian occur within the district only as fragmentary and isolated outcrops that are remnants of much more extensive deposits.

MIOCENE.

So far as the district under notice is concerned the older fossiliferous beds of Cainozoic age are limited in their occurrence to the eastern seaboard, and are found in two parallel strips of different elevations; one of these is situated on the eastern edge of the central plateau, facing the sea, and the other occurs at or near sea level. In the case of the high-level deposits the material is limited to scattered surface stones, found on cultivated land, at an elevation of from 200 to 300 feet above sea level. These free stones are in the form of a yellowish chert, and the fossils, which are in the same material, are mainly in the form of casts. The common fossil in these cherty fragments is *Turritella aldingae*, which occurs in great numbers, and fixes the geological horizon as that of the Turritella clays and cherts of Aldinga and other places on both sides of Gulf St. Vincent, which are now considered to be of Miocene Age.

1. *The High-level Outcrops.* The top of the banks on the northern side of Horse Gully are capped by these Miocene cherts, especially the prominent knoll of the Sheaoak Hill, which is included in the section given on page 196. Similar outcrops occur at intervals on the higher ground, going northward; and after crossing the Maitland road, 1 mile from Ardrossan, surface stones belonging to these beds cover a considerable area in the neighbourhood of Dinham's quarries, where a fine example of the rare fossil, *Pleurotomaria,* was obtained. These high-level occurrences extend in a north and south direction for a distance of about 3½ miles. At Horse Gully the fossiliferous cherts rest on the Cambrian pteropod limestones, while at Dinham's they rest on the Cambrian basal grits.

2. *Outcrops at sea level.* At Rogues Point, about 5 miles to the southward of Ardrossan, the fossiliferous Miocene beds make their appearance on the beach, and from thence, for about 2 miles to the southward, they make an almost continuous feature along the beach. At the first small point in the sea cliffs, to the southward of the old jetty at Rogues Point, highly siliceous Turritella beds occupy the beach and slope upwards to the base of the cliffs, which are formed of recent deposits. At a quarter of a mile distance, in a southerly direction, near Meninie Hill, there is another exposure of these beds, highly silicified, and situated at sea level. A little further south, near a small creek, the Tertiary beds make a cliff 20 feet in height and are divided up into hard and soft layers. The silification has followed certain horizons where we find Turritella cherts forming beds about a foot in thickness, and these are separated by glauconitic clays of somewhat greater thickness, which are coloured green or red, according to the measure of oxidation to which the glauconite has been subjected. These glauconitic clays appear to be unfossiliferous, but scattered through them are cherty concretions and bifurcating cylindrical forms containing impressions and casts of fossil shells.

As the beds pass more to the southward they have a low dip to the south, and the mottled clays, which have such a striking development in the cliffs near Ardrossan, put in an appearance overlying the fossiliferous beds, attaining a thickness in the cliff face of 20 feet. Before reaching the next small projecting point in the cliffs, at the northern fence of Section 49, the consolidated freshwater sands replace the mottled clays and rest immediately on the fossiliferous Miocene.

To the southward of the last-named point the Miocene beds roll slightly, in long curves, with a maximum dip of

5°, and make a more important feature in the cea cliffs. The beds now have the form of soft, yellowish, sandy clays, and continue to "Sliding Rocks," already described (see page 201).

The Miocene beds continue to outcrop at intervals in the same direction. Near Muloowurtie Point they are so highly glauconitic that on the flat they have the appearance of a green tablecloth. At Hart's Mine, on the coast, they rest immediately on the Pre-Cambrian complex, the divisional line being a brecciated zone in which fragments of the basement rock are included in the lower portions of the Tertiary beds. They are also seen at Rocky Point, 4 miles to the southward of Hart's Mine, where they underlie the freshwater consolidated sands and pass below sea level.

PLEISTOCENE.

Not the least interesting of the geological features of this district is the occurrence of certain freshwater deposits that are of considerable antiquity. They occur as surface features in two positions. One of these is along the escarpment of the coastal ridge, near Ardrossan, and the other occurs on the beach or exposed in the sea cliffs. They represent three distinct lithological types, and probably belong to three distinct stages in relation to geological occurrence. The oldest of these are highly siliceous sands and fine gravels occurring at high levels. The intermediate in age consist of more or less consolidated sands that occur at a few places in the sea cliffs, and the newest in variegated and mottled sandy-clay typically developed in the cliffs near Ardrossan.

(a) THE OLDER SERIES.

1. *The high-level occurrences* of these beds follow a lineal course skirting the eastern flanks of the coastal ridge (pl. xxii.) from near Parara to Mr. Dinham's farm, a distance of 3 miles, the beds being about half a mile distant from the sea in the former case and 2 miles in the latter. Their most southerly exposure (pl. xxiii.) is on the northern side of the district road that runs west from Parara sheep station, past the house on Cliff's farm (late Naughton's). In this locality three outcrops of the beds occur at different levels (fig. 2), showing a vertical range in elevation of about 100 feet. Similar outcrops occur at intervals along the face of the ridge (pls. xxiv. and xxv.), some of which are several acres in extent, and pass upwards to the edge of the plateau on cultivated ground, giving a width of about one-third of a mile. Some large boulders of this rock can be seen on the

southern side of the Maitland road, about a mile from Ardrossan. The most northerly examples noted were patches of large rounded stones in the paddocks on either side of the private road going up to Mr. Dinham's farmstead in Section 77.

Lithologically, the beds give evidence of having been laid down under alluvial conditions, the fragmental material varying from fine sand to small quartz-gravel in grades up to 1 inch in diameter. The sedimentation shows rapid changes in short distances, both vertically and horizontally, and is frequently current-bedded. An extensive silicification has taken place over wide areas by the introduction of secondary silica that has converted the open sediments into a very compact, vitreous rock, with conchoidal fracture, and by blending the original quartz material with the siliceous cement makes a true quartzite. The cement is sometimes of a ferruginous character. The weathering of

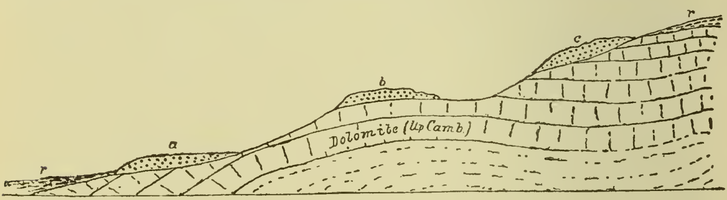

Fig. 2.

Diagrammatic Section showing 3 patches of consolidated ancient river alluvia (resting on Upper Cambrian Dolomite) at successive altitudes; *a*, *b*, *c*, consolidated river deposits; *r*, *r*, Recent mantle rock. Near district road, opposite Parara Head Station.

the rock varies according to the measure of siliceous penetration. With a high proportion of introduced silica the weathering is spheroidal (pl. xxiii.) in large blocks and smooth surfaces, as occurs at the southern end of the outcrops near Parara. With less cement the clastic portions become prominent and the stone takes on a gritty appearance. About midway between Parara and Ardrossan a portion of these beds are in a perfectly loose condition, not having passed through the processes of consolidation, and are worked as sand and gravel pits. In places a line of demarcation can be seen with consolidated sands on the one side and loose sand on the other. The breaks in the continuity of these beds have undoubtedly arisen from the weathering and removal of the looser portions of the sediments. On account of the irregular action in the silicification of the beds the outcrops sometimes weather into prominent and grotesque figures, and by the weathering-out of soft pockets on flat surfaces there are so-called human "footprints" to be seen, as often happens in cases of this kind.

Along the coastal escarpment the consolidated alluvia rest unconformably on the dolomite, or lowest member of the Cambrian limestones. In some places the silicified grits are seen to fill the joints in the Cambrian dolomite on which they rest, forming pseudo-dykes, varying in width from 1 foot to several yards. Near Dinham's they are in close proximity to the Tertiary cherts, which they apparently overlie. The upper limits of the deposits are estimated at about 300 feet above sea level.

The occurrence of two sets of siliceous grits in close proximity was at first a little confusing, notwithstanding the great disparity which exists in their respective ages, and it required a general examination of the geological area before definite conclusions could be reached with respect to their stratigraphical relationships. It is, therefore, not to be wondered at that Mr. Tepper, in his pioneer papers on the geology of the neighbourhood, should have failed to recognize the distinction which exists between the two sets of grits, and placed them in one category as "Ardrossan grits." If examples taken from the respective beds be promiscuously mixed together it becomes almost impossible to discriminate which examples are Cambrian and which are Pleistocene. The newer beds are often the more siliceous and ancient looking. Apart from the evidence in the field the chief points of distinction are: (1) the Cambrian basal grits are usually more or less arkose in their composition, including a proportion of clastic felspar, while in the alluvial grits there is an absence of felspar and the granular constituents are represented almost exclusively by quartz; and (2) the Cambrian grits are distinctly bedded, sometimes laminated and fissile, while the alluvial grits present no fissile bedding planes and form spheroidal and solid siliceous masses or massive rocks with irregular weathering. This difference is recognized in a practical way in the neighbourhood, for whilst the basal grits are commonly used for building purposes the consolidated alluvial grits are never so used.

2. *Consolidated Sandstones near Sea Level.* The occurrence of silicified fossil wood at Rocky Point, 12 miles south of Ardrossan, was brought to my knowledge by Mr. O. W. Thompson, of Ardrossan, whose uncle, now deceased, had made the discovery many years ago. Under Mr. Thompson's guidance I made two visits to the spot.

Rocky Point (pl. xxvi.) is a notable headland, about 80 feet in height. The upper portions of the cliff consist of red, white, and variegated sands and clays, and the middle and lower portions consist of layers of sandstone which are separated from each other by highly-coloured sands or clays, the whole series being horizontally bedded. The principal sandstone, which has become altered from a loose sand by the infiltration of silica, is about 3 feet 6 inches in thickness, and occurs in the series about 20 feet from the base of the cliff. The sandstone is even-grained, sometimes cross-bedded, and weathers under sea action to a rough surface, and is often cavernous. Some portions of the stone are very siliceous, while others are less so, causing much irregularity in weathering (pl. xxvii.). The upper surfaces of the stone show peculiar effects of the siliceous infiltration, producing knob-like protuberances, concentric and serpentine patterns, in low relief (apparently caused by successive waves of silicification), some of which look like artificial design, and might be compared with examples of Maori carvings. Slabs of silicified rock alternate with other beds that are less indurated, and the former are sometimes joined by connecting pillars of harder material, which in the case of cross-bedding make oblique angles with the horizontal slabs.

By the undermining action of the waves the softer beds are washed away, while the harder sandstones remain and litter the beach with very large blocks of stone. No examples of petrified wood were seen *in situ*, but examples were common on the beach, and a good supply was bagged. The Rev. J. R. Andrew (who accompanied us) in my presence picked up a beach stone of the indurated sandstone carrying the impression of a dicotyledonous leaf, which is now in the museum of the Adelaide University.

The following is a more particularized statement of the beds as they occur at Rocky Point:—

	ft.	in.	
Sandy soil	3	0	
Nodular travertine and calcareous marl	15	0	
Yellow indurated sandstone	9	0	
Indurated reddish sandstone	1	6	
Yellow sand	5	0	
Red ferruginous sand	3	0	
Calcareous clay (honeycombed)	3	0	
Yellow ferruginous sandstone with ironstone layers	8	0	
White laminated clay with yellow and red colouration in transverse joints, and layer of pebbles on top	1	6	
Yellow sand	7	0	
Siliceous consolidated sandstone	3	6	
Red, yellow, and purple sandy-clay ...	10	0	
Yellow clay	4	0	
Fossiliferous Miocene rock (decomposed)	6	6	(above sea level)
	80	0	

Near the old jetty, situated at a quarter of a mile to the northward of Rocky Point, the beach is occupied with a large area of bedded hydrous oxide of iron, which is a development within the limits of the freshwater beds, and for a time was worked for flux.

An indurated sandstone, similar to that of Rocky Point, occurs about three-quarters of a mile to the north of Muloowurtie Point, near the northern fence of Section 49, where the beds make a small point. Here the silicification of the beds has taken a greater vertical range than at Rocky Point, but the cliffs in which they occur are not so high. As at Rocky Point the sandstone rests on the fossiliferous Miocene, which at this place is highly glauconitic, as described before. The freshwater sandstones end on the southern side of the small point, just before entering on the little bay which is immediately north of the "sliding rocks."

The siliceous sandstones differ from the silicified Tertiary beds of the neighbourhood in that while the latter are flinty the freshwater consolidated beds are sandy with a siliceous cement.

Mr. Tepper records the occurrence of petrified wood and the impression of a fossil leaf in a locality more northerly than that mentioned in these notes. His use of the term "grits" for three very distinct geological formations, and of widely different ages, creates some uncertainty as to which is intended in his descriptions. I take it, however, that the following references are intended to apply to the alluvial grits:—"The only place where distinct fossils were discovered by me is about the south-west corner of Section 41 [on the south side of the Maitland road, 4 miles from Ardrossan], where they were preserved in mottled ferruginous coarse sandstone, associated with nodules of iron oxide. . . . A single specimen of a leaf, resembling those of some *Cinnamomum* species in veination, has been found impressed upon a fragment of rock. . . . Specimens of silicified wood are much more numerous. After finding some few fragments along the beach and others among the gravels forming the upper portion of the cliffs, I succeeded in finding a spot where they strewed the ground in plenty, *viz.*, on the road crossing Horse Gully, between Sections 22 and 30. They are embedded in the clays covering the Silurian limestones."—(Geol. Hundred of Cunningham, Trans. Roy. Soc. S. Austr., vol. iv., 1882, p. 66.)

(*b*) THE NEWER SERIES.

The sea cliffs at Ardrossan make a striking feature. They have a maximum height of about 70 feet, and consist of three distinct beds which are unconformable with each other.

The lowest bed is very strongly coloured with iron in irregular patches, which, in contrast with the rest of the material, which is white, forms a mottled pattern (pl. xxviii.). The bed is a fine-grained argillaceous sand-rock, sufficiently indurated to resist the mechanical effects of rain, and is operated upon only slowly by the sea. Scattered sporadically through the finer material in places are small angular stones, of local derivation, including examples of the chalcedonized Miocene and small pellets of lateritic ironstone. The base is not seen, as it forms a hard floor on the beach and passes from view under the sea, and has been dredged adjacent to the end of the jetty. The lower portions of the bed are freest from stones, while towards the upper limits a layer of small stones, like small gravel, occasionally occurs. The cliffs are nearly vertical, and as the tide when high washes the base with a depth of 4 feet of water, a certain amount of undermining is going on, which causes lateral cracks at the surface, and finally sheets of the cliff face slip down to the beach, where they become divided up into large cuboidal masses on which the waves make small impression. These blocks between tides, as well as the cliff face as far up as the tides go, are penetrated by countless numbers of holes caused by a small boring phyllopod crustacean. This mottled bed, which comprises generally two-thirds or more of the cliff face, agrees in all respects with a similar mottled arenaceous clay that forms cliffs on the other side of the gulf, as well as inland. The upper portion of these mottled clays, when seen in section, usually exhibit an eroded surface.

The clay cliffs gradually decrease in height on the northern side of Ardrossan jetty, and at a distance of $1\frac{1}{2}$ miles in that direction retreat in the form of low banks faced by sandhills. They also decrease in height on the southern side of the jetty and disappear, as a cliff feature, at Parara; but they are seen again at intervals where the cliffs rise to any considerable height, as, for example, south of Meninie Hill (half-way between Rogues Point and Muloowurtie Point), where by a shallow syncline in the fossiliferous Miocene the mottled clays are brought into the section showing a thickness of 20 feet.

The mottled beds can be seen in outcrop at many points inland, as, for example, on either side of the road going north from Ardrossan to Winulta. They also occur in many sinkings and bores in the neighbourhood, as in the following instances:—

Government Bore on West Park Lands, Township of Maitland.

Clay, 3 feet	Recent
Clay with limestone, 13 feet	Recent
Red and white indurated sandy-clay, 35 feet	Pleistocene
Granite (not bottomed), 181 feet	Pre-Cambrian

Government Bore on Section No. 83, Hundred of Cunningham.

Clay and gravel, 46 feet	Recent
Red and white clay, 11 feet	Pleistocene
White clay with gravel, 17 feet	Pleistocene
White clay, 30 feet	Pleistocene
Coarse gravel, 2 feet	Pleistocene
Granite (not bottomed), 393 feet	Pre-Cambrian

RECENT.

(a) Red Clays and Gravels.

In a superior position to the mottled sands and clays are red and brownish clays, which contain at various horizons layers of gravel and sand. These beds are less indurated than the mottled series, and often obscure the face of the latter through being washed down the face of the cliff by the rain. An unconformity between the two sets of beds can be recognized by a slight shelf in the cliffs (see pl. xxviii.) which marks the dividing line, as well as an uneven line of erosion between them, as is well seen in the yard at the landward end of the jetty, where an eroded gutter in the older beds is occupied by the gravel of the newer (pl. xxix.). In the sea cliffs the newer beds attain a thickness of 15 feet, or less; they are also well exposed in Clay Gully, which has its outlet at Ardrossan jetty, and are there seen to be at least 20 feet in thickness. They are comparable to similar clays that overlie the mottled beds on the eastern side of Gulf St. Vincent, and although quite independent of the existing drainage are undoubtedly Recent in their age.

The uppermost bed on the Ardrossan cliffs, as well as the most common surface deposits throughout the region now described, is a nodular travertine more or less associated with marls and loose sand.

A visit was paid to Balgowan (Port Warrenne), on Spencer Gulf, 11 miles north-west of Maitland. On the northern side of the jetty the cliffs consist of recent reddish clays, about 60 feet in height. At the jetty (Point Warrenne) there is a cliff of travertine limestone, 12 feet in height, which in parts is very compact and breaks away in large blocks. A short distance south of the jetty a flat-topped reef of travertine limestone runs for a considerable distance out to sea. In travelling between Maitland and Balgowan no definite outcrops were noticed, but the rises in the ground were usually covered by loose stones of travertine.

The large amount of the latter class of rock in the neighbourhood suggests that the Cambrian limestones probably form the bed rock of the district.

(b) Raised Beaches.

A common building stone in use at Port Victoria and neighbourhood is a shelly limestone, obtained from a raised beach area situated 2½ miles to the southward of the township. I was informed that this deposit is on the landward side of the sandhills, covering low ground, several square miles in extent, and in wet seasons forms a swamp. The beach being raised above sea level and receiving surface waters highly charged with calcium carbonate, the lime conveyed in this way has cemented the shelly deposits forming a recent fossiliferous travertine. The stone is tough, and can be got in good-sized blocks, and is used for road metal as well as for building stones throughout the district. In the stones that came under observation, *Bulla australis* was present as a common form.

There is a raised beach in the neighbourhood of Parara, but its location could not be definitely fixed. Examples of *Arca trapezia*, a very characteristic shell in the older of the raised beaches of South Australia and no longer living in South Australian waters, occur in considerable numbers on the beach, and one example embedded in sandstone was picked up on the beach near Parara. It is probable that in this case the "raised" beach is situated below high-water level, as occurs also with the same bed in the vicinity of Port Adelaide.

(c) Subsidences.

Some of the coast features on Yorke Peninsula indicate a certain measure of subsidence, a movement which is probably in process at the present time. The evidences may be summarized under the following phenomena:—(1) Submerged platforms of travertine limestone at Parara, on the shores of Gulf St. Vincent, and also at Balgowan, on Spencer Gulf. (2) Submerged "raised" sea bed, with subfossil shells, imbedded in an indurated sandy matrix, south of Ardrossan. (3) Juvenile coast lines, indicated by narrow beach and several feet of water at base of cliffs at high tide, seen at Ardrossan, "Sliding Rocks," Edithburgh, and elsewhere. At "Sliding Rocks" the Cambrian limestones dip directly into the sea without being breached by the water (see pl. xxi.).

The fact that the coast line of South Australia, as a whole, gives evidence of recent uplift is quite consistent with the view of a recent subsidence. At Port Adelaide there are clear evidences of alternations of movement, up and down, within recent times. The evidences of subsidence are especially marked within the limits of the rift valley.

General Considerations.

1. Stratigraphical and Lithological Characteristics.

Yorke Peninsula, as a geological province, stands related to the South Australian highlands, on the east, and also to Eyre Peninsula, on the west, and yet is different from both. In common with the land lying to the eastward it possesses a Cambrian fauna, which, so far as known, is not shared by the country lying to the westward; but, like Eyre Peninsula, its dominant geological feature is that of a Pre-Cambrian massif. There is reason to think that the region now known as Yorke Peninsula has existed as a stable horst from Pre-Cambrian times, and has received less sedimentation in the interval than the country on the eastern side of Gulf St. Vincent, and has also been for longer periods under the influence of subaerial waste.

The basement (Pre-Cambrian) series, in its highly felspathoid rocks of pegmatites, syenites, porphyries, schistose rocks, and basic igneous dykes, show a striking similarity to the Pre-Cambrian complex that forms the axes of the orogenic deformations of the Mount Lofty and associated ranges. Professor Tate recognized the existence of two series of ancient rocks, separated by an unconformity, on Yorke Peninsula, but failed to see that a similar order of occurrence existed in the Mount Lofty Ranges, and the whole section, from the sea to the River Murray, was classed by him under one system as Archaean. That a major unconformity exists in the Mount Lofty Ranges, as it does on Yorke Peninsula, can be clearly demonstrated; and that the basement rocks, on either side of the Gulf, are of the same order and corresponding age, also admits of no doubt; but in the case of the Cambrian beds which rest immediately upon the Pre-Cambrian floor the order of occurrence is strikingly different in the respective areas.

Between Aldgate and Brighton, in a direct line of 12 miles, taking in Mount Lofty and the foothills on its western side, there is a series of grits, phyllites, slates, quartzites, tillites, and limestones of Lower Cambrian Age (fig. 3), having a thickness of many thousands of feet that are entirely wanting on Yorke Peninsula; and not only these, but thousands of feet of purple slates and quartzites of Upper Cambrian Age, which in other places overlie the Lower Cambrian beds and underlie the Archaeocyathinae limestones, are also absent from the section on Yorke Peninsula. This remarkable hiatus in the geological sequence must be accounted for in some way.

The following sketch (fig. 4) represents the occurrences and relative thicknesses of the beds in the neighbourhood of Ardrossan, Maitland, and Port Victoria:—

In this table of strata the entire Cambrian System is represented by about 300 feet in this locality, as against, probably, 15,000 feet on the eastern side of Gulf St. Vincent. The Archaeocyathinae beds represent a late stage in the Cambrian terraine, and they form a geological horizon which in other localities is both underlain and overlain by conformable sediments of Upper Cambrian Age. The missing upper members can be easily accounted for by denudation, but how can the absence of the underlying beds be explained?

The most plausible explanation that occurs to the author is that during the long Cambrian Period deposition was accompanied in South Australia by a geosynclinal downfold that formed an extensive trough in a north and south direction,

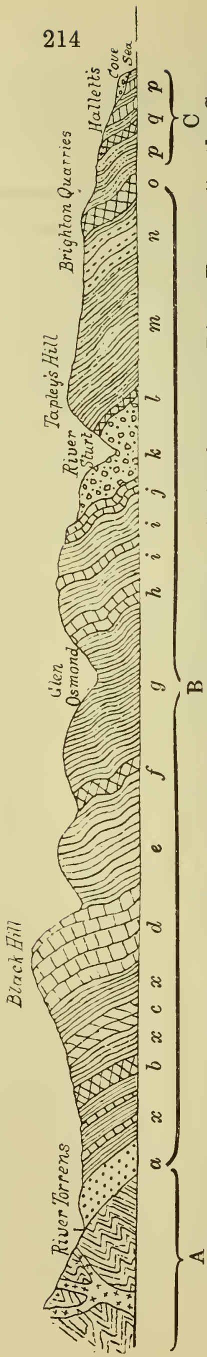

Fig. 3. Diagrammatic Section of the Lower Beds of the Cambrian Series from the River Torrens to the Sea.

A. *Pre-Cambrian Complex.* B. *Lower Cambrian.* *a*, Basal Grits and Conglomerates; *x*, Lower Phyllites; *b*, Lower Torrens-Limestone; *c*, Upper Torrens-Limestone; *d*, Thick Quartzite; *e*, Upper Phyllites; *f*, "Blue-metal" Limestone; *g*, Glen Osmond Clay-slate; *h*, Glen Osmond and Mitcham Quartzite; *i*, Upper Clay-slates; *j*, Sub-glacial Quartzite; *k*, Tillite; *l*, Impure Dolomitic Limestone; *m*, Tapley Hill Ribbon-slate; *n*, Banded Siliceous Limestones; *o*, Brighton Limestones. C. *Upper Cambrian.* *p*, Purple Slates and Quartzites; *q*, Gritty Limestone. The Permo-Carboniferous Tillite is shown unconformably resting on the Upper Cambrian of the sea cliffs at Hallett Cove.—Howchin's "Geology of South Australia."

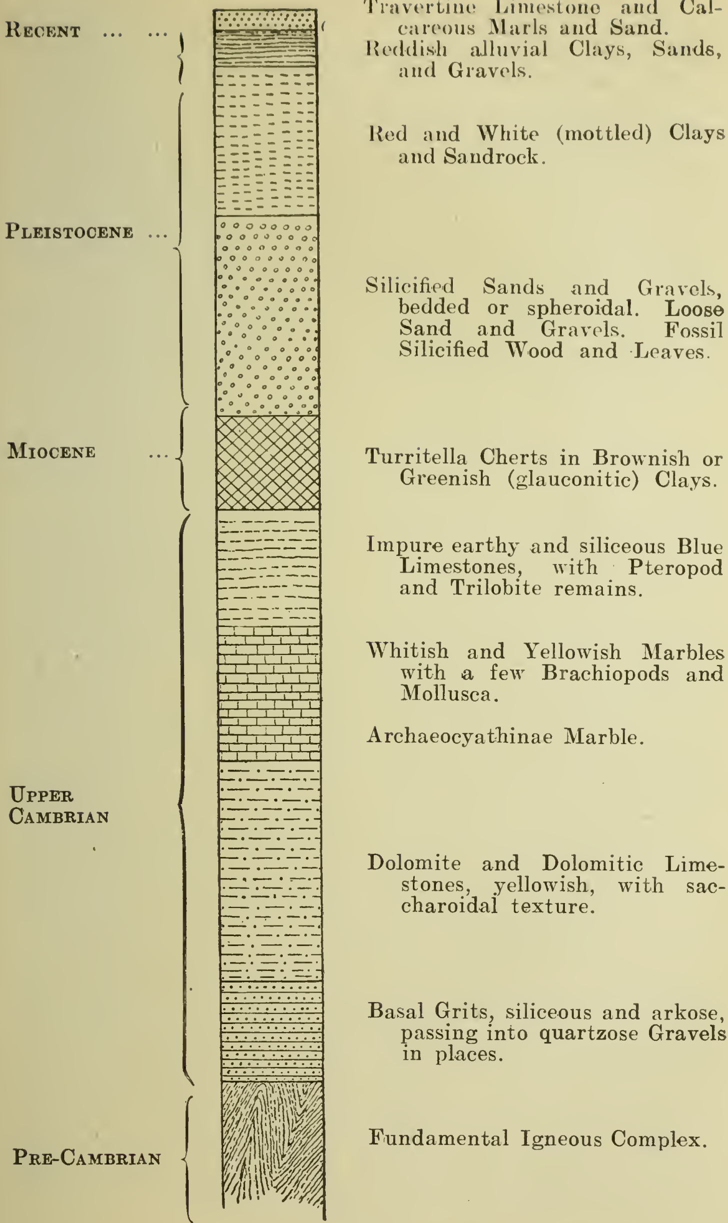

Fig. 4.
Table of Strata as they occur at Ardrossan and Neighbourhood.

bounded on the east by the Pre-Cambrian massif of the Murray and Broken Hill regions, and on the western side by a similar massif that formed the great Pre-Cambrian plateau of Eyre Peninsula. The protracted subsidence of this area permitted a vast accumulation of sediments of various kinds which would lie thickest in the centre of the geosynclinal trough, and gradually thinned towards the lateral margins, where successive overlaps of sediments would take place. This transgression of the Cambrian sea reached the horst-like massif of Yorke Peninsula only at a late stage in the development of the trough—indeed, not until shortly before or during the Archaeocyathinae stage—which will explain the absence of all the sediments that in the eastern areas form the Lower Cambrian and lower portion of the Upper Cambrian series.

A different explanation from the above might be given by supposing that the missing beds were laid down within this area and then subsequently removed by denudation before the Archaeocyathinae limestones were deposited. Such an explanation would involve an unconformity for the Archaeocyathinae beds, in relation to the missing beds, which is not borne out by comparison with other localities. Elsewhere the Archaeocyathinae beds are uniformly both underlain and overlain by thick strata of the purple slates series without any sign of interrupted sedimentation. This may be taken as presumptive evidence that no such unconformity exists on Yorke Peninsula as is implied in the above suggestion. It is assumed that the explanation based on the supposition of transgression and overlap is more in consonance with the evidence.

The Cambrian terrain on Yorke Peninsula began its history when the transgressing sea reached the level of the ancient horst and spread itself over the prepared plateau. The sea was shallow, and the advancing waves operated upon the granitic and felspathic outcrops of the older rocks over a wide littoral. The breaking down of these rocks led to the formation of coarse felspathoid grits and beds of conglomerate which are congenetic with similar arkose grits and conglomerates that form the basal beds of the Cambrian on the Mount Lofty district. The chief lithological difference in the two areas is that, on the Mount Lofty side the Pre-Cambrian and the basal grits are rich in ilmenite, while on Yorke Peninsula the latter mineral is not so extensively present either in its original condition, in the Pre-Cambrian rocks, or in its secondary form, as a clastic product, in the basal sediments.

With respect to the Cambrian limestones, those of Yorke Peninsula bear a general resemblance to the corresponding beds in the Flinders Ranges. The order of occurrence, as dolomitic in the lower members, Archaeocyathinae reefs in the middle portion, and pteropod-trilobite limestones in the upper, is much the same in both cases, but the respective beds are greatly attenuated in the Yorke Peninsula series as compared with those in the Flinders Ranges.

The Sellick Hill section of the same beds, with respect to thickness, is intermediate in this respect, being a thinner series than is developed in the Flinders Ranges, but thicker than the Yorke Peninsula series, with purple slates underlying the Archaeocyathinae limestones and impure flaggy limestones and purple slates above them.

The fossils obtained from the Ardrossan beds are reserved for further examination and description.

2. Tectonic Problems.

It is roughly estimated that the Lower and Upper Cambrian series combined have a thickness of not less than 15,000 feet.(5) So extensive a sedimentation in one area implies, as already stated, a geosynclinal fold which supplied the necessary conditions by which the great Cambrian System could be built up. Positive earth movements that occurred subsequently to the filling up of the basin exercised a lateral pressure on the sediments which threw them into folds, having a north and south direction, and developed numerous small overthrusts to the west. With respect to these movements, the very strong and stable foreland of the Pre-Cambrian massif, lying to the west, must have existed as a controlling factor, presenting a barrier to the passage of the earth waves in that direction, and compelling them to find relief in height instead of horizontal extension. In this way the Pre-Cambrian floor was raised nearly 2,000 feet higher in the centre of

(5) In a paper read before the Australasian Association for the Advancement of Science in 1907 (see Reports, vol. xi., p. 414), the author mentioned 30,000 feet to 40,000 feet as the probable thickness of the Upper and Lower Cambrian in South Australia. Since then there has been a tendency among geologists, on various considerations, to give a reduced estimate of the thicknesses of great mountain masses. These considerations, together with a wider knowledge of the tectonic structures of our highlands, led to a modification of this estimate, so that, in 1914, when in a brief outline of the Geology of South Australia, prepared for a visit of the British Association to Australia, it was stated that "on a moderate estimate the Cambrian System in South Australia represented a thickness of from 15,000 feet to 20,000 feet" (Handbook of South Australia, Brit. Assoc. Ad. Science, 1914, p. 212).

the basin than at the margins, and thereby brought to the surface and exposed to view the whole section of the Cambrian deposits at its greatest thickness.

This view of the tectonic phenomena may explain a few of the facts which seem to fall naturally into line with it:—

(a) The Mount Lofty beds, as constituting the lowest members of a thick series which reached the point of maximum depression, must have been subjected to a higher degree of metamorphism than the beds which occupied a shallower position around the margins. This is borne out by the geological features, as there is a gradual increase of metamorphic intensity as the beds are followed in a downward order towards the Cambrian base. The great field of igneous intrusion, which was developed on the eastern side of the basin, greatly modified the petrographic features on that side and had the effect of obscuring the succession.

The Yorke Peninsula region was probably situated on the western edge of the Cambrian basin, or otherwise occupied a high-level position as compared with the deeper portion, and therefore the isogeotherm conditions would be in strong contrast to those under which the more deep-seated beds were laid down. In harmony with this view the basal grits and conglomerates are but feebly fortified by secondary silicification—even less so than the comparatively recent alluvial grits of the same locality—and they give no evidence of powerful shearing, rock flowage, or mylonitic effects, such as are seen in the Mount Lofty Ranges, as, for example, at the Grey Spur in the Inman Valley. The metamorphism on Yorke Peninsula has been of the mildest type; even quartz veins in these beds are rarities, and the limestones have only undergone such slight molecular reconstructions that might take place in beds of this type at only moderate depths.

(b) Whilst on the eastern side of Gulf St. Vincent the Cambrian beds are greatly disturbed and thrown into acute folds and overthrusts (in which the beds of the Upper Cambrian have shared as well as those of the Lower), the beds on Yorke Peninsula give only slight evidences of orogenic activity. The beds, if not horizontal, make long undulations within the range of a few degrees of dip, the highest inclination being 40°, and this occurs on the beach at their eastern limits and on the margin of the rift valley. This slight deformation is what might be expected under the circumstances. The Cambrian beds formed a relatively thin capping on the strong foreland which not only presented a barrier to the oncoming earth-waves, but at the same time protected the overlying Cambrian sediments from the thrusts

directed from the east. This protective force exerted by the stable basement is evidenced by the comparatively undisturbed condition of the Cambrian beds, not only in the Ardrossan district, but in the extension of those beds in a northward direction, as well as on the western side of Lake Torrens and over the Pre-Cambrian plateau.

(c) The relation of Yorke Peninsula to the great epeirogenic uplift, that isolated the interior of the continent and rejuvenated the rivers and formed the prelude to the sculpturing of the South Australian highlands in their latest aspects, cannot be clearly defined on account of the peculiar position occupied by the region. It is almost surrounded by sea, and as a fault-block its elevation would probably be modified by the rift valleys by which it is bounded. There is evidence, however, that the region at some comparatively recent date stood higher than it does at present, from the fact that important river deposits occur in the present topography of the country at sea level, particulars of which have already been given (page 205 *et seq.)*.

(d) The development of the great rift valley of South Australia with its bifurcating branches, marked by the drowned valleys of the two local gulfs, stands related to the Peninsula in a peculiar way. On the Adelaide plains, within 4 miles of the sea, the Cambrian beds have dropped to a depth of over 2,000 feet below sea level. As the sunken beds form a faulted segment of the Mount Lofty peneplain, it is not unreasonable to suppose that below this level the most of the Lower Cambrian beds occur, and below these again the Pre-Cambrian floor, at a much greater depth; and yet that Pre-Cambrian floor forms the main plateau of Yorke Peninsula as well as the axis of the Mount Lofty Ranges. The vertical displacement, as thus viewed, must be very great. The relatively high dip of the Cambrian limestones at "Sliding Rocks," where they pass below sea level at an angle of 40°, may be caused by the proximity of the rift fault, as occurs on the other side of the Gulf, at Sellick Hill, where both the Cambrian and Tertiary beds are thrown down to the west at a very high angle. In this instance at "Sliding Rocks," however, the Tertiary beds, presumably of the same age as those at Sellick Hill, and which here also overlie the Cambrian, do not participate in the downthrow.

(e) The undisturbed condition of the Permo-Carboniferous glacial beds in the southern portions of Yorke Peninsula, as well as on the eastern side of Gulf St. Vincent, is proof that this part of Australia has not been subjected to orogenic deformations since Palaeozoic times. The only forms of diastrophic modifications that have occurred in the interval

have been those of epeirogenic uplifts, block-faulting, and the developments of the great rift valley.

3. Peneplanation and Geological Cycles.

There is perhaps no part of South Australia in which long-continued atmospheric waste can be better illustrated than in the region now under description. There are no less than five distinct geological systems represented in this small area, and yet the country possesses no lines of strong relief, but maintains throughout the form of a featureless plain. This is not the result of a single period of peneplanation, but several such periods. There are tremendous gaps in the geological order of succession, indicating long periods during which denudation exceeded aggradation.

(a) Pre-Cambrian Peneplain.

That the Pre-Cambrian complex had been reduced to a comparative level before the Cambrian sediments were laid down on this ancient floor is self-evident from the common level which this floor generally maintains under the Cambrian deposits. The Pre-Cambrian schists are usually nearly, or quite, vertical in position, as compared with a relatively low angle in the case of the Cambrian beds that rest upon them, indicating an incalculable interval of time between the respective geological systems. This comparison applies to the beds on the mainland equally with those on Yorke Peninsula. The Pre-Cambrian floor has been broken, tilted, and rifted down, in various segments, under tectonic movements; but in this floor we have the base level of the original cycle of erosion in the history of this continent—the first great cycle of peneplanation of which there is any record.

(b) Palaeozoic Peneplanation.

The loss that the Cambrian beds have undergone by denudation in the region now under description is excessive. That these beds originally covered the whole of what is now known as Yorke Peninsula admits of little doubt, but at present they only exist as scattered fragments. The most southerly outlier occurs at Curramulka, a narrow coastal strip is seen at Ardrossan, a few scattered stones were observed on the western side of Yorke Valley, and they were proved in the Maitland No. 1 Bore, where they are obscured in their outcrop by a mantle of surface material. They gradually make larger surface features as they pass to the northward at Dowlingville, Montgomery's, Clinton, Kainton, Port Hughes, Wallaroo, Kulpara, the Hummocks, etc.

What once constituted the upper beds of the Cambrian System on the Peninsula, of unknown thickness, has entirely disappeared. Of those that are left the fossiliferous beds, which form the highest members of the series, are nearing extinction; the dolomitic limestones, which underlie the latter, have a somewhat wider range, but come second in their restricted areas; the basal grits are a little more prevalent, again; and the rest of the country, when cleared of the more recent deposits, exposes the old Pre-Cambrian base level. Here we have the evidences of a peneplanation which began in early Palaeozoic times and has continued intermittently to the present day; the effects are seen in the few broken and disconnected remnants of great geological systems that have survived to tell the tale.

(c) CAINOZOIC PENEPLANATION.

From the close of the Cambrian period to middle Tertiary times the geological history of the greater part of Yorke Peninsula is a blank. Geological cycles may have come and gone in this interval without leaving a trace behind. A striking illustration of this is seen in the survival of an outlier of the Permo-Carboniferous till in the southern portions of the Peninsula. In this latter case favourable circumstances combined to preserve this fragment of a past age in a local patch which otherwise would have been unrepresented on the Peninsula. The occurrence of the Permo-Carboniferous deposits, as stated, helps to bridge the long interval and throws light on the geology of the Peninsula in two ways: it proves that in late Palaeozoic times the land in this region was certainly above sea level, and that the climate was very cold.

So far as we can judge from the evidences that are extant this particular region remained above sea level from the close of the Cambrian period until the great coastal submergence of Australia which took place during the Miocene period. At that time a great maritime strip of country passed below sea level and received a thick layer of sediments which in places amounted to 1,000 feet. Whether so great a thickness of these beds ever existed on Yorke Peninsula is difficult to say, probably not; but at present they are reduced to near vanishing point. On the eastern side of the Gulf fossiliferous sands and limestones of Pliocene Age are commonly found resting upon the eroded surfaces of the Miocene, but no remains of these beds have survived on the Yorke Peninsula side, having been, apparently, planed off by the denuding forces. Some indications of the underlying Miocene beds, however, still remain. On the slightly elevated rises and, at times, on the seashore these beds are represented by scattered and loose stones of a cherty kind, which might also have disappeared had it not been for the infiltration of a siliceous cement which has made them resistant to atmospheric waste.

Like the Cambrian sediments the marine Tertiary beds have been gradually reduced to a thin and almost imperceptible covering, and even the alluvium of more recent times, laid down by rivers that have long since ceased to flow, has helped to fill up the hollows in the older landscape, and thus contributed to the existing topographical dead level, which makes of several distinct geological systems a common peneplain.

4. River Systems, Past and Present.

In attempting to give an interpretation to the older hydrographic features of Yorke Peninsula it is necessary to take into account that, within comparatively recent times, the two South Australian gulfs had no existence, and this now almost isolated region formed part of a continuous land area. The time of which we speak was probably subsequent to the transgression of the sea within the limits of the rift valley, in late Pliocene times, which has left its marine sediments several hundreds of feet below the present level of the Adelaide plains. It may also be assumed that the older river system of the Peninsula dates from the time when the epeirogenic uplift was in progress, and, although rising, the differential movements had not proceeded so far as to bar the way of the rivers of Central Australia from reaching the southern coast. This conclusion is based on the facts that there are important alluvial deposits on the Peninsula which have no relationship to the existing lines of drainage, and also that the older system of drainage ran north and south, which is inconsistent with the existing coast lines.

On account of the great development of mantle rock over the country and the absence of geological sections, the evidences of the past river systems are limited, and are restricted, so far as known, chiefly to the eastern coast. The coastal scarp near Ardrossan, which can be defined as a topographical feature over a length of 2 miles, is evidently an old river terrace resting upon a Cambrian limestone floor. The terrace is built up of fine to coarse river deposits, often highly siliceous, which form outcrops that spread themselves over the face of the scarp, equal to 100 feet in height, as already described. An important river could only occur in that position when the area now covered by the waters of the Gulf was dry land. The same remark applies to the occurrence of similar alluvia in the cliffs and on the beach a few miles to the southward of Ardrossan. The difference in altitude of the respective river deposits is about 200 feet, and may mark the deepening of the river courses, consequent on the gradual rise of the land, in which case the deposits at sea level would be relatively younger than those on the higher terrace. There is every reason to think that, at that time, the rift valley was already well developed, and that a wide and shallow valley existed in the region of the present Gulf St. Vincent, which would form the main longitudinal waterway from the interior, and into which the lateral streams would find their way.

Few features have survived in the inland districts to throw further light on this subject. Yorke Valley, which probably represents one of these ancient lines of drainage, is a peculiar elongated basin-shaped valley that maintains a north and south direction for many miles. The main south road from Maitland to Yorketown passes along the bottom of this valley. No creek occupies the valley, but there is a soakage that finds its way southwards, where the valley ends in a saline marsh. In the neighbourhood of Maitland the valley has been excavated in the Pre-Cambrian basement rocks, which on the rises on either side are sometimes capped by thin layers of Cambrian grits or limestones. Every feature of this valley suggests river erosion, but belonging to a past age. It has no outlet, and is gradually filling up by rain wash from the sides. Unfortunately there are few wells in the district from which can be gathered any information as to the nature of the alluviation in the valley. Mr. B. Cornish called my attention to a bore that had been put down near Yorke Valley Public School, on Mr. Smith's land; but the only information concerning it that could be obtained was that the bore was 413 feet in depth, the first 30 feet was in clay, and there "followed rocks of various kinds." Granite was met with in the bore, but it is not likely that so great a depth would have been sunk in this rock.

Little need be said on the recent river drainage of Yorke Peninsula, as no connected water system exists at present. The area is limited in extent, and is almost flat, so that the run off is practically *nil*. There are no inland waterways, and there are only a few small channels near the coast which carry water, and these only for a few hours after a heavy rain. In this respect Yorke Peninsula bears a close likeness to Eyre Peninsula, where there is practically no natural delivery of the drainage to the sea. In southern Yorke Peninsula, where rock solution has led to the formation of depressed basins, the conditions are similar to those of inland basins of drainage; numerous small depressions receive the drainage from the soil during the winter rains, followed by the deposition of salt in summer.

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My acknowledgments are due to the Rev. J. R. Andrew, of Ardrossan, who has been most assiduous in the collection of specimens, and in many ways has furthered my objects; also to the Rev. J. C. Jennison and Mr. B. Cornish, of Maitland; and to Mr. O. W. Thompson and Mr. Tiddy, of Ardrossan, by whose valuable aid, respectively, I was enabled to visit distant places of interest.

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DESCRIPTION OF PLATES.

Plate XIX.

Basal Grits of Upper Cambrian, Dinham's Quarry, near Ardrossan.

Plate XX.

Basal Grits and Conglomerate of Upper Cambrian, Winulta Creek, near Public School.

Plate XXI.

"Sliding Rocks." Outcrops of beds of Dolomite which form the lowest members of the Upper Cambrian Limestones series and pass below sea level at "Sliding Rocks," situated 6½ miles south of Ardrossan.

Plate XXII.

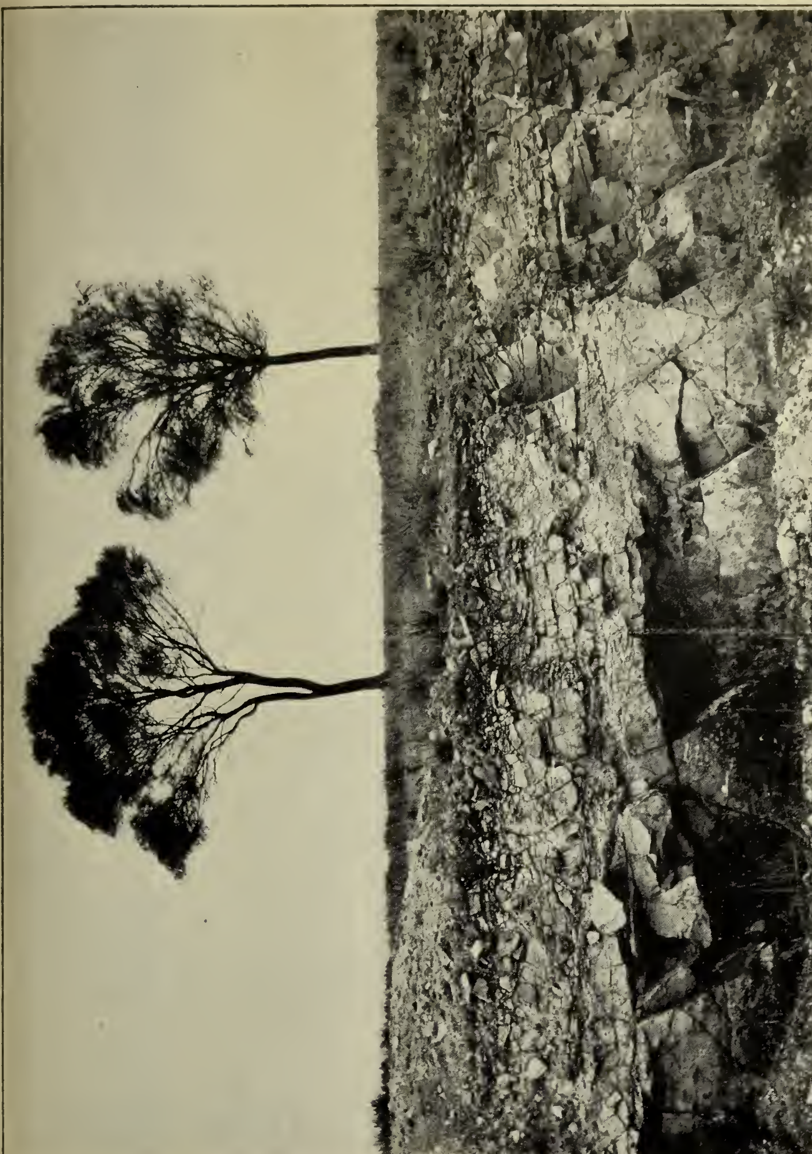
General view of ancient River Terrace with consolidated beds of alluvia forming a low scarp, facing to the sea, near Ardrossan.

Plate XXIII.

Group of spheroidal masses of highly siliceous and consolidated alluvia, resting on an ancient river terrace, forming a coastal ridge, near Ardrossan.

Plate XXIV.

Silicified alluvia weathered into large irregular masses, resting on scarp face of coastal range, near Ardrossan.



Basal Grits of the Upper Cambrian, Ardrossan.

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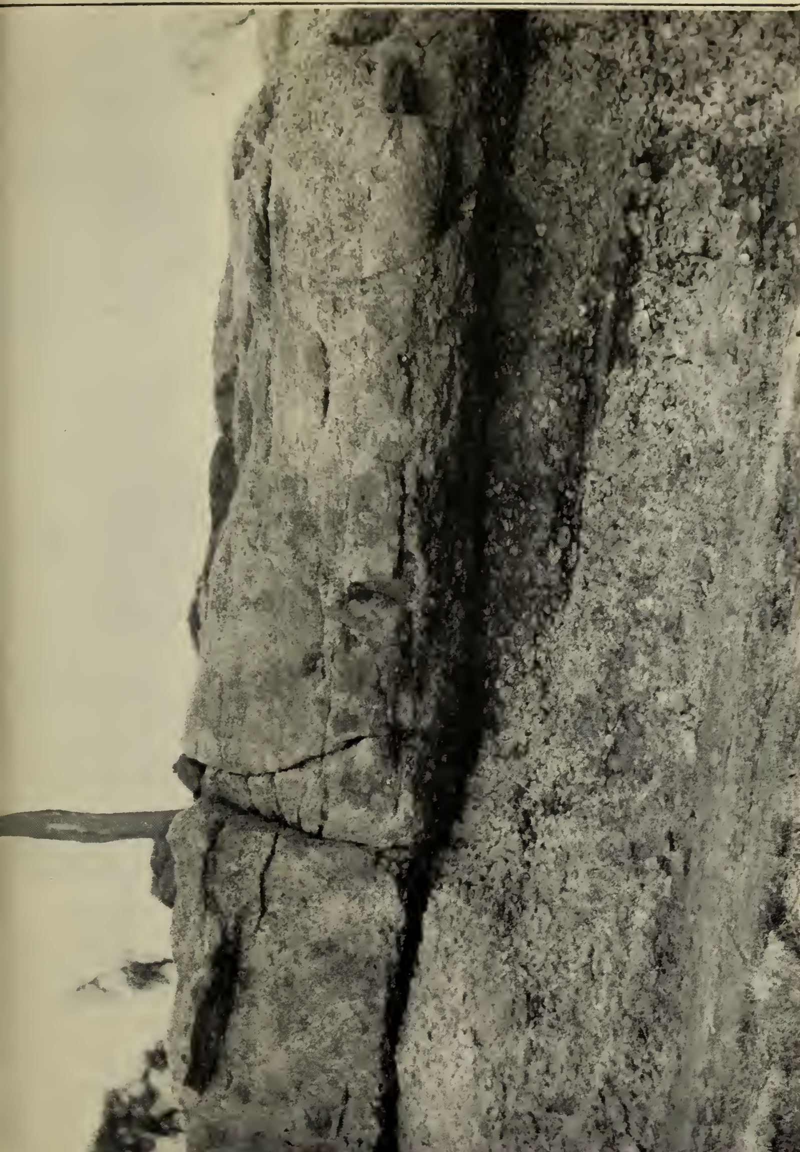

Basal Conglomerate and Grits of Upper Cambrian, Winulta Creek, Yorke Peninsula.

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Dolomites of Upper Cambrian, "Sliding Rocks," south of Ardrossan.

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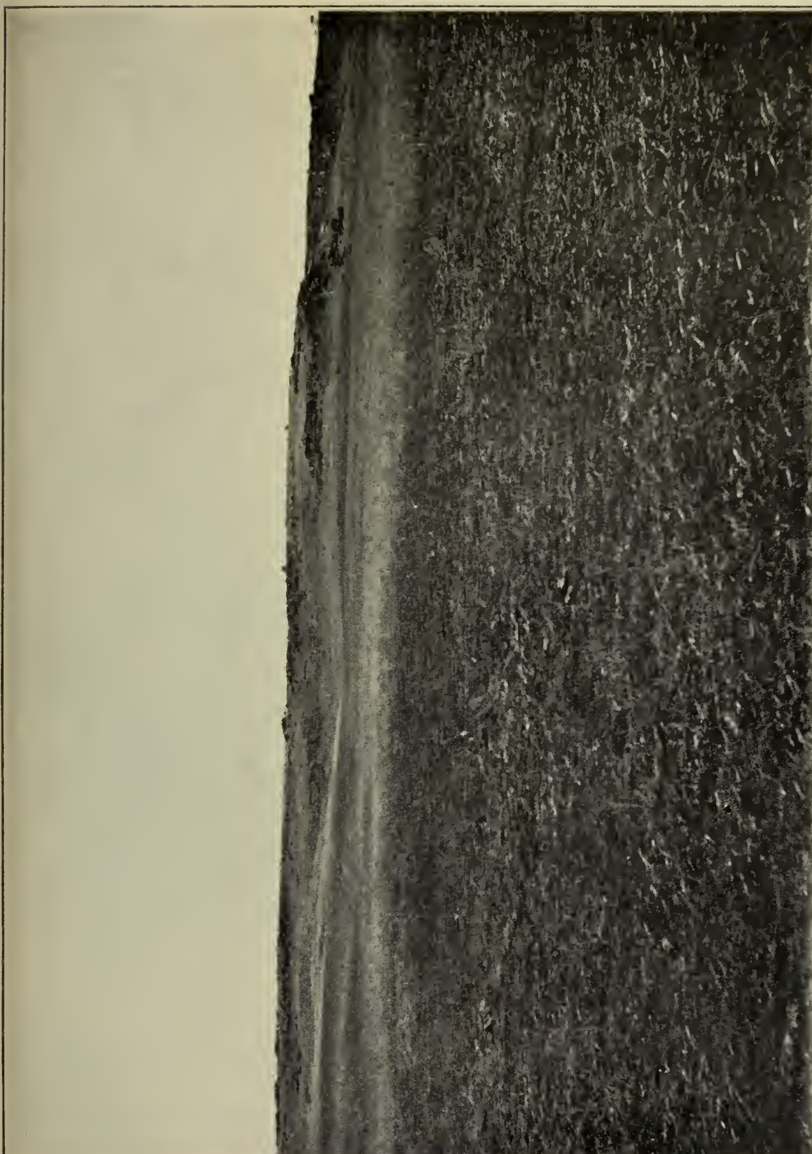

Ancient River Terrace formed of Consolidated Sands and Gravels, Ardrossan.

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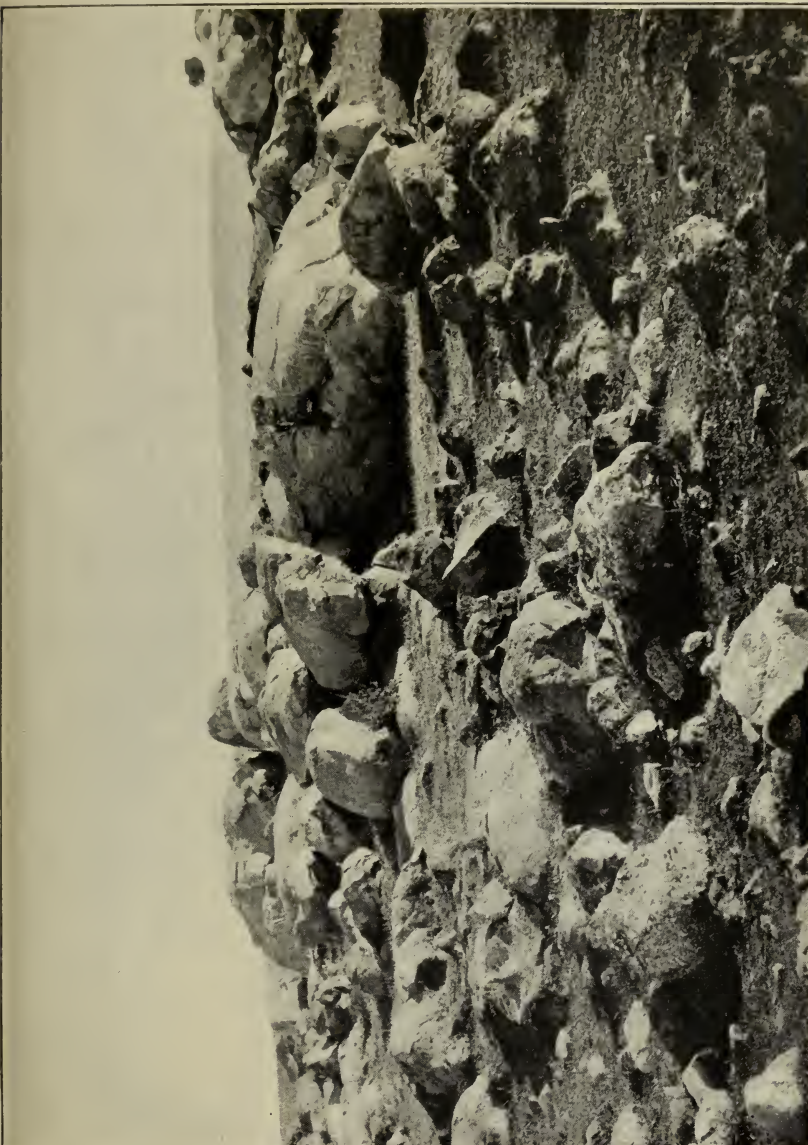

Ancient River Terrace, Ardrossan, view at southern end.

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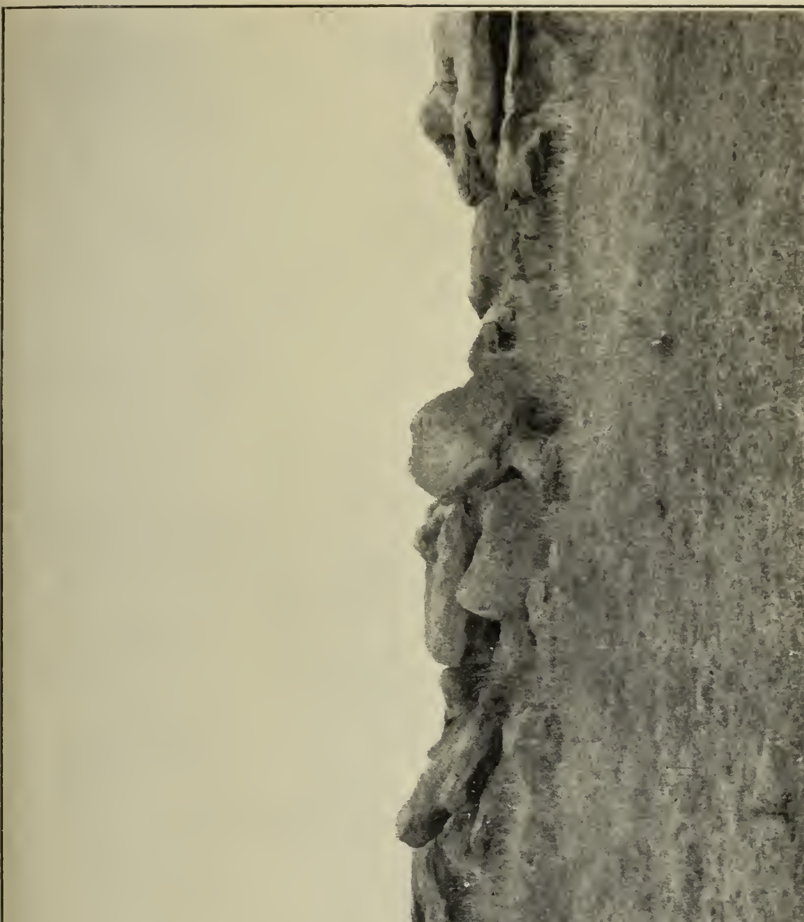

Ancient River Terrace, Ardrossan, near view.

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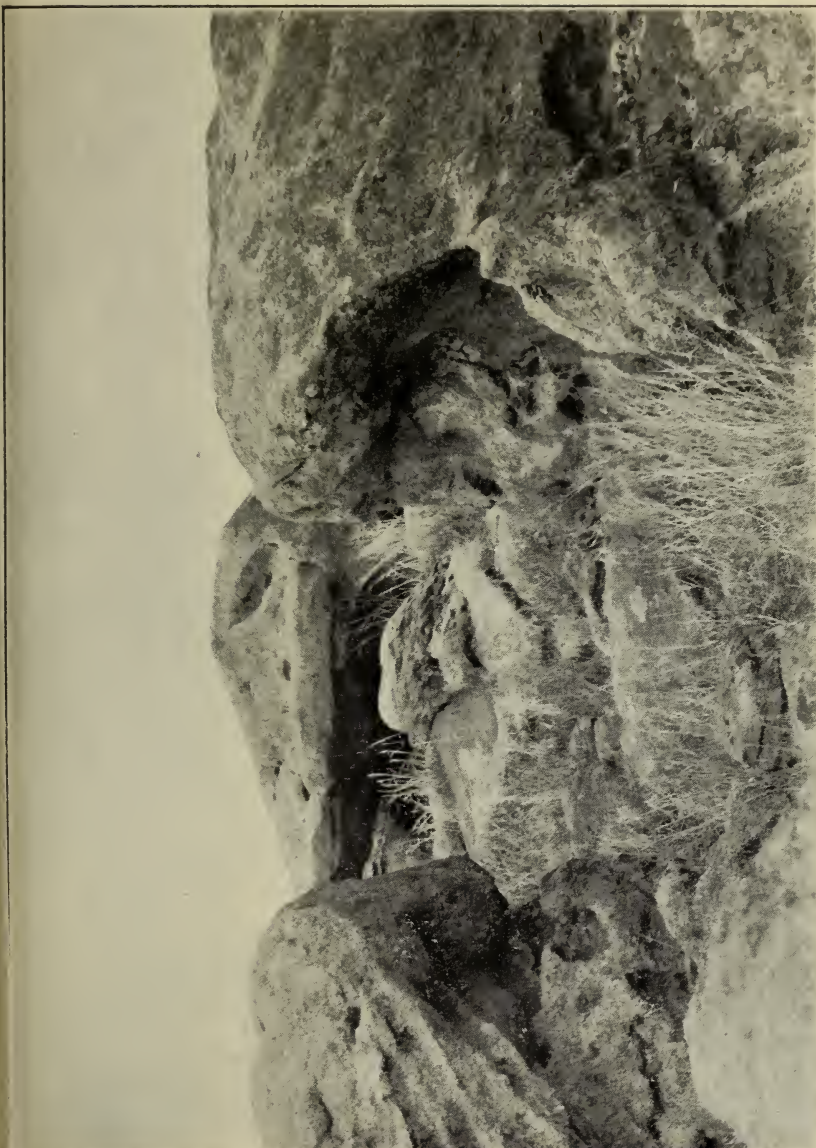

Ancient River Terrace of Consolidated Alluvium, Ardrossan, nearer view.

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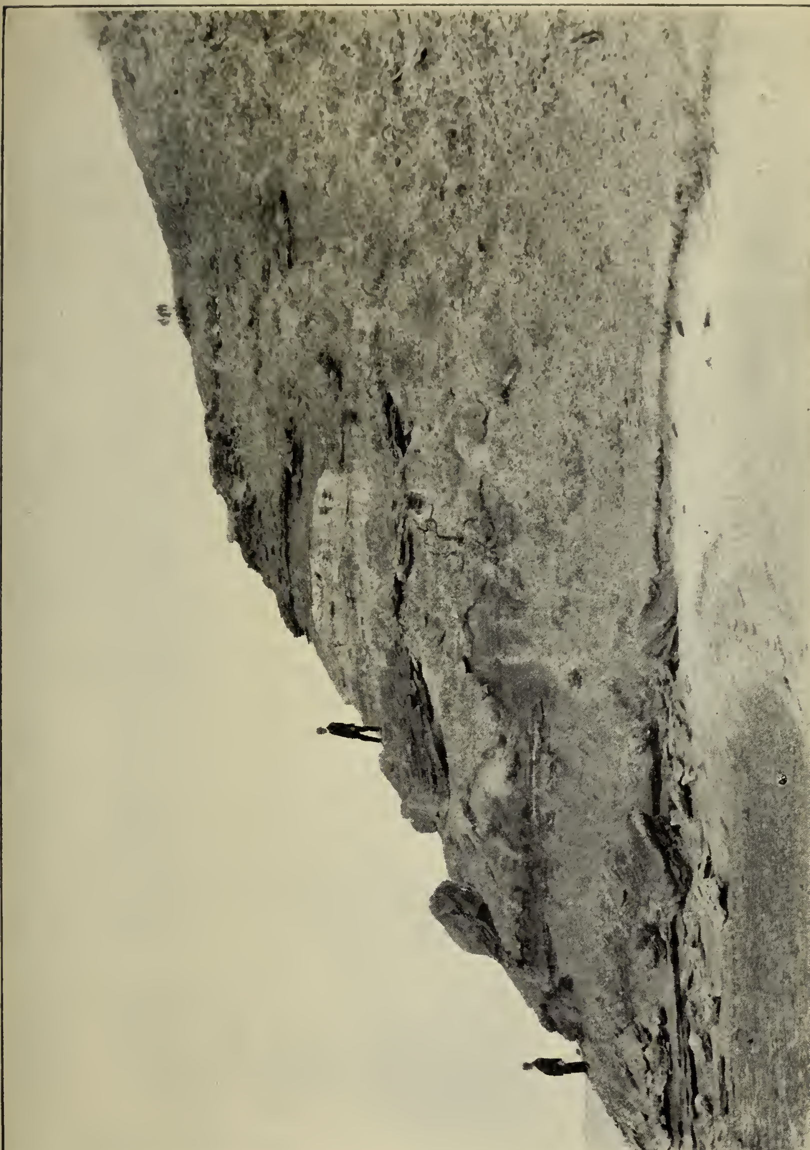

Rocky Point, south of Ardrossan.

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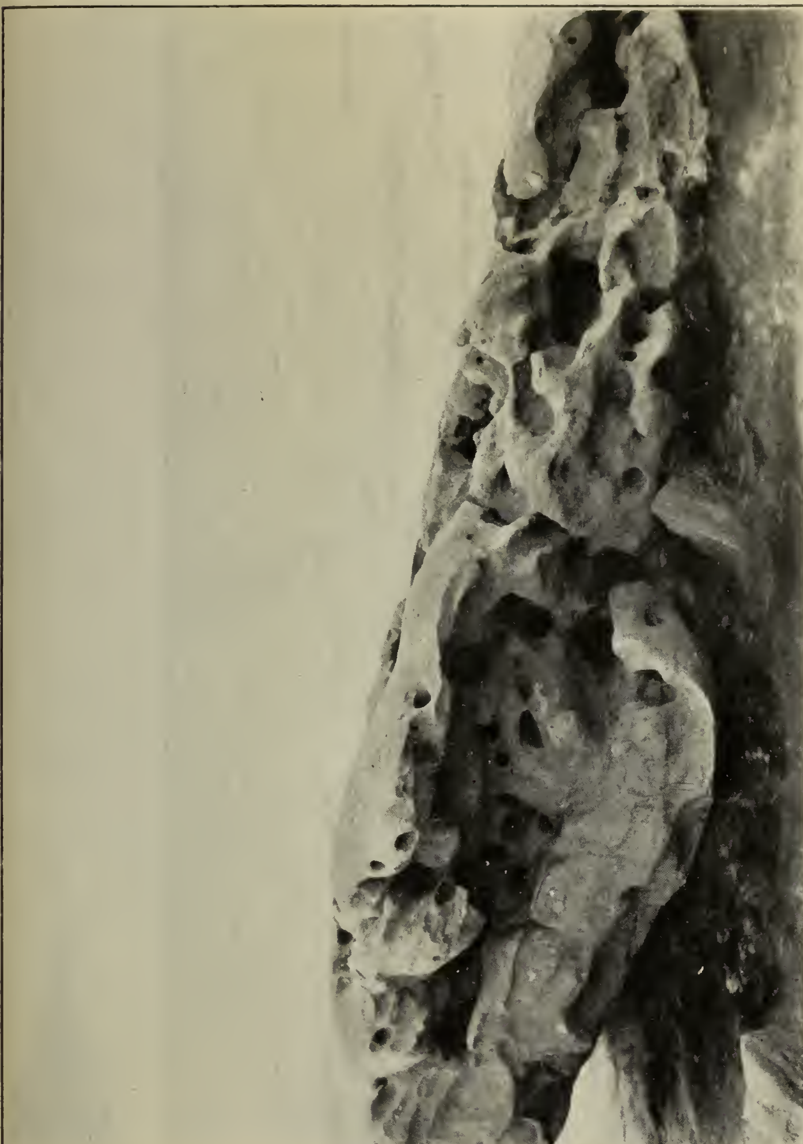

Silicified Alluvial Sandstone, between tides, Rocky Point.

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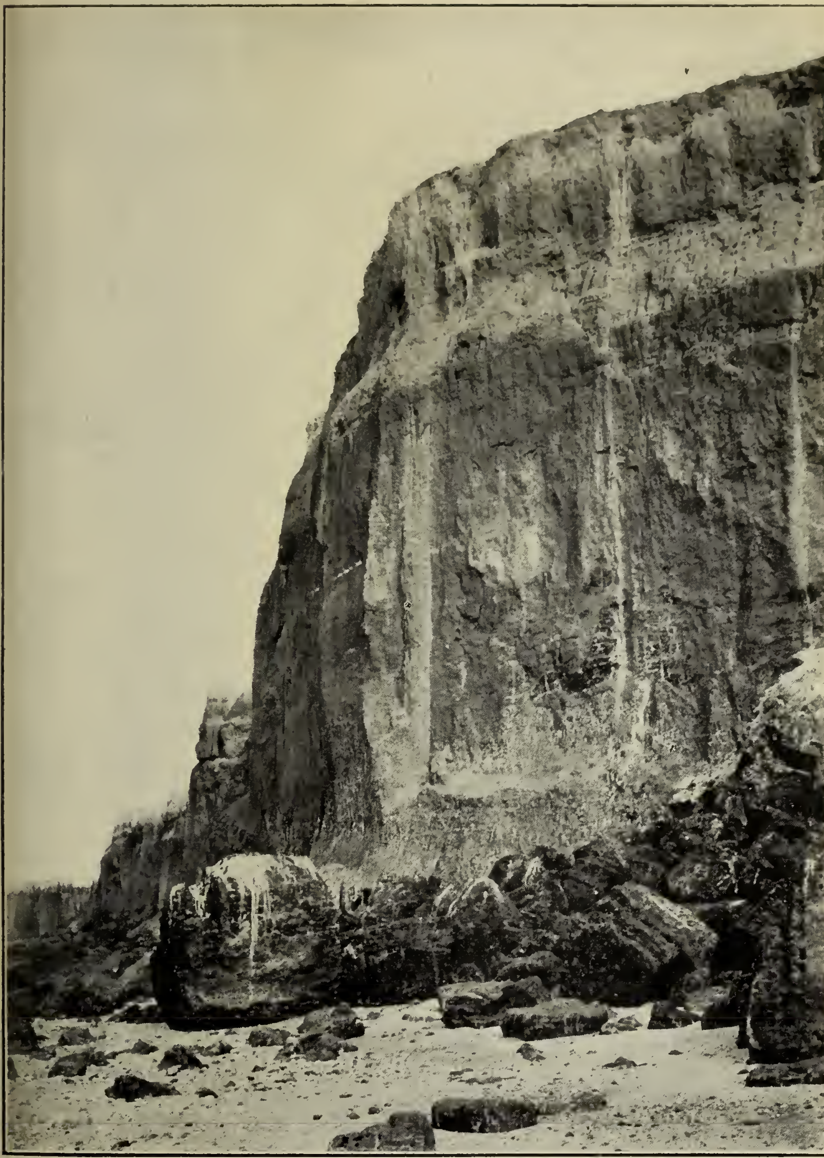

Clay Sea Cliffs, Ardrossan.

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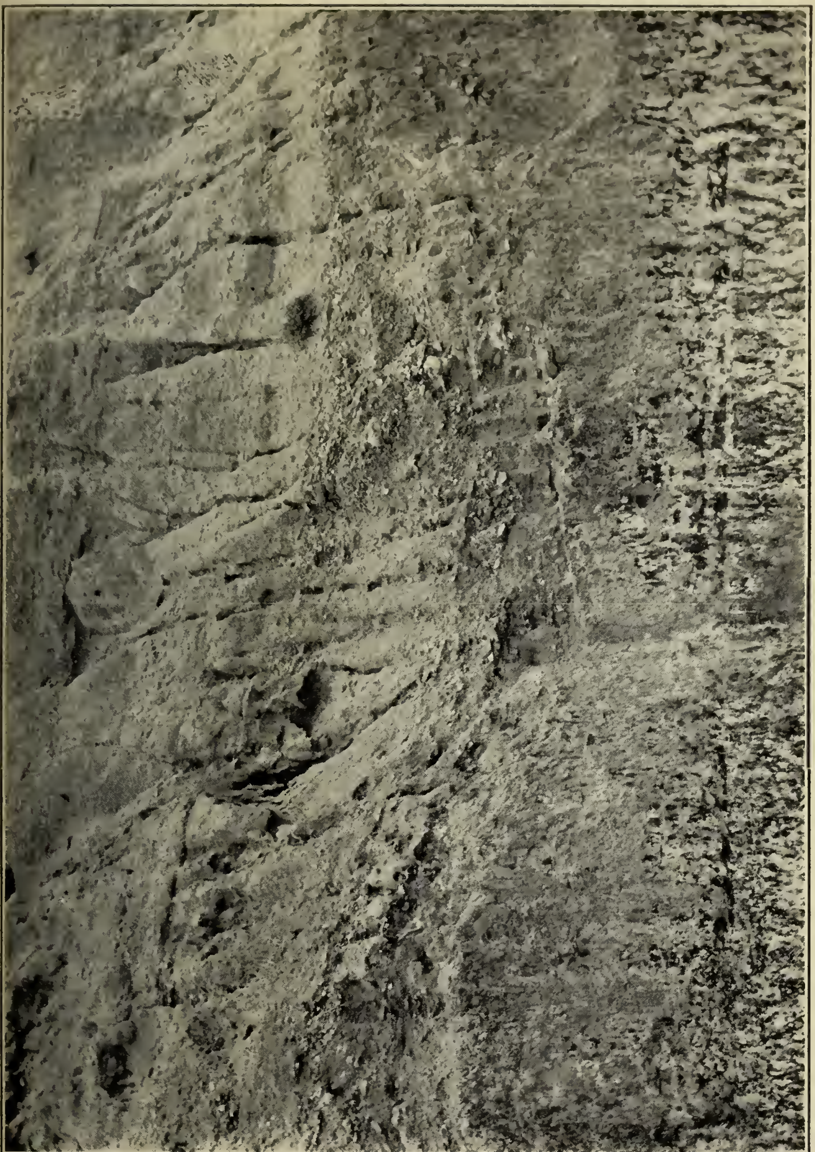

Clay Sea Cliffs, Ardrossan; showing an erosion surface, as a plane of Unconformity between the Pleistocene and Recent beds.

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Plate XXV.

Near view of consolidated siliceous alluvia forming part of old river terrace, coastal ridge, near Ardrossan.

Plate XXVI.

View of Rocky Point (looking south), situated on coast, 12 miles southward of Ardrossan. The Point, which is 70 feet in height, consists of ancient fresh-water beds, some of which have become consolidated by the introduction of secondary silica. The higher of the two human figures seen in the photograph stands upon the chief bed of consolidated alluvium contained in the section.

Plate XXVII.

A large block of consolidated alluvial sandstone on the beach, about half-way between high and low watermark, at the base of Rocky Point cliff. The honeycomb form of the rock illustrates the irregular character of the silicification.

Plate XXVIII.

Sea cliffs at Ardrossan composed in their middle and lower portions of mottled sand-rock of Pleistocene Age. A narrow shelf, situated near the upper part of the cliffs, forms the dividing line between the Pleistocene mottled clays below and the Recent reddish clays and gravels which rest unconformably upon the former. The rain washes down the softer rocks near the top of the cliffs, and this to some extent obscures the features of the mottled beds that lie beneath.

Plate XXIX.

Section in the sea cliffs, exposed by an excavation near the landward end of the Ardrossan jetty, showing an unconformity; the lower portion of the cliff face is composed of the Pleistocene mottled sand-rock, and the upper portion, consisting of Recent reddish clays and gravels, occupies an eroded gutter in the former.

The Lepidoptera of Broken Hill, New South Wales. Part IV.

By Oswald B. Lower, F.Z.S., F.E.S., etc.

[Read October 10, 1918.]

This paper contains a supplementary list of species taken since the first part was published, together with those omitted, and a few new species. I also add the few Rhopalocera taken here.

Family ARCTIADAE.

Subfamily ARCTIANAE.

565. Spilosoma (?) cosmeta, Low.

Rather common in April and May; also occasionally from June to October. I have not yet seen the female, which is probably apterous.

Subfamily AGARISTIDAE.

566. Comocrus behri, Angas.

One specimen, in March.

This species is known to most Australian collectors as *casuarinae*, Scott. It varies somewhat in the hindwing, as the yellow postmedian band may be broken into spots or entirely absent, as in the form *flexuosa*, Wlk.

NOCTUINA.

Subfamily AGROTINAE.

567. Meliceptria aleurota, Low.

Two specimens in March. The type came from Derby, Western Australia, which habitat was accidentally omitted in the original description (Proc. Linn. Soc. N.S. Wales, 1901, p. 641).

Subfamily CUCULLIANAE.

568. Ariathisa emboloma, n. sp.

One specimen, in May.

Subfamily ACRONYCTIANAE.

569. Euplexia melanops, Low.

One specimen, at light, April.

570. Apina callisto, Wlk.

Not uncommon during March and April. A rapid day flier. Exceedingly common in the larval state, destroying a large amount of low herbage. The larvae are very partial to the "Cape weed" *(Cryptostemma coronaria)*, but a small clear-winged Ichneumon destroys huge numbers; out of seventy-five larvae I bred but three imperfect imagoes. The species is widely distributed throughout Australia.

571. Ipanica cornigera, Butl.

Taken occasionally during October and November. This is another widely distributed species, its geographical range extending from this district to New Guinea.

Subfamily SARROTHRIPINAE.

572. Elesma subglauca, Wlk.

Two specimens, in March.

Subfamily NOCTUINAE.

573. Setida quadrisignata, Wlk.

Not uncommon, at light, September to November.

574. Byturna digramma, Wlk.

Taken occasionally during March and April. The specimens taken here are generally much redder than those taken in South Australia.

Subfamily ERASTRIANAE.

575. Tarache micrastis, Low.

Two specimens, in March; also from Tennant Creek, South Australia, and Birchip, Victoria.

576. Xanthoptera opella, Swinh.

Five specimens, in March and April; also taken at Birchip, Victoria.

Subfamily ACONTIANAE.

577. Earias fabia, Stoll.

Rather common during September and October. I also take it freely at Wayville, South Australia. The markings vary from deep emerald-green to dull yellowish-fuscous.

578. Aconita congenita, Hmps.

Nine specimens, taken at dusk, in March. These were attracted to the flowers of the common "water melon." The type came from Queensland.

579. Maurilia iconica, Wlk.

Four specimens, in March and April.

Subfamily CATOCALINAE.

580. Ophideres materna, Linn.

Three specimens, in April. These were all taken at the same time at one of the city fruit stores.

581. Grammodes callimeris, Low.

Two specimens, in October. The type came from Cooktown, Queensland.

582. Grammodes chrysomera, Low.

Three specimens, in March, October, and December.

583. Trigonodes hyppasia, Cram.

Five specimens, in February and July. The specimens are much smaller than those from Brisbane, Queensland.

Subfamily HYPENIDAE.

584. Gonitis sabulifera, Gn.

Taken occasionally, March.

585. Cosmophila erosa, Hb.

Not uncommon, during March, April, and May. The specimens taken here are much darker than those from India. It stands in some collections as *xanthindyma*, Bdv., and *indica*, Wlk.

GEOMETRINA.

Subfamily MONOCTENIADAE.

586. Taxeotis phäeopa, Low.

The female of this species is always smaller than the male. Usually taken during May and June, but I have secured specimens in September.

Subfamily SELIDOSEMIDAE.

587. Amelora idiomorpha, Low.

Two specimens, taken at light, in June and September.

588. Chlenias cyclosticha, Low.

One specimen (type), taken in June.

589. Chlenomorpha sciogramma, n. sp.

One specimen, in November.

590. Paurocoma coniopa, n. sp.

One specimen, in May.

BOMBYCINA.

Subfamily LYMANTRIADAE.

591. Aprosita obscura, Wlk.

Two male specimens, in October and November; also from Aldgate, South Australia. Dr. Turner named a specimen *Aprosita ulothrix* (type in South Australian Museum). Walker made it a *Trichiura*, Kirby makes it a *Clathe*, but for the present we will allow Turner's genus to stand to receive it.

Subfamily NOTODONTIDAE.

592. Capusa senilis, Wlk.

Three male specimens, in November. Almost certainly attached to *Casuarina*. Being an exceedingly swift flier, it is difficult to secure perfect specimens.

Subfamily ZEUZERIDAE.

593. Zeuzera perigypsa, Low.

One specimen, in March.

594. Culama caliginosa, Wlk.

Three specimens, in April and May. The larvae feed in the roots of *Eucalypti*, and I have found pupae about 6 feet away from the trunk of the tree.

595. Hectomanes noserodes, Meyr.

Five specimens, all males (at light), in March and April.

PYRALIDINA.

Subfamily PHYCITIDAE.

596. Homoeosoma melanosticta, Low.

Three specimens, in October.

597. Myelois flaveotincta, Lucas.

Not uncommon, especially at light, September to December. The perfect insects frequent the stunted plants of *Bassia*, and lie motionless on the stems or leaves; they are then difficult to discern on account of the blending of colour.

Subfamily PYRAUSTIDAE.

598. Notarcha clytalis, Wlk.

Taken occasionally, in March and April.

599. Botys phoenicealis, Hb.

Taken occasionally, in March.

600. Semioceros (Nacoleia) mesochlora, Meyr.

Rather common, in March and April.

Subfamily ENDOTRICHINAE.

601. Endotricha puncticostalis, Wlk.

Taken occasionally, in March and April, also September. The specimens are much darker, and more shapely marked than those from Queensland.

Subfamily PTEROPHORIDAE.

602. Sphenarches caffer, Zeller.

Taken occasionally, in March.

TORTRICINA.

Subfamily TORTRICIDAE.

603. Tortrix postvittana, Wlk.

Several specimens, in March and April.

Subfamily EUCOSMIDAE.

604. Argyroploce doxasticina, Meyr.

Not uncommon, in March and April. I have recently taken this species at Wayville, South Australia.

TINEINA.

Family OECOPHORIDAE.

605. Zonopetala synarthra, Meyr.

Three specimens, in November.

606. Linosticha(?) stichoptis, Low.

One specimen, in July.

607. Linosticha sericopa, Low.

Two specimens (at light), in November.

608. Trachyntis mimica, Low.

One specimen, in March.

609. Nephogenes maculisarca, Low.

Two specimens, in October.

610. PHILOBOTA EREMOSEMA, Low.

One specimen, in November.

611. GUESTIA DELOSTICHA, Low.

One specimen, in March.

612. GUESTIA SYMMADELPHA, Low.

One specimen, in May.

613. PAURONOTA LASIOPREPES, Low.

One specimen, in May.

614. PSECADIA POSTICA, Zeller.

Not uncommon, August and September. I have never taken this species except at light.

615. OECOPHORA PSEUDOPRETELLA, Stt.

Not uncommon, from December to March. A well-known European species.

616. MACROBATHRA HEMITROPA, Meyr.

Three specimens, September and October.

Family XYLORYCTIDAE.

617. XYLORYCTA PARTHENISTIS, Low.

Two specimens, in November.

In the original description (Trans. Roy. Soc. S. Austr., 1902, p. 237) the habitat was omitted. It should be:— *Hab.:* Tennant Creek, Central Australia, taken in October.

Family GELECHIADAE.

618. ARISTOTELIA HEMISARCA, Low.

Several specimens, in March and April.

RHOPALOCERA.

Family PAPILIONIDAE.

619. PAPILIO STHENELUS, Macl.

Not uncommon, October to May.

620. PAPILIO AEGEUS, Don.

Two specimens, in November.

621. PAPILIO ANACTUS, Macl.

One specimen, in October.

Subfamily PIERIDAE.

622. Terias smilax, Don.

Taken occasionally, October to March.

623. Callidryas pyranthe, Linn.

Taken occasionally, in October.

624. Anaphaeis teutonia, Fab.

Rather common, October to December.

625. Delias aganippe, Don.

Fairly common, October to January.

Subfamily DANAIDAE.

626. Danais petilia, Stoll.

Rather common, during November to March.

627. Danais erippus, Cram.

Rather scarce, April.

Subfamily NYMPHALIDAE.

628. Pyrameis kershawi, McCoy.

Common, during October and November.

629. Pyrameis itea, Fab.

Not uncommon, September to March.

630. Junonia vellida, Fab.

Tolerably common, September to December.

Subfamily LYCAENIDAE.

631. Lycaena biocellata, Feld.

Common, September to March.

632. Lycaena serpentata, Herr Sch.

Not uncommon, October and November.

633. Lycaena labradus, Godt.

Not uncommon, October to December.

634. Ogyris oroetes, Hew.

Taken occasionally, in November. Frequents the flowers of *Eremophila Sturtii.*

NOCTUINA.

Subfamily CUCULLIANAE.

Ariathisa emboloma, n. sp.

♀, 40 mm. Head and thorax dark fuscous, head mixed with whitish, centre of thorax and patagia white. Antennae fuscous. Palpi whitish, terminal joint short, fuscous. Abdomen grey-whitish, beneath white. Legs grey-whitish, tarsi fuscous, ringed with whitish. Forewings elongate-triangular, costa straight, termen oblique, gently waved throughout; dark fuscous, wing between base and first line strongly mixed with whitish, sometimes mixed with pale rufous; first line strongly waved, white, edged throughout by a blackish shade, from one-quarter of costa to about one-third of dorsum; second line rather broad, waved, with a broad median projection, rather obscure in one specimen, black, more or less narrowly edged throughout with white; wing below cell between first and second lines strongly mixed with rufous, but not reaching dorsum; orbicular snow-white, centred with black; reniform black, edged anteriorly with white; cell more or less filled in with black; subterminal line strongly dentate, snow-white, from costa near apex to tornus, edged anteriorly and in one specimen posteriorly, with lanceolate black marks, which are well marked, space between second and subterminal lines strongly mixed with rufous, except at reniform, where it is suffusedly whitish; a series of four white dots on posterior half of costa; a black line along termen with a series of somewhat lunulate spots between veins; cilia grey, rufous-tinged with a rufous median line. Hindwings light smoky-fuscous, paler on basal half; line along termen as in forewings, cilia snow-white with a grey median line.

Not unlike some specimens of *Euxoa radians*, Guen.

Hab.—Pinnaroo, South Australia; two specimens, in May and June. Broken Hill, New South Wales; one specimen, in May.

GEOMETRINA.

Subfamily SELIDOSEMIDAE.

Chlenomorpha, n. gen.

Face with appressed scales. Palpi long, porrected, two and a half times width of eye, terminal joint short. Antennae of male bipectinated, apex simple. Thorax without crest. Posterior tibiae somewhat dilated. Forewings with small fovea; 10 free, 12 anastomosing with 11. Hindwings normal.

A curious genus, apparently related to *Chlenias* on the one hand, and *Paralaea*, on the other, but differing from both by the presence of fovea of forewings.

Type *sciogramma*, Low.

Chlenomorpha sciogramma, n. sp.

♂ and ♀, 28-30 mm. Head, palpi, antennae, and thorax dull slaty-fuscous, palpi darker beneath, antennal pectinations 10, apical portion simple. Abdomen yellow-ochreous. Legs whitish-fuscous, posterior pair whitish. Forewings elongate-triangular, termen oblique, rather prominent on vein 3; greyish-fuscous, somewhat slaty-tinged; markings hardly traceable; a fine crenulate line from just before middle of costa to before middle of dorsum, more pronounced on dorsum; an irregular whitish line, from three-quarters of costa to just before tornus, followed by a fine whitish crenulate line, from costa just before apex to tornus; a fine black interrupted line along termen; cilia grey, with a pale fuscous subbasal line. Hindwings faintly crenulate; grey-whitish; an indistinct fuscous line from costa at one-third to one-third dorsum; a fuscous discal dot; an obscure faintly waved fuscous line, from costa at three-quarters to two-thirds of dorsum, followed by a narrow obscure whitish shade; an obscure fuscous band before termen; line along termen and cilia as in forewings. Underside of both wings grey-whitish, a blackish band just before termen, well defined on both wings.

Hab.—One male, Broken Hill, New South Wales; two females, Pinnaroo, South Australia, all taken in November.

Amelora lithopepla, n. sp.

♀, 30 mm. Head, palpi, and thorax ochreous-grey. Antennae ochreous. Abdomen greyish-ochreous, grey-whitish beneath. Legs grey-whitish, sparsely sprinkled with fuscous scales, middle and posterior tibiae and tarsi fuscous, banded with whitish. Forewings elongate-triangular, termen gently rounded; ochreous-grey; a narrow very outwardly oblique fuscous streak, from costa at about one-fifth, reaching about one-third across wing, indicating anterior line; a very obscure pale-fuscous mark at posterior end of cell; a very short dark-fuscous outwardly-oblique mark on costa at five-sixths, indicating posterior line; from each of the costal streaks there are faint indications of waved lines reaching dorsum at one-quarter and at tornus; cilia ochreous-grey. Hindwings grey, becoming fuscous-tinged around margins; a dull-fuscous discal spot; cilia grey. Hindwings beneath with an outwards curved series of fuscous dots, from costa at five-sixths to just near tornus.

Not very near any other species of the genus.

Hab.—Dundas, Western Australia; one specimen, in October.

Paurocoma coniopa, n. sp.

♀, 28 mm. Head, palpi, antennae, and thorax dull ochreous. Abdomen grey. Legs ochreous-fuscous, posterior pair greyish. Forewings elongate-triangular, termen waved throughout, gently rounded; pale dull ochreous, more or less minutely irrorated with blackish scales; an obscure fine fuscous line, from two-fifths of costa to one-third dorsum, with two rounded projections above and below middle; a fine fuscous transverse discal dot; an obscure fascia-like fuscous shade, from five-sixths of costa to tornus; median third of wing somewhat lighter than rest of ground-colour; a fine waved blackish line along termen; cilia greyish-ochreous. Hindwings with termen as in forewings; grey-whitish, sparsely irrorated with some fine fuscous scales; line along termen as in forewings; indications of a fine waved fuscous line, from beyond middle of costa to beyond middle of dorsum; cilia whitish. Underside of hindwings with fuscous median discal dot, and submedian waved line very clear. Probably allied to *molybdina*, Low., but quite differently coloured.

Hab.—Broken Hill, New South Wales; one specimen, in May.

PYRALIDINA.

Subfamily PYRAUSTIDAE.

Metallarcha thioscia, n. sp.

♀, 20 mm. Head and thorax deep yellow. Antennae fuscous. Palpi yellow, terminal joint fuscous. Abdomen fuscous, ringed with deep yellow. Legs fuscous, posterior pair sprinkled with yellow. Forewings elongate-triangular, costa straight, termen oblique, gently rounded; dark fuscous; markings yellow; a broad dorsal streak, occupying half of wing, becoming narrowed at posterior end but continued to anal angle, where it joins a narrow streak along termen and continues almost or quite to apex; an irregular spot in cell, at one-fourth from base, a second, larger and somewhat sphenoid, in middle of wing, and a third, transverse, at three-quarters, just below costa, at four-fifths; cilia fuscous, with a darker basal line. Hindwings orange; a blackish discal spot; a moderately broad fuscous band along termen, becoming broader at apex, upper edge very slightly waved;

a narrow yellow streak along termen, sometimes obscure; cilia fuscous.

Nearest the following species, but distinct by the broad dorsal streak.

Hab.—Pinnaroo, South Australia; three specimens, in October.

METALLARCHA CLETHRODES, n. sp.

♀, 20-22 mm. Head and thorax yellow, head sprinkled with fuscous. Antennae and palpi fuscous, second joint of palpi beneath yellow. Abdomen fuscous, ringed with yellow. Legs fuscous, posterior pair sprinkled with yellow. Forewings elongate-triangular, costa straight, termen oblique, hardly rounded; orange-yellow, with shining fuscous markings; a narrow costal streak throughout; a small quadrate spot on lower edge of costal streak at one-sixth; an outwardly curved moderately thick fascia, from costa at two-fifths to dorsum in middle; a somewhat similar, but thicker fascia from just before three-quarters of costa to dorsum before tornus, indented in middle, the indentation sometimes meeting previous fascia; a thick fascia along termen, from costa, where it is broadest, to termen above tornus, where it joins previous fascia; a narrow streak of groundcolour, from five-sixths of costa, and continued along termen to tornus; cilia dark fuscous, darker basally. Hindwings bright orange; a dark-fuscous discal dot; a dark-fuscous band along termen, moderately broad, becoming broadest at apex; a narrow line of groundcolour along termen; cilia as in forewings.

Allied to *Goudii*, Low., but differs in smaller size, palpi, thorax, and narrower markings.

Hab.—Pinnaroo district, South Australia; five specimens, October and November.

METALLARCHA GOUDII, Low. (Trans. Roy. Soc. S. Austr., 1902, p. 234).

Having obtained a nice long series of this species, I am redescribing it, as the original description is faulty.

♂ and ♀, 20-30 mm. Head, palpi, antennae, and thorax dark fuscous, basal joint of palpi beneath orange, patagia yellow. Abdomen fuscous, banded with orange-yellow. Legs dark fuscous, anterior coxae and posterior tarsi and tibiae sprinkled with orange. Forewings elongate-triangular, costa straight, termen oblique, gently rounded; deep yellow, with shining fuscous markings; a rather thick streak along costa, from base to apex, attenuated posteriorly, and emitting a flattened spot near base; a slightly outwards curved fascia, from costal streak at one-third to dorsum before middle; a similar fascia from costal streak at three-fifths to dorsum at about three-quarters, strongly indented in middle, rarely reaching previous fascia, upper half much thicker; a fascia from about three-quarters of costa, reaching half across wing, thence curved around to meet preceding fascia just above indentation; whole of area of wing beyond this, excepting a narrow orange line along termen, filled in with light fuscous, minutely irrorated with yellow; cilia dark fuscous. Hindwings deep orange; a dark-fuscous discal spot; a moderately broad fuscous band along termen, strongly dilated on apical portion; a narrow orange line along termen, sometimes suffused with fuscous; cilia as in forewings.

Allied to *diplochrysa*, Meyr.

Hab.—Birchip, Victoria; two specimens. Pinnaroo district, South Australia; twenty specimens, in October and November.

TINEINA.

Family GELECHIADAE.

ARISTOTELIA PERIBAPTA, n. sp.

♂ and ♀, 18-20 mm. Head, thorax, antennae, and palpi pale ochreous, head paler, antennae of male minutely ciliated, about half. Abdomen pale ochreous-whitish. Legs ochreous-whitish, posterior tibiae very roughly haired. Forewings elongate, moderate, apex pointed; 7 and 8 out of 6; pale ochreous-yellow, margins minutely irrorated with darker ochreous; cilia ochreous, more or less mixed with light ferruginous. Hindwings with apex pointed, produced, termen sinuate; pale fuscous; cilia as in forewings.

Not near any other of the genus. Reminds one of *Nothris meliphanes*, Low.

Hab.—Henley Beach, South Australia; five specimens, in September.

EPIPHTHORA DELOCHORDA, n. sp.

♂, 18 mm. Head whitish. Thorax and palpi ashy-grey-whitish, palpi internally white. Antennae whitish, obscurely annulated with fuscous. Abdomen ochreous. Legs ashy-grey-whitish, posterior pair more whitish. Forewings narrow, acutely long pointed; ashy-grey-whitish; a narrow white streak along costa, from one-quarter to three-quarters; a narrow white streak along fold, obscured posteriorly; a fuscous outwardly oblique rather broad bar, from dorsum at one-third to termination of white streak along fold; cilia grey, becoming ashy-grey-whitish on apical portion. Hindwings with emargination obtuse, produced apex about one-quarter; grey, tinged with pale fuscous; cilia greyish.

Probably nearest *niphaula*, Meyr., but differs by shorter costal streak, narrower white streaks, and the oblique fuscous bar.

Hab.—Pinnaroo, South Australia; one specimen, in July.

Family TINEIDAE.

Chrysoryctis (?) idiochroa, n. sp.

♂, 20 mm. Head pale ochreous-yellow. Thorax white. Antennae ochreous. Palpi ochreous. Abdomen ochreous-orange. Legs ochreous. Forewings elongate, costa gently arched, termen very obliquely rounded; white; a fine ochreous line along costa from base to three-quarters; cilia pale ochreous. Hindwings dull ochreous-orange; cilia as in forewings. Underside of all wings dull ochreous-orange.

Probably nearest *ochracea*, Meyr.; the white forewings should make it easily recognizable.

Hab.—Broken Hill, New South Wales; one specimen, in January.

Trisyntopa, n. gen.

Head with appressed hairs. Antennae moderate, in male filiform, ciliations two, with strong basal pecten. Palpi moderate, curved, ascending, second joint tolerably smooth, terminal joint half of second, just reaching base of antennae. Abdomen moderate. Posterior tibiae rough-haired above and beneath. Forewings with veins 7 and 8 stalked, 7 to apex, 9 out of 7 above middle; 3 and 4 short-stalked. Hindwings over 1, subovate; 3 and 4 from a point, 5 approximated to 4, 6 and 7 parallel.

A curious genus not near any other known to me. The neural characters are somewhat abnormal for this group, but until further material is forthcoming it can remain here.

Type *euryspoda*, Low,

Trisyntopa euryspoda, n. sp.

♂, 25 mm. Head, palpi, and thorax ashy-grey-fuscous, palpi paler beneath. Antennae fuscous, annulated with darker, ciliations 2. Abdomen ochreous-grey, silvery-grey beneath. Legs silvery-grey, anterior and middle tibiae and tarsi infuscated. Forewings elongate, moderate, costa moderately arched, apex rounded, termen rounded; ashy-grey-whitish; veins, especially towards termen, more or less outlined with fuscous; an obscure elongate dot in cell; a second, more distinct at posterior end of cell; base of wing somewhat darker than rest; a somewhat obscure curved row of more or less disconnected spots just before and parallel to termen; cilia grey-whitish, basal half fuscous. Hindwings grey-whitish, slightly fuscous-tinged around apex; cilia white, with a fuscous subbasal line.

Hab.—Broken Hill, New South Wales; one specimen, in October.

Family ELACHISTIDAE.

Limnoecia pycnogramma, n. sp.

♂ and ♀, 20 mm. Head orange-yellow. Thorax orange-yellow, with a moderately large somewhat quadrate patch of fuscous on anterior two-thirds. Antennae fuscous, annulated with yellow. Palpi orange, terminal joint paler and mixed with fuscous anteriorly. Abdomen pale yellow. Legs fuscous, posterior pair yellow. Forewings elongate, moderate, costa gently arched, termen obliquely rounded; bright yellow, with purplish-fuscous markings; a rather thick oblique basal fascia, leaving a narrow streak of groundcolour at base; a broad median fascia occupying median third of wing, edges oblique, containing a somewhat triangular-shaped spot of groundcolour on costa, and sometimes a narrow outwardly oblique streak of groundcolour just above dorsum; a narrow streak along termen, dilated gradually to apex; cilia dark fuscous. Hindwings elongate-lanceolate, moderately broad; pale grey, finely irrorated with light fuscous; cilia orange-yellow.

Nearest *xanthopelta*, Low.

Hab.—Broken Hill, New South Wales; two specimens, in September.

Notes on Some Miscellaneous Coleoptera, with Descriptions of New Species.—Part IV.

By Arthur M. Lea, F.E.S., Museum Entomologist.

[*Contribution from the South Australian Museum.*]

[Read October 10, 1918.]

Plates XXX. to XXXII.

PSELAPHIDAE.

Articerus.

The genus *Articerus* (like *Mandalotus* of the Curculionidae and *Laius* of the Malacodermidae) contains species many of which are characterized by remarkable sexual features. In the male the metasternum is always different from that of the female, being often armed with one or two spines or projections and sometimes largely excavated; the under-surface of the abdomen of the female is usually evenly convex, with the pygidium in the normal position of that organ; but on the male the abdomen is strongly depressed towards the base, with the apex incurved and the pygidium overhanging; as a result the sex of a specimen carded in the ordinary way may be distinguished from the side, the female having the metasternum and abdomen almost continuously resting on the card, while in the male there appears a gap (sometimes of great extent) between the tip of the abdomen and the highest point of the metasternum; the tibiae of the male are often armed and sometimes have curious flanges, the femora and trochanters are also subject to great sexual variation; but the sexual variation of the antennae is seldom very pronounced. It is desirable to set unique specimens so that both surfaces may be closely examined, and in describing new species quite as much attention requires to be paid to the under-surface and appendages as to the upper-surface. At one time several exotic species were referred to the genus, but these have all been excluded by Raffray.

The following references, mostly since the date of Masters' Catalogue, have been made:—

Schaufuss: Ann. Mus. Civ. Gen., 1882, pp. 176-196.
Monographs the genus (then containing several foreign species), one being described as new; this paper, except for *aurifluus* (given as for 1883), was not referred to in Masters' Catalogue.

Raffray: Rev. d'Ent., Caen., 1887, p. 18.
One species described as new.

Raffray: Proc. Linn. Soc. N.S. Wales, 1900, pp. 241-244.
Four species described as new.

Raffray: Ann. Mus. Nat. Hung., 1903, p. 97.
One species described as new.

Raffray: Ann. Soc. Ent. Fr., 1904, pp. 445, 454.
Notes on genus.

Raffray: *l.c.*, 1909, p. 50.
One species described as new.

Raffray: Wytsman's Gen. Insect., 1908, fasc. 64, pp. 417, 425, 426.
Notes on genus and catalogue of species.

Raffray: Junk's Catal. Col., 1911, part 27, pp. 172, 173.
Catalogue of species.

Blackburn: Trans. Roy. Soc. S. Austr., 1889, p. 138.
One species described as new.

Lea: Proc. Roy. Soc. Vict., 1904, pp. 375, 376.
Notes on four species given.

Lea: *l.c.*, 1910, pp. 163-174.
Notes on most of the known species given and nine described as new.

Lea: *l.c.*, 1912, pp. 53-56.
Notes on several species given and one described as new.

The males of the species known to me may be tabulated as follows:—

A. Antennae circular in transverse section throughout.
  a. Abdomen suddenly constricted near base ... ... *nitidicollis*
  aa. Not so constricted.
    b. Excavation on upper-surface of abdomen not encroaching on middle of convex portion.
      c. Middle legs with femora strongly arched and trochanters very conspicuous ... *regius*
      cc. Middle femora not arched and trochanters not conspicuous.
        d. Metasternum strongly armed posteriorly ... ... *cremastogastri*
        dd. Metasternum unarmed ... ... *fortnumi*
    bb. Excavation encroaching on middle of convex portion.
      e. Antennae (except for the basal constriction) of even width throughout ... ... *cylindricornis*
      ee. Antennae more or less conspicuously dilated to apex.
        f. Front tibiae with a very conspicuous flange on outer side ... ... *cultripes*
        ff. Middle tibiae with a very conspicuous flange or tooth on outer side ... ... *hamatipes*
        fff. Front or middle tibiae not flanged, or, if flanged, not on the outer side.
          g. Metasternum bidentate posteriorly.
            h. The teeth very conspicuous and with a common base ... ... *bispinosus*
            hh. The teeth much smaller and separated at base.
              i. Antennae evenly dilated to apex ... ... *femoralis*
              ii. Antennae suddenly dilated near apex ... ... *bipartitus*
          gg. Metasternum unidentate posteriorly.
            j. Apex of abdomen bidentate.
              k. Antennae conspicuously curved and almost uniformly dark ... ... *lophosternus*
              kk. Antennae scarcely curved, shorter, and apex distinctly paler than base *dentiventris*
            jj. Apex of abdomen unarmed.
              l. Metasternum conspicuously clothed along middle ... ... *intercoxalis*
              ll. Metasternum almost glabrous ... ... *gibbulus*

AA. Antennae wider than deep, at any rate in parts.
B. Middle femora enormously inflated ... ... *tumidus*
BB. Middle femora not so inflated.
C. Excavation on upper-surface of abdomen encroaching on middle of convex portion.
m. A conspicuous seta projecting from the mouth ... ... *curvicornis*
mm. Without such a seta.
n. Superficial area of each antenna about equal to that of head ... ... *dilaticornis*
nn. Much less.
o. The posterior encroachment of the excavation shallow and inconspicuous except from a few directions ... ... *brevipes*
oo. The encroachment very conspicuous.
p. Front tibiae conspicuously armed at apex ... ... *pascoeus*
pp. Front tibiae not so armed ... ... *mastersi*
CC. Excavation not encroaching as on C.
D. Antennae constricted in middle. ... ... *constricticornis*
DD. Antennae not so constricted.
E. Metasternum with a large deep excavation, behind which are two large suberect teeth.
q. Each wall of the excavation dentate in middle ... ... *griffithi*
qq. Walls not dentate ... ... *excavipectus*
EE. Metasternum at most lightly excavated posteriorly.
F. Metasternum unarmed ... ... *irregularis*
FF. Metasternum with two spines transversely placed ... ... *aurifluus*
FFF. Metasternum armed, but not transversely.
G. Middle trochanters very conspicuously armed ... ... *dentipes*
GG. Not so armed.
H. Under-surface of abdomen longitudinally sulcate ... ... *sulciventris*
HH. Under-surface excavated or foveate.
I. Sides of the excavation of under-surface with two small teeth ... ... *raffrayi*
II. Without such ... ... *coelogaster*

Notes on Table.

A. On some of the species of this section the antennae are more or less strongly curved, but they are nowhere flattened, so that a section cut anywhere through them, at right angles to their length, would be a perfect circle; on some of the species of AA *(e.g., curvicornis)* part of the antennae, more especially about the apex, is more or less circular in cross-section, but there is at least a portion between the middle and the base, where they are flattened, so as to be more or less narrowly elliptic in cross-section.

e. Seen both from below and from the sides; in *intercoxalis* the increase in width to the apex is rather slight, but quite distinct.

f. See Proc. Linn. Soc. N.S. Wales, 1900, pl. x., fig. 23.

ff. *L.c.*, fig. 40.

C. On the abdomen of *curvicornis* the excavation slopes backwards on to the convex portion of the abdomen, although there is not a special median encroachment of it; but although thus somewhat intermediate between C and CC, the species has many distinctive features; in *brevipes* the encroachment is more conspicuous than on *curvicornis*, but less than on the others; on some of the species of CC, the excavation encroaches upon the sides of the convex portion.

oo. *pascoeus* and *mastersi* are also very distinct by their sternal armature.

D. As viewed from the sides, see Proc. Linn. Soc. N.S. Wales, 1910, pl. xxvii., fig. 39.

Comments follow on the species not included in the table.

A. ANGUSTICOLLIS, Westw. The type was probably a female; judging by the description and figure it could be placed in the table as far as DD, but not beyond, as the metasternum was not mentioned.

A. ASPER, Blackb. Should be distinct by the absence of a prothoracic fovea, but the legs (except as to their colour), under-surface of abdomen, and metasternum were not mentioned, so it cannot be placed in the table beyond AA.

A. BOSTOCKI, Pasc. Schaufuss regarded this name as a probable synonym of *fortnumi*, a surmise not accepted by Raffray. By the description alone it cannot be placed in either A or AA.

A. BREVICEPS, King. Probably belongs to A of the table, but the metasternum, abdomen, and legs were not mentioned; a cotype that I examined some years ago was a female without antennae.

A. CONSTRICTIVENTRIS, Lea. A remarkable species, allied to but abundantly distinct from *nitidicollis*, with which it would be associated in the table, but the female only being known it has not been included.

A. CYLINDRICORNIS, Lea (= CYLINDRICORNIS, Raffr.).

A. DEYROLLEI, Sharp. Belongs to AA of the table, but the particulars given by Sharp are not sufficient to carry it beyond BB; it should, however, be very distinct by the absence of abdominal fascicles.

A. DUBOULAYI, Waterh. Evidently belongs to AA, but the metasternum not being mentioned, cannot be carried beyond DD; I have seen nothing approaching the original figure.

A. FALCATUS, Raffr. Allied to *curvicornis*, the description being little more than a comparison with that species; in the table it cannot be carried beyond BB.

A. FOVEICOLLIS, Raffr. The metasternum and under-surface of the abdomen were not described, but the figure given by Raffray is strikingly different from that of any other species known to me; in the table it cannot be carried beyond *ee*.

A. KINGIUS, Sharp. This name is probably synonymous with *cultripes*, over which it has precedence.

A. ODEWAHNI, Pasc. (= FORTNUMI, Hope).

A. SELYSI, Schauf. Evidently belongs to AA, but no particulars of the under-surface and legs were given, and the type was a female.

A. SETIPES, Westw. The type appears to be a male; in some respects it appears to approach *dentipes*, but differs somewhat in the antennae and legs; as the metasternum was not mentioned it cannot be placed in the table beyond DD.

A. SHARPI, Masters (= TUMIDUS, Westw.).

A. SPINIFER, Sharp. Evidently belongs to A of the table, and the male should be very distinct by its antennae, legs, and under-surface.

A. TUMIDUS, Sharp (= TUMIDUS, Westw.).

A. WESTWOODI, Sharp. Very close to if not synonymous with *curvicornis;* the latter was originally described from Victoria, but occurs also in New South Wales, Tasmania, and South Australia.

ARTICERUS DEYROLLEI, Sharp.

A female from North-western Australia (Fortescue River, taken by Mr. W. D. Dodd from a nest of *Iridomyrmex)* possibly belongs to *deyrollei* (described as from "Australia"). In general appearance it is like an elongated specimen of *curvicornis*, and the clothing of the upper-surface is somewhat similar, but the head is longer, antennae more parallel-sided, and impression of pronotum much less conspicuous. Its antennae, as seen from above, are (except about the base) parallel-sided, but from the side each appears thin from the base to near the apex, when it is strongly triangularly inflated and truncated; its abdomen is without distinct fascicles (it is the only species I have seen of which this could be said), but the margin of each near the base is rather more densely clothed than the rest of the upper-surface.

Articerus gibbulus, Sharp.

With doubts I previously[1] identified some Victorian specimens as *gibbulus;* but since then have seen four specimens in the South Australian Museum (including three males) labelled as *bostocki*, and as from Western Australia, that evidently belong to *gibbulus*, and are certainly distinct from the Victorian specimens (described on page 251 under the name of *cremastogastri).* The original description of *bostocki* is worthless, but the name (probably incorrectly) has been regarded as a synonym of *fortnumi; fortnumi* is an abundant species in South Australia, but I have seen no specimens of it from Western Australia.

Articerus dentiventris, n. sp.

♂. Dark castaneous-red; head, prothorax, and base of antennae still darker. Moderately clothed with reddish (in some lights almost golden) pubescence, becoming setae on tips of elytra; upper-surface of abdomen almost glabrous, but sides near apex with a few stiff setae, each side of base with two fascicle-like patches of clothing; metasternum conspicuously clothed along middle.

Head short, wide, and deep, a longitudinal impression on basal half; punctures dense and comparatively large. Antennae moderately long, cylindrical in section throughout, basal two-thirds rather thin, then suddenly and strongly dilated to the truncated apex. *Prothorax* moderately transverse, front angles rounded off, the hind ones almost rectangular; with a rather large and deep, subelliptic, medio-basal fovea; punctures much as on head. *Elytra* rather strongly dilated to apex, subsutural striae distinct; base with punctures as on prothorax, sparser (but quite distinct) elsewhere. Upper-surface of *abdomen* with a wide deep excavation, with two oblique flat elevations inwards of the fascicles, the posterior end encroaching on the middle of the convex portion behind the fascicles; under-surface at base

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[1] Proc. Roy. Soc. Vict., 1904, p. 376.

conspicuously obliquely strigose, apex with a small fovea, overhanging which is the pygidium armed with two short acute teeth. *Metasternum* convex along middle, with a conspicuous process overhanging base of abdomen. Front and hind *tibiae* dilated about apex, the middle ones each terminated by a strong hook; middle tarsi unusually short. Length, 2 mm.

♀. Differs in having the abdomen more dilated posteriorly, its under-surface scarcely depressed below level of metasternum, almost evenly convex, not foveate at apex, not encroached upon by pygidium (which is unarmed), metasternum not ridged along middle, unarmed at apex and more sparsely clothed, and middle tibiae similar to the others at apex.

Hab.—Queensland: Stewart River, from nests of a species of *Iridomyrmex*, in appearance somewhat like *detectus* (W. D. Dodd). Type, I, 8536.

Readily distinguished from all previously described species by the remarkable metasternum and abdomen of the male; the colour is also considerably darker (at first glance the head and prothorax appear to be almost black). The setae on each side of the abdomen vary from two to four in number, and are almost spine-like, the dense patch of clothing on each side of the base is divided into two by the elevated margin; there is a stiff seta projecting from the mouth of the male, and a smaller, but still fairly distinct one, from that of the female. From some directions the end of the metasternum appears to have a conical tubercle, but this is really the upper part of an oblique (scarcely vertical) carina, whose lower end (as viewed from the side) appears to be separated from the abdomen by a notch.

Articerus lophosternus, n. sp.

♂. Dark castaneous-red; head, prothorax, and antennae still darker. Moderately clothed with rusty pubescence, becoming longer and more golden on elytra, upper-surface of abdomen glabrous except for a conspicuous oblique golden fascicle on each side of base, and for a few stiff setae at the sides and apex, a distinct line of clothing along middle of sterna, hind femora also conspicuously clothed.

Head short, wide, and deep, with a short longitudinal impression in middle; punctures dense and rather coarse. Antennae moderately long, strongly curved, cylindrical in section, rather thin about base, beyond the middle rather strongly inflated to the truncated apex. *Prothorax* about as wide as long, front angles rounded off, the others almost rectangular; with a deep and rather narrow impression on basal half; punctures much as on head. *Elytra* rather strongly dilated to apex, subsutural striae distinct; punctures at base as on prothorax, sparser but quite distinct elsewhere. Upper-surface of *abdomen* with a large basal excavation, towards each side of which are two oblique lightly elevated ridges, excavation shallowly encroaching upon convex portion; under-surface obliquely strigose about base, about apex with a small fovea, overhanging which is the pygidium armed with two short stout teeth. *Metasternum* with a narrow ridge from base to just beyond the middle, where it terminates in a small conical tubercle. Front *tibiae* lightly curved on upper-surface, lightly bisinuate on lower-surface, and terminating in a hook; middle pair with a shallow subapical notch, the apex hooked; hind pair rather thin at base, moderately dilated to middle, and then almost parallel to apex. Length, $2\frac{1}{4}$ mm.

Hab.—Queensland: Stewart River, taken in a nest of the same host-ant as that of the preceding species (W. D. Dodd). Type (unique), I. 8537.

With many of the remarkable features of the male of the preceding species, but antennae considerably longer, entirely dark, and more strongly curved, apex (although quite as wide) not so suddenly inflated, ridge of metasternum commencing nearer the base, more acutely pointed and not overhanging the abdomen, apical spines of abdomen stouter, hind femora stouter, and with a very conspicuous oblique ridge of golden setae, front tibiae less dilated near apex and with a slight notch, hind pair different, and abdominal fascicles different. The under-surface of the apical half of the antennae has a granulated appearance, and from some directions each appears to be finely but deeply constricted at the basal third.

Articerus bispinosus, n. sp.

♂. Bright reddish-castaneous. Moderately clothed with depressed, golden pubscence, becoming longer and more irregular on upper-surface of abdomen, near base on each side of abdomen with a semi-double fascicle; under-surface rather sparsely clothed.

Head rather short, with a fine median impression, and with fairly conspicuous punctures. Antennae moderately long, cylindrical in section, thin at the base, thence almost evenly dilated to near apex, but more rapidly (although not strongly) about apex; with numerous small granules. *Prothorax* lightly transverse, front angles rounded off; with a round and conspicuous but not very deep medio-basal fovea; punctures as on head. *Elytra* rather strongly dilated to apex, subsutural striae distinct; punctures not very dense or large but distinct, becoming denser about base. Upper-surface of *abdomen* with a wide and deep excavation, its middle distinctly encroaching upon the convex median portion; lower-surface with fine oblique striation about base, about middle with two fine oblique lines. *Metasternum* strongly elevated in middle, at summit of elevation with two strong, acute, oblique, slightly diverging spines. *Legs* comparatively long and thin; front tibiae with a small spine (invisible from most directions) near apex; middle tibiae with a short terminal spur. Length, $1\frac{1}{2}$-$1\frac{3}{4}$ mm.

♀. Differs in being wider posteriorly, abdomen evenly convex on under-surface, metasternum gently convex along middle and unarmed, and the tibiae unarmed.

Hab.—Lord Howe Island: Mounts Gower and Ledgbird. Type, I. 8535.

The armature of the metasternum of the male is exceptionally strong and double, this character alone rendering the species abundantly distinct from all others; of the described species it is nearer to *bipartitus* than to any other known to me, but it is larger, abdomen, metasternum, and legs different; the antennae are intermediate in shape between those of *bipartitus* and *cylindricornis*. The antennae from some directions appear to be gently curved throughout, the granules are more conspicuous about their middle than elsewhere. The excavation on the upper-surface of the abdomen, when viewed from behind, appears to have a wide flat oblique process (triangularly notched at its tip) semi-detached from the middle of each elytron, the space between the processes deeper than elsewhere; from other directions there appear to be four semi-detached processes; the oblique lines on the under-surface of the abdomen appear to mark the sides of a shallow depression, they are present on both sexes, but more conspicuous on the male. The male has a short stout projection from the mouth; on the female it is present, but shorter and less conspicuous.

I had examined numerous nests of ants on the island without finding an inquiline of any sort, and had given up examining their nests when Mrs. Lea, on the slopes of Mount Ledgbird, found some specimens of this species in a nest of a small, blackish, hairy *Iridomyrmex*, under a stone; subsequently I also took a few specimens in a nest of the same species of ant under dry bark of a fallen tree, high up on Mount Gower.

Articerus intercoxalis, n. sp.

♂. Reddish-castaneous; upper-surface, except of abdomen, not very shining. Clothed with rather sparse, pale, depressed pubescence, more golden and conspicuous on apical slope of elytra than elsewhere, upper-surface of abdomen more sparsely pubescent, but in addition with numerous erect or suberect setae, each side of base with a conspicuous golden fascicle, middle of metasternum moderately clothed.

Head moderately long, with a vague median line; with crowded punctures. Antennae moderately long, cylindrical in section, thin about base, then somewhat dilated and parallel-sided to near apex, where it is moderately dilated. *Prothorax* lightly transverse, front angles rounded off, with a rather large, but not very deep, medio-basal fovea; punctures much as on head. *Elytra* moderately dilated to apex, subsutural striae distinct; punctures rather dense and small but distinct, becoming crowded at base. Upper-surface of *abdomen* with a large excavation, semicircularly encroaching upon convex median portion; under-surface constricted in middle. *Metasternum* rather strongly elevated (but not acutely ridged) in middle, posterior slope with a small spine projecting obliquely backwards, a larger and stouter one between middle coxae. Front and hind *tibiae* somewhat dilated at apex, middle ones with a strong, recurved, apical hook. Length, 2 mm.

♀. Differs in being more dilated posteriorly, the metasternum only gently convex along middle and unarmed, abdomen more strongly convex on under-surface, and scarcely depressed below level of metasternum, and the middle tibiae unarmed at apex.

Hab.—South Australia: Lucindale (B. A. Feuerheerdt), Adelaide (A. M. Lea); New South Wales: Kuringai (W. du Boulay). Type, I. 8541.

In general appearance like *cylindricornis* on a small scale, but metasternum of male more convex, with a strong and acute projection between the middle coxae, front tibiae thinner and not notched, the middle ones thinner, and the apical hook at a different angle, the abdominal excavation is smaller and narrower, and the elytra are without apical fascicles. The female may be distinguished from the female of that species by its smaller size, somewhat different abdominal excavation, different prothoracic fovea, and by the absence of a golden line of clothing from the metasternum. From *regius*, which has somewhat similar antennae, it is still more distinct. In some respects it is close to *gibbulus*, but it is darker and more densely clothed, elytral punctures distinct, metasternum of male more conspicuously clothed along middle, and the intercoxal projection more conspicuous. The elytra and abdomen are somewhat paler than the rest of the upper-surface. There is a projection from the mouth, but it is too short and stout to be regarded as a bristle.

The antennae, from some directions, appear to be lightly curved near the apex. All the specimens were taken from nests of a small blackish *Iridomyrmex*, with a metallic-greenish gloss.

ARTICERUS CREMASTOGASTRI, n. sp.

♂. Bright reddish-castaneous. Moderately clothed with pale depressed pubescence, upper-surface of abdomen rather sparsely pubescent, but in addition with numerous suberect setae, each side near base with a distinct fascicle; under-surface more uniformly clothed.

Head rather short, median line lightly impressed; with crowded punctures, but becoming smaller and sparser in front. Antennae moderately long, circular in cross-section, rather strongly and suddenly curved about middle; thin at base, almost evenly dilated to apex. *Prothorax* feebly transverse, front angles rounded off; with a rather large and deep medio-basal fovea, continued as a rather shallow median line almost to apex; punctures dense and comparatively coarse, becoming smaller and sparser in front. *Elytra* moderately dilated to apex, subsutural striae rather feeble; punctures small and not very dense, becoming denser at base. Upper-surface of *abdomen* with a large basal excavation, its middle not semicircularly encroaching upon the convex median portion, but with an oblique impression on each side; under-surface finely strigose at base, constricted in middle. *Metasternum* rather lightly ridged along middle, the ridge terminating in a small but acute process near abdomen. Hind *tibiae* somewhat dilated at apex, the front ones more conspicuously so, the middle ones terminating in an acute hook. Length, 2 mm.

♀. Differs in being slightly more dilated posteriorly, antennae somewhat shorter and stouter, less suddenly (but almost as strongly) curved, metasternum less convex, unarmed, and scarcely elevated (except at the junction) above abdomen (this more strongly and evenly convex), and all tibiae simple at apex.

Hab.—Victoria: Birchip, in nests of *Cremastogaster laeviceps* (J. C. Goudie). Type, I. 8543.

Specimens of this species were previously (2) identified by me with doubts as *gibbulus*, but it differs from some specimens of that species now available from Western Australia (the original locality) in being more densely clothed, the head somewhat shorter, the antennae strongly curved, elytra with more conspicuous punctures, the metasternum differently

(2) Proc. Roy. Soc. Vict., 1904, p. 376.

armed, and no spine between middle coxae; on the western specimens the metasternum is more strongly ridged along the middle, but the ridge is more rounded, commences at the base with a spine between the middle legs, and its greatest elevation is hardly spinose and more distant from the abdomen. From *curvicornis* it differs in being larger, antennae of both sexes circular in cross-section throughout (on *curvicornis* in places the antennae are distinctly wider than deep), metasternum and legs very different, oral bristle less conspicuous, etc. Some parts are slightly paler than others, but there are no sharply defined differences. The abdominal fascicles are distinct, but smaller and less conspicuously golden than usual; the under-surface of the abdomen of the male (viewed from the sides) appears to have a few short erect spines, but these are really due to a slight congestion of short setae; the projection from the mouth is very short. The median line of the head is conspicuous from some directions. The front tibiae of the male, from a few directions, appear to have a pale membranous fringe at the inner apex, conspicuously increasing the apparent width. Both sexes have distinctly granulate antennae.

ARTICERUS SULCIVENTRIS, n. sp.

♂. Reddish-castaneous; some parts slightly darker than others. Clothed with very short pubescence, more conspicuous at apex of elytra than elsewhere, upper-surface of abdomen almost glabrous, except for a few short setae, and for a rather elongate fascicle of short clothing on each side of the base; under-surface rather indistinctly clothed, except for a distinct line along middle of metasternum.

Head unusually short and without a median line; punctures dense and rather coarse. Antennae short, scarcely longer than greatest width of head, moderately wide, lightly curved, basal half somewhat flattened, about apex briefly elliptic in cross-section. *Prothorax* distinctly transverse, widest near apex, front angles not completely rounded off; with a large, round, deep, medio-basal fovea; punctures (except in middle of apex, where they are smaller) much as on head. *Elytra* moderately dilated posteriorly, subsutural striae lightly defined; with rather dense and small, but distinct punctures, becoming crowded at base. Upper-surface of *abdomen* with a wide, deep excavation, not encroaching upon middle of convex median portion; under-surface with a rather narrow groove from base to beyond the middle. *Metasternum* sloping from base to beyond middle, where the slope terminates in a short acute spine, beyond this somewhat widely flattened or gently concave. Front and hind *tibiae* somewhat dilated at apex, the former with a small apical spine, middle pair with an acute apical hook. Length, $1\frac{3}{4}$ mm.

♀. Differs in being somewhat wider posteriorly, antennae shorter, and (as viewed from the sides) somewhat stouter, under-surface of abdomen evenly convex, not grooved, and metasternum and tibiae unarmed.

Hab.—North-western Australia: Fortescue River, from nests of a small species of *Iridomyrmex* (W. D. Dodd). Type, I. 8539.

Not very close to any other species known to me; *brevipes* (also from North-western Australia) is a shorter species, with less conspicuous prothoracic fovea, and with abdomen, legs, clothing, etc., different. The clothing of most of the upper-surface is so short that it appears almost like very small scales, but the elytra have a conspicuous apical fringe of short spines; the male has a short spine projecting from the mouth. The antennae of the male are lightly curved, viewed from above they appear to be almost parallel-sided from near the base to the truncated apex, but from the sides each appears to be rather thin on the basal half, and then evenly and rather strongly dilated; from some directions they seem to be finely longitudinally striated, but this is really due to the arrangement of the granules. From an oblique direction the widest part of the prothorax appears to be quite angular. From the sides, and in a rather poor light, the under-surface of the abdomen of the male appears to have an acute spine, but in a good light and from an oblique direction this is seen to be due to two erect setae, close together, but one on each side of the median groove.

Articerus coelogaster, n. sp.

♂. Dark castaneous-brown; elytra, upper-surface of abdomen, and appendages somewhat paler. Clothed with very short pubescence, becoming more conspicuous and golden about apex of elytra, upper-surface of abdomen with a few erect setae about sides and apex, and with a small fascicle on each side of base.

Head short, wide, and deep, without median line; punctures dense and rather coarse. Antennae short and wide. *Prothorax* lightly transverse, front angles rounded off; with a feeble medio-basal depression; punctures as on head. *Elytra* moderately dilated posteriorly, subsutural striae lightly defined; base with dense and moderately coarse punctures, smaller and sparser (but distinct) elsewhere. Upper-surface of *abdomen* with a short deep excavation, not encroaching upon the convex portion; under-surface with a large almost circular fovea, extending from base to the slightly overhanging pygidium; with two short medio-apical processes. *Metasternum* sloping upwards from base to beyond the middle, and then strongly sloping downwards to apex. Front and hind *tibiae* somewhat dilated, the middle pair short, strongly curved, and terminated by a sharp spur. Length, $2\frac{1}{4}$ mm.

Hab.—Queensland: Cairns district, from a nest of ants (F. P. Dodd). Type (unique), I. 8538.

The type was somewhat mouldy, and on cleaning it possibly some of the pubescence was removed; the species, however, is one of the most distinct in the genus; it is a rather large dark one, at first glance somewhat resembling, but really very different from, *dentiventris* and *lophosternus;* it is about the size of *dilaticornis*, but the abdomen is very different, antennae smaller, etc. Structurally it is close to *raffrayi*, but is much darker, the under-surface of the abdomen with a more sharply defined excavation (without sub-basal armature), and antennae slightly shorter. The antennae are narrow at the base, then suddenly and strongly dilated and flat, near the apex they become narrower and deeper, with the apex itself almost circular, the greatest width is almost median; seen from below the basal two-thirds appear to be finely striated. The medio-basal impression of the pronotum is, for the genus, decidedly feeble, but is quite distinct. The excavation on the under-surface of the abdomen is actually of greater extent than the one on the upper-surface; the summit of the metasternal elevation is not spinose, but from some directions appears to be slightly angular.

CUCUJIDAE.

LAEMOPHLAEUS BLACKBURNI, Grouv. (1902).

L. frenchi, Blackb. (1903).

There was not time for the description of *blackburni* to be noted in the Zoological Record when the description of *frenchi* was sent for publication; otherwise the late Rev. T. Blackburn would certainly not have redescribed this remarkably distinct species.

SCARABAEIDAE.

NESO FLAVIPENNIS, Macl. (formerly *Platydesmus).*

N. yorkensis, Blackb.
N. planicollis, Blackb.

The late Rev. T. Blackburn has already [3] referred to *planicollis* as a synonym of *flavipennis;* but he was under the

(3) *Ante*, 1907, p. 274.

impression that *yorkensis* was distinct on account of the club and the base of the prothorax. The antennae, however, are very different sexually; in the male the lamellae of the club are much longer than in the female, although in that sex they are so long that a unique specimen would probably be regarded as a male. On some specimens the convexity of the prothorax is more pronounced than on others, but the difference is certainly less striking than is implied in the table, and its *apparent* convexity is subject to alteration by the closeness of its application to the elytra. Of *yorkensis* there are in the Museum a cotype male and the type female; of *planicollis* there are two cotype females and a named male (but not marked as a cotype), and, sex for sex, these agree well in structure. There are also numerous other specimens before me, and the species may be taken in abundance at lights in Northern Queensland. The head and prothorax are frequently more or less reddish-castaneous, but vary (in both sexes) almost to black, occasionally they are scarcely darker than the elytra; pale females in colour are scarcely distinguishable from some forms of *Haplonycha testaceipennis*, but may be at once distinguished by the base of the prothorax being almost simple, instead of narrowly but conspicuously upcurved as on that species.

NESO DUCALIS, Blackb.

The carinae on the pygidium of this species is sometimes very conspicuous, but varies so that on some specimens it is not traceable. The male differs from the female in being more parallel-sided, and with the lamellae of the club almost twice as long. The size varies from 12 to 16 mm.

ANODONTONYX VIGILANS, Sharp.
A. creber, Blackb.
A. chalceus, Blackb.
A. indignus, Blackb.

Two specimens, one without label, the other[4] labelled "Austral.," in Dr. Sharp's writing, were sent by Mr. Arrow as *A. vigilans*, a species comented upon by the late Rev. T. Blackburn as incapable of determination[5] but as nearest in description to *chalceus*. They, in fact, agree well with three specimens from his collection labelled as *chalceus*, and their iridescence is quite as pronounced as on those specimens. They agree also with two named specimens of *indignus*, a cotype, and some other named specimens of *creber*.

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[4] Almost certainly one of the specimens mentioned by Sharp.
[5] *Ante*, 1907, p. 260.

In Blackburn's table reliance was placed on the lateral parts of the prothorax being "very closely (almost confluently) punctulate" in *creber* and "much less closely" in *chalceus* and *indignus*. On the cotype of *creber* the punctures there are certainly somewhat denser than on specimens of the other supposed species, but they are also denser than on a specimen from Ballarat and two from Forest Reefs also identified by him as *creber*, and on these the punctures both there and elsewhere (including those between the first and second elytral striae) are much as on the specimens of *indignus* and *chalceus;* the two latter were distinguished by "Hind angles of prothorax quite distinct, though strongly obtuse" in *chalceus*, and "quite rounded off".in *indignus;* on the specimens in the Museum I can find no difference whatever in the actual rotundity of the angles when viewed from exactly the same direction; if viewed from different points and with the base closely applied to the elytra or not there appear to be slight differences. The apparent convexity of the prothorax of the various specimens differs also with the point of view, but from the same viewpoint the difference is extremely small, certainly not of more than individual importance.

Anodontonyx planiceps, Blackb. (formerly *Sericesthis).*
Sericesthis parvipes, Blackb.

There are in the Museum the type female, six other specimens labelled as *planiceps* by Blackburn, and numerous others. These vary in colour from light reddish-castaneous to forms whose prothorax, scutellum, and elytra are almost black; some have only the pronotum blackish, and some have the elytra dark but diluted with red about the shoulders. On some specimens, especially of the large dark ones, the clypeus is conspicuously bilobed in front, and it varies (independently of sex) to almost evenly rounded. The sizes of the elytral punctures are also somewhat variable.

Of *parvipes* there is one specimen labelled as a cotype, and I cannot distinguish this structurally from females of *planiceps*, the character relied upon by Blackburn, "Intermediate tarsi very little longer than their tibiae" as against "nearly twice as long" (of *planiceps)* is, on these specimens, more apparent than real; on some of them the claws are directed almost at a right angle to the claw joint, on others they appear to continue the line of the claw, and specimens of the latter (especially if males) appear to have much longer tarsi, but to the eye the four basal joints are just perceptibly longer than the tibia in both sexes.

Var. *ater*, n. var. Seven specimens (from Hawker) differ in having the entire upper-surface deep black, with the under-surface and appendages dark reddish-brown, becoming black in parts. The clypeus in all of them is rather conspicuously bilobed. They were sent with many other specimens having the head pale and the general colour not deep black.

ANTITROGUS BURMEISTERI, Blackb.

The table differentiating the three known species of *Antitrogus* given by Blackburn *(ante*, 1911, p. 199) readily permits of the specimens before me being divided into three aggregates, but he appears to have been in doubt as to whether the colours may not have been of more than individual importance. A long series of males (including a cotype and many specimens taken by Mr. Griffith, some of which were commented upon) indicate that the general colour varies from a rather dark reddish-brown to almost black. The size varies from 21 to 24 mm. The female is rather larger and stouter than the male, and the club is much smaller, but the proportions between the third and fourth joints of the antennae are the same; the spurs to the hind tibiae are somewhat stouter, but are otherwise scarcely different.

ANTITROGUS TASMANICUS, Burm.

This species varies in size from 19 to 23 mm., and in colour from a reddish-brown to piceous-brown, with or without a pruinose gloss; occasionally the elytra are paler than the rest of the upper-surface. The female differs from the male as does the female of *burmeisteri*, but the proportions of the third and fourth joints of the antennae are as in its own male.

SEMANOPTERUS.

By various authors nineteen (6) names have been referred to this genus, and in dealing with these (7) Mr. Gilbert J. Arrow transfers one *(dentatus*, Blackb.) to *Eophileurus*, and regards all the others, largely by "a study of the genitalia of the males" (these, however, not being otherwise noted) as belonging to but five species. I differ from him, however, as regards two *(meridianus* and *tricostatus)* of the names, and consider that but four species can be maintained.

There are in the South Australian Museum, from the Blackburn collection, specimens of all his supposed species,

(6) Really twenty, as Mr. Blackburn *(ante*, 1896, p. 250) refers to "my *S. punctiventris*," evidently an MS. name subsequently altered.

(7) Ann. and Mag. Nat. Hist., Ser. 8, vol. xiv., 1914, p. 267.

with the exception of *dentatus;* by the courtesy of the Curator of the Australian Museum (Mr. R. Etheridge) I have also been able to examine the types of Macleay's two species, and Mr. Arrow sent specimens which he identified as *solidus* and *subcostatus*.

SEMANOPTERUS CONVEXIUSCULUS, Macl.: Trans. Ent. Soc. N.S. Wales, ii., p. 201.

S. angustatus, Blackb.: Trans. Roy. Soc. S. Austr., 1887, p. 232; 1896, p. 252.
S. minor, Blackb.: *l.c.*, 1887, p. 233; Proc. Linn. Soc. N.S. Wales, 1888, p. 1413.
S. longicollis, Blackb.: Proc. Linn. Soc. N.S. Wales, 1888, p. 1412.
S. rectangulus, Blackb.: Trans. Roy. Soc. S. Austr., 1895, p. 41.
S. persimilis, Blackb.: *l.c.*, p. 42.
S. carinatus, Blackb.: *l.c.*, p. 43.
S. meridianus, Blackb.: *l.c.*, 1896, p. 250.
S. concentricus, Blackb.: *l.c.*, p. 251.
S. tricostatus, Blackb.: *l.c.*, p. 52.
S. distributus, Blackb.: *l.c.*, p. 252.

Pl. xxx.; pl. xxxi., figs. 21, 22; pl. xxxii., figs. 30-35, 41.

To the synonymy of this species as given by Arrow the two last names have been added, making it as above. In Blackburn's table of the genus primary use was made of the basal angles of the prothorax, and in fact it is difficult at first to accept the idea that a specimen whose basal angle of prothorax is without the slightest incurvature, as on the type of *convexiusculus* (pl. xxxii., fig. 30) can be conspecific with another whose basal angle is very conspicuously notched, as on the cotype of *rectangulus* (pl. xxxii., fig. 32), especially when these differences are accompanied by others in the pygidium, prosternum, etc. However, from examination of the actual types Mr. Arrow came to his conclusion, and in this I am reluctantly compelled to follow him. I have very carefully studied Blackburn's table of the genus with the cotypes (marked as such by himself), and believe that in preparing it he could only have closely examined the types themselves, and made no allowance for variation. For instance, *concentricus*, *angustatus*, and *minor* are stated to have the sides of prothorax "strongly incurved in front of base"; those of two cotypes of *concentricus*, a cotype of *angustatus*, and two cotypes of *minor* have the sides just perceptibly incurved to base (pl. xxxii., fig. 31); on the type female of *concentricus* there is no incurvature at all, the sides being as on the type of *convexiusculus* (pl. xxxii., fig. 30), but on a specimen he identified as *minor* (pl. xxxii., fig. 33), and which I regard as belonging to the variety *rectangulus*, there is a conspicuous notch near the base. A specimen labelled as *carinatus*, the type female of *persimilis*, two cotypes of *rectangulus*, and two of *distributus* could fairly be said to have the sides "strongly excised," as noted in the table, but a cotype of *tricostatus* (pl. xxxii., fig. 36) has but a slight incurvature there. The clothing of the pygidium is a practically useless character for a table, as the hairs are certain to become more or less abraded with age; the punctures of the pygidium are strikingly different on some of the cotypes, but here again, from them, I cannot follow Blackburn's comments. The discal depressions of the prothorax, as on most of the Dynastides, are particularly liable to variation.

Meridianus was regarded by Arrow as a synonym of *subcostatus*, but his opinion is not borne out by the type female, which placed side by side with the type of *convexiusculus* is seen to be absolutely conspecific with it, differing in a very slight degree in the basal angles and in the punctures; but in size, outline, and general sculpture the two are in perfect unison. Possibly the type male belongs to *subcostatus*, and the type female to *convexiusculus*, but this is doubtful from the description. A cotype female from Bindogundra has the prothoracic margins exactly as on the type of *convexiusculus*, but differs somewhat in the elytral punctures.

Tricostatus was apparently considered as distinct by Arrow, although all he says of it is that it is apparently confined to Western Australia.[8] A cotype male in the Museum (pl. xxxii., figs. 32, 36) agrees absolutely (except for a slight degree in the notching of the base), with a specimen pl. xxx., fig. 8, and pl. xxxii., fig. 33) identified by Blackburn as *minor)*. Two other cotype males (from Geraldton) have the prothoracic excavation exactly as on a cotype of *rectangulus*, and the basal notch as in fig. 35 (pl. xxxii.), with the third carina on each elytron less conspicuous than on the other cotype. It appears, therefore, that this name should also rank with the synonyms of *convexiusculus*.

A copy of these notes was submitted to Mr. Arrow for his opinion, which was given as follows:—"I strongly suspect that some of the specimens upon which you are relying as cotypes of Blackburn's species are not the same species as his types. *S. tricostatus* is a well-marked species, as you will see if you will examine the genitalia, which are of supreme

[8] Blackburn, however, said that from it "a single male example . . . from North Queensland seems indistinguishable . . ."

importance in distinguishing these insects. *S. meridianus* type is a female, but is certainly not *convexiusculus*, Macl., if the latter is *angustatus*, Blackb. I have mounted and carefully compared the aedeagi of all ten types and very many other specimens, and consider my conclusions certain."

I have not felt justified in breaking up the abdomen to examine the aedeagus of any of the male types or cotypes, but three figures are given from some specimens carefully compared with them.

Five males agreed closely with *rectangulus*, and the aedeagus of one is figured (pl. xxxii., fig. 41). The aedeagi of the others all differed slightly from it and from each other; on one of them the two serrations on each side were extremely feeble.

Four males agreed closely with a specimen considered by Mr. Blackburn to be *adelaidae;* of these one has the aedeagus as on pl. xxxii., fig. 39, two had it somewhat similar although not exactly the same, but that of the fourth (pl. xxxii., fig. 40) was without the subapical notch.

It would appear, therefore, that the aedeagus in some species is just as unreliable as external features.

SEMANOPTERUS SUBCOSTATUS, Cast. *(Phileurus)*, Hist. Nat., ii., p. 116 *(Chiroplatys*, Mast. Cat., No. 2478).

S. adelaidae, Hope: Trans. Ent. Soc. Lond., iv., p. 281.
S. subaequalis, Hope: *l.c.*, p. 282.
S. depressus, Hope: *l.c.*, p. 282.
S. depressiusculus, Macl.: Trans. Ent. Soc. N.S. Wales, ii., p. 200.

Pl. xxxi., figs. 17-20; pl. xxxii., figs. 36, 39, 40.

Blackburn of *subcostatus* remarked that it "might be almost any *Semanopterus*, but is probably *adelaidae*, Hope." Arrow says,[9] "I have already[10] expressed my opinion that the three names bestowed by Hope *(adelaidae, subaequalis*, and *depressus)* refer all to one species. To this species *depressiusculus*, Macl., and *meridianus*, Blackb., also apply, and it should be called *S. subcostatus*, Cast." In neither reference, however, does he give the grounds for his belief, and presumably the type of *subcostatus* is not in the British Museum. As regards *meridianus*, I consider that as a synonym it should be transferred to *convexiusculus*, and comment upon it under that species.

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(9) *L.c.*, 1914, p. 267.

(10) *L.c.*, Ser. 8, vol. viii., 1911, p. 156; in this reference, however, he did not include *adelaidae*.

Semanopterus solidus, Burm. *(Scapanes)*, Handb. v., p. 207.

S. subaequalis, (Hope) Blackb.: Trans. Roy. Soc. S. Austr., 1887, p. 231.

Asemantus subaequalis, (? Hope), Blackb.: *l.c.*, 1896, p. 248.

Pl. xxxi., figs. 23-26; pl. xxxii., fig. 37.

Blackburn had doubts as to his identification of *subaequalis*, and these doubts were evidently well founded, as Arrow (no doubt from examination of the types) regards all three of Hope's names as belonging to but one species. The former, however, from his comments on *solidus*, evidently considered the probability of its being the same species as the one he identified as *subaequalis*. On pl. xxxi. are figures (23 and 24) of the specimens described by him as belonging to his new genus *Asemantus*, and the species he supposed to be *subaequalis;* whilst figs. 25 and 26 (pl. xxxi.) are of specimens identified by Arrow as *solidus*, they certainly belong to but one species, a fairly common one in parts of Queensland, New South Wales, Victoria, and South Australia.

Curiously enough standing under the name of *Scapanes solidus*, in many Australian collections, was one of the largest of our *Dynastides* (pl. xxxi., fig. 29),[11] but a reference to the original description proves that this legendary identification is utterly wrong.

Semanopterus leai, Blackb. *(Asemantus)*, *l.c.*, 1897, p. 29.

Pl. xxxi., figs. 27, 28; pl. xxxii., fig. 38.

Regarded by Blackburn as congeneric with the preceding species and generically distinct from *Semanopterus;* it occurs in Western Australia, and is very different from any other species of the genus.

Eupatorus australicus, Arrow, Trans. Ent. Soc. Lond., 1908, p. 354.

Pl. xxxi., fig. 29.

This species appears to be confined to the southern parts of coastal Queensland.

Corynophyllus modestus, Blackb.

A male from Queensland (Stanthorpe) differs from a cotype male of this species in having the cephalic horn larger

(11) *Eupatorus australicus*, Arrow.

and more acute, the space on the head behind it flat instead of concave, and the clypeus and tibiae reddish.

Horonotus optatus, Sharp.
H. variolicollis, Fairm.
Palmerstonia minor, Blackb.
P. pusilla, Blackb.

Prior to their despatch to the British Museum I examined the types of *minor* and *pusilla*, and was satisfied that they are but forms of *optatus*, a species that varies greatly in size, and is frequently attracted to lights in the tropical parts of Queensland. Part of this synonymy has already been recorded.

Horonotus bovilli, Blackb. (formerly *Palmerstonia)*.

A male from Cairns (E. Allen) differs from the male previously commented upon by Blackburn *(ante*, 1896, p. 254), in being considerably larger, in having the cephalic horn considerably larger, and the three prothoracic horns larger, more acute, and not placed in a transverse row (as on that specimen), but closer together, two in front and one behind; the difference to the eye is a very striking one, but the species of *Horonotus* are so variable that the difference is not likely to be more than an individual one. The stridulating file of the pygidium is a very beautiful one.

Hemipharis froggatti, Macl.

I have recently examined the types (sexes) of this species. As suspected[12] they belong to the variety *speciosa* of *H. insularis*.

Chlorobapta viridisignata, Macl.

A female in the Macleay Museum is evidently the type of this species, and as suspected[13] it is a variety of *frontalis*. On its prothorax there are two small green spots on each side; associated with it is a male with quite ordinary markings.

Diaphonia dorsalis, Don.

A male (from the Richmond River) in the Macleay Museum has the black markings much more extended than usual, the pale portion on each side of the prothorax being very narrow, the elytra are dark except for a very narrow lateral margin, and even this becomes infuscated about the apex; a second specimen (also from the Richmond River) has the pale elytral margins somewhat wider, and about the apex

(12) Trans. Roy. Soc. S. Austr., 1914, p. 149.
(13) *L.c.*, p. 156.

somewhat irregular, so that the dark portion at the summit of the apical slope appears to be trilobed.

DIAPHONIA MNISZECHII, Jans.

A specimen of this fine species is in the Macleay Museum from the Darling River.

LYRAPHORA OBLIQUATA, Westw.

A specimen labelled as from Mudgee (New South Wales) is in the Macleay Museum, but the locality is probably wrong.

GLYCYPHANA BRUNNIPES, Kirby.

There are two specimens of this species in the Macleay Museum, from North-western Australia, with the white markings occupying an unusually large proportion of the elytra.

MICROVALGUS QUINQUEDENTATUS, Lea.

Some specimens, that appear to be males of this species, differ from the females in having the apical segment of abdomen flattened in middle, and the general colours somewhat darker.

MICROVALGUS DUBIUS, Lea.

There are specimens of this species in the Macleay Museum from South Australia.

CURCULIONIDAE.

MYLLOCERUS HERBACEUS, Pasc.

Mr. Arrow sent for examination a cotype of this species; it has a strong conical tubercle projecting backwards from the under-surface of the rostrum, and all the femora are acutely and distinctly dentate; as these characters (the first of which is a very remarkable one) were not mentioned in the original description I thought that possibly a mistake had been made in the identification, and wrote to Mr. Arrow for confirmation of same. In reply he wrote, "I have examined Pascoe's type and find it has the peculiar hooked process on the rostrum and also sharply spined femora." *Mirabilis*, the only other Australian species with the under-surface of rostrum somewhat similar, belongs to a different section of the genus, and has the base of prothorax much wider and clothing very different.

ESSOLITHNA RATTULA, Pasc. (formerly *Pephricus).*

A cotype of this species, evidently the one noted as having "two fine white lines at the base of the elytra," was sent for examination; specimens were in the Macleay Museum from the Darling River. The species in general appearance is fairly close to *cordipennis*, but the space between the scrobes is strongly narrowed posteriorly, whereas on that species it is slightly dilated posteriorly; the clothing also is different. As in some respects it seemed to agree with the description of *umbratus*, some years ago specimens were sent for comparison with the type of that species, and of these the late Rev. T. Blackburn wrote, "Specimens sent are certainly not *umbratus*. Apart from colouring (which is very different) it differs, *inter alia*, as follows: Shape of prothorax—in *umbratus*, less rounded laterally with greatest width in front of middle; in your species well rounded, widest at middle. Interval between scrobes in *umbratus* continuously and evenly narrowing from base to apex, in your species at its narrowest near base." The latter character will also distinguish the species from *mediofusca*, which in many respects it resembles. There is a whitish ring on each of the femora.

Essolithna nigescens, Pasc. (formerly *Chaodius*).

A cotype of this species sent for examination has the front coxae exactly as on *Essolithna rattula*, that is to say, the intercoxal process is rather narrow, about half the width of that between the middle coxae and transversely cleft at its narrowest part; the claws are unidentate. It was only on these characters (in comparison with *Polyphrades*) that *Chaodius* was proposed as new, and I regard it is absolutely synonymous with *Essolithna*. The elytra were described as subparallel, but the shoulders are rather strongly rounded, the sides at the apical fourth are coarctate, and the sides between are gently rounded; possibly the sides are sexually variable, but the word subparallel as applied to the cotype would be misleading. The species is extremely close to *cordipennis*, but differs in having longer and narrower elytra.

Essolithna umbrata, Blackb. (*Pephricus*).

On closely examining a cotype of this species each claw is seen to have a smaller one soldered to it at the base; the smaller claw is invisible from most directions, but its presence on this species and its gradual enlargement on several species of *Polyphrades*, till at the apex the claws are noticeably cleft, but of equal size, seem to imply a doubt as to whether *Essolithna* (to which genus *Pephricus* has already been referred) can be eventually maintained as distinct.

Catasarcus pollinosus, Pasc.

C. maculatus, Pasc.

A specimen sent for examination by Mr. Arrow, marked as a cotype and bearing a label "*Catasarcus pollinosus*, Pasc.," in Pascoe's own writing, is simply a specimen of *maculatus* that has the whole of the upper-surface with a curiously leaden or varnished appearance. It was described as "having an ashy-waxy appearance above." This appearance is liable to occur on *any* species of *Catasarcus*, and I have previously commented upon it under the word "Varnishing."(14) As, however, the description of *pollinosus* was printed (p. 23) before that of *maculatus* (p. 25) the latter name must be treated as a synonym. The species occurs in abundance at King George Sound and near same.

It is quite possible that the species is the *Cneorhinus impressipennis* of Boisduval.(15) The figure of that species is certainly an extremely poor one, but, such as it is, it seems to come closer to this species than to any other before me.

Catasarcus stigmatipennis, Boi. (formerly *Cneorhinus)*.

C. transversalis, Germ.

C. memnonius, Pasc.

A specimen sent for examination by Mr. Arrow as a cotype of *memnonius* is simply an abraded(16) one of *transversalis*, the only species of the genus of which I have seen authentic specimens from any other State than Western Australia. It is common in many parts of Victoria and South Australia, is considerably variable in size, and abraded specimens have a very different appearance from ones in good condition. I am also convinced that it is the *Cneorhinus stigmatipennis* of Boisduval, described as from Port Western (near Melbourne).

Catasarcus ovinus, Pasc.

A specimen from the British Museum bears three labels: — 1. "N. Australia." 2. "Bowring, 63.47." 3. "*Catasarcus ovinus*, Pasc. Compared with type, G. J. A." But in that institution (judging from specimens sent to me for examination) there are many specimens labelled as from North Australia and Bowring that are certainly not from the tropical portions of Australia, belonging to quite common

(14) Proc. Linn. Soc. N.S. Wales, 1897, pp. 593, 594.

(15) Voy. "Ast.," p. 350, and Atlas, pl. vii., fig. 9.

(16) It was described as being "without any scales."

species in New South Wales, Victoria, or Western Australia. This species is a common one in Western Australia, and is the one I previously [17] surmised to be such.

Catasarcus griseus, Pasc.

A specimen sent as a cotype of *griseus* is certainly very close to the preceding one, but differs in the elytral striation being less evident posteriorly, and the punctures towards the base more or less transversely confluent (much as on many specimens of *transversalis)*. In Pascoe's table they are separated by *griseus* being "oval and more or less oblong" and by *ovinus* being "shortly ovate"; there is certainly a slight difference in the comparative widths of the specimens sent, but there are specimens of *ovinus* before me with a still greater range in width. In *griseus* the first joint of the funicle was described as "very little longer than the second," in *ovinus* as "considerably longer"; but on each of the specimens sent the first joint appears to be about one-fourth longer than the second, the proportions being exactly the same. That the two forms represent distinct species I can hardly believe; if they should eventually prove to be varieties *griseus* has priority.

Catasarcus ceratus, Pasc.

C. granulatus, Lea.

A specimen sent for examination by Mr. Arrow, marked as a cotype, and bearing a label "*Catasarcus ceratus*, Pasc.," in Pascoe's own writing, is simply a varnished one of the species I subsequently named *granulatus*. Its finer sculpture is naturally less conspicuous and the varnishing has extended even to parts of the legs. Its antennae are missing, but those of the type were wrongly described. [18]

Catasarcus longicornis, Pasc.

A Champion Bay specimen sent for examination as a cotype of *longicornis* agrees well (even as to the antennae) with a species, common about the Swan River, which I have long had as *hopei*. But probably Pascoe had another species as *hopei*, and I am not prepared to defend my identification of the latter. It might be pointed out, however, that the differences relied upon in his table by Pascoe could very well be sexual.

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(17) Trans. Roy. Soc. S. Austr., 1909, p. 155.

(18) See note Trans. Roy. Soc. S. Austr., 1909, p. 156.

CATASARCUS ARMATUS, Blackb.

Six specimens before me, from Kalgoorlie, are evidently in better condition than the type was; four of them have the elytra at the base densely clothed (mostly in three conspicuous patches) with ochreous scales, having, on close examination, a somewhat golden glitter, and similar scales rather thickly scattered elsewhere. Along the middle of the prothorax there is usually a conspicuous line of bluish scales; three of the specimens have the shoulders tuberculate, but on the others they are unarmed.

CATASARCUS SERICEUS, Blackb.

A specimen, from Kuminin, possibly belongs to this species. Its scales, whilst mostly greenish, are considerably mixed with sooty and somewhat golden ones; the posthumeral tubercle (directly above the middle of the metasternum) is an obtuse swelling only, instead of a spine, as on most species of the genus.

AMISALLUS NODOSUS, Er.

A specimen, from Tasmania, agrees with Erichson's description of *nodosus*, but in addition to the large elytral tubercles described by him it has several small ones on the suture about summit of apical slope; these were not mentioned, but their presence on any species of the Leptopsides is of importance as an aid to identification, and *nodosus* is the only described species of *Amisallus* with such tubercles. A specimen from Mount Tambourine (Queensland) has similar sutural tubercles to the Tasmanian one, but the interior row on the right elytron is composed of five, and on the left elytron of seven, large tubercles.

AMISALLUS WHITEI, Waterh., var.

A specimen, from Cairns, differs from the typical form of this species in having a cluster of four conjoined tubercles, forming an irregular mass on each shoulder; the furrow on its prothorax is distinct, narrow, and scarcely interrupted, and the inter-ocular tubercles smaller and more obtuse than usual.

LIPOTHYREA CHLORIS, Pasc., var.

Five specimens from Charters Towers differ from the typical form of this species in having the green scales replaced by ashen ones, and the size decreasing to 6 mm.; the general appearance of the smaller specimens is much like that of *arrowi*, but they are without the conspicuous long setae of that species.

Oxyops gemella, Pasc.

A specimen from "Western Australia" (the type was from Champion Bay) sent as a cotype of *gemella* is very close to *multidentata*, but differs in the front tibiae being thicker, straighter, and less conspicuously dentate. The original description is distinctly misleading (if the cotype agrees well with the type), as the elytra were noted as having the third interstice elevated throughout and as having "singulatim medio nigro-plagiatis et postice macula alba distincta notatis"; also no mention was made of a rather strong prothoracic carina. On the cotype there is a semicircular irregularly double row of large punctures or foveae, commencing near the shoulder, curved round to near suture, and then obliquely hindwards, terminating about summit of apical slope; these punctures appear darker than the adjacent parts owing to partial absence of clothing, but the space there is certainly not black. The species also occurs in South Australia and Victoria.

Ethemaia alternata, Lea.

Mr. Feuerheerdt has recently taken numerous specimens of this species. On some of them the elytral scales are mostly slaty-white, but with patches varying to sooty; on many of them there are small patches of ochreous scales at the base of the head; some of them have a second tubercle on the fifth interstice before the one crowning the apical slope.

Lycosura breweri, Pasc. (formerly Pantoreites).

L. inermis, Lea.

A cotype of *breweri* sent for examination by Mr. Arrow does not even belong to the Gonipterides, but is a *Lycosura*, and is the species I have named *inermis*.

Opsittis atomaria, Pasc.

Sediantha maritima, Lea.

Mr. Arrow sent for examination a cotype of *Opsittis atomaria*. The genus and species are the same as those I subsequently named *Sediantha maritima*. The eyes were correctly described by Pascoe as transverse, small and approximate in front, but the figure (pl. vii., fig. 8) of the side view of the head is utterly misleading. The genus is quite close to *Desiantha* of the Erirhinides, but Pascoe referred it to the *Molytides*, where I would never have thought of looking for it.

Phrenozemia.

This genus was referred by Pascoe to the group Eugnomides of the Erirhinides. A female of the typical species, *lyproides*, was recently sent to me for examination by Mr. Arrow; it bears a name label by Pascoe, and is no doubt a cotype; there are also numerous specimens from Geraldton before me that belong to the species. The genus looks out of place in the Erirhinides, and more as if it should be associated with *Medicasta*, or possibly *Acalonoma*, but regarding it as an Erirhinid it could, in Blackburn's table[19] (disregarding the position assigned to it by him on account of the "eyes as much on rostrum as on head," a scarcely correct character,[20] as the eyes, although quite frontal, are not any more "on" the rostrum than on many other Erirhinid genera), be associated with *Desiantha*, to which it is far from being closely allied; but if excluded from I of that table, it could be placed in MM,[21] and the ocular lobes being entirely wanting, it would be associated with *Omorophius*, to which also it is far from being closely allied. The eyes are rather large but not prominent, coarsely faceted, and distant from the prothorax; the head is regularly narrowed from its base to the base of the rostrum, and the eyes are so little prominent that they scarcely interfere with the general obliquity of the sides.

Phrenozemia lyproides, Pasc.

This species is individually and sexually variable. In the specific description the scales were noted as "*griseo-albis*," but in the generic one as having "a pearly lustre"; on the pronotum there is often a pale median line of scales extending forwards on to the base of the head, and backwards to beyond the scutellum; towards each side of the elytra there is often a whitish vitta, with a golden or greenish gloss, but often the scales of the upper-surface are smoky-brown, pale golden-green and golden confusedly mixed; on the under-surface and legs they are also variable, but with the paler colours prevailing; some specimens, however, have scarcely any gloss to the scales, and the expression "*griseo-albis*" well applies to them. The rostrum of the male is almost straight and almost as long as the prothorax, and the antennae, when stretched out at right angles to the rostrum, are so placed

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(19) *Ante*, 1894, pp. 148-150; although tabulated by Blackburn it was apparently unknown to him.

(20) Nor can I find any warrant in Pascoe's description or in his table of genera for such a character being used.

(21) Pascoe corrected the original description of the funicle when describing a second species of the genus.

that the distance separating them is slightly greater than the distance between them and the tip of the muzzle. In the female the rostrum is thinner, more noticeably but not strongly curved, about one-fourth longer, and the distance between the antennae is scarcely more than half that between them and the tip of the muzzle. The basal segment of the abdomen of the male is moderately concave, and the second is flat in the middle; in the female the basal segment is gently convex in the middle, and the second decidedly convex.

CYROTYPHUS FASCICULARIS, Pasc.

A specimen from Coolgardie differs from the normal form of this species in being considerably larger (17 × 7 mm.), fascicles on the elytra more numerous (there are nine small ones on each side of the suture), the transverse series of four tubercles on the pronotum larger, and the apex with two fairly large ones (on the normal form these are represented by slight ridges).

CTENAPHIDES MACULATUS, Pasc. (formerly *Eurhynchus*).
C. gymnostictus, Lea.

Mr. Arrow sent a female of *Eurhynchus maculatus* for examination, marked as having been compared with the type. It is the species I subsequently named *C. gymnostictus*. Pascoe's description is somewhat misleading, as the club was given as black and the elytral interstices as having piceous spots; the elytra certainly have a spotted appearance, but this is due to small glabrous spaces, these being exactly the same colour as the rest of the derm. The scutellum was described as triangular; as a matter of fact, it is almost vertical with a conspicuous median groove.

HAPLONYX SCOLOPAX, Pasc.

A cotype of this species sent for examination proves to be, as previously suspected,[22] simply an abraded specimen of *spencei;* the sexes differ in the length of the rostrum, that of the female being distinctly longer than that of the male.

HAPLONYX DOTATUS, Pasc.

A cotype of this species is certainly but one of the many varieties of *myrrhatus*. The clothing and scales of specimens of *Haplonyx* that have been preserved in liquids often differ considerably in appearance from specimens of the same species that have been killed and kept dry. Partial abrasion also considerably alters their appearance.

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(22) *Ante*, 1910, p. 44.

HAPLONYX FALLACIOSUS, Pasc.

A cotype of this species is structurally very close to *fasciculatus*, but has the prothorax non-fasciculate. The description implies that there is but one fascicle on each elytron, but on the cotype there are five on each, three on the third interstice and two on the fifth.

DECILAUS INFAUSTUS, Pasc. (formerly *Drassicus).*

Decilaus coryssopus, Lea.

A specimen sent for examination by Mr. Arrow as a cotype of *Drassicus infaustus* and agreeing with the description, agrees with the type of *D. coryssopus*. Pascoe referred it with some doubt to *Drassicus*, but it belongs to *Decilaus;* he recorded it from Wide Bay, and the cotype is so labelled; the types of *coryssopus* were from Hobart, and it is very doubtful if Wide Bay was correctly given.

PHLAEOGLYMMA PALLIDA, Lea.

Two specimens, from the old collection, and without locality labels, evidently belong to this species. They differ from the type in having most of the scales on the upper-surface of a dingy light brown, but in places verging to sooty. The white scales form three lines on the pronotum, of which the median line is no longer than the others. On each elytron they form an oblique stripe from the shoulder to near the suture, and another across summit of posterior declivity. On the under-surface the light-brown scales are fairly numerous. The three specimens, that I have now seen of the species, appear to be all males.

PACHYPOROPTERUS SATYRUS, Pasc. *(Poropterus).*

Poropterus inominatus, Pasc.

Mr. Arrow informed me that these names are synonymous, *satyrus* was recorded from Tasmania and *inominatus* from Queensland; the former occurs in many parts of Tasmania, but apparently not beyond that State. If the type of the latter was really from Queensland, I should be dubious about its being really a synonym, especially as Pascoe compared them, saying of *inominatus* that it was "shorter, less convex, the parts behind the carina marking the upper region of the epipleura, abruptly constricted, and the scales at the base of the elytra concolorous with and closely fixed to the derm, the part, except under a strong lens, appearing denuded." However, in a second communication Mr. Arrow wrote, "The single type specimen of *inominatus* bears only the loc. Queensland in Pascoe's handwriting. The only part of the above comparative description which I can confirm is the denuded appearance, which is an unmistakeable reality. I think Pascoe must have made a mistake in the locality and imagined the rest."

Omydaus luridus, Fab. (formerly *Rhynchaenus).*
Cryptorhynchus fuliginosus, Boi.
Acalles immansuetus, Boh.
O. plinthoides, Pasc.

In commenting [23] on the synonymy of *fuliginosus*, I was somewhat dubious as to *luridus* really being the same species, as Pascoe stated that it was a *Poropterus;* I have seen the type of *fuliginosus*, which is certainly the same as *immansuetus* and *plinthoides*, and Mr. Arrow has recently compared the types of *luridus* and *plinthoides*, and considers them identical.

CHRYSOMELIDAE.

Diaphanops westermanni, Boh.
Var. *D. meyricki*, Blackb.
Var. *D. parallelus*, Blackb.

There are before me 28 specimens, all of which I believe to be *westermanni*, but they present considerable differences in size, colour, and clothing. The difference in appearance of the clothing is often due to partial abrasion [24] and to the colour of the derm upon which it is resting, but on some specimens it is beautifully regular, and on others it appears to be rougher, this, however, probably being due to some of them having been preserved in alcohol. The colour of the derm varies from entirely pale reddish-brown to entirely deep black, many specimens have the elytra and appendages conspicuously paler than the head and prothorax, some have the elytra only paler, and some have only parts of the head and of the antennae darker than the other parts. On the male the prothorax is rather shorter than on the female, and with the front angles more conspicuously rounded off, its elytra also are proportionately wider than on the female, and the antennae are slightly longer. The specimens commented upon or described by Blackburn [25] were all taken by Mr. Meyrick at Geraldton, and of these there are in the Museum two doubtfully identified as *westermanni*, two marked as

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(23) Proc. Linn. Soc. N.S. Wales, 1913, p. 463.

(24) On partially abraded specimens there are seen to be seriate rows of large punctures on the elytra, but these are normally almost or quite concealed.

(25) Proc. Linn. Soc. N.S. Wales, 1889, pp. 457-9.

cotypes of *meyricki*, and one as a cotype of *parallelus*.[26] Of a pair taken *in cop.* at Geraldton the male agrees perfectly with the specimens identified as *westermanni*, the female agrees perfectly (except that the head and part of the antennae are much darker) with the cotypes of *meyricki*. Of another pair taken *in cop.* at Bunbury, the male agrees perfectly with the cotype of *parallelus*; the latter certainly has not anything near as parallel elytra as is implied by the description, these being (except for the sexual difference in width) practically the same as in the cotypes of *meyricki*.

CRIOCERIS FUSCOMACULATA, Clark.

C. recens, Blackb., var.

This species is very variable and is abundant in Northern Queensland. The following more or less constant colour forms may be noted:—

A. Flavous; head (neck usually excepted), scutellum, parts of under-surface and of appendages (most of femora excepted) black. In general appearance this form is close to *C. nigripes*, but differs considerably in the punctures and in the shape of the prothorax; that species appears also to have the scutellum invariably pale, on this (and in all other forms of the species) it is invariably dark. On this and on form B the elytral punctures are often surrounded by watery rings, when they appear to be considerably larger than they really are; on examining them from the sides, however, they are seen to be no larger than on the darker specimens.

B. Like A, except that on each elytron before the middle there is a conspicuous more or less rounded black spot. This is the typical form.

C. Black, elytra flavous, a large black spot on each elytron.

D. Like A, except that there is a large black blotch on the elytra occupying more than half of the surface, but leaving the basal third, margins, and apex pale.

E. Like D, except that the suture is pale throughout.

F. Black, basal fourth of elytra (and sometimes the extreme margins or portions of them) pale. This is the variety *recens*.

There are other forms varying in the under-surface and legs; one before me is entirely black, except that a narrow basal edging to each elytron and parts of the under-surface and of the femora are reddish. The pale colour on the various forms varies from a clear flavous to a rather dark red, but this may be due to age, etc.

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(26) Although he stated that "a single specimen was taken."

Stethopachys formosa, Baly.

This species occurs from the Richmond River, through the coastal districts of Queensland to Darwin. In the most abundant form the elytra have five spots; three somewhat angular sub-basal ones, and two rounded or transverse subapical ones; occasionally the three sub-basal ones are conjoined, and frequently the subapical ones are; on an occasional specimen the spots are entirely absent, and occasionally they are reduced to two small subapical ones and a minute one near each shoulder; on one specimen each subhumeral spot is split up into two, so that there is a transverse series of five spots near the base. There are also other varieties, but I have seen none bearing the cephalic spot of the type.

Stethomela purpureipennis, Lea.

A specimen of this species has recently been taken at Hobart by Mr. G. H. Hardy.

Calomela tenuicornis, Lea.

Mr. Carter informs me that the locality "Sandgate" for the specimen received from him should have been "Sandstone" (half-way between Murchison and Kalgoorlie).

Arsipoda kingensis, Blackb.

The late Rev. T. Blackburn described *kingensis* as a variety of *variegata*, but I am convinced that it should be regarded as a distinct species. In addition to the King Island specimens numerous others have been taken in various parts of Tasmania, and there were two in the Blackburn collection from Adelaide, and all these differ from *variegata* in being distinctly narrower, prothoracic and elytra punctures considerably larger, colour invariably very pale, and the elytra never with darker markings. *Variegata* is certainly a variable species, but I have never seen a specimen without some darker markings, and even the palest specimens differ from *kingensis* in the structural features noted.

Chirida multicolor, Blackb.

The type of this species was described as having on its prothorax "a short broad blackish vitta running forward a short distance from the base and dilating at its front." But on a cotype the vitta, although of the shape described, is of a rather light brown. There are numerous other specimens before me (from Cairns, Mulgrave River, Mackay, and Clarence River) that structurally agree so well with the cotype that I cannot regard them as distinct, but they all have the prothorax immaculate.

Photo by H. M. Hale.

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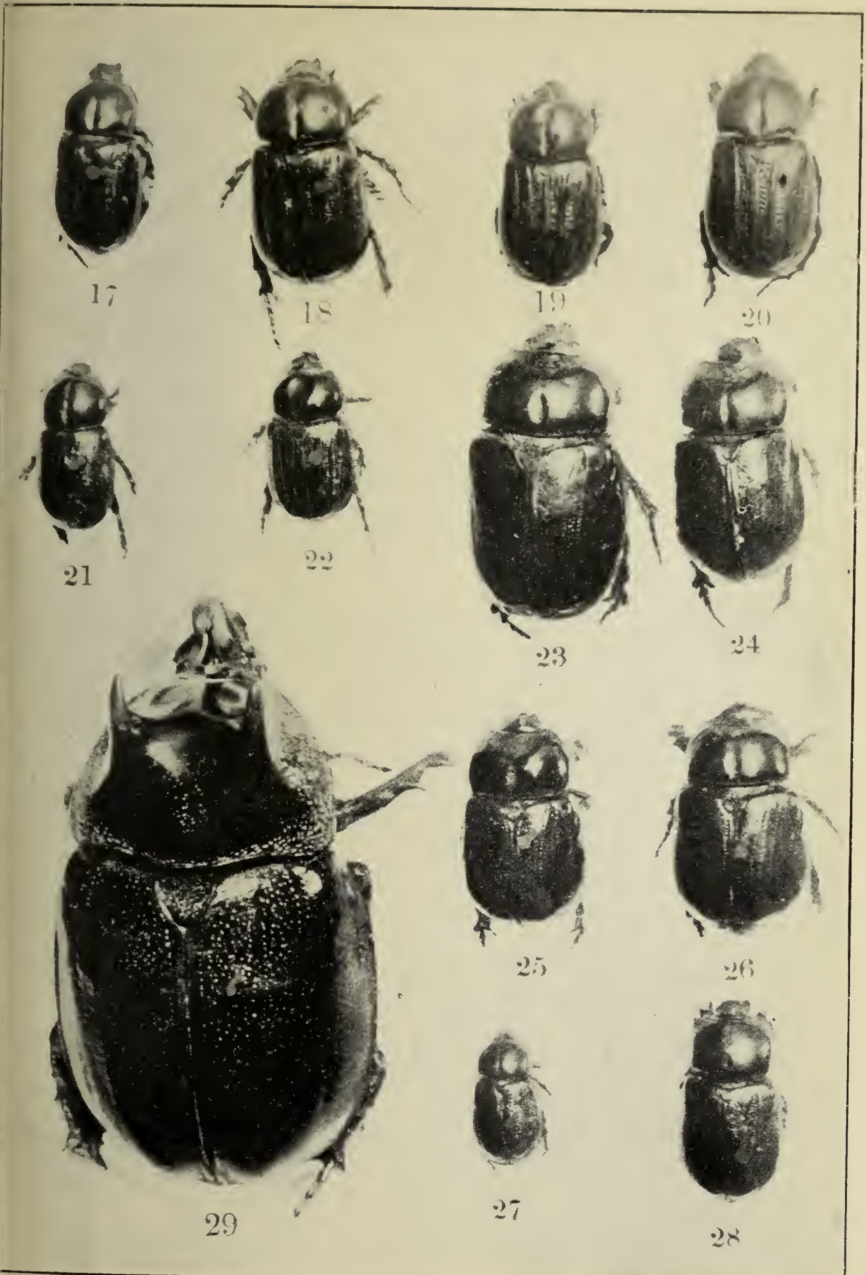

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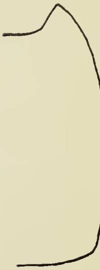
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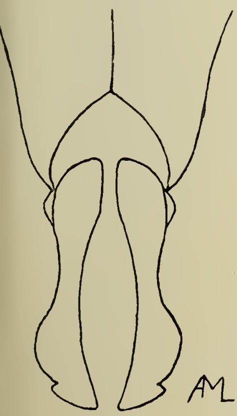

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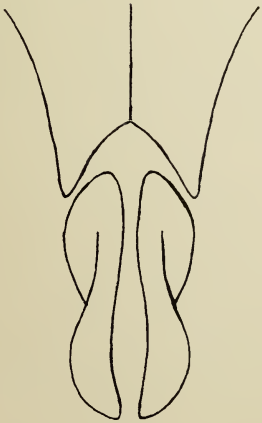
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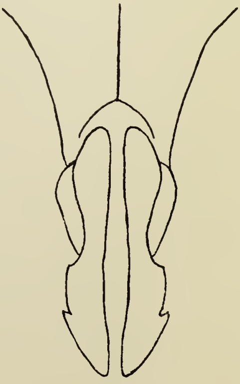
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EXPLANATION OF PLATES.

Plate XXX.

(All of *Semanopterus convexiusculus*, Macl.)

Fig. 1. Type, Gayndah.
,, 2. *S. angustatus*, Blackb. Cotype, South Australia.
,, 3. *S. minor*, Blackb. Cotype, South Australia.
,, 4. *S. minor*, Blackb. Type of female, South Australia.
,, 5. *S. longicollis*, Blackb. Type of female. Coonabarabran.
,, 6. *S. rectangulus*, Blackb. Type of female, Alice Springs.
,, 7. *S. rectangulus*, Blackb. Cotype, Leigh Creek.
,, 8. *S. rectangulus*, Blackb. (identified as *minor*, Blackb.). Elder Expedition.
,, 9. *S. rectangulus*, Blackb. N. Queensland.
,, 10. *S. persimilis*, Blackb. Type of female, N. Queensland.
,, 11. *S. carinatus*, Blackb. Bears name-label but is not a cotype, Queensland.
,, 12. *S. concentricus*, Blackb. Type of female, Darling Downs.
,, 13. *S. concentricus*, Blackb. Cotype, Beverley.
,, 14. *S. concentricus*, Blackb. Without name label, but numbered 6207, Nullabor Plains.
,, 15. *S. distributus*, Blackb. Type of female, Whitton.
,, 16. *S. distributus*, Blackb. Cotype, Tamworth.

Plate XXXI.

Fig. 17. *S. subcostatus*, Cast. (identified by Mr. Arrow). New South Wales.
,, 18. *S. subcostatus*, Cast. (identified by Mr. Blackburn as *adelaidae*, Hope). South Australia.
,, 19. } ,, 20. } *S. subcostatus*, Cast. (*depressiusculus*, Macl., types). Gayndah.
,, 21. *S. convexiusculus*, Macl. (*meridianus*, Blackb., type of female). New South Wales.
,, 22. *S. convexiusculus*, Macl. (*tricostatus*, Blackb., cotype). Western Australia.
,, 23. } ,, 24. } *S. solidus*, Burm. (identified by Mr. Blackburn as *subaequalis*, Hope). South Australia.
,, 25. } ,, 26. } *S. solidus*, Burm. (identified by Mr. Arrow). Queensland.
,, 27. *S. leai*, Blackb. Cotype, Pinjarrah.
,, 28. *S. leai*, Blackb. Type of female, Western Australia.
,, 29. *Eupatorus australicus*, Arrow.

Plate XXXII.

Fig. 30. Sides of prothorax of figs. 1 and 12.
,, 31. ,, ,, ,, 2, 3, 4, 5, 13, 14, and 21.
,, 32. ,, ,, ,, 6.
,, 33. ,, ,, ,, 7, 8, and 15.
,, 34. ,, ,, ,, 9 and 10.
,, 35. ,, ,, ,, 11 and 16.
,, 36. ,, ,, ,, 17, 18, 19, 20, and 22.
,, 37. ,, ,, ,, 23, 24, 25, and 26.
,, 38. ,, ,, ,, 27 and 28.
,, 39. Aedeagus of *S. adelaidae*, Hope.
,, 40. ,, ,, ,,
,, 41. ,, *S. rectangulus*, Blackb.

Further Notes on Some Moths from Lord Howe and Norfolk Islands in the South Australian Museum.[1]

By A. Jefferis Turner, M.D., F.E.S.

[Read October 1C, 1918.]

A preliminary note on some moths taken by Mr. A. M. Lea on these islands appears in these Transactions (vol. xli., 1917). My departure to England prevented me from dealing with them more thoroughly at the time, but has enabled me to obtain valuable help from Mr. Edw. Meyrick, F.R.S., Sir Geo. Hampson, and Mr. L. B. Prout in determining some of them. Some corrections will be made in the former lists, all new species described, where this can be done, and the relationships of the fauna in each case will be discussed.

At first sight the collections appeared disappointing, for they consisted mainly of well-known and widely distributed species; but a closer examination showed the presence of a considerable percentage of new species, for the most part small and inconspicuous, but of great interest. It must be remembered that Mr. Lea was mainly bent on collecting Coleoptera, and that the moths obtained were chance captures, including a large proportion taken at light. The latter might be expected to consist mainly of species feeding on common weeds and garden plants, for the most part not endemic, and some at least artificially introduced. The collections, however, establish the existence on each island of an endemic lepidopterous fauna, and there can be no doubt that by systematic collecting many interesting species would be added to the list.

Lord Howe Island.

Corrections and additions to former list:—

Arctiadae—For *n. gen.*(?) *et. sp.* (page 53) substitute *Ilema*, n. sp.

Geometridae—For *Boarmia inflexaria*, Snel. (page 53), substitute *Cleora inflexaria*, Snel. For *Cidaria*(?). sp. (page 53), substitute *Xanthorhoe*(?) n. sp.

Tineidae—*Hyponomeuta*, sp., is referable to *paurodes*, Meyr., previously known only from Queensland. Add two new species of *Blastobasis* and one of a new genus *Eretmobela*.

The following species, six in number, were taken on the island several years ago, and presented to me by Mr. G. A. Waterhouse; not one of them is endemic.

Arctiadae—*Utetheisa pulchella*, Lin., (?) or *pulchelloides*, Hmps. (?) One female example, which might be referable to either of these widely distributed species, which can be distinguished only by the secondary sexual characters of the male. The latter occurs in the Kermadec Islands and New Zealand.

Noctuidae—*Ophideres fullonica*, Lin. Three examples. Common on the Queensland coast and throughout the Eastern tropics. Has also been taken in New Zealand. *Dasypodia cymatodes*, Gn. One female example. A common species in Queensland and New South Wales.

Sphingidae.—*Sphinx convolvuli*, Lin. Two examples. Common throughout the Eastern Hemisphere.

Geometridae—*Urolitha bipunctifera*, Wlk. One female example. Also from Queensland and New South Wales. I believe the larva feeds on the mango, and it may have been introduced.

Pyralidae.—*Botyodes asialis*, Gn. One example. Widespread throughout the Eastern tropics, including New Guinea. I have no record for Queensland, though it should occur there.

Family ARCTIADAE.

Ilema haploa, n. sp. (ἁπλοος, simple).

♂, 24-28 mm. Head, palpi, and thorax brown. Antennae brown; in male with short ciliations ($\frac{1}{2}$) and longer bristles (1). Abdomen whitish-brown. Legs brown. Forewings narrow-elongate, somewhat dilated posteriorly; costal margin bent over to form a strong costal fold on under-surface from base to $\frac{2}{3}$; pale brown; cilia pale brown. Hindwings with 6 and 7 coincident; whitish-ochreous; cilia whitish-ochreous.

Although of plain inconspicuous colouring this species appears to be not very closely related to any other in the genus. Eight male examples.

Calamidia pamphaea, n. sp. (παμφαιος all dusky).

♂, 31 mm. Head, thorax, and abdomen fuscous-brown. Palpi in male very long (5), ascending; terminal joint longer than second, spathulate; fuscous-brown. [Antennae broken.] Legs fuscous-brown. Forewings elongate, narrowly oval; brown closely irrorated with fuscous; an ill-defined median fuscous spot at $\frac{2}{3}$; cilia fuscous-brown with pale apices. Hindwings and cilia pale fuscous.

Very near the Australian *C. hirta*, Wlk., but much darker and of uniform coloration. Two male examples.

Philenora euphileta, n. sp. (εὐφιλητος, well beloved).

♂, 15 mm. Head and thorax white. Palpi dark fuscous. Antennae pale fuscous; in male shortly ciliated ($\frac{1}{2}$). Abdomen pale ochreous. Legs ochreous; anterior pair with some pale-fuscous suffusion. Forewings elongate-triangular, costa gently arched, more strongly towards apex, apex rounded, termen obliquely rounded; white; costal edge ochreous; a large fuscous blotch in disc beneath middle, where it extends from $\frac{1}{4}$ to $\frac{1}{2}$, extending nearly to dorsum, where it is only half as long; a large pale-fuscous terminal suffusion not reaching apex; cilia pale ochreous. Hindwings and cilia pale ochreous.

One example. The type is wasted and the description of the forewings is probably therefore inexact, but the species is very distinct.

Family GEOMETRIDAE.

Subfamily LARENTIANAE.

Xanthorrhoe (?) aphanta, n. sp. (ἀφαντος, inconspicuous).

♀, 24 mm. Head ochreous-whitish. Palpi $2\frac{1}{2}$; ochreous-whitish. Antennae ochreous-whitish. Thorax, abdomen, and legs ochreous-whitish with some pale-brownish irroration. Forewings triangular, costa straight to $\frac{2}{3}$, thence slightly arched, apex round-pointed, termen slightly bowed, moderately oblique; ochreous-whitish; markings fuscous-grey mixed with brownish, a moderate basal patch, its outer margin transverse, dentate; a slight suffusion beyond this; a broad median band, its anterior edge from $\frac{1}{3}$ costa to mid-dorsum, concave, wavy; posterior edge from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum, wavy, with a single, prominent, rather obtuse, median tooth; towards costa the middle part of median band is paler and contains a transverse linear blackish discal mark; three rippled lines beyond median band, the last edged posteriorly by an interrupted dentate whitish line; a terminal series of blackish dots; cilia ochreous-whitish. Hindwings whitish with some greyish suffusion; a terminal series of dark-fuscous dots.

An inconspicuous species of ordinary *facies*. The type being a female, it is impossible to be sure that it may not belong to the genus *Cidaria*. One example.

Subfamily ACIDALIANAE.

Brachycola (?) microsticta, n. sp.
(μικροστικτος, minutely speckled).

♀, 34 mm. Head, antennae, and thorax ochreous-whitish. Palpi in female 4, slender, terminal joint $\frac{1}{2}$

second; ochreous-whitish, upper edge of second joint purple-brown. Abdomen ochreous-whitish with four suffused dark-fuscous transverse bars on dorsum. Legs ochreous-whitish. Forewings triangular, costa very slightly arched, apex acute, slightly produced, termen slightly bowed; oblique; ochreous-whitish with very scanty, fine, dark-fuscous irroration; a postmedian series of minute dark-fuscous dots on veins; a terminal series of dark-fuscous dots between veins; cilia ochreous-whitish. Hindwings with termen slightly bowed; colour and markings as forewings. Underside as upper but faintly tinged with rosy, and dots paler.

Here, also, it is impossible to be certain of the genus in the absence of the male. One example.

Family PYRALIDAE.

Subfamily PYRALINAE.

MACALLA PHOENOPASTA, n. sp.
(φοινοπαστος, sprinkled with dark red).

♂, 36 mm. Head and thorax reddish-brown irrorated with whitish. Palpi in male dilated and very long, erect; ochreous-brown irrorated with whitish. Antennae fuscous; in male moderately ciliated ($\frac{1}{2}$); antennal process in male large, reaching to middle of thorax; reddish-brown mixed with whitish, upper edge partly fuscous. Abdomen ochreous mixed with fuscous and whitish. Legs whitish mixed with dark red and fuscous, posterior pair paler. Forewings elongate-triangular, costa moderately arched, apex rounded-rectangular, termen slightly rounded, slightly oblique; in male with a short transversely linear glandular swelling on upper side of costa at $\frac{2}{3}$; whitish irregularly mixed with dark-red and greenish scales; a dark-fuscous transverse line at $\frac{1}{4}$ from lower edge of cell nearly to dorsum, margined posteriorly with reddish; a very ill-defined whitish line from costa at $\frac{4}{5}$ to dorsum before tornus, margined posteriorly with reddish, which towards dorsum forms an incomplete dentate line; some dark-fuscous streaks on veins before apex; three fuscous spots on termen beneath apex; cilia whitish. Hindwings fuscous; paler towards base; cilia whitish.

This belongs to a small Australian group within the genus, characterized by the costal gland in the male. It comprises *costigeralis*, Wlk.; *concisella*, Wlk.; *demotis*, Meyr. (which, however, I have not seen); and *prasina*, Warr. One male example.

Subfamily PYRAUSTINAE.

MECYNA INSULICOLA, n. sp. (?)
(*Insulicolus*, inhabiting an island).

♀, 35 mm. Head and thorax fuscous with some ochreous-whitish admixture. Palpi 4; fuscous, basal half of under-surface white. Antennae fuscous. Abdomen ochreous-yellow, paler beneath. Legs whitish suffused with reddish-ochreous; anterior pair more reddish. Forewings elongate-triangular, costa straight to $\frac{2}{3}$, thence strongly arched, apex rectangular, termen nearly straight, only slightly oblique; fuscous irrorated with whitish, more densely so in posterior part of disc; an ill-defined oblong dark-fuscous spot on mid-dorsum; a large transversely oval dark-fuscous spot beneath midcosta; an interrupted dark-fuscous line represented by dots on veins from $\frac{2}{3}$ costa, bent inwards below middle to join dorsal spot; terminal area tinged with dark red; cilia fuscous mixed with dark red. Hindwings ochreous-yellow, a dark-fuscous apical blotch prolonged by a narrowing process to mid-termen, containing some reddish scales; cilia ochreous, bases fuscous on apex of wing. Underside ochreous with large reddish blotch prolonged along costa and termen on both wings; forewings with an oblique fuscous mark on end of cell. One example.

This species presents a difficulty. It is very distinct from the Australian *M. ornithopteralis*, Gn. (which, however, is almost, if not quite, identical with the European *M. polygonalis*), in which there is always a complete dark terminal band on the hindwings. On the other hand, it is very nearly similar to some examples of the American *M. reversalis*, but unless this species has been artificially introduced (which seems barely possible) it can hardly be identical. The most satisfactory way of dealing with the difficulty would probably be to regard all four forms as one species.

Family TINEIDAE.

Subfamily OECOPHORINAE.

ELAEONOMA PHAEOPASTA, n. sp. (φαιοπαστος, darkly sprinkled).

♂ and ♀, 15-17 mm. Head and palpi ochreous-whitish. Antennae ochreous-whitish; in male with extremely long ciliations (8). Thorax pale fuscous. Abdomen pale fuscous, apices of segments and tuft ochreous-whitish. Legs ochreous-whitish with a few pale-fuscous scales. Forewings not dilated, costa moderately arched, apex round-pointed, termen oblique, scarcely rounded; ochreous-whitish with patchy fuscous irroration more marked in male, especially in posterior part of disc; three well-marked fuscous discal dots, first in disc at $\frac{1}{3}$, second on fold slightly beyond first, third in disc before $\frac{2}{3}$; cilia ochreous-whitish. Hindwings and cilia grey.

But for the stalking of veins 2 and 3 of the forewing this might pass for one of the *convictella* group of the genus *Eulechria*. Three examples.

Blastobasis episema, n. sp. (ἐπισημος, distinctly marked).

♂, 17 mm. Head whitish-ochreous. Palpi whitish-ochreous; in male with second and terminal joints much enlarged, the latter obtuse. Antennae with basal joint dilated to form a small eyecap with a well-developed pecten on its lower edge; whitish-ochreous; ciliations in male 2. Thorax whitish-ochreous, anterior edge fuscous. Abdomen fuscous, basal segment, apices of segments, tuft, and underside whitish-ochreous. Legs fuscous with some whitish-ochreous admixture; posterior pair mostly whitish-ochreous. Forewings narrow, lanceolate; whitish-ochreous; markings dark fuscous; a well-marked V-shaped fascia from $\frac{1}{3}$ costa obliquely outwards, then acutely bent back to mid-dorsum; a dot above tornus, and a second between this and $\frac{2}{3}$ costa; a series of dots on apical part of costa and on termen; cilia whitish-ochreous. Hindwings lanceolate; pale grey; cilia ochreous-grey. One example.

Blastobasis dyssema, n. sp. (δυσσημος, badly marked).

♂ and ♀, 14-18 mm. Head whitish-ochreous. Palpi whitish-ochreous; in male with second and terminal joints much enlarged, the latter obtuse. Antennae with basal joint enlarged and pectinate; pale fuscous; ciliations in male 2. Thorax fuscous. Abdomen fuscous; underside, and in male tuft ochreous-whitish. Legs pale fuscous; posterior pair mostly ochreous-whitish. Forewings narrow, lanceolate; ochreous-grey, in female pale fuscous; a minute longitudinal fuscous mark in middle of disc, and another before it on fold; a fuscous dot above tornus, and another between it and $\frac{3}{4}$ costa; cilia whitish-ochreous, in female pale fuscous. Hindwings lanceolate; pale grey; cilia ochreous-grey. Five examples.

Family TINEIDAE.

Subfamily GRACILARIANAE.

Gracilaria, n. sp. One of the group allied to *xylophanes*, Turn., but distinct. Unfortunately during the journey to England both forewings became detached and lost, so that it is impossible to give a description.

Subfamily LYONETIANAE.

Erechthias, sp. One example not in a fit state for determination.

Subfamily TINEINAE.

Gen. Eretmobela, nov.

(ἐρετμοβελος, with paddle-shaped weapons—palpi).

Head smooth-scaled; side-tufts closely appressed. Labial palpi long, recurved; second joint moderate, with rough spreading short hairs anteriorly, and three or four long hair-like bristles from apex posteriorly; terminal joint longer than second, stout, obtuse, flattened, and dilated antero-posteriorly. Maxillary palpi obsolete. Antennae shorter than forewings; apices of joints dilated. Forewings with eleven veins, 2 and 3 stalked from angle of cell, 4 approximated to them at origin, 5 and 6 separate and parallel, 7 and 8 coincident and running to costa, 9 separate, 10 from upper angle of cell, 11 from $\frac{5}{6}$. Hindwings with 2 from $\frac{2}{3}$, 3, 4, 5, 6, 7 separate and parallel, forking vein in cell well marked.

Mr. Meyrick informs me that this genus is allied to *Setomorpha*, though differing in neuration.

Eretmobela phaeosema, n. sp. (φαιοσημος, dusky marked).

♀, 16 mm. Head brown-whitish mixed with fuscous. Palpi ochreous-whitish; external surface of terminal joint fuscous. Thorax fuscous, extreme apex posteriorly narrowly whitish-ochreous. [Abdomen broken.] Legs dark fuscous; middle and posterior coxae ochreous-whitish; tarsi and apex of tibia sharply annulated with ochreous-whitish. Forewings moderate, posteriorly somewhat constricted, costa strongly arched to middle, thence only slightly, apex round-pointed, termen obliquely rounded; ochreous-whitish irrorated with fuscous; markings dark fuscous; a dot on costa at $\frac{1}{4}$, an elongate mark on costa before middle, a large spot on $\frac{3}{4}$ costa, with a costal dot midway between the two preceding; irregular but well-defined dorsal blotches at $\frac{1}{4}$ and middle; a median discal dot at $\frac{1}{3}$ and a second at $\frac{2}{3}$; a terminal line dilated at tornus and interrupted above tornus; cilia fuscous obscurely barred with ochreous-whitish. Hindwings grey; cilia ochreous-whitish, on costa and dorsum grey. One example.

Mr. Lea obtained 32 species; adding the six obtained through Mr. Waterhouse we have a total of 38. Among them are 25 known species and 13 are endemic species, which have just been described. Of the 25 there are 16 which have a wide distribution, and 5 of these extend to New Zealand. These 16 species throw no light on the relationship of the local fauna; 2 of them (*Hieroxestis omoscopa* and *Trichophaga tapetiella*) are certainly introduced, and possibly this is true of some of the others. Nine species are known to occur only in Lord Howe Island and Australia (*Dasypodia cymatodes*, *Dichromia quinqualis*, *Hypena sylpha*, *Urolitha bipunctifera*, *Cleora inflexaria*, *Epicrocis sublignalis*, *Scenedra decoratalis*, *Diplopseustis perieresalis*, *Hyponomeuta paurodes*), except that one of them (*C. inflexaria*) extends also to New Guinea, and another (*D. perieresalis*) also to New Zealand.

Of the 13 endemic species 5 admit of no definite statement of their geographical affinities. They are:—

Xanthorhoe (?) *aphanta*	*Gracilària*, n. sp.
Mecyna insulicola	*Erechthias* (?), sp.

Eretmobela, n. gen. *et* sp.

There remain 8, which are clearly of Australian affinity. They are:—

Ilema haploa	*Macalla phoenopasta*
Calamidia pamphaea	*Elaeonoma phaeopasta*
Philenora euphileta	*Blastobasis episema*
Brachycola (?) *microsticta*	*Blastobasis dyssema*

The conclusion to be drawn is simple. Lord Howe Island is in its lepidopterous fauna merely a detached and isolated fragment of Australia. To this it is necessary to make one qualification; the relation is to that part of the Australian fauna that has Indo-Malayan affinities, and not to that part that is peculiarly and distinctively Australian. A glance at the map will show that this conclusion might have been expected. Lord Howe Island lies about 350 miles from the Australian coast, nearly in the latitude of Port Macquarie, and is not in such close relation to any other land. The lepidopterous fauna, so far as known, shows no affinity to that of New Zealand.

Norfolk Island.

Corrections and additions to former list:—

NOCTUIDAE—Delete *Ariathisa*, sp. (page 55), which was an erroneous determination, and substitute *Perigea capensis*, Gn. One example. Common in the Eastern tropics. Has also been taken in the Kermadec Islands.

GEOMETRIDAE—For *Boarmia*, n. sp. (page 55), substitute *Cleora*, n. sp.

Tineidae, Subfamily Gelechianae—Insert *Brachmia*, sp. One imperfect example, closely allied to *arotraea*, Meyr., from Ceylon and India. Subfamily Tineinae—For *Tinea*, sp. (page 56), substitute *Tinea*, n. sp.

Arctiadae—*Nesiotica cladara*, n. gen. *et* sp. This has been already described.

Family GEOMETRIDAE.

Subfamily BOARMIANAE.

Cleora idiocrossa, n. sp. (ἰδιοκροσσος, with peculiar margin).

♀, 40 mm. Head grey-whitish. Palpi 2; grey-whitish. Antennae grey-whitish. Thorax and abdomen whitish-grey with a few darker scales. Legs grey-whitish irregularly speckled with fuscous; anterior and middle tarsi annulated with fuscous. Forewings with termen dentate; 10 and 11 separate; whitish-grey sparsely irrorated with fuscous; markings brownish-grey and fuscous; antemedian and median lines brownish-grey, suffused, ill-defined; a dark-fuscous dot on lower edge of cell posterior to antemedian line; a pale-centred fuscous median spot just posterior to median line; a well-marked dark-fuscous line from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum, strongly but irregularly dentate, slightly projecting above middle; immediately posterior to this a brownish-grey shade; twin roundish subterminal fuscous spots above middle, and a short subterminal fuscous line from dorsum; an incomplete fuscous submarginal shade; a fine dark-fuscous terminal line thickened in indentations; cilia grey-whitish, towards tornus whitish. Hindwings somewhat elongate, termen strongly dentate; as forewings but without antemedian and median lines; subterminal line completely developed. Underside whitish with fuscous median circular spots, fine dentate postmedian line, and incomplete broad terminal band on each wing.

A very distinct species of the *acaciaria* group, easily distinguished from its allies by the strongly dentate termen of both wings. Mr. Prout writes "near *samoana*, Butl., termen slightly less oblique and postmedian line less outbent at veins." One example in fair condition.

Family PYRALIDAE.

Subfamily PYRALINAE.

Endotricha dyschroa, n. sp. (δυσχροος, deficient in colour).

♂, 20 mm. Head and thorax pale fuscous slightly purplish-tinged. Palpi pale fuscous, beneath whitish. Antennae grey-whitish; ciliations in male slightly over 1.

Abdomen ochreous-whitish with some grey irroration; a minute median dorsal crimson dot on antepenultimate segment. Legs ochreous-whitish irrorated with fuscous. Forewings elongate-triangular, costa nearly straight but slightly sinuate, apex pointed, termen slightly rounded, moderately oblique; whitish, closely irrorated with fuscous, slightly purplish-tinged; a series of ill-defined ochreous-whitish dots on posterior half of costa; a fuscous subcostal dot at $\frac{2}{3}$; an ill-defined pale transverse median line; a better-marked pale subterminal line from 9/10 costa to tornus; traces of a fine fuscous terminal line; cilia purple-whitish. Hindwings whitish with some fuscous suffusion; a faint pale line from tornus towards middle; a very fine fuscous terminal line; cilia purple-whitish.

Three male examples all worn, but there seems to be no doubt as to their constituting a new species.

Subfamily PYRAUSTINAE.

Diasemia delosticha, n. sp.

(δηλοστιχος with conspicuous lines).

♂ and ♀, 16-20 mm. Head fuscous-brown. Palpi $3\frac{1}{2}$; fuscous, beneath whitish. Antennae fuscous; ciliations in male $\frac{2}{3}$. Thorax dark fuscous; margins whitish-brown, except for a dark-fuscous spot on base of patagia. Abdomen dark fuscous, apices of segments whitish. Legs brown-whitish; anterior pair except coxae fuscous. Forewings narrowly-triangular, costa straight to $\frac{4}{5}$, thence arched, apex pointed, termen sinuate, oblique; dark fuscous; a reddish-brown subcostal bar from base to $\frac{3}{5}$, indented beneath at middle of disc; an ill-defined whitish basal dorsal area; an irregular whitish median area, thinly scaled like the preceding; a very distinct, inwardly curved, slightly wavy, whitish line from $\frac{3}{4}$ costa to tornus, posteriorly suffusedly edged with reddish-brown; a whitish apical suffusion curved inwards towards tornus; cilia fuscous irregularly barred with white. Hindwings with termen strongly sinuate; dark fuscous; a whitish basal area containing a dark-fuscous subcostal spot; a white fascia from mid-costa to dorsum before tornus, slightly angled outwards in middle; a white line from $\frac{3}{4}$ costa to beneath middle of termen, bent inwards in middle; cilia white with a dark-fuscous sub-basal line, and dark-fuscous bars at apex and above middle of termen.

Nearly allied to *D. grammalis*, Dbld., from New Zealand, but in that species the posterior line of forewings terminates in dorsum well before tornus. Both species are nearly related to the European *D. litterata*, Scop. Evidently abundant, 62 specimens secured.

Scoparia tritocirrha, n. sp.

(τριτοκιρρος, three times pale yellow).

♀, 14 mm. Head and palpi grey; labial palpi $2\frac{1}{2}$. Antennae dark fuscous. Thorax fuscous. Abdomen grey. Legs fuscous irrorated, and tarsi annulated, with fuscous. Forewings narrowly triangular, costa straight to $\frac{2}{3}$, thence arched, apex round-pointed, termen nearly straight, scarcely oblique; grey; a short longitudinal pale-yellowish line, edged above with blackish, from base of costa; a broader yellowish longitudinal line before middle beneath cell, also edged with blackish above; a narrowly-oval longitudinal yellowish median spot beyond middle, edged with blackish except on dorsal margin; from its upper-surface extend two short blackish processes towards costa; blackish dots on costa at $\frac{1}{4}$, middle, and before $\frac{3}{4}$; a faintly indicated whitish spot median line; a dark-fuscous line close to termen; terminal edge yellowish; cilia grey with a fuscous sub-basal line. Hindwings pale-grey; cilia whitish with a pale-grey sub-basal line.

An inconspicuous little species, yet very distinctly characterized by the slender yellowish longitudinal markings. Three examples.

Family TORTRICIDAE.

Subfamily TORTRICINAE.

Capua aridela, n. sp. (ἀριδηλος, most conspicuous).

♂, 21 mm. Head white. Palpi 2; white, second joint with a broad subapical dark-fuscous bar on external surface. Antennae fuscous; in male dentate, ciliations $\frac{1}{4}$. Thorax whitish-grey; patagia with basal half black, apical half white. Abdomen whitish with fuscous irroration; legs whitish with fuscous irroration; anterior pair mostly fuscous; posterior pair nearly wholly whitish. Forewings strongly dilated posteriorly; in male with a strong costal fold extending to middle; silvery-white with scanty grey irroration and sparsely scattered pale-ochreous scales; markings black; a sub-basal line slightly prolonged along dorsum; costal fold with two transverse bars and again black at apex; a median streak from sub-basal line to $\frac{2}{3}$, strongly ∽ curved; an irregular oblique band from costa before middle to dorsum beyond middle, touching median streak, and strongly bent outwards at point of junction; from the upper part of this band posteriorly is given off a strong square-ended process; an irregularly bent fascia from costa at $\frac{2}{3}$ to tornus, giving off two processes to costa before apex; a sub-apical costal dot; a subapical terminal mark; cilia white, bases barred with blackish. Hindwings whitish-grey, somewhat darker towards apex; cilia whitish with a faint grey sub-basal line.

Although conspicuous the coloration is probably protective on lichen-covered rocks. One example.

SCHOENOTENES CAPNOSEMA, n. sp.

(*καπνοσημος*, with dark markings).

♀, 17 mm. Head grey. Palpi $2\frac{1}{2}$; fuscous, apices of second and terminal joints and whole of inner surface whitish. Antennae grey. Thorax grey, posteriorly tinged with brownish. Abdomen pale grey, towards apex darker. Legs fuscous; anterior and middle tarsi annulated with whitish. Forewings rather narrow, not dilated; whitish with silvery reflections, crossed by numerous fine, wavy, ochreous-brown transverse striae; numerous small tufts of raised scales; a prominent transverse ridge of raised scales from $\frac{1}{4}$ dorsum to beyond middle, edged posteriorly by a blackish line; a similar slightly oblique ridge from costa before middle to dorsum beyond middle, with a broad blackish line on posterior edge; a tuft in mid-disc at $\frac{2}{3}$, preceded and followed by blackish spots; a slender blackish line from $\frac{4}{5}$ costa to termen above tornus, angled outwards beneath costa; a slender interrupted blackish terminal line; cilia ochreous-whitish, on tornus grey. Hindwings and cilia grey. One example.

TORTRIX, sp.

Two examples in poor condition of ordinary facies and not determinable.

Subfamily EUCOSMINAE.

ACROCLITA MACROMA, n. sp.

(*μακρωμος*, with elongate shoulders).

♂, 12 mm. Head green-whitish. Palpi 2; pale fuscous. Antennae grey; in male slightly serrate, minutely ciliated. Thorax brown-whitish, in centre mixed with dark fuscous; patagia in male long, extending well behind thorax. Abdomen fuscous. Legs fuscous-whitish. Forewings in male with strong costal fold extending to $\frac{1}{3}$; green with dark-fuscous markings; fold strigulated with dark fuscous; several dots and some scales in basal part of disc; a subcostal spot at $\frac{1}{3}$; a narrow interrupted fascia from $\frac{2}{3}$ costa to mid-dorsum; a second fascia from apex to $\frac{2}{3}$ dorsum, giving off a short outwardly curved line to tornus; a fine terminal line; cilia green-whitish, apices partly dark-fuscous. Hindwings dark grey; cilia grey-whitish. One example.

Family TINEIDAE.

Subfamily GELECHIANAE.

BRACHMIA, sp.

One male example, imperfect, pronounced by Mr. Meyrick to be closely allied to *Brachmia arotraea*, Meyr., from Ceylon and India.

Subfamily TINEINAE.

TINEA CAPNITIS, n. sp. (καπνιτις, smoky).

♂, 17-18 mm. Head fuscous-whitish. Palpi 2½; fuscous, inner surface whitish. Antennae pale fuscous; in male with joints enlarged at apices, minutely ciliated. Thorax fuscous. Abdomen ochreous-whitish, suffused with fuscous on dorsum. Legs fuscous; tibiae and tarsi annulated with ochreous-whitish; posterior pair almost wholly ochreous-whitish. Forewings moderate, not dilated, costa strongly arched, apex pointed, termen very obliquely rounded; ochreous-whitish rather densely irrorated with fuscous; absence of irroration leaves an obscure pale dorsal streak containing some fuscous scales near margin; very obscure fuscous discal dots at ⅓ and ⅔; cilia fuscous. Hindwings and cilia grey-whitish.

A very obscure species belonging to a cosmopolitan genus, of which many species are domestic in their habits and artificially introduced. I should not have ventured to describe it, but for the decided opinion of Mr. Meyrick, who kindly examined my examples, that it is both new and endemic. Two examples.

The collection contains 33 species. Of these two are not determinable; one of these is a species of the genus *Tortrix*, the other a *Brachmia*, closely allied to *arotraea*, Meyr., from Ceylon and India. Of the remaining 31 there are 22 well-known species, 9 of which are endemic.

Of the 22 known species 15 are of wide distribution. All of these occur in Australia, six of them also on Lord Howe Island. Four of them are recorded from New Zealand and the Kermadec Islands and one from the Kermadec Islands only (*Perigea capensis*). Of these 22 at least three (*Eucosma plebeiana*, *Polychrosis botrana*, *Hieroxestis omoscopa*), and possibly others, have been artificially introduced. Two species (*Acidalia rubriaria* and *Crocydopora cinigerella*) occur both in Australia and New Zealand, but probably originated in the former. The remaining five—

Chloroclystis laticostata	*Corambus cuneiferellus*
Xanthorrhoe sodaliata	*Argyroploce illepida*
Acidalia hypochra	

are Australian species, though the first occurs also in the Kermadec Islands.

Of the nine endemic species five are clearly of Australian affinity—

Nesiotica cladara, n. sp.
Cleora idiocrossa, n. sp.
Endotricha dyschroa, n. sp.
Schoenotenes capnosema, n. sp.
Acroclita macroma, n. sp.

Whether the genus *Cleora* (as distinguished from *Boarmia)* occurs in New Zealand may be regarded as an open question, but the Norfolk Island species is not allied to any found in New Zealand. *Nesiotica* is a new genus closely allied to a genus described from Queensland, and the group to which it belongs is not represented in New Zealand. The genera *Endotricha*, *Schoenotenes*, and *Acroclita* are well represented in Queensland, but do not occur in New Zealand. The genera *Scoparia* and *Capua* have numerous species in both Australia and New Zealand, and no stress can be laid on the two species described from Norfolk Island. Mr. Meyrick assures me that they are not closely allied to any New Zealand species. The genus *Tinea* is cosmopolitan. There remains only *Diasemia delosticha*, which is the only new species here described clearly of New Zealand affinity.

So far as these results go, the lepidopterous fauna of Norfolk Island shows only a slender connection with that of New Zealand, but a strong connection with that of Queensland. Why the connection should be with Queensland rather than with the southern half of the continent is explained by the map. The distance from Norfolk Island to the northern extremity of New Zealand is about 450 miles, to New Caledonia (the next nearest land mass) about 550 miles. Of the lepidopterous fauna of New Caledonia I know nothing, but the 500-fathom line shows a considerable extension of shallow water around that island, together with a much greater extension westward from the Australian coast just north of the tropic. This suggests strongly a former extension westward, bringing Australia and New Caledonia into close connection, not necessarily by dry land, but with only one or two comparatively narrow intervening straits. Measuring from the 500-fathom limits that of Norfolk Island becomes nearly equidistant from those of New Caledonia and New Zealand, the distance being about 350 miles.

A Graphical Computator for Determining the Most Economical Beam to carry a Given Load.

By Prof. R. W. Chapman, M.A., B.C.E.

[Read October 10, 1918.]

An ordinary rectangular beam, designed to carry a given load, will have its cross section of minimum area when it is so proportioned that it is just as likely to fail by horizontal shearing along the neutral axis as to fail by rupture in the ordinary way. For a beam of breadth b and depth d, carrying a uniformly distributed load W over a span l, the conditions that this may be the case can be readily expressed in the form:—

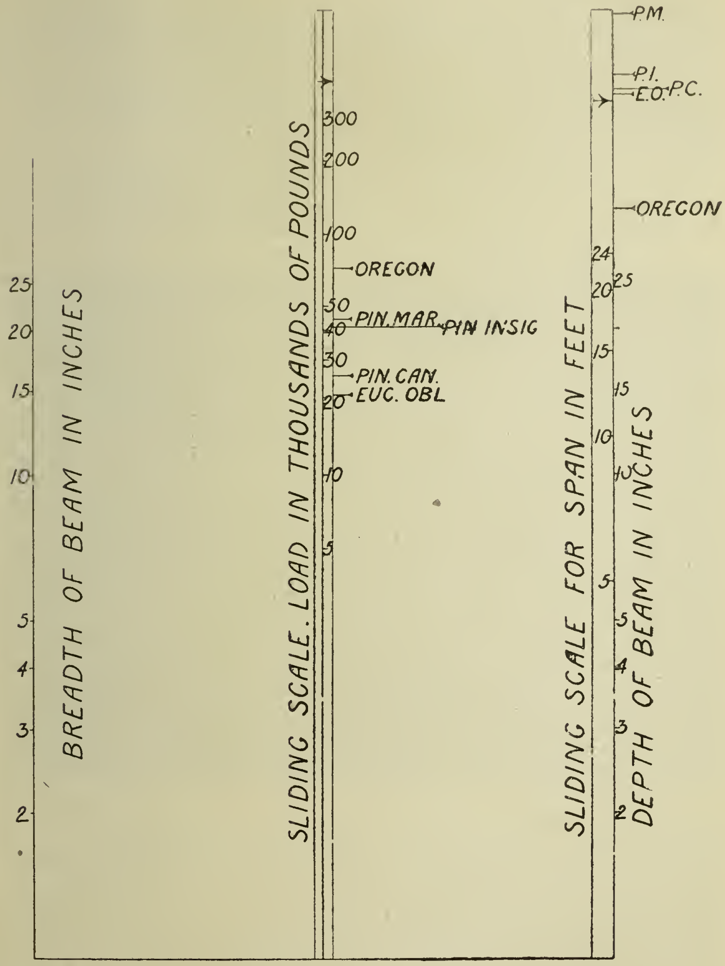
$$\log b + \log d = \log W - \log \tfrac{4}{3} s \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

$$\log d = \log l - \log \frac{f}{s} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where s is the maximum resistance of the timber to shearing in pounds per square inch and f is the modulus of rupture.

The computing apparatus illustrated is designed to facilitate the determination of the proper size of beam required to satisfy these two equations. Standing up at right angles to the base line are two fixed logarithmic scales for the breadth and depth of the beam in inches. Midway between is another parallel scale, so that if a straight edge be placed between two points representing b and d, the intercept on the middle scale will be $\frac{1}{2}$ $(\log b + \log d)$. This middle scale is graduated so that the distance from the base line to the graduation marked $W = \frac{1}{2}$ $(\log W - \log \frac{4}{3} s)$. As the value of s depends on the nature of the timber, the middle scale is made to slide to different positions corresponding to different woods. Thus if a straight edge be placed across the three scales, the three quantities b, d, and W then in line satisfy the condition (1). Alongside the scale of depths is another sliding scale for the span, so graduated that when set to any particular timber it satisfies the condition (2).

Thus if we wish to find the minimum beam to carry a given load, we first set the two sliding scales to the marks indicated for that particular timber. Then corresponding to the given span we at once read off the proper depth of the beam, and putting a straight edge across the graduations corresponding to the depth and the load, we read off on the other scale the proper breadth of the beam.



The load to be carried should be multiplied by the appropriate factor of safety.

The computer is designed for the case of uniformly distributed loads, but it is applicable to a single concentrated load at the centre by doubling the readings on the scale for the span and to the case of a concentrated rolling load by doubling the readings on the scale for the load.

It is applicable to any timbers by setting for suitable values of f and s, but in the one shown provision is made for five timbers only, the values for f and s being the averages of a large number of tests made in the engineering laboratory at the Adelaide University. As these are timbers of considerable local importance, I append the experimental determinations of f and s:—

Timber.	f Lbs. per sq. inch.	s Lbs. per sq. inch.
Pinus insignis	6,900	776
Pinus maritima ...	4,900	730
Pinus canariensis ...	11,930	1,250
Oregon	7,430	444
Eucalyptus obliqua ...	14,100	1,448

MISCELLANEA.

Notes on the Occurrence of Fulgurites in a Sandhill at the Reedbeds, near Adelaide.

In 1908 my attention was drawn to some strange tubular objects that were standing straight up in a sand-drift upon my property at the Reedbeds. There were sections of these tubes lying on the surface which appeared to have broken off by their own weight and want of support after the sand had drifted away from them.

I dug down in the sand to ascertain to what depth these tubes went, but was unable to bottom them. There were two tubes, one a good deal larger than the other, and I was puzzled as to their origin, for although they were very rough and corrugated on the outside, the interior had a very glassy surface. It was not until nearly twelve months later that I drew Dr. Wm. McGillivray's attention to these tubes, and he expressed the opinion that the tubes were caused by lightning. Later Dr. A. M. Morgan expressed the same opinion and asked me for a fragment, which he exhibited at a meeting of the Royal Society. After this I visited the spot where the drift was steadily going on, and from time to time laying bare further portions of the tubes. I discovered that the smaller tube of the two ceased to appear much sooner than the larger one. From my knowledge of the original height of the sandhill and the position where the last portion of the larger tube was seen. it could not have been less than 20 to 23 feet in length. The two tubes went straight down and were within 3 inches of each other. The larger tube measured in diameter 39 mm. outside measurement, and varied very little, not more than 2 or 3 mm. in thickness. The smaller tube measured 22 mm., and did not vary even so much as the larger one. The figures on page 293 are reproductions from photographs of the two fulgurites, and are about half natural size.

Not within my recollection has any sandhill on my property been seen to be struck by lightning, but I well remember that thirty or more years ago thunderstorms were very frequent and large trees were struck nearly every season, but of late years such storms with lightning have been of rare occurrence.

S. A. White.

Evening Meeting, September 12, 1918.

A New Locality for Older Tertiary (Miocene) Fossiliferous Beds.

The recently constructed line to Willunga has exposed the older marine tertiary beds in two railway cuttings in the neighbourhood of Hackham. The first of these occurs 1 mile southward of the Morphett Vale railway station and extends from the 21-milepost to the $21\frac{1}{4}$-milepost. Towards the southern end of the cutting a gravel bed composed of well-rounded white-quartz pebbles, averaging in size about that of kidney beans, rests unconformably upon the fossiliferous beds. The second cutting extends from the $22\frac{3}{4}$-milepost to the 23-milepost, and is capped by travertine limestone. The beds have a maximum thickness (within sight) of 12 feet. An embankment constructed between the two cuttings has been built up from the material excavated from these cuttings. Sections of the beds can also be seen in the road cuttings which are adjacent to the first of those mentioned as occurring on the railway. On the main road to Adelaide the overlying sands and fine gravel are very conspicuous, but the underlying tertiary beds are grass grown and largely obscured by talus. Another cutting is seen on the road nearby which turns off in a westerly direction to Port Noarlunga, and here, again, the fossiliferous beds show in the rise of the road, but soon pass below surface level, and are covered, first by the small quartz gravel and then by variegated river sands of considerable thickness.

Lithologically, the beds bear a close resemblance to the argillaceous limestones of Blanche Point, with which they also agree in having *Turritella aldingae* as the characteristic fossil. The beds at Hackham, however, have a greater tendency to become cherty in their composition.

With the exception of the fossil named, the organic remains are not particularly numerous, and are present only as impressions or casts. Examples of *Siliquaria* (undescribed) sometimes occur in considerable numbers in groups, and there were also noted: *Pecten*, *Magellania*, *Cellepora gambierensis*, and spines of echinozoa.

Walter Howchin.

Evening Meeting, September 12, 1918.

Note on Lepidopleurus badius (Hedley and Hull).

Lepidopleurus badius, Hedley and Hull: Records Austr. Mus., vol. vii., No. iv., 1909, p. 260, pl. lxxiii., figs. 1, 2; Gatliff and Gabriel: Proc. Roy. Soc. Vict., vol. xxv. (N.S.), part 1, 1912, p. 171.

This species was taken by me at Cape Jervis on December 28, 1917, and is now recorded for the first time for South Australia. The species was named from New South Wales, and was later taken in Victoria. Mr. Hull and Mr. Gatliff kindly identified the South Australian shells, which were taken on the under-surface of a medium-sized boulder on the reef below water at low tide. It manifested the same habitat as at the type locality, where, "though a rare shell, fifteen specimens were found under one small stone"; for at Cape Jervis fourteen examples were taken from beneath one stone.

Frank L. Saunders,

(presented through the President).

Evening Meeting, October 10, 1918.

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia

(Incorporated)

FOR 1917-1918.

ORDINARY MEETING, NOVEMBER 8, 1917.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

THE PRESIDENT reported that Mr. T. M. Young, who had been nominated as Fellow, had since died.

THE PRESIDENT reported that Honorary Fellow Professor W. H. Bragg had received the decoration Companion of the Order of the British Empire (C.B.E.) for his work as a member of the Board of Invention and Research in connection with the Admiralty.

EXHIBITS.—MR. EDWIN ASHBY, M.B.O.U., showed two specimens of a parrot, *Platycercus elegans fleurieuensis*, Ashby (Fleurieu Peninsula rosella), the type specimen having been collected by Messrs. E. Ashby and F. E. Parsons near Second Valley last Easter, and described by Mr. Ashby in *The Emu* for July, 1917. Also, for comparison, *P. elegans adelaidae*, Gould (Adelaide rosella), *P. elegans melanopterus*, North (Kangaroo Island crimson parrot), and *P. elegans nigrescens*, Ramsay (northern crimson parrot), of North Queensland. Also the larva of a large bombex moth, found feeding on a native peach tree *(Santalum)*, near Pungonda, in the Loxton district on September 11, 1917. MR. A. M. LEA, F.E.S., exhibited some click beetles (Elateridae), the larvae of which are locally known as wire-worms.

PAPERS.—The Hon. Secretary read abstracts of two papers by Prof. T. G. B. OSBORN, M.Sc., "On the Habitat and Method of Occurrence in South Australia of Two Genera of Lycopods hitherto unrecorded in the State," and "Notes on South Australian Fungi, with Description of a New Species of *Puccinia*."

Ordinary Meeting, April 11, 1918.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Nomination.—A. H. Elston was nominated as Fellow.

The President drew attention to the albums containing the portraits and signatures of the officers of the Society from its formation in 1853. This was fairly complete, and would be kept up to date.

Exhibits.—Mr. Walter Howchin, on behalf of the Museum Director, exhibited a sand-cementing fungus. The object is 6 inches in length, half of which is composed of a cylindrical stem from ⅝-inch diameter at the base to 1 inch at top of the stem. The distal end is pyriform, 1½ inches in diameter, ending in a bluntish point containing a crateriform cavity. The organic structure is limited to mycelium, which interpenetrates the mass and cements the sand grains, giving the object a definite outline. The specimen came from the Pinery, 12 miles from Balaklava, and was handed in to the Museum by the Rev. J. Blacket. Mr. L. K. Ward exhibited a stone collected by Mr. Winton from the New Burra Mine, containing fossil markings of *Cryptozoon*, this being the first known specimen from South Australia. Mr. E. Ashby showed the following birds:—*Porzanoidea plumbea immaculata* (eastern spotless crake), obtained from near Cape Jervis in March, with eggs of same from Tasmania; *Porzana fluminea* (eastern spotted crake) from Sandford, Tasmania, immature, received last February; *Hypotaenidia brachypus* (slate-breasted rail) from Blackwood; and *H. philippensis australis* (eastern buff-banded rail) from Blackwood. Mr. Edgar R. Waite showed photographs of a drain into which millions of fish had been collected by the reclamation of a swamp on the River Murray. Mr. J. M. Black exhibited an orchid new to South Australia, which he believed to be *Caladenia congesta*. Mr. A. M. Lea exhibited three samples of weevilly wheat. The largest of these had been covered with 20 inches of sand, but in 25 minutes some of the weevils had worked their way to the top. Also a large number of ferment flies that had been attracted to strong methylated spirits. Also two bombycid moths resulting from larvae found by Mr. Ashby last November. Also, on behalf of Mr. E. L. Savage, a live lizard, *Moloch horridus*, that had survived for some months by feeding on ants which had been induced to visit the box in which it was confined.

Paper.—"Polyplacophora, Genus *Ischnoradsia*," by Edwin Ashby, M.B.O.U.

Ordinary Meeting, May 9, 1918.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Nominations.—Ernest H. Ising, Locomotive Department; H. W. Andrew, Botanical Assistant, Department of Agriculture; and the Rev. James C. Jennison, Minister of the Gospel, were nominated as Fellows.

Election.—A. H. Elston, clerk, was elected a Fellow.

The President congratulated Capt. S. A. White upon his recognition by the British Ornithological Union as a Distinguished Colonial Ornithologist. Also that an open letter, signed by himself and the Hon. Secretary, had been given to Mr. Edwin Ashby on the eve of his departure for America, introducing him to scientific workers there.

Exhibits.—Prof. Chapman showed a form of viscometer constructed by Mr. A. G. M. Michell, of Melbourne, by which the viscosity of an oil is measured by the time taken by a bearing-ball before falling from a concave cup, from which it is separated by a film of the oil $\frac{1}{1000}$ millimeter in thickness; the time in seconds divided by 50 being the viscosity. Capt. S. A. White exhibited a spray of *Eucalyptus pyriformis*, gathered in the sandhills at the Ooldea soak, on the Port Augusta to Kalgoorlie Railway. The flowers are bright scarlet, and occasionally cream-colour. Also two aboriginal grinding stones, found 15 or 20 feet below the surface of the swamp at the Reedbeds. Mr. Edgar R. Waite exhibited two necklaces from Stormy Island, to the northward of New Ireland; one, 27 feet long, made of portions of beetles' legs; the other of beetles' legs and antennae of crustaceans. Also a complete set of Australian Typhlopidae, with the exception of the species *T. waitii*. These all live underground, and feed chiefly on termites. Mr. A. M. Lea showed two drawers of showy beetles, mostly from South America, some having tufts of hair on the antennae and legs. Mr. Edquist showed two objects found in sandhills, near the roots of wattle trees, about $1\frac{1}{2}$ inches long, approximately egg-shaped, with a $\frac{1}{2}$-inch circular aperture on one side, composed of agglutinated sand. Their origin is unknown, but it was suggested that they might be the pupa cases of beetles or other insects. Mr. F. R. Zietz exhibited living specimens of four species of lizards: gecko or night-lizard *(Gymnodactylus miliusii)*; mountain devil *(Moloch horridus)*; jew or bearded lizard *(Amphibolurus barbatus)*, adult and young; and two specimens of the banded skink *(Lygosoma fasciolatum)*. Mr. Selway stated that he had recently found under a log an egg about the size of a sparrow's, which, while held in the hand, had hatched out a gecko.

Papers.—"Polyplacophora, Genus *Stenochiton*," by Edwin Ashby, M.B.O.U.; "Notes on Australian Orchids, with a Description of some New Species," by R. S. Rogers, M.A., M.D.; and "Deflection of Columns under Axial and Eccentric Loading," by Prof. R. W. Chapman, M.A., B.C.E., F.R.A.S.

Ordinary Meeting, June 13, 1918.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

The President referred to the death of Augustus Simson, J.P., of Launceston, conchologist and entomologist, and a Fellow of the Society since 1893.

Elections.—Ernest H. Ising, machinist; H. W. Andrew, botanical assistant in Department of Agriculture; and the Rev. J. C. Jennison, were elected Fellows.

Exhibits.—Capt. S. A. White stated that Mr. Howchin considered that the so-called grinding stones shown by himself last month were only cores from which flakes had been chipped, but that he still believed that they had been used for grinding. He exhibited the following birds:—Regent or warty-faced honey-eater *(Zanthomiza phrygia)* from Mount Lofty Ranges; blue-faced honey-eater *(Entomyzon cyanotis)* from River Murray; helmeted friar bird *(Neophilemon buceroides)* from Queensland; friar bird *(Tropidorhynchus corniculatus)* from Queensland; white-eared honey-eater *(Nesoptilotis leucotis)* from South Australia; pied honey-eater *(Certhionyx variegatus)* from South Australia; white-fronted honey-eater *(Gliciphila albifrons)* from South Australia; grey-headed honey-eater *(Lichenostomus keartlandi)* from Central Australia; New Holland honey-eater *(Meliornis novae hollandiae)* from South Australia; and ornate honey-eater *(Ptilotis ornatus)* from South Australia. Mr. A. M. Lea showed two drawers of exotic insects from the collection of the late Augustus Simson; also a tray of bones collected from the pellets or castings of a barn owl. These proved that in two months the bird had eaten at least 544 mice, 39 rats, 1 young rabbit, 203 sparrows, 5 starlings, 5 blackbirds, 9 frogs, 1 lizard, and numerous night-flying insects; and that it was therefore a most useful bird. Capt. White stated that birds of this species roosted in the blow holes on the Nullarbor Plains, and would help to check the threatened advance of sparrows along the East-West Railway. Mr. A. G. Edquist showed cocoon of emperor gum moth attached to leaf of apple tree, showing that the larva attacked these trees; also several hard cocoons of moths, each pierced with a minute round hole, which he suggested was for breathing purposes; also a bunch of silky material, being feathers stripped from the body of a moth to cover its eggs. Dr. J. C. Verco exhibited several shells of *Trivia*, *Erato*, and *Ovula*.

The President intimated that as the Board of the South Australian Museum contemplated publishing the results of the researches of its staff, the contributions of the latter to the Society's Transactions would be smaller in future.

Papers.—"Notes on South Australian Polyplacophora, with Additions to the Fauna, together with a list of Australian Species, showing their Distribution in the Australian States," by Edwin Ashby, M.B.O.U.; and "Additions to the Flora of South Australia, No. 13," by J. M. Black.

Ordinary Meeting, July 11, 1918.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Resolved on the motion of Capt. S. A. White, seconded by Mr. S. Dixon: "That this Society requests the Government to introduce without delay the Bill for the Incorporation of Flinders Chase, Kangaroo Island, which has already been drafted."

Resolved on the motion of Mr. S. Dixon, seconded by Capt. S. A. White: "That the portions of land within the boundaries of the proposed Chase, at present alienated, be purchased by the Government and incorporated in the Chase."

Resolved: "That the following be a committee to bring these resolutions before the Government: Capt. S. A. White, Mr. J. M. Black, and Mr. S. Dixon."

Resolved: "That Capt. S. A. White represent this Society on a deputation about to wait on the Minister of Agriculture to urge the amendment and consolidation of the Birds Protection Act, the Animals Protection Act, and the Gun Act."

Exhibits.—Mr. Walter Howchin exhibited two broken examples of *Turbo jourdani* and two sea-worn opercula belonging to the same species, found by Mr. Bowman, of Parara, near Ardrossan. The shells, which are large examples of our largest sea shells, come from a new locality, not having been obtained in the Gulf before. The weathered condition of the shells suggests that they may have been washed out from a raised beach deposit, and would then be sub-fossil; the occurrence of *Arca trapezia* shells on the beach, a very common shell in these raised beaches, while not living in our local seas at the present time, gives further probability to this view. Mr. Howchin also exhibited the left valve of an *Ostrea hyotidoidea*, obtained from the River Murray cliffs at

Mannum. The shell is of unusual proportions and thickness, measuring 7 inches in length and 5¼ inches in breadth, while the shell has a maximum thickness of 2⅝ inches, and weighs 1¾ lbs.; the ligamental cavity is 1⅜ inches in length, and the muscular impression is very large and deep. It represents the only oyster known to occur in the lower marine tertiaries of Australia, but as individuals is moderately common. The largest example in the museum of the Adelaide University is very small in comparison. The shell gives evidence of age, not only in its massive development, but also in the modification of the form. The radial ribs and foliaceous scales of the younger stages of growth have become nearly obliterated by the coarseness of its shelly growth. Mr. A. M. Lea exhibited a male and female of the largest known South Australian insect, *Tropidoderus childreni*, belonging to the Phasmidae or leaf insects. The female, with legs and wings extended, measured 9 inches by 9 inches.

Papers.—"Australian Fungi and Notes and Descriptions, No. 1," by John B. Cleland, M.D., and Mr. Cheel; "Notes on South Australian Marine Mollusca, with Descriptions of New Species, Part XVI.," by Jos. C. Verco, M.D., F.R.C.S.

Ordinary Meeting, August 8, 1918.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Capt. S. A. White reported having attended a deputation to the Attorney-General *re* amendment of the game laws, with the result that he and two others had assisted the Government in drafting a Bill for their amendment and consolidation.

Exhibits.—Mr. W. Howchin exhibited the casts of the two largest known shells of the Australian Tertiary. One of these, supplied by the President (Dr. J. C. Verco) was obtained from the flux quarries at Stansbury, Yorke Peninsula, and sent by Mr. O. H. Rogers. It is apparently a *Trochus*, and Dr. Verco thinks it may be an immature *Trochus niloticus maximus*, a form that is living on the northern shores of Australia. If this identity of species can be established it will supply another link in fixing the geological age of our tertiary beds. The other cast was that of a giant *Turbo*, which must have been at least 9 inches in diameter. The specimen, with others of a like kind, was obtained from northern Yorke Peninsula. As casts of shells are usually too indefinite to admit of scientific diagnosis neither of these forms can be described. Mr. Rogers also sent from Stansbury a fragment of a turreted shell which is probably a *Turritella*, and is much larger than any described *Turritella* of our local rocks. This was also placed on exhibit. PROFESSOR OSBORN showed specimens of sweet pea *(Lathyrus odoratus)* infected with "streak" disease caused by *Bacillus lathyri*. The infection is produced by the entry of the bacillus through the stomata, and its spread is always likely to be rapid during periods of rain or heavy dew. Also various methods of demonstrating by curves the continuous or fluctuating variability shown by organisms. CAPT. S. A. WHITE showed cast of a large fossil shell, probably a volute, from Linley, near Morgan, 120 miles north-east of Adelaide; also a shell *(Pecten bifrons)* from an excavation between Port Adelaide and the Grange in the raised estuarine area; also nest of the South Australian fantail *(Rhipidura flabellifera whitei)*; also stone chippings found round the Ooldea native well on the edge of the Nullarbor Plain. DR. J. C. VERCO, for Professor Grant, showed a piece of a plate glass window containing a minute round hole at the bottom of a circular depression. Various opinions as to its origin were expressed.

PAPER.—The paper laid on the table by Dr. J. C. Verco at the last meeting was described by him and illustrated by exhibits.

ORDINARY MEETING, SEPTEMBER 12, 1918.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

MR. S. DIXON reported that the committee *re* Flinders Chase, appointed on July 11, had issued a circular and interviewed many prominent men, that a preliminary meeting had been held in the Mayor's parlour, and that a deputation would wait on the Premier next week.

EXHIBITS.—MR. DIXON showed a grass imported from South Africa, named *Ehrharta villosa*, var. *maxima*, which is superior to marram grass as a plant for binding drift sand. DR. PULLEINE exhibited millstones, scrapers, and axes from old native camps near Broken Hill, and for comparison palaeolithic remains from the caves in the Dordogne Valley, France; also shell axe from Mattei Island, New Britain, where there is absolutely no stone, and neolithic axes from lake dwellings, Lake Zurich, Switzerland; also a hollow stone from the banks of the River Murray, which Mr. Howchin declared to be an amygdule or chalcedonic silica lined with crystals, an unusual example of a hollow agate stone. MR. W. HOWCHIN showed rock specimens and fossils from near Hackham, indicating a new locality for the older tertiary beds *(vide* Miscellanea). CAPT. S. A. WHITE showed portion of the lower end of a fulgurite from

Fulham (*vide* Miscellanea); also a limestone formation from Linley, consisting of a hollow boulder with crystals in the interior; also from the Murray Cliffs, beyond Morgan, a blackened bone found upon blackened earth—probably the caudal vertebra of a large animal. Mr. W. H. Selway showed a plant resembling *Sparaxis*, found wild in the Waterfall Gully, near Adelaide. Dr. J. C. Verco showed a large series of cowries, *Cypraea moneta* and *C. annulus*, demonstrating the many varieties of each species and how they grade into each other.

Paper.—"Aborigines of West Coast of South Australia: Vocabularies and Ethnographical Notes," by Daisy M. Bates, communicated by J. M. Black.

Annual Meeting, October 10, 1918.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Election.—W. J. Kimber, orchardist, was elected a Fellow.

The Annual Report and Balance Sheet were read and adopted.

Election of Officers.—*President*, J. C. Verco, M.D., F.R.C.S.; *Vice-Presidents*, Professor E. H. Rennie, M.A., D.Sc., F.C.S., and Lieut.-Colonel R. S. Rogers, M.A., M.D.; *Hon. Treasurer*, W. B. Poole; *Members of Council*, Samuel Dixon and Professor T. G. B. Osborn, M.Sc.; *Hon. Auditors*, W. L. Ware, J.P., and H. Whitbread; *Representative Governor* on Board of Public Library, etc., Walter Howchin, F.G.S.

Exhibits.—Mr. A. M. Lea exhibited some wheat and weevils from a badly-infected stack at Birkenhead. The stack had been enclosed with malthoid and fumigated with carbon dioxide gas, with the result that the whole of the weevils had been destroyed without injury to the wheat. Also a tube containing thousands of spring-tail insects (Poduridae) taken by Mr. H. S. Cope, of Copeville, from a string half a chain wide and three chains long.

Papers.—"Notes on the Geology of Ardrossan and its Neighbourhood," by Walter Howchin, F.G.S.; "A Graphical Computator for determining the most Economical Beam to carry a given Load," by R. W. Chapman, M.A., B.C.E., F.R.A.S.; "Notes on the occurrence of *Lepidopleurus badius* in South Australia," by Frank L. Saunders, communicated through J. C. Verco, M.D., F.R.C.S.; "The Lepidoptera of Broken Hill, N.S.W., Part IV.," by Oswald B. Lower, F.Z.S., F.E.S.; "Additions to the Flora of South

Australia, No. 14,'' by J. M. Black; ''Notes on some Miscellaneous Coleoptera, with Description of New Species, Part IV.,'' by Arthur M. Lea, F.E.S.; ''Lepidoptera taken by A. M. Lea on Lord Howe Island and Norfolk Island,'' by A. Jefferis Turner, M.D., F.E.S.

ANNUAL REPORT, 1917-18.

During the year papers in continuation of those already published upon the same subjects have been received from Dr. J. C. Verco upon "South Australian Marine Mollusca," from Mr. A. M. Black upon "Additions to the Flora of South Australia," and from Mr. Oswald B. Lower upon "The Lepidoptera of Broken Hill," and also the first paper of a new series by Dr. J. B. Cleland and Mr. Cheel upon "Australian Fungi." Such series have been a valuable feature of the Society's *Transactions* for many years. Other papers on natural history have been contributed by Professor Osborn on Lycopods and Fungi, by Dr. R. S. Rogers on Orchids, by Mr. E. Ashby on Polyplacophora, by Dr. A. Jefferis Turner on the Lepidoptera of Lord Howe and Norfolk Islands, and by Mr. A. M. Lea on Coleoptera; while further geological results were contributed by Mr. W. Howchin. The Aboriginal Languages, together with Ethnographical Notes on the Natives of our own West Coast, were dealt with in a paper by Mrs. Daisy M. Bates.

As the South Australian Museum is issuing its own publication, many valuable papers by the Museum staff have been diverted from our *Transactions*, thus relieving the pressure upon our space, and affording opportunity for further contributions from other sources.

The evening meetings have been enlivened by the exhibition of a great diversity of objects of scientific interest by the members.

The growth of the library and the distribution of our *Transactions* have been greatly interrupted by the war. Not only have exchanges with enemy countries ceased, but in many cases allied and neutral countries have postponed the dispatch of their publications until shipping space and safe transit can be assured.

The conservation of our native fauna and flora, which is of such importance on account of their very distinctive character and the fact that in many cases they embody forms of life long extinct in other parts of the world, has for many years engaged the attention of the Society. As a step towards this end the Government has prepared a Bill for the amendment and consolidation of the existing game and cognate Acts, and the assistance of one of our Fellows, Capt. S. A. White, and two other experts, has been availed of in drafting the same. With the same object in view the Society has made a renewed effort to obtain the reservation of the western portion of Kangaroo Island under the name of Flinders Chase for the protection of those animals and plants which would otherwise soon become extinct. A committee has been appointed to deal specially with this matter, and a scheme has been devised by which the Chase may be made a profitable investment by including the afforestation of portions of the land with suitable valuable timber. A pamphlet setting forth the advantages and details of the scheme has been widely distributed by the committee, and a large and influential deputation waited upon the Minister of Industry on the 27th inst. to urge the Government to seek the necessary approval of Parliament. The Minister, although personally viewing the project with favour, could only promise to lay the matter before his colleagues, and the result is not yet known.

The membership of the Society now comprises 10 Honorary Fellows, 5 Corresponding Members, 76 Fellows, and 1 Associate.

Jos. C. Verco, *President.*
Walter Rutt, *Hon. Secretary.*

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Revenue and Expenditure for 1917-18.

	£	s.	d.	£	s.	d.
To Balance October 1, 1917				310	0	6
,, Subscriptions—						
Royal Society	83	4	0			
Field Naturalists' Section ...	16	0	0			
				99	4	0
,, Grants from Government—						
On Subscriptions	102	10	1			
For Printing Reports and Scientific Investigations ...	150	0	0			
				252	10	1
,, Grant from Public Library Board on account of cost of reproducing illustrations of Central Australian Expedition				10	0	0
,, Refund of unexpended Grant to G. N. Hardy				10	8	1
,, Receipts for use of Room by other Societies				4	12	6
,, Sale of Publications				2	12	6
,, Savings Bank Interest	4	14	5			
,, Interest transferred from Endowment Fund	142	3	5			
				146	17	10
				£836	5	6

	£	s.	d.	£	s.	d
By Transactions—						
Printing	270	13	9			
Illustrating	80	16	3			
Publishing	7	3	7			
				358	13	7
,, Grant—						
Field Naturalists' Section				20	0	0
,, Library—						
Librarian, Cataloguing, Receiving, and Issuing ...	25	4	0			
Slips	2	1	3			
				27	5	3
,, Sundries—						
Cleaning and Lighting ...	10	13	4			
Printing, Postages, Stationery, and Photographs	22	10	2			
Advertising	3	1	0			
Insurance	2	10	8			
				38	15	2
,, Balance September 30, 1918—						
Savings Bank of S.A.	155	15	1			
Bank of Australasia	235	16	5			
				391	11	6
				£836	5	6

Audited and found to be correct—

W. L. Ware,
Howard Whitbread, } *Hon. Auditors.*

W. B. Poole, *Hon. Treasurer.*

ENDOWMENT FUND.

(Capital, £3,479 17s. 6d.)

	£	s.	d.	£	s.	d.
1917—October 1.						
To Balance				3,479	17	6
,, Interest received on Government Stock	141	17	6			
,, Savings Bank Interest	0	5	11			
				142	3	5
				£3,622	0	11

	£	s.	d.	£	s.	d.
1918—September 30.						
By £2,000 S.A. Government 3¾% Inscribed Stock at cost ...	1,997	10	0			
,, £450 S.A. Government 3¾% Inscribed Stock at cost ...	432	0	0			
,, £800 S.A. Government 3¾% Inscribed Stock at cost ...	753	10	8			
,, £500 S.A. Government Consolidated 3% Stock at cost ...	292	8	9			
,, Savings Bank Account ...	4	8	1			
				3,479	17	6
,, Interest transferred to Revenue Account				142	3	5
				£3,622	0	11

Audited and found to be correct—

W. L. Ware,
Howard Whitbread, } *Hon. Auditors.*

Adelaide, October 4, 1918.

W. B. Poole, *Hon. Treasurer.*

DONATIONS TO THE LIBRARY

FOR THE YEAR ENDED SEPTEMBER 30, 1918.

TRANSACTIONS, JOURNALS, REPORTS, ETC., presented by the respective governments, societies, and editors.

AUSTRALIA.

AURORA RELIEF EXPEDITION. Report of voyage. Melb. 1918.

AUSTRALASIAN ANTARCTIC EXPEDITION, 1911-14. Scientific reports, ser. C, v. 3, pt. 2; 4, pt. 2-3; 5, pt. 1-5; 6, pt. 1. 1917-18.

AUSTRALASIAN INSTITUTE OF MINING ENGINEERS. Proc., n.s., no. 27-30. Melb. 1917-18.

AUSTRALIA. ADVISORY COUNCIL OF SCIENCE AND INDUSTRY. Bull. 1-7. Melb. 1917-18.

——— *Bureau of Census and Statistics.* Official yearbook, no. 10. 1917.

——— ——— Australian joint life tables.

——— *Bureau of Meteorology.* Monthly report, vol. 4, no. 3-7, 1913.

——— *Fisheries.* Zoological results of fishing experiments carried out by F.I.S. "Endeavour," v. 4, pt. 5. Melb. 1918.

——— *Northern Territory.* Bull. 16, 21. 1916.

——— ——— Report of Administrator, 1915-17.

EWART and DAVIES. Flora of the Northern Territory. Melb. 1917.

NEW SOUTH WALES.

AUSTRALIAN MUSEUM. Records, v. 11, no. 11-12; 12, no. 1-5. 1917-18.

——— Report of the trustees, June, 1917. Syd.

CARSLAW, H. S. Teaching of Mathematics in Australia. Syd. 1914.

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LIST OF FELLOWS, MEMBERS, ETC.,

AS EXISTED ON

SEPTEMBER 30, 1918.

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* Those marked with an asterisk have contributed papers published in the Society's Transactions.

Any change in address should be notified to the Secretary.

NOTE.—The publications of the Society will not be sent to those whose subscriptions are in arrears.

Date of Election.

HONORARY FELLOWS.

1910. *BRAGG, W. H., C.B.E., M.A., F.R.S., Professor of Physics, University College, London (Fellow 1886).
1893. *COSSMAN, M., 110, Faubourg Poissonnière, Paris.
1897. *DAVID, T. W. EDGEWORTH, C.M.G., B.A., D.Sc., F.R.S., F.G.S., Professor of Geology, University of Sydney.
1890. *ETHERIDGE, ROBERT, jun., Director and Curator of the Australian Museum of New South Wales, Sydney.
1905. GILL, THOMAS, C.M.G., I.S.O., Under-Treasurer, Adelaide.
1905. *HEDLEY, CHAS., Assistant Curator, Australian Museum, Sydney.
1892. *MAIDEN, J. H., I.S.O., F.R.S., F.L.S., Director Botanic Gardens, Sydney, New South Wales.
1898. *MEYRICK, E. T., B.A., F.R.S., F.Z.S., Tohrnhanger, Marlborough, Wilts, England.
1894. *WILSON, J. T., M.D., Ch.M., Professor of Anatomy, University of Sydney, New South Wales.
1912. *TEPPER, J. G. O., F.L.S., Elizabeth Street, Norwood (Corresponding Member 1878, Fellow 1886).

CORRESPONDING MEMBERS.

1913. *CARTER, H. J., B.A., Wahroonga, New South Wales.
1909. *JOHNCOCK, C. F., Clare.
1893. *STRETTON, W. G., Darwin, Northern Territory.
1905. THOMSON, G. M., F.L.S., Dunedin, New Zealand.
1908. *WOOLNOUGH, WALTER GEORGE, D.Sc., F.G.S., Professor in Geology, University of Perth (Fellow 1902).

FELLOWS.

1918. ANDREW, H. W., North Street, Collinswood.
1895. *ASHBY, EDWIN, M.B.O.U., Blackwood.
1917. BAILEY, J. F., Director Botanic Garden, Adelaide.
1902. *BAKER, W. H., F.L.S., Glen Osmond Road, Parkside.
1907. *BLACK, J. MCCONNELL, 1, Brougham Place, North Adelaide.
1909. BRADLEY, EDGAR J., C.E., Hydraulic Engineer's Department, Adelaide.
1912. *BROUGHTON, A. C., Young Street, Parkside.

1911. Brown, Edgar J., M.B., D.Ph., 3, North Terrace.
1883. *Brown, H. Y. L., 286, Ward Street, North Adelaide.
1893. Brummitt, Robert, M.R.C.S., Medindie.
1916. Bull, Lionel B., Laboratory, Adelaide Hospital.
1906. Bundey, Miss Ellen Milne, 148, Molesworth Street, North Adelaide.
1907. *Chapman, R. W., M.A., B.C.E., F.R.A.S., Professor of Mathematics and Mechanics, University of Adelaide.
1904. Christie, W., 49, Rundle Street, Adelaide.
1895. *Cleland, John B., M.D., Government Bureau of Microbiology, Sydney, New South Wales.
1907. *Cooke, W. T., D.Sc., Lecturer, University of Adelaide.
1912. Corbin, H., B.Sc., University of Adelaide.
1914. Cornish, K. M., on Active Service.
1916. Darling, H. G., Franklin Street, Adelaide.
1914. Darroch, D. G., on Active Service.
1887. *Dixon, Samuel, Bath Street, New Glenelg.
1915. *Dodd, Alan P., Kuranda, N. Queensland.
1911. Dutton, H. H., Anlaby.
1902. Edquist, A. G., 20, King Street, Mile End.
1918. Elston, A. H., Childers Street, North Adelaide.
1917. Fenner, A. E., D.Sc., F.G.S., Education Department, Adelaide.
1914. Ferguson, E. W., M.B., Ch.M., Gordon Road, Roseville, Sydney.
1904. Gordon, David, c/o D. & W. Murray, Gawler Place, Adelaide.
1880. *Goyder, George, A.M., F.C.S., Gawler Place, Adelaide.
1910. *Grant, Kerr, M.Sc., Professor of Physics, University of Adelaide.
1904. Griffith, H., Brighton.
1916. Hackett, W. C., Rundle Street, Adelaide.
1916. Hancock, H. Lipson, A.M.I.C.E., M.I.M.M., M.Am.I.M.E., Kennedya, Wallaroo Mines.
1896. Hawker, E. W., F.C.S., East Bungaree, Clare.
1883. *Howchin, Walter, F.G.S., Lecturer in Geology and Palæontology, University of Adelaide.
1918. Ising, Ernest H., Loco. Department, Islington.
1912. Jack, R. L., B.E., Assistant Government Geologist, Adelaide.
1893. James, Thomas, M.R.C.S., Tranmere, Magill.
1918. Jennison, Rev. J. C., Maitland.
1910. *Johnson, E. A., M.D., M.R.C.S., 295, Pirie Street, Adelaide.
1915. Laurie, D. F., Agricultural Department, Victoria Square.
1897. *Lea, A. M., F.E.S., South Australian Museum, Adelaide.
1884. Lendon, A. A., M.D. (Lond.), M.R.C.S., Lecturer in Obstetrics, University of Adelaide, and Hon. Physician, Children's Hospital, North Adelaide.
1888. *Lower, Oswald B., F.Z.S., F.E.S., 18, Bartley Crescent, Wayville.
1914. Mathews, G. M., F.R.S.E., F.L.S., F.Z.S., Foulis Court, Fair Oak, Hants, England.
1905. *Mawson, Sir Douglas, D.Sc., B.E., Lecturer in Mineralogy and Petrology, University of Adelaide.
1874. Mayo, Geo. G., C.E., 90, Hill Street, North Adelaide.
1907. Melrose, Robert Thomson, Mount Pleasant.
1897. *Morgan, A. M., M.B., Ch.B., Angas Street, Adelaide.

1913. *Osborn, T. G. B., M.Sc., Professor of Botany, University of Adelaide.
1886. Poole, W. B., Savings Bank, Adelaide.
1911. Poole, T. S., B.A., LL.B., *Register* Chambers, Grenfell Street.
1908. Pope, William, Eagle Chambers, King William Street.
1907. Pulleine, Major R. H., M.B., North Terrace, Adelaide.
1916. Ray, William, M.B., B.Sc., Victoria Square, Adelaide.
1885. *Rennie, Edward H., M.A., D.Sc. (Lond.), F.C.S., Professor of Chemistry, University of Adelaide.
1913. Riddle, Staff-Sergt. A. R., No. 7 A.G. Hospital, Keswick.
1911. Roach, B. S., Education Department, Flinders Street, Adelaide.
1905. *Rogers, Lieut.-Col. R. S., M.A., M.D., Flinders Street, Adelaide.
1869. *Rutt, Walter, C.E., College Park, Adelaide.
1891. Selway, W. H., Treasury, Adelaide.
1906. Snow, Francis H., National Mutual Buildings, King William Street.
1910. *Stanley, E. R., Government Geologist, Port Moresby, Papua.
1881. *Stirling, Sir Edward C., Kt., C.M.G., M.A., M.D., F.R.S., F.R.C.S., Professor of Physiology, University of Adelaide, Hon. Curator of Ethnology, South Australian Museum.
1907. Sweetapple, H. A., M.D., Park Terrace, Parkside.
1897. *Torr, W. G., LL.D., M.A., B.C.L., Brighton, South Australia.
1894. *Turner, A. Jefferis, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.
1878. *Verco, Joseph C., M.D. (Lond.), F.R.C.S., Consulting Physician Adelaide Hospital and Children's Hospital.
1883. Wainwright, E. H., B.Sc. (Lond.), Seafield Tower, Glenelg.
1914. *Waite, Edgar R., F.L.S., Director South Australian Museum.
1912. Ward, Leonard Keith, B.A., B.E., Government Geologist, Adelaide.
1878. Ware, W. L., King William Street.
1907. Webb, Noel A., Barrister, Waymouth Street, Adelaide.
1904. Whitbread, Howard, c/o A. M. Bickford & Sons, Currie Street, Adelaide.
1912. *White, Captain S. A., D.M.B.O.U., "Wetunga," Fulham, South Australia.
1912. *Zietz, F. R., South Australian Museum.

Associate.

1904. Robinson, Mrs. H. R., "Las Conchas," Largs Bay, South Australia.

APPENDICES.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

THIRTY-FIFTH ANNUAL REPORT OF THE COMMITTEE

For the Year Ended September 30, 1918.

Your Committee has much pleasure in reporting that the work of the Section has been enthusiastically carried on during the year.

The election of officers for the year resulted in the following members being elected to the respective positions:—*Chairman*, Mr. W. J. Kimber; *Vice-Chairmen*, Dr. C. Fenner, F.G.S., and Mr. J. F. Bailey; *Hon. Treasurer*, Mr. B. B. Beck; *Hon. Librarian*, Miss I. Roberts; *Hon Secretary*, Mr. Wm. Ham; *Committee*, Lieut.-Col. R. S. Rogers, M.A., M.D., Prof. T. G. B. Osborn, M.Sc., Capt. S. A. White, M.B.O.U., Mr. E. H. Lock, F.R.H.S., Mrs. R. S. Rogers, Mr. W. H. Selway, Mrs. J. F. Mellor, and Mr. E. H. Ising, and Messrs. Edwin Ashby and Percy Runge, Chairman and Secretary of the Fauna and Flora Protection Committee; *Hon. Auditors*, Mr. Walter D. Reed, F.C.P.A., and Mr. A. W. Drummond.

The Fauna and Flora Protection Committee was also elected at the annual meeting, and comprised:—Messrs. E. Ashby and P. H. Runge, Dr. R. S. Rogers, Dr. W. Ramsay Smith, Dr. R. H. Pulleine, Messrs. J. W. Mellor, W. H. Selway, J. M. Black, A. G. Edquist, E. H. Lock, A. M. Lea, S. Angel, J. Willmott, R. Llewellyn, and S. Stokes, and Capt. S. A. White.

The membership is now 157.

At the annual meeting held on September 18, 1917, the retiring President (Prof. T. G. B. Osborn, M.Sc.) delivered an instructive address on "Parasitic Flowering Plants in

South Australia. He referred particularly to such plants as *Bartsia latifolia*, and to members of the Scrophulariaceae, Loranthaceae, and Santalaceae. *Euphrasia Brownii* was also referred to and described. *Exocarpus cupressiformis* (the native cherry) the lecturer stated as probably parasitic, and some reference was made to the various species of *Loranthus*.

At an adjourned meeting held on October 2, 1917, Prof. T. G. B. Osborn, M.Sc., continued his address dealing with a common weed of the park lands *(Romulea bulbocodium)*. The speaker drew the attention of the members of the Section to the various forms of botanical work which could be done near the city. The professor hoped that the Section would be able to do some work towards a detailed study of three species of mistletoe growing on native and other trees near Adelaide. The root systems of many common plants were also well worthy of study, *e.g.*, those of the common nutgrass *(Cyperus rotundus)*, and those of various species of the native Liliaceae. Another suggestion was that the Section should undertake to compile a map showing the distribution of native trees near Adelaide, and exact census of the plants in some limited area, such, for example, as the National Park. At the same meeting many interesting specimens were shown. Mr. W. J. Kimber exhibited several shells, including the new *Volvatella*, obtained in the dredging expedition of January 29, 1917. The species was as yet undetermined, but it was described as somewhat resembling *V. pyriformis* (Pease) of Queensland. Mr. Kimber also showed a fossil from the tertiary beds at Gaza. Mrs. Harris tabled an aboriginal skull obtained from the banks of the River Torrens. Miss I. Roberts showed a specimen of Archaeocyathinae, a fossil from the Cambrian series, and a piece of chiastolite, or "luck stone," from Bimbowrie, South Australia. Other specimens tabled by Dr. Fenner included a fine beryl and several fossils forwarded from the war fronts in France, Gallipoli, and Palestine. These included *Helix* sp., brachipods, and others. Many fine orchids were tabled by Mrs. E. H. Ising and Miss Janet Davidson. Mr. Runge tabled specimens of bismuth, wolfram, asbestos, and gold ore. The Secretary showed a collection of native plants from Kangaroo Island.

On September 29 a large party, under the guidance of Prof. T. G. B. Osborn, M.Sc., took part in an excursion to Slape Gully. The leader directed the attention of members more particularly to the sundews *(Drosera)* and heath plants of the district.

The monthly meeting on October 2 was devoted to the exhibition of specimens, a number of native plants being shown by members.

On October 23 Messrs. A. Wilkinson and P. H. Williams gave an exhibition of some interesting and beautiful slides from photographs taken by themselves. Many of the slides were views taken on various excursions, while there were also fine pictures of the River Murray.

Horsnell Gully was visited by members on October 13, under the guidance of Mr. E. H. Lock. The scenic beauties were greatly admired, and specimens of the native flora gathered as well as of the English dandelion and Scotch thistle.

On October 27 the party visited the National Park, and collected a number of species of the native flora.

A large party travelled to Dunstan's Gully on November 10, when Dr. C. Fenner spoke on the physiographic features of the foothills and the geology of the Mount Lofty Range.

On October 10, 1917, the members journeyed to Ambleside under the leadership of Mr. E. H. Ising. The wonderful profusion of flowers was the outstanding feature of the outing. The leader spoke on leaves, their shapes and functions, and directed special attention to the well-known "pink eyes" *(Tetratheca ericifolia)*.

On November 24 a party travelled to Eden Hills under the guidance of Prof. T. G. B. Osborn, M.Sc. The introduced plants of the district formed the main subject of the afternoon's work, including a description of the various species of clovers. A good many species of native flowers were collected. At the conclusion of the afternoon's work the party was entertained by Mr. and Mrs. M. Symonds Clark at Eden.

On April 27, 1918, excursions were resumed by the Section, the members travelling to Aldgate to view the autumn tints, Mr. E. H. Lock being the leader. Mr. A. G. Edquist spoke on the formation of colour in the leaves both from the botanical and chemical standpoint.

On May 6 a large party travelled to Mylor, and succeeded in collecting many species of the hills flora, and studied the river and cliff formation along the River Onkaparinga.

Mr. A. M. Lea spoke on "Ants and their Guests" at the evening meeting held on May 16. He described the manner in which ants recognized other individuals from the same nest by the power of smell. Many species of ants kept slaves. Others stored up grain, which they dried to prevent germination. The honey ants of Central Australia became reservoirs of honey, which were largely availed of by the aboriginals, as had been noticed by Captain White in his recent visit to Central Australia. The use of the episcope to show various drawings illustrating ant life tended greatly to enhance the interest of the lecture.

A seaside trip was undertaken on May 18, when a party under the leadership of the President and Mr. A. G. Edquist went along the coast from the Grange towards the Semaphore. Several interesting forms of marine life were noticed and described by Mr. Kimber, after which Mr. Edquist described the characteristic plants of the sandhills bordering the shore, and spoke on the many interesting adaptations shown by such plants growing under xerophytic conditions.

On June 1 the Director of the Botanic Garden (Mr. J. F. Bailey) conducted a large party over the Garden and Botanic Park. The leader dealt more particularly with the trees growing in the garden, pointing out their modes of growth and economic uses.

The evening meeting held on June 18 was well attended. Mr. H. W. Andrew, of the Agricultural Department, gave a most interesting address on "Weeds and Seed Control." By means of lantern slides and a fine collection of well-mounted specimens the lecturer illustrated many of the most troublesome weeds which have been imported into our State to the detriment of the producers, and described the methods by which it was attempted to prevent the introduction of fresh species and to diminish the spread of existing pests.

The excursion of June 22 was devoted to the Morialta Gorge. Under Dr. C. Fenner's leadership, and with the aid of maps supplied to each member of the party, the formation of the gorge was studied. The leader clearly explained the physiographic factors which had brought about the formation of the waterfalls, the picturesque canyon, and the many other forms of rock structure to be seen in the Morialta Reserve.

On July 6, Prof. T. G. B. Osborn, M.Sc., conducted a party of members of the Section over the North Park Lands at Montefiore Hill, and gave an interesting exposition of the manner in which the common onion weed was enabled to spread with such destructive rapidity in pasture lands, and by means of specimens demonstrated the peculiar root system possessed by this plant. Several other introduced weeds were dealt with, and an adjournment was made to the banks of the Torrens. The formation of "hooks" was pointed out, and attention was directed to the colonization of the newly-formed mudbanks by various species of plants.

At the evening meeting held on July 16, Prof. T. G. B. Osborn, M.Sc., spoke on "The Variability of Organisms." By means of a card containing a number of leaves from two branches of a pittosporum plant mounted to show the number of leaves of each of various lengths, the speaker was able to vividly illustrate the variability of the plant in this respect. A graph formed from these numbers gave a curve of variability which was made the text of an interesting lecture on the subject of variability in general and the question of the limitations of its control. Another graph compiled by the speaker showed the variations in the number of ray florets in a large number of specimens of the common ox-eye daisy *(Chrysanthemum leucanthemum)* growing near Mount Lofty. In this case the graph showed that there were two apices, probably pointing out that there were really two species included, varying only in the number of ray florets. The speaker also exhibited specimens showing the ravages of the streak disease of the winter-flowering sweet pea.

The excursion of July 20 was taken in the neighbourhood of the Black Hill. Mr. E. H. Ising (the leader) spoke on the heath-like plants, particularly dealing with *Epacris* and the various species of *Styphelia*. By means of specimens and blackboard diagrams the peculiar adaptations of these plants were explained and the construction of the floral organs shown. The botanical characteristics of the styphelias were illustrated, and the distribution of the various species touched upon. In addition to the lecture the leader was able to identify and speak upon a large number of species of native flowers which had been collected by members in this locality.

Members visited Upper Sturt on August 17, under the leadership of Mr. A. G. Edquist. By special permission the party was enabled to follow the railway line into the National Park. The members were greatly pleased to find that the authorities were carefully protecting the native flora along the railway. Here many interesting native plants were noted, especially *Hardenbergia monophylla*. No collections were made, but at various points the leader dealt with the different plants seen. At a later stage Mr. Edquist delivered an address on the wattles. Specimens brought by the lecturer were handed to members, who were able to compare the foliage and flowers of the various species, the speaker giving a short account of each species, with particular reference to its suitability for planting. A general discussion on the acacias followed.

At the evening meeting held on August 20 Dr. C. Fenner, F.G.S., gave an interesting lecture on "Volcanoes and Volcanic Products," illustrated by a fine series of lantern views. With the help of the episcope the speaker was able to show specimens of the various products of volcanic activity in the shape of lavas, pumice, and volcanic bombs. Some fine specimens of obsidianites or australites were made the text of a short address, in which by means of diagrams the lecturer illustrated the various theories of their origin and distribution.

On August 24 members took the tram to Paradise, and walked to Highbury under the leadership of Mr. W. H. Selway. The geological features of the locality were explained, special attention being directed to the beds of fluviatile origin corresponding in age with the marine tertiaries of the coast. The sandy soil of Highbury is prolific in native flowers, including a considerable variety of orchids, of which several species were found, in particular *Diuris palustris*. Heath-like plants were numerous, amongst these being *Cryptandra tomentosa*. Many acacias were in full bloom, including *A. montana*, which is usually found only at higher altitudes. Dr. Fenner explained the existence of gravel beds at a high elevation, forming an apron of alluvial, the water-worn material having been deposited at the base of the ranges.

On September 14 Mr. W. H. Selway conducted an excursion to the National Park. The leader gave an interesting account of the steps which had been taken to secure the old Government Farm as a National Park, and of the various troubles which the pioneers of the movement had to encounter from the opposition of those desirous of seeing the land cut up for occupation as working men's blocks, etc.

W. J. Kimber, *Chairman.*
W. Ham, *Hon. Secretary.*

TWENTY-NINTH ANNUAL REPORT OF THE NATIVE FAUNA AND FLORA PROTECTION COMMITTEE.

On May 1, 1918, Mr. E. Ashby resigned his chairmanship prior to leaving for America, and Capt. S. A. White, C.M.B.O.U., was elected as chairman.

Several committee meetings took place during the year to discuss important questions. The chairman attended two meetings of sportsmen and others to consider the advisability of bringing in a new Bill for the protection of animals and birds. This was decided upon, and the chairman, through the courtesy of the Government, had a good share in the framing of the Act. The Bill was introduced into Parliament by the Hon. the Attorney-General (Mr. H. N. Barwell), and was keenly watched and contested, and several points were lost, the most important being the definition of an aboriginal. Still, great progress has been made, for hitherto many birds which have been unprotected will now have full protection. Many loopholes in the old Act have been rectified, and it will be much easier now to bring offenders against the Act to justice. At the time of writing this report the Bill is coming forward for the third reading.

The committee considered the seal question, for one sealer admitted having killed 1,400 seals in the last six months. The seal was placed in the totally protected list, but when before the House the clause was lost. Action is now being taken to declare both gulfs inside Kangaroo Island as a closed area or sanctuary for seals.

The Royal Society elected a committee, comprising the chairman of the committee, as well as Messrs. S. Dixon and J. M. Black, to arrange a deputation to the Government, asking that Flinders Chase, Kangaroo Island, be constituted. On Wednesday, September 10, 1918, a meeting of influential citizens took place in the Mayor's parlour, Adelaide, and the Hon. J. Lewis, M.L.C., presided. The question was discussed in all its aspects, and a committee appointed, consisting of Capt. S. A. White, Messrs. S. Dixon and J. M. Black, to arrange for a deputation. A circular was printed, setting out the objects of the Chase, and circulated amongst the members of both Houses of Parliament, citizens, etc. On September 27, a large and representative deputation waited upon the Attorney-General (Mr. H. N. Barwell). Prof. Sir Edward Stirling, the chairman of the committee, Mr. H. Robins, and others spoke, and put the situation very clearly before the Minister. The question has been before Cabinet, but the results are not yet to hand.

It can be said that much good work has been accomplished during the year, and a great deal of additional protection has been secured for our fauna and flora. Still much remains to be accomplished.

S. A. White, *Chairman.*

Field Naturalists' Section of the Royal Society.

Statement of Receipts and Expenditure for Year ended September 16, 1918.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
By Balance brought forward	2	13	6	To Members' Subscriptions paid to Royal Society	16	0	0
,, Grant from Royal Society	20	0	0	,, Postages	4	1	0
,, Members' Subscriptions	16	0	0	,, Stationery	0	7	0
,, Bank Interest	0	7	9	,, Hire of Hall and Lantern	3	5	8
				,, Advertising	0	9	6
				,, Printing	9	13	0
				,, Carriage	0	3	10
				,, Balance carried forward	5	1	3
	£39	1	3		£39	1	3

Excursion Account.

	£	s.	d.		£	s.	d.
By Balance brought forward	6	14	6	To Hire of Motor	6	0	0
,, Excursion Fares	12	15	6	,, Hire of Dredge	5	10	0
				,, Refreshments	0	3	9
				,, Gratuity to Sailors	0	5	0
				,, Credit Balance	7	11	3
	£19	10	0		£19	10	0

Audited and found correct,

WALTER D. REED, F.C.P.A., }
A. M. DRUMMOND, } *Auditors.*

September 16, 1918.

W. J. KIMBER, *Chairman.*
W. HAM, *Hon. Sec.*

GENERAL INDEX.

[Generic and specific names printed in italics indicate that the forms described are new.]

TRANSACTIONS AND PROCEEDINGS

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(INCORPORATED).

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Royal Society of South Australia

(INCORPORATED).

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CONTENTS.

CONTENTS (Continued).

The late Sir E. C. Stirling, Kt., C.M.G., F.R.S.,
M.A., M.D. (Cantab.), F.R.G.S., C.M.Z.S.

THE
Transactions
OF
The Royal Society of South Australia

(Incorporated.)

Vol. XLIII.

Obituary Notice.

WITH FRONTISPIECE.

It is with profound regret we refer to the death of one of our most eminent and helpful Fellows, the late Sir E. C. Stirling, Kt., C.M.G., F.R.S., M.A., M.D. (Cantab.), F.R.G.S., C.M.Z.S. He was elected a Fellow on October 4, 1881, a member of Council in 1882, and a Vice-President in 1883. Resigning this post in 1884, because he was leaving the State, he was re-elected in 1885 a member of Council, in 1888 Vice-President, and in 1889 he was chosen President. Directly his term of office expired he was again made a member of Council, and was repeatedly re-elected until 1900; so that he was in office for about eighteen consecutive years.

From the first he took an active and prominent part in the affairs of the Society; in fact, we find him in the chair within about four months of his election. Having been recently appointed Lecturer on Physiology at the University he showed and explained one of his laboratory instruments, Williams' Freezing Microtome; and being also a surgeon he exhibited some kangaroo tendon, and indicated its advantages as a ligature for tying vessels in operations.

He went to England in 1884 for a few months, partly to secure the most recent and perfect apparatus for conducting physiological observations, and these on his return he exhibited and described to the members.

In 1886 he showed a preparation of the genitalia of a female kangaroo, demonstrating the young attached by its umbilical cord, so proving it to be produced and born in the same manner as other mammals.

During 1889, the year of his Presidency, he was not once absent from the gatherings of the Society, and we find him showing the cranium of a South Australian aboriginal presenting a marked resemblance to the celebrated prehistoric Neanderthal skull, and having a very ape-like appearance; also a specimen of teal of brilliant plumage *(Anas castanea)*. He did not know the locality from which it came, though several members had seen similar individuals in various parts of the Province. He did not agree with Gould that it was only the nuptial dress of the male of an ordinary teal, but felt satisfied it was a distinct species. On retiring from the Presidential chair he read an address on "Weissmann's Theory of Heredity," and the meeting carried a unanimous resolution that the address should be printed.

He was Chairman of the South Australian Museum Committee in the year 1884-5, and when Dr. Haacke resigned his position in 1889 Dr. Stirling was installed as Honorary Director of the Museum. This gave him free access to the valuable ethnological, palaeontological, and other novelties in that institution, many of which he brought before the Society as exhibits, or as subjects of the scientific papers with which he enriched our Transactions. There was, for instance, the marsupial mole *Notoryctes typhlops*, the blind burrower in the sand, first brought under our notice in 1888, and again named, described, and beautifully illustrated in 1891, and still further dealt with in the volume for 1894. In 1890 he accompanied Earl Kintore and a party overland from Port Darwin to Adelaide, and devoted himself to the collection of flora and fauna. In this way he was fortunate in securing half a dozen individuals of this new marsupial mole, as well as much other material, to supply not only our own Museum, but those in the Commonwealth and in foreign lands.

In 1893 he went with a party to Lake Callabonna to investigate the remarkable deposit of fossil bones belonging to gigantic extinct beasts and birds and to superintend their transport to Adelaide. By the patient industry and technical skill of Mr. A. E. H. Zietz they were collected, specially treated, packed, and removed to the Museum, where they were further prepared and preserved bone by bone; and from these Dr. Stirling and he were able to reconstruct the complete skeleton of the enormous marsupial, the *Diprotodon australis*, a cast of which graces the entrance-room of the Australian wing of the Museum. There were also parts of an immense wombat, the *Phascolomys gigas*, and portions of the skeleton of *Genyornis newtoni*, a struthious bird allied to the New Zealand moas, and almost equal in size to the largest of these. For more than four years these monsters occupied his attention, and several papers on the physical features of Lake Callabonna and its fossil remains were submitted to our Society and were printed as Memoirs, of which they constitute the whole of our first volume.

In 1894 he accompanied the Horn Expedition to the MacDonnell Ranges as medical officer and anthropologist. To him was allotted the task of dealing with the ethnological material then collected, and in nearly 160 pages of the fourth volume of the Horn Scientific Expedition to Central Australia, 1896, may be found the results of his investigations. Doubtless we will remember his exhibition of quite a large number of ceremonial sticks and stones from that region, and the public lecture delivered under the auspices of our Society, in which he revealed the manners and customs of its inhabitants, illustrated with very fine diascopic photographs taken in Central Australia. He and Mr. Zietz dealt with all the vertebrata obtained by the Elder Exploration in 1893, and published their results in our Transactions for 1896.

In 1895 he was appointed Director of the Museum as a salaried officer, and held this post until the end of 1912, when he resigned (being followed by Mr. E. R. Waite), and in April, 1914, was made Honorary Curator of Ethnology. Sir Edward Stirling was, perhaps, as much interested in the anthropology and ethnology of Australia as in its palaeontology. He gradually accumulated a fine library of works dealing with its history and its aboriginals, and with the inhabitants of adjacent islands. He collected in our Museum a large series of native skulls and skeletons, implements of war and peace, and, in fact, everything pertaining to their primitive life, and he spent his last three or four years as honorary curator of this department in cataloguing, arranging, and displaying this exceedingly rich collection. The exhibit of these in the top gallery of the Australian wing of the Museum is a monument to his expert knowledge of this branch of science, as well as an enduring testimony to his persevering industry and special enthusiasm.

In 1898 he proposed a resolution in one of our meetings, which was carried unanimously, "That whereas the aborigines of South Australia are rapidly disappearing, it is desirable in the interests of science and of our successors that a comprehensive and enduring record of the Australian race in fullest anthropological and ethnological sense should be undertaken before it is too late." Whenever any paper dealing with this subject was presented for acceptance the Council felt it had in Dr. Stirling an expert to whom it could be submitted for an estimate of its value. It is to his zeal and patriotism that we possess a very large number of valuable and even unique examples of ceremonial ornaments and other rarities which but for his intervention would have been lost, not only to our State, but to our nation.

As recently as 1911 he wrote a lengthy paper entitled "Preliminary Report on the Discovery of Native Remains at Swanport, River Murray, with an Enquiry into the Alleged Occurrence of a Pandemic among the Australian Aboriginals." He intended to discuss later his anthropological findings from examination of the bones and skulls of more than 160 natives obtained from the Swanport burial place, but "art is long, and life is short," and this work is left for some other hand.

He was also a lover of the Australian flora and fauna—an enthusiast in Natural History. The Field Naturalist Section found him ready to assist, as is witnessed by his evening lecture, in 1886, "On the Borderland of the Animal and Vegetable Kingdoms"; also in the appeals of its Flora and Fauna Protection Committee, made time and again to consecutive Governments of the day, for reservation of more or less of the western end of Kangaroo Island, under the name of Flinders Chase, as an asylum or sanctuary for our fast disappearing indigenous animals and plants. Dr. Stirling several times supported its petition by cogent arguments urged in its favour, rendered the more forcible by his well-known scientific standing.

As so recent and for so long a Fellow of the Royal Society of South Australia, we are in duty bound, as we are also glad, to pay a sincere and grateful tribute to his memory for the work he has done and the help he has given. Others than ourselves have during his lifetime been ready to recognize the value of his contributions. The Queen of the Netherlands conferred upon him a gold medal "for science and art" after the National Muesum of Natural History in Leyden, Holland, had been enriched by him. He was made a Fellow of the Royal Geographical Society and a Corresponding Member of the Zoological Society, and above all else, and valued by him beyond bronze or silver or gold decorations, was his title of "Fellow of the Royal Society of London." which stamped his published work with the hall-mark of excellence, and gave him an accredited place among the scientists of the world.

Jos. C. Verco, *President*.

Evening Meeting, April 10, 1919.

Vitality of Seeds.

By Alf. G. Edquist.

[Read November 21, 1918.]

In March, 1918, were commenced a number of experiments for the purpose of finding a practicable way of safely storing grain for lengthy periods against the ravages of rats, mice, weevil, and rain. The object in our investigation was to determine, if possible, that *dry* grain (wheat) could be stored safely in an atmosphere rich in CO_2 or of nitrogen, from harvest to the time of seeding, and even for longer periods, without impairing its vitality or germinating qualities.

The report recently issued by Dr. Hargreaves, of the Chemistry Department, has necessitated the publishing of the following results. We had already been experimenting in this direction, and now have the pleasure of submitting further evidence of the value of the work done by the Department of Chemistry.

Why CO_2 and Nitrogen were chosen.

1. It was recognized that CO_2 gas would quickly asphyxiate any animal life existing in the wheat, and prevent eggs of weevil and other beetles from hatching.
2. Carbonic acid gas is easily and cheaply generated.
3. It can be stored under pressure and safely transported to any part of the State.
4. It is perfectly safe and easily manipulated by any intelligent person.
5. It does not quickly destroy the vitality of *dry* wheat, and therefore might prove a safe medium in which to store seed wheat from harvest time to the time of seeding.
6. Carbonic acid gas is heavier than air, and readily displaces it.

Nitrogen was chosen because it fails to support life, is inert, and readily available without the use of gas-generating apparatus.

Experiment 1. — To prove whether or not dry grain respires.

Method.—A glass tube closed at one end was partly filled with *dry* wheat harvested in 1917. In the open end of this tube was sealed a straight piece of narrow glass tubing. A retort stand supported the apparatus with the open end of the narrow tube immersed in fresh lime-water. Every day the tube containing the wheat was lifted from the lime-water and the contents aerated for a few minutes. The water film which sometimes closed the mouth of the narrow tube was removed with blotting paper, by centrifugal force or by the passage of an air current across the open end of the tube.

Result.—So far as visible evidence was concerned, dry wheat appeared to breathe very slowly or not at all. The grain appeared to be in a state of suspended animation. From the results of other experiments on vitality of seeds, it is definitely known that each kind of seed retains its vitality for a more or less lengthy period, and then dies either from the effects of desiccation or oxidation of the germ plasm. It may be said that a seed stored in a dry condition either dies of thirst or breathes its life away. Some seeds that we have tested lose their vitality at the end of one or two years; others, such as acacia seeds, retain their germinating qualities for years. The seeds of *Goodia latifolia* are credited with having retained vitality for 105 years. Ten years ago Professor A. J. Ewart, of Melbourne, gave me three seeds of *Goodia latifolia* which he said were 101 years old. One of the three was successfully germinated.

Experiment 2.—To demonstrate that germinating grain respires freely.

Method.—The apparatus was arranged and manipulated in every particular as in Experiment 1, the only difference being the condition of the enclosed grain. The wheat used was placed in water at a temperature of 160° Fah. and allowed to cool, and to soak for twenty-four hours, before being enclosed in the glass tube. This treatment caused the grain to germinate rapidly, and probably helped to minimise attacks from moulds.

Result.—The lower end of the narrow glass tubing, which extended below the surface of the lime-water, and into which the lime-water was forced by atmospheric pressure as the oxygen was converted by the wheat into CO_2 gas, became clogged with a white deposit of carbonate of lime. The significance of this result may be stated thus:—The oxygen of the air enclosed with the wheat was slowly absorbed by the germinating grain and converted into CO_2 gas. As fast as the CO_2 was formed it gravitated towards the lime-water and was absorbed with the formation of carbonate of lime.

The inference.—Germinating wheat breathes freely and requires oxygen.

Experiment 3.—To prove that dry grain can be stored in an air-tight receptacle for a considerable period without impairing the vitality or germinating qualities of the grain.

Method.—On March 1, 1918, small quantities of wheat harvested in 1917 were sealed in three glass bottles—A, B, and C, respectively.

Test (1).—At the end of fourteen days the wheat in bottle A was planted on damp soil under a sheet of glass.

Result.—The grain germinated freely.

Test (2).—At the expiration of twenty-eight days the wheat in bottle B was planted on damp soil under glass.

Result.—The grain grew freely.

Test (3).—On September 13, just 196 days after being sealed in bottle C, the grain was planted on damp soil under glass.

Result.—The grain grew freely.

Conclusion.—The result of these three trials, which mark progress in a long series of experiments, goes to show that wheat may be stored in hermetically sealed receptacles for a considerable period without impairing its vitality.

EXPERIMENT 4.—To prove that *dry* grain can be safely stored in an atmosphere rich in CO_2 gas for considerable periods without injury to the vitality of the seed.

Method.—Small quantities of grain harvested in 1917 and having good germinating qualities were placed in three bottles—A, B, and C, respectively. The bottles were charged with CO_2 gas and then sealed. The method of charging the bottles was simple. CO_2 gas, generated in a flask from marble and hydrochloric acid, was introduced by means of a delivery tube passing through the stopper of the bottle. The displaced air passed through a second tube into lime-water. The lime-water was used to test the quality of the air expelled from the bottle containing the grain. When the overflow was rich in CO_2 the bottle was carefully sealed.

Test.—At the end of fourteen days, twenty-eight days, and 196 days, respectively, the grain in the three bottles was tested by planting it on damp earth under glass.

Result, Bottle A.—After immersion for fourten days in air rich in CO_2 gas the grain grew well. It appeared to show more vigour than the untreated grain used in the check experiments.

Result, Bottle B.—The grain grew well after experiencing the effects of CO_2 gas for twenty-eight days.

Result, Bottle C.—At the end of twenty-eight weeks the grain appeared not to have suffered as a result of confinement in air rich in CO_2. The grain germinated freely.

Note.—It will be noticed that the results of germination have not been expressed in percentages. To secure accurate percentage results it would be necessary to duplicate the experiments to an extent impracticable under the circumstances governing work in the laboratory where 225 students are conducting two or three experiments each.

Experiment 5.—To demonstrate that *dry* wheat may be stored for some time in an atmosphere of nitrogen gas without impairing the vitality of the seed.

Method.—Small quantities of wheat harvested in 1917 were placed in three bottles—A, B, and C, respectively. In each bottle were placed two small tubes, one containing lime-water and the other an aqueous solution of pyrogallic acid. The bottles were then carefully sealed. The lime-water absorbed the CO_2, the evidence being the formation of a crust of carbonate of lime within the tube containing the lime-water. The aqueous solution of pyrogallic acid absorbed the oxygen contained in the bottle, evidence of the absorption being the brown discolouration of the otherwise perfectly clear liquid.

Test (1).—The grain from bottle A grew well when planted on damp soil under glass. Immersion in practically pure nitrogen for fourteen days did not seem to produce any bad effects.

Test (2).—At the end of twenty-eight days the grain from bottle B was planted on damp soil under glass. It germinated freely.

Test (3).—Through an accident the bottle was broken and the grain lost before its vitality could be tested. A later experiment demonstrated that *dry* wheat enclosed in an atmosphere of nearly pure nitrogen can retain its vitality for a period of 104 days, but will not survive an immersion in nitrogen for more than 143 days.

Experiment 6.—To demonstrate the behaviour of *wet* grain stored in an air-tight receptacle.

Method.—A small quantity of wheat harvested in 1917 was soaked in water for about twelve hours. It was then drained of free water, and sealed in a bottle having a few layers of wet blotting-paper at the bottom.

Result.—The grain germinated and grew freely until the plumule became about five-eighths of an inch long and the radicle carrying root-hairs had grown to a length of three-quarters of an inch. At this stage of growth further development ceased. No chlorophyll was developed in the plumules, although they were exposed to light. The plants quickly perished.

Experiment 7.—To demonstrate the visible effects of CO_2 on *wet* wheat enclosed in an air-tight receptacle.

Method.—A small quantity of wheat that had been soaked in water for about twelve hours was sealed in a bottle containing CO_2 gas. The method of charging the bottle with CO_2 was the same as that employed in Experiment 4.

Result.—The grain failed to germinate, but swelled to an unusual size before it died.

Inference.—Germinating wheat is asphyxiated by CO_2 because of the absence of chlorophyll in the plumule.

Experiment 8.—To demonstrate the effects of an atmosphere of nitrogen upon *wet* wheat.

Method.—The apparatus and methods employed were similar to those outlined in Experiment 5. In this instance soaked wheat was used instead of dry grain.

Result.—Germination proceeded slightly, just sufficient to show the development of the radicle and plumule. Growth ceased abruptly and the grain died. No chlorophyll was formed in the plumule.

Inference.—Free oxygen is essential to the development of a germinating seed, and also to the development of chlorophyll.

Simple Method of Testing Air-tight Bottles.

Completely immerse the sealed bottle in water that is a little warmer than the atmosphere. The air within the bottle expands, and should the bottle leak, silvery-looking air-bubbles will mark the position of the aperture.

Concluding Remarks.

1. Vermin may be destroyed in properly-enclosed wheat stacks by the use of CO_2 or nitrogen gas without damage to the germinating qualities of the grain.

2. Perfectly ripe, dry grain can be safely stored from harvest time until the time for seeding in an atmosphere rich in CO_2 gas.

3. Excess of CO_2 gas and nitrogen prevents the development of weevil from eggs within a properly-heated stack.

4. Any ordinary barn properly lined with asbestos sheets will serve as a suitable storehouse or gas-envelope.

5. The CO_2 gas can be generated by pouring dilute hydrochloric acid on chips of marble or limestone.

6. The gas should be introduced near the top at one end of the stack, and the outlet pipe for the displaced air should be inserted near the bottom of the stack at the other end.

7. The escaping air should be tested with a little lime-water. When the escaping air causes the lime-water to turn

milky in appearance, sufficient CO_2 for all practical purposes has been introduced.

8. If the inlet and outlet pipes be fitted with stopcocks, the CO_2 gas can be drawn off at any time to permit of entrance to the barn. If both stopcocks be opened the CO_2 gas will drain away through the lower tap.

9. Asbestos-covering to stacks built on stone or concrete floors is suggested, because it is fire-proof, rat and mice-proof, and will withstand heavy knocks which would make holes through softer material. When the asbestos-coverings to stacks have served their purpose, the material could be sold or used for building purposes. Less durable materials are more costly in the long run.

10. Cracks and joints can be made gas-tight with a stiff mixture of finely-ground pipeclay and raw linseed oil.

11. Asbestos sheets can be made in the State from local deposits of the mineral.

Australian Fungi: Notes and Descriptions. No. 2.—The Sclerotia-forming Polypores of Australia.

By J. Burton Cleland, M.D., and Edwin Cheel, Botanical Assistant, Botanic Gardens, Sydney.

[Read April 10, 1919.]

Plates I. to V.

In Australia there seem to be at least three species of stipitate polypores growing from large true sclerotia, and two from large false sclerotia. Of those with true sclerotia, the best known is *Polyporus mylittae*, the "Native Bread." It is characterized by a very large sclerotium, which on section is divided up into alveolar spaces, whilst the fruiting body has a whitish pileus with a centre the colour of a poached egg. The sclerotium of the second species resembles closely that of the former, but is smaller, whilst the pileus is brown. C. G. Lloyd (Mycolog. Notes, No. 39, December, 1915, p. 533, figs. 728-732) has described specimens of this species received from one of us as *Polyporus mylittae*, but we have compared our other examples of it with fruiting bodies obtained from R. T. Baker, described by him (Proc. Linn. Soc. N.S. Wales, vol. xxvii., p. 542, 1902) and deposited in the Technological Museum, Sydney, and the two are apparently distinct species. The sclerotium of the third form is also very large (one weighed 7 lbs.), and resembles the other two, though the exterior differs, and the cut surface does not show any alveolar arrangement. So far we have not obtained fruiting bodies of this.

The forms with false sclerotia have a deeply-situated mycelium which penetrates and surrounds sand and small stones, compacting them together into a mass, at times enormous. One of these is *Laccocephalum basilapiloides*, the "stone-making fungus," and the other is the fruiting body belonging to the mycelial masses referred to by Lloyd when speaking of *Polyporus tumulosus* (Synop. of Sect. Ovinus of Polyp., p. 87).

We have had an opportunity of examining the type of the former in the Herbarium of the University of Adelaide, and find it is closely allied to, but apparently not identical with, a specimen we recently collected that seems to be the latter species. We find from an examination that *L. basilapiloides* does not belong to the section Amaurodermus, as Lloyd, from its description, was led to believe, but probably to the section Ovinus.

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To Mr. J. H. Maiden, I.S.O., F.R.S., of the National Herbarium, Sydney.

To Mr. R. T. Baker, of the Technological Museum, Sydney.

To Professor Sir W. B. Spencer, C.M.G., F.R.S., of the National Museum, Melbourne.

To Messrs. W. Laidlaw, Biologist, and C. C. Brittlebank, Plant Pathologist, of the Department of Agriculture, Science Branch, Melbourne.

To the Board of Governors of the Public Library, Museum, and Art Gallery of South Australia; and to Mr. Edgar R. Waite, Curator of the South Australian Museum.

To Professor T. G. B. Osborn, of the University of Adelaide.

To Mr. A. G. Hamilton, for the photographs in pl. v., figs. 1 and 2.

Polypores with True Sclerotia.

81. *Polyporus mylittae*, Cooke and Massee: Grevillea, vol. xxi., p. 37 (1892).

The subterranean sclerotium, or "tuber," called "Blackfellow's Bread," "Native Bread," or occasionally "Native Truffle," was originally described under the name *Mylitta australis* by Berkeley in 1839. It is also recorded in M. C. Cooke's Handb. of Austr. Fungi, No. 1351, under the latter name. In 1885 H. T. Tisdall discovered some specimens with fructification, and forwarded them to M. C. Cooke, who identified them as a *Polyporus* and named them *P. mylittae* (Gardener's Chronicle, Oct. 29, p. 526, 1892). In 1902 R. T. Baker (Proc. Linn. Soc. N.S. Wales, vol. xxvii., p. 542, pls. xxii. and xxiii. [1902]) exhibited some specimens with sporophores, and gave a detailed description of the same, and also had a coloured drawing made of the fresh specimen, which shows that the pileus is quite velvety and whitish, with more or less egg-yellow on the upper-surface. By his kind permission we are able to reproduce part of his sketch of the fresh specimen. D. McAlpine, Government Vegetable Pathologist of Victoria, in 1893 (The Australian Journal of Pharmacy, Melbourne, viii., p. 291, Sept. 20 [1893], and Journ. Agric., Vict., ii., p. 1012 [figs. i.-v.], 1903), gives a very interesting and complete account of this species, together with photographic figures showing various stages of development. Professor A. J. Ewart (Proc. Roy. Soc. Vict., vol. 24, N.S., p. 59 [1911]), gives an account of some experiments in which he induced some sporophores to develop which measured 5 in. across. As showing the size to which these sclerotia may attain, we may mention that W. H. Breton (Tas. J., ii., p. 463, 1846) refers to a specimen of "Black-fellow's Bread" weighing 25¼ lb. J. H. Maiden (Agric. Gaz., N.S. Wales, iv., p. 909, 1893) states that A. P. Miller, of Hobart, had sent a specimen weighing 39 lb., and that a sclerotium obtained at Bundanoon, in New South Wales, measured 24¼ in. in circumference and weighed 5 lb. 14¾ oz. when fresh. He also mentions another Tasmanian specimen weighing 14 lb. (Tas. Cat., Exhib., 1851).

In the National Herbarium, Sydney, there are quite a number of sclerotia which we believe belong to this species, but so far no sporophores have been forwarded with them. The localities from which these have been received are as follows:—

New South Wales—Wolumba (P. J. O. Poole, November, 1899); Garra, Great Western Railway (J. H. Maiden, 1899); Box Point, Barber's Creek (J. H. Maiden, October, 1905); Burragong (C. Miller, April, 1905); Robertson (P. Williams, May, 1909); Eastwood (C. Lund, July, 1910); Wallangarra (F. Jaeger, September, 1912); Epping (J. Cole, January, 1915); Sassafras, *via* Nowra (R. C. Sturgis, December, 1915); Inverell (T. McDonough, March, 1916). Victoria—*Ex Kryptogamae exsiccatae* (No. 211), Vienna, section only; Upper Ferntree Gully (J. M. Griffiths, March, 1909). Tasmania—Haweah, Bellerive (Miss Murphy, July, 1901).

The following are in the Technological Museum, Sydney:—(1) Sporophore (pl. i.), now quite velvety on pileus and stem, whitish. Pores dirty brownish-white. Sclerotium about 6 in. × 4 in. Its outer-surface irregularly bossed and folded with large brownish flakey crusts weathering to expose a light-brownish, almost white, surface. Cut surface alveolar, walls of alveoli white, polygonal area about 5 mm. in diameter, waxy-yellow.

(2) Another sclerotium is wrinkled with an earthy-brown cuticle, which is thin and peeling off.

The following specimens are in the South Australian Museum, in the portion set apart for exhibiting the foods of the aboriginals:—

(3) Sclerotium when fresh probably about 9 × 6 × 3 in. After arrival at the Museum it began to develop a sporophore. The upper-surface of this abortive fructification is pitted, from the specimen having been lying on perforated zinc. The surface is now dull white with slight brownish stains and finely villous. The pileus is very distorted. Irregular whitish pores have formed. Spores were not seen. Unearthed at the cyanide works of the Tasmanian Tailings Syndicate, Middle Arm Channel, River Tamar, Tasmania. Presented by Mr. Clement Phillipson, 1906 (Mus., No. 182).

(4) An irregular sclerotium, 3 × 4 in. G. F. Thorp, 1899 (Mus., No. 183).

(5) Sclerotium, 4 × 3 × 2 in. Found at Myponga "about 2 ft. underground near a gum tree in wet and sandy soil, 27/7/04. *Advertiser* Office (*vide* Proc. Roy. Soc. S. Aust.)" (Mus., No. 181).

(6) A small distorted sclerotium, 4 in. long. Professor Tate, Victoria (Mus., No. 184).

The following is in the Herbarium of the University of Adelaide:—

(7) Sclerotium apparently about 6 in. across when fresh. About 10 in. below the surface in mallee limestone country, Denial Bay district, South Australia. Presented by Mr. J. W. S. Mann, Saddleworth, South Australia, 15/10/12.

The following are in the Melbourne National Museum:—

(8) A large specimen from Toongabbie.

(9) A specimen from the Pride of Stranger's Mine, Yackindal.

Dr. F. Stoward has found the sclerotium of this species in Western Australia. By his kind permission, we are able to reproduce his excellent photographs of this (pl. ii.).

82. *Polyporus minor-mylittae* (?*Mylitta australis minor*, Berk., in Jour. Linn. Soc. (Bot.), vol. xiii., p. 175 [1873]).

We adopt this name for what we regard as a distinct species, which may be distinguished by the smaller sclerotium and a different coloured sporophore. It has already been recorded by one of us in Proc. Linn. Soc. N.S. Wales, vol. xxxviii., p. 170 (1913), and also by C. G. Lloyd in Letter No. 58, pp. 2 and 5 (1915), Note 269; and Mycol. Notes, No. 39, p. 533 (1915).

"Pileus (pl. iii.) 3-7 cm. across with a sulcate, minutely tomentose surface, raw umber (brown). Flesh usually dry, subligneous, usually in two layers, each 1 to 3 mm. thick, the upper rich cream to light brown, the lower white. Stipe mesopodial, 5-15 mm. thick, 2-6 cm. long. Pores small, roundish or irregular, 2 to 3 mm. long. Spores abundant, cylindrical, $2 \times 6\ \mu$, hyaline, smooth."—Lloyd. We have a fine series of specimens in various stages of development, some showing the sclerotia in the making from less than the size of peas, while other sclerotia are fully developed, varying in size from 2 to 7 cm. in diameter. Some specimens dug up out of the ground at Hill Top in February, 1913, show the formation of several minute sclerotia varying in size from 2×4 mm. to 6×9 mm., attached by whitish rhizomorphs to decaying *Eucalyptus* stumps. The series of specimens show that the spores germinate in moist soil, and that the hyphal strands absorb nutrient matter from decaying stumps, ultimately forming the sclerotia. In other specimens the sclerotia are soft and spongy, and are being exhausted for the purpose of forming the sporophore, as the surrounding soil is traversed by a mass of branching mycelial cords forming an indefinite mesopodial stem surmounted by the cap.

Sporophores, in various stages of development attached to mycelial cords arising from the sclerotia, have been examined from the following localities in New South Wales:—Killara and North Sydney (H. Selkirk, May, 1904, and November, 1905); Hill Top, Main Southern Line (E. C., April, 1912; February, 1913; March, 1914; and February, 1916). There are also specimens of sporophores in the National Herbarium, Sydney, unattached to their sclerotia, from the following localities:—Barber's Creek (J. H. Maiden, December, 1897); Wahroonga (W. Buckingham, July, 1899); Leura (A. A. Hamilton, March, 1910); Glenorie (E. C., February, 1910); Lawson (Miss D. Wiles, communicated by Mr. A. G. Hamilton in June, 1910). Specimens of sclerotia without sporophores are from the following localities:—Bibbenluke (Miss E. Edwards, August, 1899); Bega (Miss M. R. Otton, May, 1905); Hurstville (H. W. Hamilton, June, 1910); Hornsby (P. Williams, April, 1916).

Other Sclerotia.

In addition to the above we have also examined several remarkable sclerotia, but so far their fruiting bodies have not been found. They consist of:—

83. Two very large sclerotia (pl. iii.), somewhat resembling those of *P. mylittae*, found by Mr. W. R. Griffin, of Hurstville, Sydney, in the western suburbs of

Sydney, in the early autumn. The largest of these was roughly spherical, 6×5 in., and weighed 6 lb. 12 oz. The outer-surface was of a reddish-clay colour, irregularly furrowed and finely reticulated. On section there was an outer hard reddish crust, $\frac{1}{4}$ in. thick in places. Inside this the sclerotium consisted of a greyish mycelial mass showing irregular whitish strands in places. Attempts were made to get the sporophores to develop, but a whitish mould-like growth alone appeared.

84. Sclerotia like worm-castings. Specimens of these are in the Botanical Department at the University of Adelaide from W. H. Jackson, Robe, South Australia, September, 1912, and A. Trezize, Robe; and others in the South Australian Museum from Lake Albert (Mus., No. 186). These sclerotia are clay-brown in colour, up to 3 in. long and $\frac{1}{2}$ in. thick, or 2×1 in., and are irregularly ringed and rugose, very closely resembling earthworm casts. The constrictions sometimes cut deeply in, so as to leave adjacent portions attached by a quite narrow neck. The substance is hard, dense, and somewhat translucent white.

85. Irregularly round sclerotia, perhaps forms of No. 84. In the Herbarium of the University of Adelaide from S. H. McMillan, Chemist, Mount Gambier, September, 1912. $\frac{5}{8}$ in. in diameter, somewhat flattened spheroid in shape; slightly rugose, clay coloured, weathering to show a greyish surface. On section hard, the colour of semi-translucent quartz.

86. In the South Australian Museum, in the section devoted to the food of aboriginals, with a label, "Fungus grown on the ground. Eaten by the blacks, Central Australia. Presented by Mr. E. J. Warman" (Mus., No. 185). This sclerotium appears different from any of the others we have seen, but is considerably decayed. It is a somewhat pear-shaped light mycelial mass, splitting and irregularly alveolate, apparently composed of mycelium and reddish sand.

Polypores with False Sclerotia.

87. *Polyporus tumulosus*, Cooke: Grevillea, xvii., p. 55 (1899); Handb. Austr. Fungi, No. 586; Baker: Proc. Linn. Soc. N.S. Wales, xxii., p. 238 (1897); Cheel: *ibid*, xxxviii., p. 171 (1913); Lloyd: Synopsis Sect. Ovinus of *Polyporus*, p. 86 (1911), and Synopsis of Stipitate *Polyporoids*, pp. 67 and 168 (1912).

The following description is given in Cooke's Handbook:—"Pileus fleshy (3-4 in. diameter), firm, convex, clad with darker innate scales, margin at first incurved; flesh white;

stem short, thick, equal (1-2 in. × 1 in.), solid, ochraceous; mycelium profuse, white, forming a dense mass at the base; tubes adnate, or a little decurrent, broad; pores large, unequal, angular, spores 12 × 4·5 μ, pale olive. On the ground, Queensland."

Lloyd *(l.c.)* states that this is known from but one collection made in Australia, and preserved at Kew (England). "It is quite a distinct thing with a pileus resembling in some respects that of *Polyporus betulinus.* It has a soft, white flesh and a thin, papery, smooth cuticle. The stems are short, thick, and mesopodal. They are so covered with adhering dirt that it cannot be told whether or not they belong in the section with black stems. The pores are large, irregular, and apparently have turned black in drying. Spores not found by me." In a footnote in the same work Lloyd further states:—"On the hard, stony ridges about Brisbane, when trenching the land, large masses of mycelium are often met with. Some of the masses would weigh over a hundredweight. From its consistency one might fancy that a quantity of dough had been buried. My idea has always been that it was the mycelium of some *Boletus*" (quotation from Bailey). Lloyd also states:—"Cooke named this plant *tumulosus*, under the impression that it produced these mycelial masses. I cannot see any direct connection between this fungus in the account as published and these mycelial masses, and I think it is not certain that there is any connection."

In the neighbourhood of Penshurst, near Sydney, one of us has found on several occasions large conglomerate masses of mycelium and earth when digging in the garden, which we believe are referable to this species. On one occasion some undeveloped sporophores of a whitish colour, showing a few large irregular pores, were found arising from one of these masses. Mr. R. T. Baker has also recorded *(l.c.)* this species from specimens collected by Mr. W. Bauerlen at Lismore. In March, 1915, a fine sporophore, together with a conglomerate ball of earth and mycelium, was collected at Casino by Mr. D. J. McAuliffe, and forwarded to us through Miss LePlastrier. Mr. J. Lalchere, of Wingham, Manning River, also collected portions of earth and mycelium, similar to the above, in July, 1916. The following two collections, though the pilei have glabrous surfaces, perhaps belong to the same species as the preceding:—

(1) Pileus old and partly decayed, 2 in. across, convex and apparently slightly infundibuliform, smooth, pallid, brownish, with blackish streaks (probably from decay). Pores pallid, much decayed. Stem 5 in. long, buried in the ground

except for about 1 in., about $\frac{3}{4}$ in. thick, slightly irregularly nodular, slightly bent. Attached to a large irregular mycelial mass, several inches long, composed of sandy particles and pieces of sandstone loosely agglomerated by mycelium, apparently confined by a thin reddish-brown crust. Spores white, elongated, shaped like typical *Boletus* spores, $10{\cdot}4 \times 3{\cdot}4$ to 4 μ. Milson Island, Hawkesbury River, March, 1916.

(2) Pileus 2 in. in diameter, convex, smooth, pale brownish. Pores rather large, slightly decurrent, partitions thin, orifice slightly dentate, pale brownish. Stem 1 in. long, under $\frac{1}{2}$ in. thick, roughish, pallid brownish, succeeded by a narrower irregular root $1\frac{1}{4}$ in. long, black on the outside (? from the soil) and white within. In a dry swamp attached to a large circumscribed mass $7 \times 4 \times 3$ in. in size, composed of black sandy soil held together by whitish mycelial threads, but without a crust. Spores elongated, rather like those of *Boletus*, white, 12 to $16{\cdot}5 \times 4{\cdot}2$ to 5 μ. Narrabeen, March, 1916.

The following is a description of the specimen collected at Casino by Mr. D. J. McAuliffe in March, 1915:—Pileus 3 to 4 in. across, more or less velvety tomentose, pallid or cream colour, tending to buff colour with age; margin involute; pores rather large, angular, pallid white. Stem nearly 5 in. long, up to 1 in. thick, the upper part pallid, the lower part more or less covered with mycelial threads and adhering soil. Spores not seen. The false sclerotium sent with the sporophore measured about 3 to 4 in. across.

88. *Polyporus basilapiloides* (McAlp. and Tepper); *Laccocephalum basilapiloides*, McAlp. and Tepper: Proc. Roy. Soc. Vict., vol. vii., (N.S.) p. 166 (pl. x.), 1894; *Polyporus* (section Amaurodermus) *basilapidioides*, Lloyd: Syn. Sect. Ovinus of *Polyporus*, p. 76, 1911, and Syn. Stipitate Polyp., p. 115 (1912).

McAlpine and Tepper described this species and placed it in a new genus *Laccocephalum*. The characteristics of this proposed genus are that the plants are hard and woody from the first, that the pileus is peculiarly pitted, and that the spores are large, spherical, and coloured. On the strength of the lastnamed Lloyd placed the species under the designation *basilapidioides*, in the section Amaurodermus. The spores, however, are white, and not coloured. The plant probably belongs to the section Ovinus, with other species forming true or false sclerotia. Though hard and woody to touch externally, the section of the stem of one of the specimens we examined was, though firm and resistant, velvety to the touch. We would question further, therefore, the generic definition of "hard and woody from the first," believing that growing plants will not be found to possess these characteristics, though the surface of old dried plants, which are most likely to be found, will suggest these qualities. The genus *Laccocephalum* cannot, we feel sure, stand on the pitted surface of the pileus alone. We have examined the type, as well as three other false sclerotia, one with a pileus, in the Herbarium of the University of Adelaide; five complete specimens in the South Australian Museum; another complete specimen and two false sclerotia in the Museum of the Department of Agriculture, Melbourne; and one false sclerotium in the National Herbarium, Sydney. We give descriptions of these in full. It will be noted that two specimens, one in Melbourne and one in Adelaide, differ from the others in having a strongly tuberculate crinkled edge to the pileus; also that, whilst the pitting, or alveolation, is marked in some plants, it is barely recognizable in others.

The following are in the Herbarium of the University of Adelaide:—

(1) Type specimen, labelled "*Laccocephalum basilapiloides.*" Pileus 3½ in. in diameter, convex, rather irregular, the centre a little depressed, dull pallid stony-white, pitted with irregular very shallow alveoli. Pores slightly decurrent, small, the colour of the cap. Stem ⅞ in. high, ⅝ in. thick, pallid brownish-white, slightly flattened. The false sclerotium is somewhat flask-shaped with a flattened base, 3 in. high by 3½ in. broad, the surface somewhat irregularly nodular; it is apparently composed of sandstone particles or sand, welded by a mycelium into a firm mass, which can, however, be disintegrated into particles by scratching with the finger. From South-eastern District of South Australia (A. Molineux).

(2) Pileus 2⅝ in. in diameter, convex, slightly depressed in the centre, slightly fibrillose, no pitting, dirty white with greyish areas from weathering. Pores a little larger than in the type specimen. Stem ½ in. high and ½ in. thick. False sclerotium irregular, somewhat ringed, 2½ in. high, 1½ in. broad. Allawoona, Brown Hill Line, May, 1914 (S. G. Taylor, engineman, Murray Bridge).

(3) and (4) Two false sclerotia; localities not noted.

The following, in the South Australian Museum, have been examined by us:—

(5) Pileus 2 in. across, deeply convex, pallid white from weathering, the surface areolarly pitted in a very shallow way, the alveoli ⅛ in. in diameter, the septa with thin edges. Pores adnate, medium small. Stem ⅝ in. high, ¼ in. across in the middle, expanding a little upwards and downwards. The

false sclerotium $2\frac{1}{2}$ in. high and 2 in. wide. Loxton District, 19/10/14 (Mr. H. R. Parnell, Librarian, Public Library).

(6) Pileus $1\frac{3}{4}$ in. across, with indistinct alveolar markings, and in the centre several irregular pits, pallid white from weathering. Pores adnate, medium size, pallid brownish. Stem $\frac{3}{4}$ in. high, $\frac{1}{4}$ in. thick in the middle, a little thickened upwards and downwards. False sclerotium irregular, $1\frac{1}{2} \times 1\frac{1}{4}$ in., a piece of *Mesembrianthemum* embedded in it. Locality not noted. (Mr. Jas. R. Beck, "Kircaldy," Wyandra.)

(7) This is the freshest specimen we have seen. Cap 2 in. across, convex, edge rather inturned, smooth, rather polished, showing small alveolar depressions, sometimes indicated merely by raised darker lines, irregularly tinted with chestnut to yellow-brown. Pores adnate, medium sized, pallid-biscuit tinted. Stem $\frac{1}{2}$ in. high and $\frac{1}{2}$ in. thick, the colour of the pores, rather sand incrusted, apparently slightly irregularly pitted as if from the presence of aborted pores; flesh of the stem firmish, villous to touch. False sclerotium $1\frac{1}{2}$ in. high, $1\frac{1}{4}$ in. broad, composed of sand bound together by mycelium, easily disintegrated by scratching.

(8) Pileus 5 in. across, with the centre depressed and the rest of the surface nearly plane, the edge consisting of large irregular tuberculate projections marked off by a slight depression from the plane surface of the cap, colour dull white from exposure. Pores rather small. Stem $\frac{3}{4}$ in. high and broad. False sclerotium irregular, 3 in. broad and $1\frac{1}{2}$ in. high. (Presented by Mr. H. E. Ellis, Kensington Park, Adelaide.)

By the kind permission of the Board of the Public Library, Museum, and Art Gallery of South Australia, and the courtesy of the Museum Director, Mr. Edgar R. Waite, we are able to show photographs (pl. iv.) taken under Mr. Waite's supervision of this remarkable specimen. A specimen in the Museum of the Department of Agriculture, Melbourne, closely resembles this one. The alveolar markings on the cap are absent or ill-defined in both.

(9) Pileus 3 in. across, slightly convex and wavy, centre a little depressed, slightly irregularly rugose and shallowly lacunose, smooth, pale brownish. Pores adnate, small, pallid wood colour. Stem $\frac{1}{2}$ in. thick and broad, finely lacunose, pale wood colour. False sclerotium 3 in. high, 4 in. broad, irregular and rather knobby, composed of pallid brownish sandy particles welded together, easily disintegrated by attrition. Spores white, elongated, 12 to $15{\cdot}5 \times 5\ \mu$. Lake Alexandrina, South Australia. (Mr. J. A. Burrough.)

The following are in the Museum of the Department of Agriculture, Melbourne:—

(10) Pileus 4 in. across, slightly convex, edge irregularly crenate, rather alveolate, pallid whitish. Pores adnate, brownish. Stem $\frac{3}{4}$ in. high and broad. False sclerotium 4 in. high, 3 in. broad, outer crust hard, the inside capable of being scratched away. Locality not stated.

(11) Pileus 2 in. across, glazed whitish with fine anastomosing lines. Pores adnate, pale brownish. Stem $\frac{3}{4}$ in. high, $\frac{1}{2}$ in. broad, brownish, finely areolate. False sclerotium 2 in. high, $\frac{1}{2}$ in. broad.

(12) Three small false sclerotia, all from the mallee, Victoria.

The following is in the Melbourne National Museum:—

(13) "Mallee Potato." Sand held together by fungous threads; ploughed up at Nyall mallee; forwarded by Mr. Thomas J. Jenkins, 21/6/11.

The following is in the National Herbarium, Sydney:—

(14) One false sclerotium, somewhat bottle-gourd shaped, about the size of a child's head, with the neck part cut through by a ploughshare. The outer crust consists of rusty-coloured particles of sand bound together, the inner part of whitish mycelial strands and earthy and sandy matter welded together, of a similar colour and somewhat resembling cement. Forwarded from Rappville by Mr. A. Spedding through Mr. G. Marks, manager of the Grafton Experiment Farm. Mr. Marks reported that these false sclerotia are usually found in sandy soil at a depth of 4 to 6 in. They are brought up to the surface during the ploughing operations, and when first unearthed the specimens are somewhat soft, but harden upon exposure to the weather. Other false sclerotia have been found near Grafton and at Casino. Similar specimens were submitted to the Chemical Branch, Department of Agriculture, and the following is a copy of a report made by Dr. H. I. Jensen:—"The specimen of stone-making fungus was found to contain only 7·2 per cent. of organic and volatile matter, the balance being earth. On ignition the material first blackens, and then gives off heavy organic fumes with a disagreeable smell like burning bones and rags. On the destruction of all the organic matter, a pinkish-yellow earth remains. The specimen contains no carbonates of lime or iron, the cementing material seeming to be essentially fibres of organic matter. The exterior has a sandy crust, in which rather more oxide of iron has been deposited than in the more organic core."

89. In these Proceedings (vol. xlii., 1918, p. 297) Mr. Walter Howchin, on behalf of the Museum Director, exhibited and described a sand-cementing false sclerotium obtained near Balaklava by the Rev. J. Blacket. To make this series complete, by the kind permission of the Board of the Public Library, Museum, and Art Gallery of South Australia, and the courtesy of the Museum Director, Mr. Edgar R. Waite, we are able to reproduce an excellent photograph of this specimen (fig. 3, pl. v.).

DESCRIPTION OF PLATES I. TO V.

PLATE I.

Fig. 1. *Polyporus mylittae.* Reproduction of part of a water-colour sketch, made by Mr. R. T. Baker, of the sporophore described by him. Reduced by half.

Fig. 2. *Polyporus minor-mylittae.* Water-colour sketch by Miss P. Clarke. Natural size.

PLATE II.

Figs. 1 and 2. *Polyporus mylittae.* Photographs of the sclerotium of a Western Australian specimen, reproduced by kind permission of Dr. F. Stoward. Measurements in inches.

PLATE III.

Figs. 1 and 2. Photographs of one of the sclerotia described under 83. Measurements in inches.

PLATE IV.

Figs. 1 and 2. *Polyporus (Laccocephalum) basilapiloides.* Reproduced by kind permission of the Board of the Public Library, Museum, and Art Gallery of South Australia.

PLATE V.

Fig. 1. *Polyporus minor-mylittae.* Sporophores just forming.

Fig. 2. *Polyporus minor-mylittae.* Sporophore partly developed, showing partial absorption of the sclerotium at the base.

Fig. 3. Photograph of the false sclerotium referred to under 89. Reproduced by kind permission of the Board of the Public Library, Museum, and Art Gallery of South Australia.

Fig. 2.

Phyllis F. Clarke.

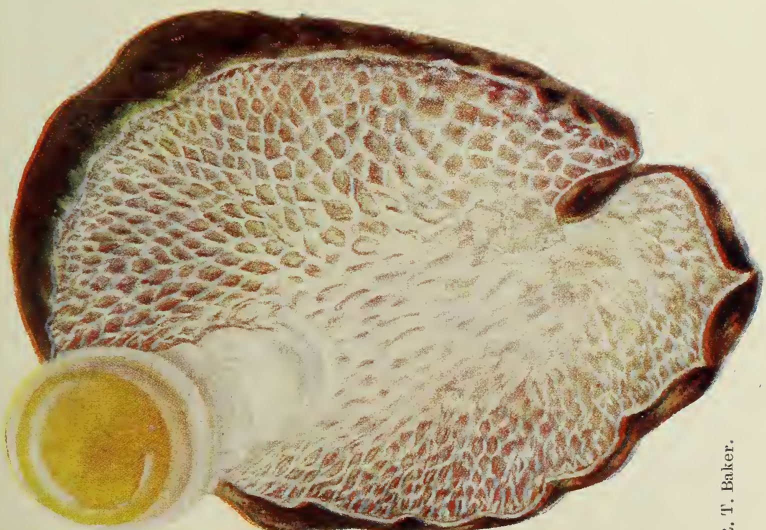

Fig. 1.

R. T. Baker.

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO AUS.

Fig. 1.

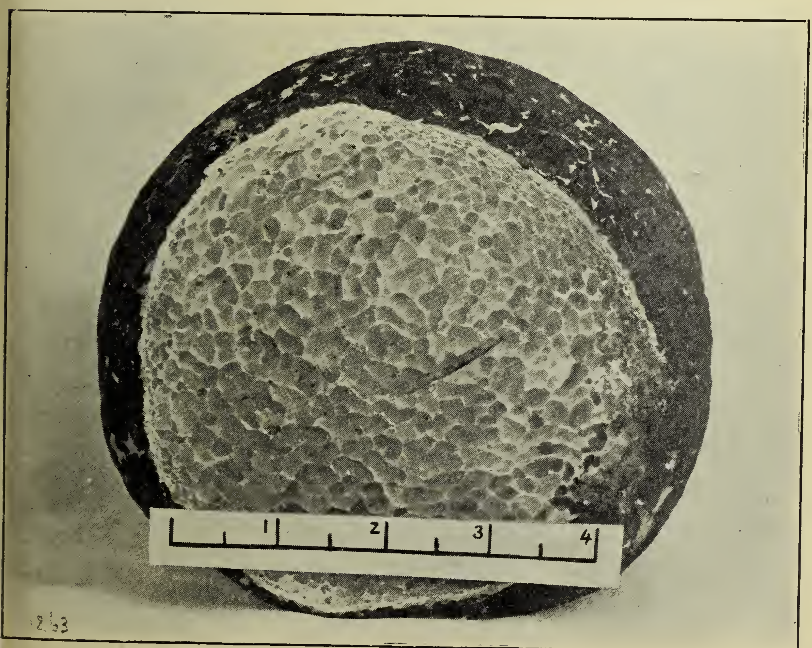

Fig. 2.

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO. AUS.

Fig. 1.

Fig. 2.

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO. AUS.

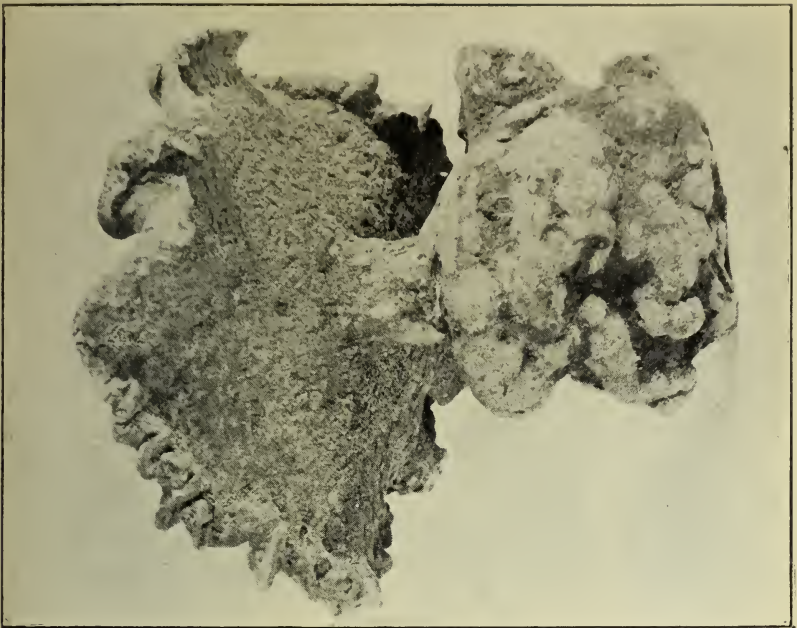

Fig. 2.

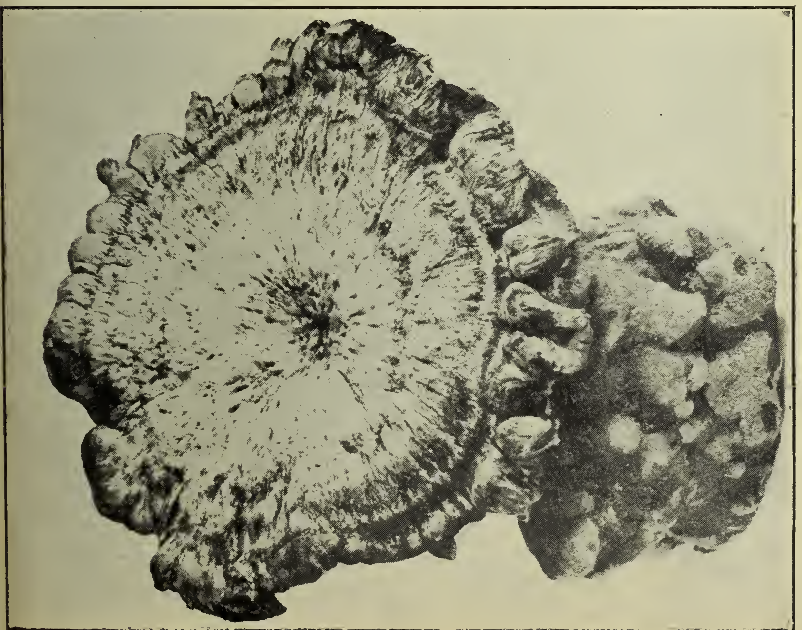

Fig. 1.

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO AUS.

Fig. 3.

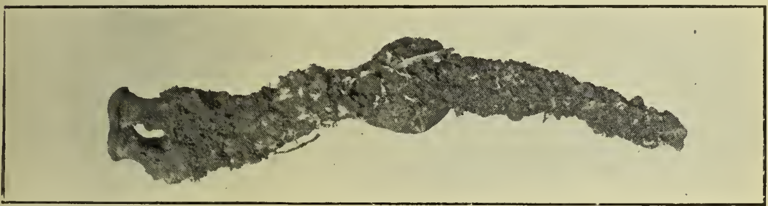

Fig. 1.

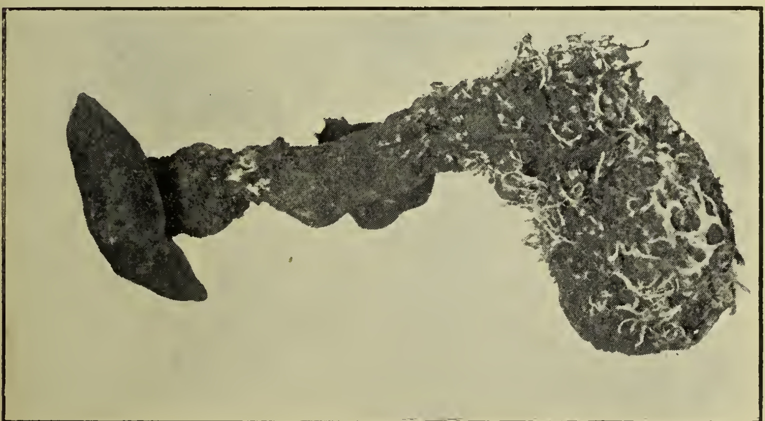

Fig. 2.

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO. AUS.

Additions to the Flora of South Australia. No. 15.

By J. M. Black.

[Read May 8, 1919.]

Plates VI. to VIII.

This paper contains notes on specimens collected by Mr. E. H. Ising in the Flinders Range, near Moolooloo head station, from September 30 to October 11, 1918; by Dr. W. A. Cannon in our Far North during last winter; by Capt. S. A. White, Mr. H. W. Andrew, and others in various parts of the State; and by myself during an excursion along the Pinnaroo railway in October last.

Three species believed to be new to science—*Kochia Cannonii*, *Pimelea Williamsonii*, and *Goodenia vernicosa*—are described and figured. A new variety of *Hibbertia virgata* is described, and an effort has been made to arrange the South Australian species of *Calamagrostis* and *Microcybe*.

The following Australian species are recorded for the first time in this State:—*Loranthus miraculosus*, *Microcybe multiflora*, *Stipa arachnopus*, *Dodonaea cuneata*, *Marsilia hirsuta*, *Goodenia Nicholsonii*, *Eucalyptus Morrisii*, *Calamagrostis minor*.

The following new aliens are recorded:—*Gastridium lendigerum*, *Eragrostis major*, *Ehrharta villosa*, *Chenopodium Vulvaria*, *Anacyclus radiatus*.

Marsiliaceae.

Marsilia hirsuta, R.Br. Pinnaroo; growing in marshy ground. Not previously recorded for South Australia. Leaflets 4-6 mm. long, more or less villous below; involucres villous, sessile or almost so.

Pinaceae.

Callitris verrucosa, R. Br. Yumali (S. A. White); scrub south of Lameroo. A shrub or small tree, often under 2 m. high. Near Ooldea (W. A. Cannon).

C. robusta, R. Br. Common near Lameroo; a tree 4-6 m. high, usually with the stem bare up to about 3 m., the branches then spreading so as to form an ovoid head. Enfield, with the cones sometimes slightly warted.

C. propinqua, R. Br. In the "Pinery," on the road from Lameroo to Winnike Berick. A good-sized tree, the branches often springing not far from the ground. The fruits vary in size on the same tree, and can sometimes be found scarcely larger than those of *C. robusta.*

Gramineae.

Eriochloa punctata, (L.)., Hamilt. Frome River near Marree (Hergott).

Pappophorum avenaceum, Lindl. Common at Marree.

Eragrostis falcata, Gaud. non Benth. (*E. lacunaria*, F. v. M.). Berri, Lake Bonney, and other places along the Murray; Everard Range (S. A. White). Plate 25, which accompanies Gaudichaud's description of *E. falcata*, and which shows the spikelets distinctly pedicellate, rather distant, and not clustered, supports the statement in Diels et Pritzel, Fragm. phyt. Austr. occ. 76, that the original specimen of Gaudichaud's plant, preserved in the Berlin Herbarium, belongs to the species described in the Fl. Aust., vii., 649, as *E. lacunaria*, F. v. M.

E. Dielsii, Pilger. (*E. falcata*, Benth. non Gaud.). Berri and along the Murray; Marree; Oodnadatta; Mulka (R. Cockburn); Strzelecki Creek (S. A. White); also Broken Hill, N.S.W. Stems stouter than in *E. falcata*, Gaud., and spikelets more curved.

**E. major*, Host. Roadside near Berri (C. G. Savage). This European grass has already been recorded in Victoria and New South Wales. It is said that cattle will not eat it on account of the obnoxious smell of the leaves when fresh, and in North America it is known as "Stinking grass." In 1912 (these Trans., xxxvi., 172) I recorded the occurrence of **E. minor*, Host., at Alice Springs, N.T., and Broken Hill, N.S.W., so that it probably occurs in our north-eastern country, although I have no specimens from South Australia. These two grasses resemble each other, both having a row of glands or tubercles along the margins of the leaf-blade, but *E. minor* is a smaller plant, with a looser panicle, narrower spikelets ($1\frac{1}{2}$-2 mm. broad), and the leaf-sheath is sprinkled with tubercles, many of which carry long hairs. *E. major* has glabrous sheaths, and the spikelets are 3 mm. broad.

Rottboellia compressa, L. f. (*Hemarthria compressa*, R. Br.). Bridgewater (H. W. Andrew); beside River Onkaparinga, Woodside. The sessile spikelet is 8-9 mm. long, and has only 1 stiff, green outer glume, the 2 inner glumes being hyaline, with a short palea in the uppermost one. The pedicellate spikelet is 10 mm. long, has 2 stiff outer glumes, 2 hyaline inner ones, and a palea. It therefore appears probable that the second outer glume of the sessile spikelet exists, but is adnate to, and obliterated in the rhachis, as described by Kunth (Enum., i., 464). All the pedicellate spikelets which I examined contained a bisexual flower, the same as the sessile ones.

Stipa arachnopus, Pilger in Engl. Jahrb., xxxv., 70 (1904). Nullabor Plain (per Dr. R. S. Rogers); Peterborough; Enfield; Pinnaroo. Our specimens seem to me to agree with the description in all particulars except that the awn varies in length from 3½ to 7 cm. The numerous young shoots in the tuft consist of subulate, rigid, almost pungent-pointed leaves, hispid with spreading hairs. From among these arise the nodeless stems to a height of 30-40 cm., including a panicle 15-20 cm. long; the long uppermost leaf-sheath, which has a subulate blade much shorter than the sheath, usually clasps the base of the panicle; the awn is distinctly hairy in the lower part. If the determination is correct, this is the first record for South Australia of this Western Australian grass.

Agropyrum scabrum, (Labill.), Beauv. Ferguson Gorge, near Moolooloo (Dist. S; E. H. Ising).

Stipa scelerata, Behr. Scrub at Enfield (Dist. A).

Danthonia penicillata, (Labill.) F. v. M. Pinnaroo (Dist. M).

Panicum leucophaeum, H. B. et K. Golden Grove (Dist. A; H. W. Andrew). Probably introduced by stock from some northern part of the State.

**Ehrharta longiflora*, Sm. Moolooloo (E. H. Ising).

**Phalaris paradoxa*, L. Railway reservoir, Hindmarsh Valley (H. W. Andrew). First record for the mainland; previously found on Kangaroo Island.

**Alopecurus pratensis*, L. Tantanoola (H. W. Andrew). Growing in crops as high as the wheat and oats.

**Gastridium lendigerum*, (L.) Gaudin. Black Forrest; Hindmarsh Valley; roadside north of Port Elliot (H. W. Andrew); Wirrabara (Tate Herbarium); Mount Barker; Myponga; Cummins, E.P. Called in England "Nitgrass." First record for South Australia and, as far as I know, for Australia, but must have existed in our State for many years, as I first collected it at Mount Barker in 1903, and the specimen from Wirrabara in the Tate Herbarium (placed without date under *Calamagrostis quadriseta)* must have been gathered several years earlier. This grass bears considerable resemblance to the native *C. quadriseta*, but the panicle is denser, spike-like, and silvery-shining, at least after flowering; the outer glumes are swollen and shining at the base, the lower one 5-6 mm. long and slightly incurved. A native of Southern and Western Europe, and introduced in Texas, California, and Chili.

**Ehrharta villosa*, Schult. f., var. *maxima*, Stapf. Sand dunes south of Glenelg (S. Dixon); Clarendon; Streaky Bay, E.P. (per H. W. Andrew). A valuable sand-binding grass; flowers October-November. Introduced to the State in recent years, and has established itself in several places. The identification was confirmed by the Kew authorities. A native of South Africa.

South Australian Species of Calamagrostis.

Panicle loose; bristle present.	
Flowering glume hairy, half as long as the outer glumes; awn attached near middle of flowering glume	*C. aemula*
Flowering and outer glumes longer, the flowering glume glabrous; awn attached below middle; maritime grass	var. *Billardieri*
Panicle dense or slightly lobed; flowering glume nearly as long as outer glumes.	
Awn almost basal.	
Bristle absent	*C. quadriseta*
Bristle present	var. *montana*
Awn attached near middle of flowering glume.	
Bristle absent	*C. minor*
Bristle present	var. *densa*

The arguments for uniting *Deyeuxia* with *Calamagrostis* are fortified by the character of our Australian species. These are all distinguished from *Agrostis* by the conspicuous tuft of hairs on the callus of the flowering glume (rhachilla, or axis of the spikelet), but some of them have a hairy bristle (pedicel of an obsolete second flower) rising at the base of the palea and continuing the rhachilla *(Deyeuxia)*, while others have no such bristle *(Calamagrostis)*. The remaining differences, however, are not such as would justify a classification under distinct genera, or even, in many instances, under distinct species. In our plants the other differences appear to me to be sometimes so slight as to be merely varietal.

Calamagrostis quadriseta, (Labill.) Spreng. *(Deyeuxia quadriseta*, Benth.) Mount Lofty; Aldgate; Belair; Bridgewater; Clarendon; Myponga; Cygnet River, K.I.; Wilpena Pound (the last two from the Tate Herbarium). Grass 50-120 cm. high; panicle 5-13 cm. long, compact but usually somewhat lobed; outer glumes keeled, subequal, $3\frac{1}{2}$-5 mm. long; flowering glume $2\frac{1}{4}$-4 mm. long, 4-toothed, narrow, minutely scabrous; awn almost basal, usually shortly exserted, but sometimes included; tuft of hairs more or less surrounding the callus; grain fusiform, 2 mm. long, the membranous pericarp loose toward the summit; hilum shortly linear.

Var. *montana*, Ewart. *(Deyeuxia montana*, Benth.) I have only inserted this variety because Bentham gives it for

"Lofty and Bugle Ranges, *F. Mueller*," in Fl. Aust., vii., 581. I have not been able to find any specimen bearing the bristle, either in my own collection or in the Tate or Menzel Herbaria. Professor Ewart, in reducing *D. montana* to a variety of *D. quadriseta*, says (Vict. Nat., xxiv., 13), "These species are both very variable and run into one another at all points."

C. minor (Benth.) combin. nov. *(Deyeuxia minor*, Benth.). A new record for South Australia. I have only one specimen, collected at Mount Lofty in December, 1908, by H. Griffith. A slender grass; panicle 4 cm. long, slightly lobed; outer glumes broad, subequal, the lower 4 mm. long, the upper one a litle longer; flowering glume broad, 3 mm. long, 4-toothed, scabrous, especially on the nerves; awn attached near the middle of the flowering glume and shortly exserted, hairs of the callus rather long, especially behind the palea, but no bristle. Our specimen agrees with one from Southport, Tasmania, kindly given me by Professor Ewart.

Var. *densa*, (Benth.) combin. nov. *(Deyeuxia densa*, Benth.). Blackwood (H. Griffith); Crafers (Tate Herbarium); quoted in the Fl. Aust., vii., 582, for "Lofty Ranges and Onkaparinga, *F. Mueller*." Bentham describes the panicle as "dense and spike-like or slightly lobed, 2 to 3 in. long." A specimen without locality lent me by Prof. Ewart has the panicle 5 cm. long and rather dense, but our own specimens have a longer and more lobed panicle, 8-16 cm. in length. Outer glumes subequal, $4\frac{1}{2}$-5 mm. long; flowering glume rather narrow, scabrous, $3\frac{1}{2}$-4 mm. long, the awn attached a little above the middle and shortly exserted; the bristle hairy and half as long as the palea; grain fusiform, 2 mm. long. The 4 teeth of the flowering glume are less conspicuous in the Tasmanian specimen than in ours. If it were proposed to retain this grass as a species in *Calamagrostis*, a new specific name would apparently be required, because *C. densa*, Vasey in Coult. Bot. Gaz., xvi., 147 (1891), a Californian grass, would be able to claim priority over *C. densa* (Benth.) Maiden et Betche, Cens. N.S. Wales, pl. 21 (1916).

Cyperaceae.

Carex Bichenoviana, Boott. Paradise (H. W. Andrew). Style-branches sometimes 2 instead of 3. Mr. R. A. Black records (Proc. Roy. Soc. Tas., 1916, p. 145) the re-discovery of this plant in a damp situation on Mount Direction, near Hobart.

Cyperus tenellus, L. Monbulla scrub, S.E. (Dist. T; H. W. Andrew).

Carex tereticaulis, F. v. M. Ferguson Gorge, near Moolooloo (E. H. Ising). Approaching *C. chlorantha*, R. Br., in its short panicle (5 cm. long), spike-like but interrupted towards the base, and tending towards *C. appressa*, R. Br., in its subtrigonous stems and leaves scabrous on the margin in the narrow upper portion.

Centrolepidaceae.

Centrolepis polygyna, Hieron. Soak at Winnike Berick, south of Lameroo.

Juncaceae.

Juncus holoschoenus, R. Br. Monbulla scrub (H. W. Andrew); Dismal Swamp, S.E.; Waterfall Gully; Myponga. Our specimens agree with Brown's characters—stem cylindrical or nearly so; stamens 6; capsule equalling the perianth; also with Buchenau's character of the complete septa in the leaves. The plants from Monbulla and Dismal Swamp are dwarf. It appears doubtful whether we possess *J. prismatocarpus*, R. Br., in South Australia. All the specimens so named in the Tate Herbarium (from Waterfall Gully, Reedbeds, Mannum, Wirrabara, and Wilpena) are *J. holoschoenus*.

J. pallidus, R. Br. Banks of Torrens Lake; Waterfall Gully; Slape Gully; Myponga; Nuriootpa; Woodside; Mount Gambier; Glencoe; Dismal Swamp. This species, as correctly defined, has always 6 stamens; capsule 3-4 mm. long, pale coloured and usually exceeding the perianth considerably; stems stout, with continuous pith.

Liliaceae.

Thysanotus Patersonii, R. Br. Pinnaroo (Dist. M).

Casuarinaceae.

Casuarina Luehmannii, R. T. Baker. "Bull Oak." Few miles south of Lameroo. Tree 8-10 m. high, with rough, brown bark; lowest branches drooping, uppermost spreading-erect; trunk usually without branches for 2 m. above the ground; internodes to 20 mm. long; young cones tomentose.

C. lepidophloia, F. v. M. Oodnadatta (Dist. C); W. A. Cannon); sheathing teeth 9-11. Willigin Water, near Moolooloo (E. H. Ising); teeth 11-12. *C. lepidophloia* was described by F. v. Mueller in 1877; Bentham, in dealing with this genus in 1873 (Fl. Aust., vi., 196), placed specimens of *C. lepidophloia* under *C. glauca*, Sieb. Mueller distinguishes the former species as having 9-10 sheathing teeth; *C. glauca*, as now understood, "having usually 15 in the whorl, varying from 12-16" (J. H. Maiden, For. Fl. N.S. Wales, ii., 95). Mr. Maiden is of opinion that *C. glauca* has not yet been found in South Australia, but a specimen without fruit, which I collected in the Yappala Hills, near Hawker, from trees locally called "Black Oak," has the branchlets fully 2 mm. in diameter and 14-16 teeth. Unfortunately I have no note as to the bark. The branchlets of our northern specimens of *C. lepidophloia* are greyish or hoary with a minute pubescence, 1-1½ mm. in diameter, and readily separating at the nodes; the cones vary from subglobular to oblong, 15-25 mm. in length and 15-20 mm. in diameter, the valves in 8-9 rows.

C. suberosa, Otto et Dietr. Lameroo. Sheathing teeth 5-6, short and appressed; male spikes 1-4 cm. long.

PROTEACEAE.

Hakea ulicina, R. Br., var. *flexilis*, F. v. M. South of Lameroo.

H. Ednieana, Tate. Witcher Well, near Moolooloo (E. H. Ising).

Grevillea aspera, R. Br. Mount Patawurta (Dist. S; E. H. Ising).

Adenanthos terminalis, Labill. Coonalpyn. (Dist. T; H. W. Andrew).

LORANTHACEAE.

Loranthus miraculosus, Miq. (*L. pendulus*, Sieb., var. *parviflorus*, Benth.). Robe (S. A. White); Port Vincent Y.P. (growing on *Melaleuca parviflora);* Ooldea (S. A. White). Leaves 1-6 cm. long, thick, nerveless, oblanceolate; the central flower in each partial cyme is sessile; corolla 15-20 mm. long.

SANTALACEAE.

Exocarpus spartea, R. Br. Scrub at Enfield; Murray Scrub; 90-Mile Desert. An erect broom-like shrub, usually 3-4 m. high, the ultimate branches drooping; pedicels at first cylindrical, thick and green, then remaining unchanged or swelling until they are globular, succulent, whitish, and as large as, or larger, than the fruit; fruit ovoid, 4-5 mm. long, at first green, but when ripe becoming orange or a rich brown.

POLYGONACEAE.

Muehlenbeckia stenophylla, F. v. M. Common in the Trans-Murray scrub at Karoonda, Lameroo, and Pinnaroo.

CHENOPODIACEAE.

Kochia Cannonii, *nov. sp. (tab. vi.). Fruticulus sericeo-tomentosus, ramis di-trichotomis, foliis aut omnino aut fere oppositis oblongis crassis obtuse trigonis 7-8 mm. longis 2-3 mm. latis apice acutis et recurvis vel fere uncinatis, floribus* *axillaribus, perianthio fructifero depresso, tubo brevissimo, lobis latis planiusculis pubescentibus alâ integrâ annulari membranaceâ horizontali 5-6 mm. diam. circumdatis.*

Plain west of Leigh Creek (Copley) railway sation (W. A. Cannon); near Port Augusta (Tate Herbarium); Telowie.

This species has the succulent, trigonous, subopposite leaves of *K. oppositifolia*, F. v. M., but they are longer and recurved or almost hooked at the summit, while the horizontal wing of the fruiting perianth is entire, and resembles that of some of the small-fruited forms of *K. villosa*, Lindl. Dedicated to Dr. W. A. Cannon, of the Carnegie Institution of Washington (Department of Botanical Research), who visited South Australia in 1918 to study the root-systems of our dry-country plants. He brought from Leigh Creek fruiting specimens of this *Kochia*, and on looking through my herbarium I found a similar specimen, without fruits, which I gathered in the Hundred of Telowie, near the coast, in 1906, and placed tentatively with *K. oppositifolia*. The Tate Herbarium contains, similarly placed, a specimen with 2 fruits, collected near Port Augusta.

K. eriantha, F. v. M. Leigh Creek (W. A. Cannon).

K. planifolia, F. v. M. Leigh Creek (W. A. Cannon). Leaves to 14 mm. long and appearing flat when dried, but when fresh I have found them rather cigar-shaped and very slightly compressed. They differ from those of *K. sedifolia* in being shortly, but distinctly, petiolate.

Chenopodium microphyllum, F. v. M. Mount Patawurta (Dist. S; E. H. Ising).

**Chenopodium Vulvaria*, L. "Stinking Goosefoot." Tantanoola District, 1918; growing in gardens and among potato crops (H. W. Andrew). This European weed, distinguished by its unpleasant and persistant smell of stale fish, has not previously been recorded for South Australia. It seems to be a somewhat recent introduction to Australia. According to Prof. Ewart (Weeds, etc., of Vict., 75) it was first recorded for that State in 1908; C. Moore does not mention it in his Fl. N.S. Wales (1893), or F. M. Bailey in his Weeds, etc., of Queensland (1906).

PHYTOLACCACEAE.

Codonocarpus pyramidalis, F. v. M. Ferguson Gorge, near Moolooloo (E. H. Ising). Fruits ripe (October 9). "A tree 5 m. high, with straight, smooth trunk; branches horizontal."

NYCTAGINACEAE.

Boerhaavia repanda, Willd. Parachilna Gap (E. H. Ising).

Caryophyllaceae.

Scleranthus minusculus, F. v. M. Pinnaroo. This little plant, although well protected by its pungent leaves and calyx-lobes, appears to be rather rare. I only found one specimen. It has previously been recorded from Murray Bridge.

S. pungens, R. Br. Moolooloo (Dist. S; E. H. Ising).

**Moenchia erecta*, Gaertn. Blackheath, near Harrogate (H. W. Andrew). Already recorded from the South-East.

**Lychnis alba*, Mill. (*L. vespertina*, Sibth.). "White Campion." Headlands of experimental plots at Cromolite, on the South Australian portion of the railway from Mount Gambier to Portland. Recorded as a weed for Victoria, but not previously observed in this State.

**Silene venosa* (Gilib.), Aschers. "Bladder Campion." North Park Lands; fields near Enfield, as well as in the hills. The principal synonyms of this species are:—

Cucubalus Behen, L. Sp. pl. 414 (1753).
C. latifolius, Mill. Gard. Dict., ed. 8, n. 2 (1768).
C. venosus, Gilibert. Fl. lituan., ii., 165 (circa 1782).
Behen vulgaris, Moench. Meth. 709 (1794).
Cucubalus inflatus, Salisb. Prodr. 302 (1796).
Silene Cucubalus, Wib. Prim. fl. werth. 241 (1799).
S. inflata, Sm. Fl. brit. ii. 467 (1800).
S. Behen, Wirzén. Enum. pl. offic. Fenn. 36.
S. venosa, Aschers. Fl. Brandenb. i. 86 (864).
S. vulgaris, Garcke. Fl. Deutschl., ed. 9, 64 (1869).
S. latifolia, Britten et Rendle. List Brit. seedpl. 5 (1907).

It is clear that when this species is transferred from *Cucubalus* to *Silene* the correct combination would be *S. Behen*, were it not that this name had been already adopted for another species by Linnaeus (Sp. pl. 418). Neither is *S. latifolia*, Britten et Rendle, admissible, because a distinct North African species had already received this name from Poiret (Voy. Barb., ii., 165). Therefore Ascherson's combination appears to be the correct one.

Ranunculaceae.

**Ranunculus trachycarpus*, Fisch. et Mey. Common in water at Murray Bridge. This species seems scarcely to differ from *R. sardous*, Crantz, except in the somewhat straighter and thicker beak of the carpel, and it should perhaps be treated, as Fiori does in his Flora analitica d'Italia, as a variety of that species. The beaks in some of our specimens are often slightly curved.

**Adonis autumnalis*, L. "Pheasant's eye." Near Blyth; a few specimens; apparently localized.—Europe and Western Asia.

LAURACEAE.

Cassytha melantha, R. Br. Mount Patawurta, near Moolooloo (Dist. S; E. H. Ising).

CRUCIFERAE.

**Coronopus didymus*, (L.) Sm. (*Senebiera didyma*, Pers.; *S. pinnatifida*, DC.). Common at Murray Bridge and Bordertown.

**C. procumbens*, Gilib. (*Senebiera Coronopus*, Poir.). Growing luxuriantly at Naracoorte and Penola (H. W. Andrew).

Lepidium hyssopifolium, Desv. Morgan (B. Beck); Pinnaroo.

DROSERACEAE.

Drosera Menziesii, R. Br. Yumali (Dist. T; S. A. White).

CRASSULACEAE.

Crassula bonariensis, (DC.) Cambess. (*Tillaea peduncularis*, Sm.; *T. purpurata*, Hook. f.). Soak at Winnike Berick, about 10 miles south of Lameroo (Dist. M). Carpels 8-13-seeded.

C. Sieberiana, (Schult.) Ostenf. Contrib. W.A. Bot., ii., 44 (1918). (*Tillaea Sieberiana*, Schult.) Pinnaroo; Moolooloo (E. H. Ising).

LEGUMINOSAE.

Acacia spinescens, Benth. Yumali (Dist. T; S. A. White).

A. tarculensis, J. M. Black. Tarcoola (W. A. Cannon). Locally called "Steel bush," from the greyish or glaucous appearance of the leaves; pods still unripe (September 6, 1918), thick but flat, 30-35 mm. long, 5 mm. broad, silky-pubescent.

A. brachystachya, Benth. Near Leigh Creek (Dist. S; W. A. Cannon).

A. sublunata, Benth. Hills five miles north of Quorn (W. A. Cannon, July, 1918). Mueller considered that his *A. parvifolia* was a species distinct from *A. sublunata*; Bentham (Fl. Aust., ii., 378) united them. Tate recorded both species (Fl. Extra-trop. S.A., 75), but his herbarium contains no specimen of either. Dr. Cannon's specimen (the only one I have seen) has no flowers except a few dry ones hanging round the branch. Many detached bracteoles are also present; they are membranous, very concave, almost semi-globular, and must enfold the flowers to a degree not usual in

Acacia. They are quite obtuse and show no points, at least at this advanced stage; in this respect they agree with the description of *A. parvifolia*, but the peduncles of the unripe, spirally-twisted pods are almost as long as the leaf, which scarcely conforms to Mueller's "capitulis subsessilibus vel breviter pedunculatis." As the only distinction between the two descriptions lies in the shape of the bracteoles, the length of the peduncles, and the density of the indumentum, it appears safer, at least until we have further material, to follow Bentham in treating them as forms of one species. This plant, which was found growing with *A. calamifolia*, seems rare or localized. The types of *A. sublunata* and *parvifolia* both came from South Australia.

A. pycnantha, Benth. Scrub south of Lameroo (Dist. M).

A. microcarpa, F. v. M. Scrub near Lameroo, Pinnaroo, and Jabuk. A low shrub with several stems rising from the ground-level or even below it; branches diffuse. The tallest plants were not more than 1 m. high, and some were only half that height. The phyllodial gland is usually present at a considerable distance from the base.

A. brachybotrya, Benth. Pinnaroo. A low shrub; branchlets, phyllodes, and peduncles beset with spreading but not silvery hairs, those on the phyllodes falling off with age; calyx obtusely lobed, half as long as the petals, which are pubescent in the upper part, especially along the midnerve, and separate readily.

A. rivalis, J. M. Black. Willigin Water, near Moolooloo (E. H. Ising). Towards the summit of the branchlets the inflorescence is often racemose, each peduncle having only 2 minute stipular bracts at its base.

A. Oswaldii, F. v. M. Mount Patawurta (Dist. S; E. H. Ising).

Templetonia Battii, F. v. M. Fowler Bay, summer, 1879 (Tate Herbarium). Originally described by Mueller in the Melb. Chemist, n.s., ii., 31 (1887), and quoted for Western Australia and South Australia in the 2nd Census (1889). The specimen in the Tate Herbarium is labelled "*Bossiaea Battii*"; this has been struck out and "*Templetonia Battii*" substituted. In his Flora of Extra-tropical South Australia, 65 (1890), Professor Tate described the plant very shortly as *Bossiaea Battii*, Tate. The specimen in the Tate Herbarium, which is presumably a co-type, is certainly a *Templetonia*, the anthers being alternately long and short, the long anthers basifixed and the short ones dorsifixed. The plant has the habit of *T. aculeata*, Benth., but appears to be quite leafless. In the small flowers, the almost orbicular bracteoles, the glabrous calyx with the lowest lobe longer than the others, it resembles *T. egena*, Benth., but the broad, flat style differentiates it from this and probably from all other *Templetonias*.

Dillwynia uncinata, (Turcz.) J. M. Black. Scrub south of Lameroo.

Pultenaea tenuifolia, R. Br.. Specimens from Robe have the calyx 3½ mm. long and the standard 4-5 mm. long, but those from Strathalbyn, Port Lincoln, Yumali, and Lameroo have the calyx 4-6 mm. long and the standard about 8 mm. long. The petals of the Port Lincoln specimen appear to be chiefly yellow, but on the eastern side of the Gulf the standard is red on the back, yellow in front, the wings yellow, and the keel dark red. The acuminate lobes of the calyx are always villous and the tube glabrous, the bracteoles oblong, scarious, inserted just below the calyx and almost equalling it in length. The leaves vary from softly villous to almost or quite glabrous.

**Trifolium resupinatum*, L. Naracoorte (H. W. Andrew).

Geraniaceae.

**Erodium Botrys*, Bertol. Common at Murray Bridge.

Linaceae.

Linum marginale, A. Cunn. Lameroo. Dwarf specimens, 5-15 cm. high, sometimes with only one stem and 1 or 2 flowers.

Rutaceae.

Microcybe pauciflora, Turcz. (Plate vii.) Port Lincoln; Yeelanna; Tooligie, E.P. The Tate Herbarium contains specimens from D'Estrées Bay and Mount Pleasant Station, K.I.; Southern Yorke Peninsula; while the Fl. Aust. gives "Lake Hamilton (Wilhelmi); Venus Bay (Warburton)." A dwarf shrub; leaves spreading, sessile or subsessile, 4-9 mm. long, tubercles inconspicuous; sepals oblanceolate, 1-1½ mm. long; petals bright yellow, 3-4 mm. long, glabrous or very rarely with a few hairs on the lower margin; filaments villous with stellate hairs on the lower part. The statement by Mueller (Fragm., i., 106) and by Bentham (Fl. Aust., i., 346) that the filaments are glabrous or villous is probably due to the fact that the 5 petaline filaments have in some flowers fewer hairs than the sepaline filaments, and sometimes are almost or quite glabrous. Professor Ewart has kindly allowed me to examine two Western Australian specimens from the Victorian National Herbarium—a co-type (Drummond, No. 209) and one from East Mount Barren (G. Maxwell). These specimens agree perfectly with ours, but, as they are more than half a century old, all colour has faded from the petals. Diels and Pritzel (Fragm. phyt. Aust. occ. 324) say the flowers are white, and if this observation is correct, there must be a white-flowered form in Western Australia.

M. multiflora, Turcz. (*Eriostemon capitatus*, var. *baccharoides*, F. v. M.) (Plate vii.) Pinnaroo; Sedan (Rothe); Eucla (J. Forrest and J. D. Batt); Hoyleton (S. Dixon in Tate Herbarium); Fowler Bay and Gawler Ranges (D. Sullivan, *teste* F. v. M., Fragm., ix., 107). Leaves spreading-erect or erect and appressed, 2-4 mm. long, oblong or somewhat dilated and cordate at base, subpeltately attached to the branch by an excavation at the base of the upper surface of the leaf, the glandular tubercles conspicuous; sepals broader, more conspicuous, and villous than in the preceding; petals white, 3-4 mm. long, glabrous or ciliate with long hairs in the lower half; filaments glabrous; seed black, slightly wrinkled longitudinally. I have had an opportunity of examining a co-type (Drummond, No. 211) from the Victorian National Herbarium, from which I also received the Eucla and Sedan specimens. This small erect shrub is very common in the scrub bordering on the 90-mile Desert, south of Pinnaroo. Both these species of *Microcybe* occur at Murrayville, Vict., just across our border (H. B. Williamson).

Eriostemon difformis, A. Cunn. Mount Patawurta, near Moolooloo (Dist. S; E. H. Ising).

Phebalium bullatum, J. M. Black. This slender shrub, which at Karoonda is rarely above 50 cm. high, grows to over 1 m. in the scrub south of Lameroo and Pinnaroo.

Boronia coerulescens, F. v. M. Both the glabrous and pubescent forms of this small shrub occur in the scrub south of Lameroo. The pubescent form has pale-purple flowers, while those of the glabrous plant are bright purple.

Tremandraceae.

Tetratheca pilosa, Labill. Scott Creek; Norton Summit; Blackwood; Brown Hill Creek; Bridgewater; Teatree Gully; Myponga; Victor Harbour. Plant hairy to almost glabrous; sepals dark red; petals varying from white to dark purple; leaves mostly scattered.

Euphorbiaceae.

Beyeria opaca, F. v. M., var. *linearis*, Benth. Pinnaroo.

Stackhousiaceae.

Stackhousia monogyna, Labill. Owienagin Gap, near Moolooloo (Dist. S; E. H. Ising).

Sapindaceae.

Dodonaea hexandra, F. v. M. Sherlock; Lameroo; Pinnaroo (Dist. M); Yumali (Dist. T; S. A. White).

D. cuneata, Rudge. Pinnaroo. A low shrub, not previously recorded for South Australia, although quoted for the "River Murray, Victoria," by Bentham in the Fl. Aust. It was included by Mueller in *D. viscosa*, but its short, almost truncate, subsinuate, mucronate leaves give it a very distinct appearance.

D. attenuata, A. Cunn., var. *linearis*, Benth. Mount Patawurta, near Moolooloo (E. H. Ising). Leaves only 1-1½ mm. broad.

Rhamnaceae.

Spyridium phlebophyllum, F. v. M. Mount Patawurta, near Moolooloo (E. H. Ising). This is the third and most northerly site where this plant has been found. The leaves vary in length from 5 to 15 mm.

Pomaderris racemosa, Hook. Yumali (Dist. T; S. A. White).

Sterculiaceae.

Lasiopetalum Behri, F. v. M. Yumali (Dist. T; S. A. White).

Dilleniaceae.

Hibbertia virgata, R. Br., nov. var. *incana*. *Variat foliis incanis cylindricis margine involutis, petalis parvis calycem aequantibus, carpellis 2-4-ovulatis.*

Karoonda; Pinnaroo; Yumali. The hoary cylindrical leaves, sometimes clustered, and the inconspicuous petals give this plant a very different appearance from the type, but it has the sepals, the broad floral bracts, and the stamens of the latter. It seems to be confined to the Trans-Murray scrub. The leaves are much like those of *H. fasciculata*, R. Br., var. *crassifolia*, Benth. (apparently rare, as I have it only from the Pinery, near Plympton, and along the railway from Woodville to the Grange), but they are usually alternate. The petals of var. *crassifolia* are deeply notched and the bracts are only reduced leaves, whereas the petals of *H. virgata*, var. *incana*, are merely emarginate, and the bracts are broad and scarious, like the sepals, and half their length.

H. stricta, R. Br., var. *canescens*, Benth. Mount Patawurta, near Moolooloo (Dist. S; E. H. Ising). Leaves and calyx softly stellate-pubescent; sepals 8 mm. long; carpels 6-ovulate.

Thymelaeaceae.

Pimelea Williamsonii, *nov. sp. (tab. vi.). Fruticulus totus sericeo-villosus circiter 20 cm. altus, ramis erectis vel ascendentibus, foliis alternis confertis subimbricatis oblongo-lanceolatis planis 10-15 mm. longis, floribus bisexualibus, spicis pedunculatis ramulos terminantibus primum ovoideis compactis et foliis supremis obtectis sed non involucratis demum usque ad 7 cm. elongatis, perianthio 4-5 mm. longo post anthesin circumscisso, parte inferiore fructiferâ 3 mm. longâ pilis longis erecto-patentibus occultâ, fructu obtuso valde ventricoso, exocarpio subherbaceo, endocarpio tenerrimo, testâ seminis crustaceâ atrâ sub lente punctulatâ apice uncinatâ, endopleurâ membranaceâ.*

South Australia.—Parilla (W. Gill Herbarium).

Victoria.—Murrayville (H. B. Williamson).

This species is named after Mr. H. B. Williamson, the well-known Victorian botanist and collector, who discovered it at Murrayville, 15 miles east of Pinnaroo, in 1917, and drew my attention to it when he was on a visit to Adelaide. It is distinguished from *P. sericostachya*, F. v. M., and *P. trichostachya*, Lindl., by its shrubby character and denser clothing of hairs, its broader leaves, which are crowded so as to appear somewhat imbricate, instead of distant, as in the two species named. It differs also in the smaller fruit, obtuse and ventricose almost from the summit, instead of gradually swollen towards the base, and in the hooked and smoother testa. The perianth of *sericostachya* is appressed-pubescent, while that of *Williamsonii* is covered by long, spreading-erect hairs. The method here employed of describing the fruit and seed is not that of the Flora Australiensis, but accords with the later view adopted by Bentham and Hooker in the Genera Plantarum, and by other recent botanists who have dealt with thus genus.

P. petrophila, F. v. M. Mount Patawurta (E. H. Ising). Leaves 10-15 mm. long, drying blue, as in some specimens of *P. flava;* flowers white, all female in my specimen. In the Tate Herbarium is a specimen from Wirrabara with leaves 15-25 mm. long, and male and female flowers in the same head. The only difference between this species and *P. flava* is that the leaves of the former are lanceolate-oblong, mostly acute and rather longer, while the involucral bracts are of the same shape as the leaves and considerably surpass the flowers. The distinction that in *P. flava* the perianth-tube does not extend above the ovary, while in *P. petrophila* it does so extend, is illusory. Both in the yellow-flowered typical form of *P. flava*, found in the Eastern States, and in the var. *diosmifolia*, the tube extends 1-1½ mm. above the ovary and is readily circumsciss about half-way between the ovary and the perianth-lobes; in the ripe flower it is circumciss just above the fruit.

P. flava, R. Br., var. *diosmifolia*, Meissn. (*P. dichotoma*, Schlecht. in Linnaea, xx., 581, ann. 1847; *P. diosmifolia*, A. Cunn. Herb. ex DC. Prodr., xiv., 510, ann. 1856-57). Apparently the only form in South Australia. It is a low shrub growing round our coasts and as far inland as Teatree Gully, Modbury, Myponga, Lameroo, and Yumali. It differs from the type in its white flowers; leaves thicker, more rigid, usually smaller, and sometimes almost orbicular, with only 2 or 3 obscure nerves on each side of the midrib. The flowers are not always strictly dioecious; on some plants, which are chiefly male, 1 or 2 female flowers may be found among the males in each head. If *P. petrophila* is retained as a species, it would be more consistent if var. *diosmifolia* were also raised to specific rank as *P. dichotoma*.

P. microcephala, R. Br. There appears to be a certain amount of dimorphism about the fruit of this species. The drupe has always a more or less succulent pericarp, but sometimes this becomes red and berry-like, while other fruits on the same plant remain green and much smaller, although ripening the seed. The short female perianth becomes membranous and divides somewhat irregularly near the middle, the lower part often remaining attached to the base of the fruit for a long time.

Myrtaceae.

Eucalyptus diversifolia, Bonpl. Yumali (Dist. T; S. A. White). In scrub south of Lameroo. Here a small mallee; leaves rather broad and very thick, resembling those of *E. capitellata*.

E. incrassata, Labill., var. *dumosa*, Maid. Pinnaroo; Lameroo; Mulgundawa; Wellington. A small mallee, 3-5 m. high, with white bark except near the base, from which the dark bark often peels off. Fruit ovoid-oblong or ovoid, 8-9 mm. long, when ripe glossy, the valves sunk but the tips very slightly exserted. Cold-and-Wet Station (west of Coonalpyn; H. W. Andrew); A good-sized tree; operculum reddish and ribbed.

E. oleosa, F. v. M. Just south of the town of Pinnaroo this mallee is 5-7 m. high, with greyish-white bark on the upper part of the stem and dark bark peeling off at the base. Rocky slopes of Mount Patawurta, near Moolooloo (E. H. Ising). "A mallee with several clustered stems, 4-5 m. high, bark peeling off in strips up to 2 m. from the ground." In the stunted scrub south of Pinnaroo grows what appears to be a dwarf form of *E. oleosa*, tending towards *E. uncinata*, Turcz. It is a small shrub, 1-2 m. high, with lanceolate, or linear-lanceolate, bright-green leaves, the operculum only 4 mm. long, but longer than the calyx-tube; fruit about 4 mm. long by 5 mm. diameter; valves 3, much exserted. Locally called "Green mallee."

E. calycogona, Turcz. Pinnaroo. In the better soil near this town this is a mallee 5-10 m. high, with fruits often 12 mm. long on unusually long pedicels of 6-7 mm. In some cases trees which have been cut down show butts 50-60 cm. in diameter, from which a number of stems spring. The inner bark is smooth and pale grey; the outer bark brown, rough, and peeling. In many instances specimens of *Fusanus acuminatus* ("Native Peach") were growing—probably parasitically—so close to these trees that the stem of the *Fusanus* was impressed into that of the *Eucalyptus*, forming a deep channel along one side. Further south, at the beginning of the 90-mile Desert, *E. calycogona* flowers as a whipstick mallee not 3 m. high.

E. Morrisii, R. T. Baker in Proc. Linn. Soc. N.S. Wales, xxv., 312 (1900). Mount Patawurta, near Moolooloo; in bud and with fruits ripe and unripe, October 2, 1918 (E. H. Ising). First record in South Australia of this species, which has hitherto been found only on the western plains of New South Wales. The determination is by Mr. J. H. Maiden. Buds obovoid, the obtuse operculum slightly longer than the tube; fruits varying in size, the largest 10 mm. long by 9 mm. diameter, rim broad, at first flat, then conspicuously domed; leaves whitish, showing a similarity to those of the allied species *E. dealbata*, A. Cunn.

E. viminalis, Labill. Ferguson Gorge, near Moolooloo (Dist. S; E. H. Ising).

Micromyrtus ciliata, (Sm.) combin. nov. (*Imbricaria ciliata*, Sm. in Trans. Linn. Soc., iii., 259, ann. 1797; *Baeckea microphylla*, Sieb. in Spreng. Syst. cur. post. 149, ann. 1827; *Micromyrtus microphylla*, Benth., Fl. Aust., iii., 65, ann. 1866; *Thryptomene ciliata*, F. v. M. in Woolls, Pl. neighb. Syd. 23, ann. 1880). A slender erect shrub, common in the scrub south of Pinnaroo, about 50 cm. high; petals and calyx-lobes light pink. Under the lens the ciliation of the upper leaves is conspicuous.

Halorrhagidaceae.

Halorrhagis elata, A. Cunn. Mount Patawurta and Owienagin Gap, near Moolooloo (Dist. S; E. H. Ising). Small specimens, 15-20 cm. high. Blackheath, near Harrogate (H. W. Andrew).

H. heterophylla, Brongn., var. *glaucifolia*, Schindl. Marree (Hergott); Hawker.

Myriophyllum verrucosum, Lindl. Swampy ground in Monbulla scrub (Dist. T; H. W. Andrew).

Umbelliferae.

**Bupleurum semicompositum*, L. Common on the plain at Tailem Bend.

Epacridaceae.

Leucopogon virgatus, R. Br. Monbulla scrub, S.E. (H. W. Andrew).

Astroloma humifusum, R. Br. "Native Cranberry," Mount Patawurta, near Moolooloo (Dist. S; E. H. Ising). This is much further north than any previous record of the species, but it is a mountainous district.

Asclepiadaceae.

**Gomphocarpus fruticosus*, R. Br. Near Rendelsham, S.E. (H. W. Andrew). The specimens differ from those found near Adelaide in the almost oblong, apiculate follicle and the shorter, more erect segments of the corona, like those of *G. physocarpus*, E. Mey. They agree closely with a form described by N. E. Brown in the Flora Capensis, where he says, "Specimens with ovoid or ellipsoid, shortly and acutely pointed follicles are probably of hybrid origin between this species *(G. fruticosus)* and *G. physocarpus*."

Labiatae.

Westringia Dampieri, R. Br. Lameroo and Pinnaroo. In some specimens all the lower leaves are in 4's, the upper ones in 3's or 4's; in others, quite similar in appearance, all, or nearly all, the leaves are in 3's; leaves 7-15 mm. long; flowers light purple. There seems no doubt that *W. Dampieri* and *W. rigida*, R. Br., should be treated as one species; they cannot be distinguished by the leaves in whorls of 3 or 4. The form with very short, spreading, rigid leaves (3-5 mm. long), also occurs at Lameroo and Pinnaroo, and is found in many parts of the State from Renmark to Ooldea, and at least as far north as Moolooloo. This might be known as var. *rigida*, as it is evidently the form indicated in Brown's description.

Solanaceae.

Solanum simile, F. v. M. Yumali (Dist. T; S. A. White).

SCROPHULARIACEAE.

Euphrasia collina, R. Br. (*E. Brownii*, F. v. M.) Lameroo (Dist. M). Flowers pale lilac.

**Veronica Tournefortii*, C. C. Gmel. Deserted gardens at Yallum, S.E. (H. W. Andrew), but apparently not established. Recorded as a "widely-spread weed" in Victoria by Prof. Ewart (as *V. Buxbaumii*, Ten.). A native of Middle and Southern Eurpoe.

MYOPORACEAE.

Eremophila neglecta, J. M. Black. O'Halloran Mount, near Oodnadatta; flowering July 7, 1918 (W. A. Cannon).

GOODENIACEAE.

Goodenia vernicosa, *nov. sp. (tab. vii.). Suffrutex erectus glaber viscosissimus et quasi vernicio illitus circiter semimetralis, foliis anguste vel late lanceolatis in petiolo attenuatis rigidis serratis 15-25 mm. longis, supremis linearibus integris, pedunculis axillaribus 1-4-floris folio aequilongis vel brevioribus, pedicellis brevibus (2-3 mm. longis) supra medium articulatis basi bibracteolatis, calyce cylindrico costato 12 mm. longo, lobis linearibus tubum subaequantibus, corollâ flavâ 15 cm. longâ, lobis extus et tubo intus puberulis, stylo villoso, indusio basi barbato, capsulae oblongo-ovoideae septo apicem illius fere attingente, seminibus circiter 12 biseriatis crasse marginatis.*

Mount Patawurta, near Moolooloo (E. H. Ising). A similar specimen is in the Tate Herbarium, without locality or name of collector, and has been placed under *G. ovata*, Sm. It differs from that species in the narrower, rigid leaves and the ovoid capsule; from *G. varia*, R. Br., in the shape of the leaves; and from both in the thick viscid covering which gives the plant a varnished appearance, in the pubescent corolla, the villous style and the uppermost leaves of the inflorescence linear and bract-like.

G. Nicholsonii, F. v. M. Moolooloo (E. H. Ising). First record of this species for South Australia; it has previously been recorded for the Northern Territory. The flowers have all dried white, so that their colour may form another distinction between this species and *G. grandiflora*, Sims.

G. albiflora, Schlecht. Moolooloo (Dist. S; E. H. Ising).

G. pusilliflora, F. v. M. Pinnaroo (Dist. M).

G. humilis, R. Br. Kybybolite (Dist. T; H. W. Andrew).

COMPOSITAE.

Helichrysum obtusifolium, Sond. et F. v. M. Yumali (Dist. T; S. A. White); scrub south of Lameroo (Dist. M).

H. leucopsidium, DC. Pinnaroo (Dist. M).

H. semipapposum, DC. Mount Patawurta, near Moolooloo (Dist. S; E. H. Ising).

Helipterum Jessenii, F. v. M. Pinnaroo.

H. corymbiflorum, Schlecht. Ferguson Gorge (E. H. Ising). Stems only about 15 cm. high and 1-headed by abortion.

H. dimorpholepis, Benth. Ferguson Gorge, near Moolooloo (Dist. S; E. H. Ising).

Calotis scapigera, Hook. Port Adelaide River; Murray Bridge; Renmark. Ray pink, turning white.

Ixodia achilleoides, R. Br. Coonalpyn (Dist. T; H. W. Andrew).

Olearia pimeleoides, var. *minor*, Benth. Yumali (S. A. White); Milang Road (E. C. Black); Dublin scrub (H. Griffith); Pinnaroo. A shrub 1-2 m. high; involucre 6 mm. long, at first cylindrical; ray-flowers, 6-10; disk-flowers about 10; achenes glabrous, when ripe cylindrical, black, ribbed, 2½ mm. long. In view of the smaller heads and leaves, the fewer flowers, and especially the glabrous achenes (not mentioned by Bentham), one feels a doubt as to whether this variety is not really a separate species.

O. Muelleri, Benth. Mount Patawurta, near Moolooloo (Dist. S; E. H. Ising).

O. ciliata, F. v. M. Lameroo; Karoonda (Dist. M).

O. lepidophylla, Benth. Loxton (Dist. M; S. A. White); Coonalpyn (H. W. Andrew); Alberton. Ray-flowers 4-6, disk-flowers 5-12.

O. floribunda, (Hook. f.) Benth. Loxton (S. A. White); Coonalpyn (H. W. Andrew). Heads numerous, apparently in dense panicles; involucre 3-4 mm. long; flowers usually 6, 3 ligulate and 3 central; leaves clustered, 1-1½ mm. long; branches slender and flexible.

Brachycome exilis, Sond. Owienagin Gap, near Moolooloo (Dist. S; E. H. Ising). A minute form with simple stem, 20-35 mm. high in our specimens; all the leaves linear-cuneate and entire; ray-flowers pink, 5-9; disk-flowers only 2 or 3. I have similarly minute specimens from Tintinara, with entire leaves, but the stems are at least once-branched and the disk-flowers rather more numerous.

B. calocarpa, F. v. M. Lameroo. These specimens present a different appearance from the ordinary form, the whole plant being more or less woolly, especially towards the base, the leaves very narrow, the lower ones 7-8 cm. long, with about 3 lanceolate lobes at the summit, or pinnatisect with a few linear or lanceolate segments, as well as the terminal lobes, the upper leaves entire or with 2 narrow lobes near the base; ray pale lilac. Prof. Ewart informs me that our plant agrees with specimens of *B. calocarpa* collected near the Murray River by Dallachy, as mentioned in the Fl. Aust.

Humea pholidota (F. v. M.), combin. nov. (*Ozothamnus pholidotus* vel *Cassinia pholidota*, F. v. M., Fragm. ii., 131 (1861); *Helichrysum pholidotum*, F. v. M., ex Benth., Fl. Aust. iii., 634 (1866); *H. squamata*, F. v. M., Fragm. xi., 86 (1880). Near Loxton (S. A. White); Karoonda; Lameroo; Pinnaroo. An erect shrub about 1 m. high.

Microseris scapigera, (Forst.) Sch. Bip. (*M. Forsteri*, Hook. f.). Lameroo. Leaves very narrow with linear-lanceolate lobes about 12 mm. long. Owienagin Gap and Ferguson Gorge (Dist. S; E. H. Ising).

Millotia Kempei, F. v. M. in Wing's South. Sci. Rec. ii., 2 (1882); var. *Helmsii*, F. v. M. et Tate in Trans. Roy. Soc. S. Austr., xvi., 368 (1896). The description of this species and a comparison with specimens in the Tate Herbarium show that it is the same as *Toxanthus Whitei*, J. M. Black in Trans. Roy. Soc. S. Austr., xxxix., 840, t. 69 (1915). This plant stands about half-way between *Millotia* and *Toxanthus*. It has the more numerous involucral bracts, the more numerous and larger flowers of *Millotia*, but it has the absence of pappus and the achenes obtruncate and slightly swollen at the base, which are characteristic of *Toxanthus*. In the endeavour to find a determining factor, I examined carefully the style-branches of *M. Kempei*, and found that they terminated, above the stigmatic streaks, in the short swollen cones of *Millotia*, rather than in the lanceolate papillose tips of *Toxanthus*. Baron v. Mueller's classification therefore appears to be the preferable one. In addition to Helms' specimens from near the Birksgate Range, the Tate Herbarium contains others from Ooldea and the Great Victoria Desert, W.A.

Erechthites prenanthoides, *DC.* (plate viii.). This plant grew in my garden at North Adelaide from seed which must have been buried in the soil of other plants brought from Mount Gambier. It lasted about one year. The female flowers numbered 10-12, the bisexual ones 5-8.

Cassinia laevis, R. Br. Between Coonalpyn and Cold-and-Wet (Dist. T; H. W. Andrew). Young leaves wrinkled above, but glabrous; flowers in head 4-5.

**Anacyclus radiatus*, Lois. This Mediterranean weed, with large yellow flowers, not previously recorded, was found growing on a dump at Port Adelaide (October, 1918; H. W. Andrew).

**Leontodon hispidus*, L. Near Lobethal (H. W. Andrew). Common; the forms with glabrous and hairy involucres both present. Already recorded for the South-East.

DESCRIPTION OF PLATES.

Plate VI.

Kochia Cannonii, n. sp. 1, leaf (side view). 2, leaf (seen from above). 3, fruit (seen from above). 4, fruit (vertical section).

Pimelea Williamsonii, n. sp. 5, flower. 6, upper part of perianth spread open. 7, pistil. 8, fruit, showing exocarp. 9, fruit after removal of exocarp, showing the delicate, transparent endocarp covering the testa. 10, seed. 11, embryo. 12, transverse section of fruit: *a*, exocarp; *b*, endocarp; *c*, crustaceous testa; *d*, membranous inner seed-coat (endopleura); *e*, albumen; *f*, cotyledons.

Plate VII.

Goodenia vernicosa, n. sp. 1, bud. 2, style and indusium. 3, vertical section of fruit. 4, corolla spread open.

Microcybe pauciflora, Turcz. 5, pistil. 6, one-half of flower spread open. 7, flower.

M. multiflora, Turcz. 8, one-half of flower spread open, 9, leaf (upper face). 10, leaf (lower face). 11, fruit: *a*, wrinkled coccus; *b*, cartilaginous endocarp; *c*, seed.

Plate VIII.

Erechthites prenanthoides, DC. 1, flower-head in bud and flower. 2, achene and pappus. 3, transverse section of achene. 4, stamens. 5, style-branches. 6, pollen-grain. 7, bisexual flower. 8, female flower.

Kochia Cannonii *nov. sp.*

Pimelea Williamsonii *n. sp.*

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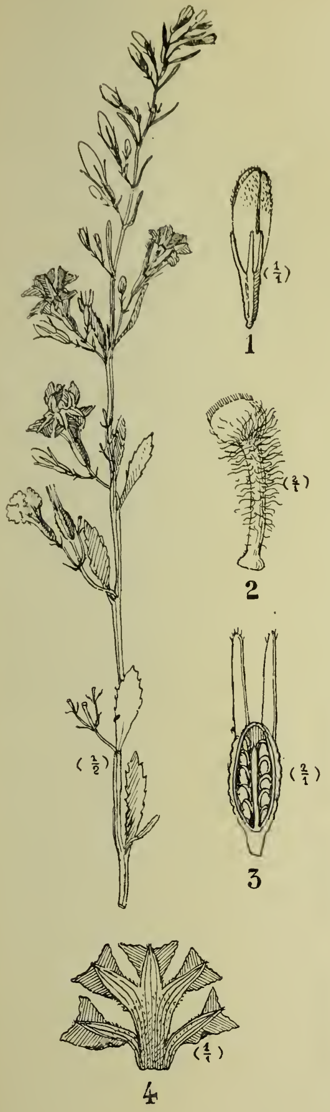
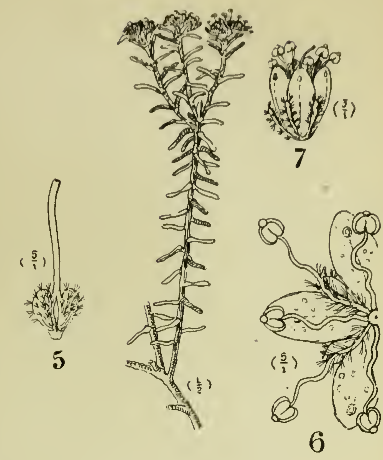


Goodenia vernicosa *n. sp.*



Microcybe pauciflora *Turcz*

M. multiflora *Turcz.*

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Erechthites prenanthoides DC.

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Geological Memoranda (First Contribution).

By Professor Walter Howchin.

Subjects:

I. The "Sarsen" Stones of South Australia.
II. Pumice and other Substances occurring as Sea-drift near Cape Banks.
III. Salt, a Cause of Mechanical Disintegration of Rocks in Arid Regions.
IV. Nodular Barytes of Peculiar Forms from Central Australia.

[Read June 12, 1919.]

Plate IX.

I. The "Sarsen" Stones of South Australia.

Scattered over many of the southern counties of England are large blocks of hard siliceous sandstone, usually oblong in shape, several feet in thickness, and up to 10 ft. or 15 ft. in length, that for centuries have been a great puzzle to the rural population. The stones are foreign to the rocks of the neighbourhoods where they occur, and appeared to the country people as though dropped promiscuously over the landscape. The name by which they are generally known is that of "sarsen," or "sarsden" stones, which is supposed to be a colloquial abbreviation of the word Saracen, a survival from the time when the name of the Moors, or Saracens, was one of superstitious terror in southern and western Europe.(1) As these stones are often seen in groups, and at a distance have the appearance of sheep lying down in the grass, they are commonly called "grey-wethers." Further, these large, slab-like shafts were eminently adapted for use in the erection of monoliths and the building of tumuli and open-air temples of the prehistoric peoples, and from their being frequently utilized for such purposes they have also obtained the name of "Druid stones." The outermost circle of great stones, as well as the second circle, at Stonehenge is constructed of sarsen stones; indeed, there was no other geological formation in the country that yielded stones anything like so great a size.

(1) Other explanations have been given as to the origin of the word. *Sarsen* is said to be a Phoenician word, meaning a stone, and may have been a survival from the time when these navigators visited England. "The early Christian Saxons used the word *Saresyn* as a synonym of pagan or heathen."—Dr. Brewer. "A corruption of a Celtic word."—Chambers' Encyclopaedia.

These mysterious stones have attracted the greater attention because of their occurrence in parts of the country where there are no hard rocks, and they therefore possess an economic value, being used for road metal, gate posts, farm buildings, paving, etc., which has led to the destruction of many megalithic monuments. Camden complained of the vandalism that was rampant in his day in destroying such interesting archaeological structures for utilitarian purposes. He says,[2] "Above the head of the River Ock, by Ashbury-park, is a camp of a figure as near round as square, the diameter above an hundred paces and the works single, but the works are now almost quite spoiled and defaced by digging for the sarsden stones as they call them) to build a house in the park belonging to the Lord Craven."

A few years ago a public movement was inaugurated in England, and an appeal for funds was made, commended and financially supported by the Geological Society of London, for the preservation of the grey-wethers of Marlborough Downs. Our Honorary Fellow, Mr. Edward Meyrick, B.A., F.R.S., was one of a committee of gentlemen formed for this object, and at my request sent out some fragments broken from sarsen stones for comparison with our local examples.

The subject has given rise to a somewhat extensive literature, and references will be found to these objects in most county histories (where they occur), geological textbooks, encyclopaedias, dictionaries, and newspaper correspondence.[3]

Many conflicting theories have been advanced to account for the origin and distribution of the sarsen stones, but it is now generally agreed that they form the remnants of what was once an extensive geological formation (or formations) of Tertiary Age that covered a considerable portion of southern England. The beds consisted of sands and fine gravels (probably of different geological ages), the greater portion of which remained unconsolidated and has been removed by denudation, but in places a lcoal silicification took place which converted more or less of these sediments into very hard siliceous rocks, that have resisted weathering and have been preserved in the form of isolated boulders or slabs of rock. This gives us the distinctive features of a sarsen stone—a partial silicification has

(2) "Britannia," 2nd ed. (1722), col. 162.

(3) The following might be consulted:—H. B. Woodward: "Geology of England and Wales," 1876, p. 363; W. Whitaker: "Age of the Grey-wethers," Jour. Geol. Soc. of London, v. 18 (1862), p. 271; E. C. Spicer: "Sarsen Stones in a Clay Pit," *ibid.*, v. 61 (1905), p. 39; A. C. Ramsay: "Physical Geology and Geography of Great Britain," 1872, p. 126; H. W. Monckton: "Notes on the Sarsen Stones of the Bagshot District," Report Brit. Assoc. Adv. Science (Southport), 1903, p. 669

taken place by the infiltration of silicated waters into an open and porous rock, causing great induration within certain limits, and such indurated portions have persisted, whilst the incoherent portions of the beds have become washed away.

As the sarsen type of stone depends on the petrological texture of the stone and its mode of distribution, rather than the geological age of the rock, they may occur in any country and of any age when the suitable conditions for their formation exist. Sarsen stones of this type are widely distributed throughout South Australia. They have not attracted the same attention from the public here as those of England, from the fact that in England they are rendered conspicuous because they occur in districts where few other hard stones are found, while in South Australia they occur in places where they are surrounded by outcrops of hard rocks, and in many cases the two classes of rocks are so similar in appearance that only an experienced field geologist can detect the difference.

In South Australia sarsens are found along the lines of ancient drainage, where the sands and gravels of rivers that no longer occupy these valleys have become intermittently subjected to silicification, having some portions altered to a close, compact, siliceous rock, while other portions have remained loose and friable, or entirely removed by denudation. They often form groups in the paddocks, preventing cultivation, or occur as large boulders overspreading some ancient terrace, like the grey-wethers of southern England. They can be seen from the railway train near Yacka, and at Stone Hut, and in many positions on the Willochra Plains between Melrose and Booleroo Centre, also on the low range facing the sea near Ardrossan,[4] and in many other situations.

The English sarsen stones are of a light-grey colour, and in most cases are very fine in the grain, possessing a saccharoidal lustre. Examined in thin sections by the microscope, they are seen to consist almost exclusively of very fine sand grains, closely dovetailed and united together by a siliceous cement. On account of this form of structure they exhibit a conchoidal fracture.

The South Australian examples answer generally to the same descriptions. In most cases a different form of silicification can be recognized between that of the siliceous quartzites of Cambrian Age and the siliceously-cemented river sediments that have made the sarsen stones. The Cambrian quartzites give evidence of metamorphic action, while the indurated river sediments do not. In the case of the metamorphic

(4) Howchin: "Notes on the Geology of Ardrossan and Neighbourhood," Trans. Roy. Soc. S. Austr., v. 42, 1918, pls. xxii. to xxvii.

quartzites the siliceous cement has absorbed the original grains of sand, which cannot always be clearly distinguished from the cement that has blended them all together. In the case of the sarsen stone, the cement, whilst intensely siliceous, is distinct from the granular constituents of the rock.

Another point of difference between the two classes of rock is that whilst the Cambrian rock is regularly bedded, possessing a rough surface, and tends to split along the bedding planes, the sarsen stone is generally more or less spheroidal, or irregular in outline, and generally possesses a smooth and glazed surface. It is the finer-textured rocks that exhibit the more complete silicification, as in the case of sands and fine gravel; the coarser gravels are frequently strongly cemented, but they do not show the same clean fracture as is seen in the finer-grained examples.

II. Pumice and other Substances found as Sea-drift near Cape Banks.

I am indebted to Mr. G. A. Payne, late Head Keeper at Cape Banks Lighthouse, for a number of interesting objects that he has collected from the beach in that locality. The more interesting of these comprise pumice, scoriaceous lava, torbanite, asphaltum, and native resin.

pumice.

Mr. Payne states that he has collected from the beach three examples of this rock. He says that "two were about the size of a small loaf of bread and the other the size of two loaves." The latter specimen was kindly donated by Mr. Payne to the University Museum. It is slightly water-worn and, roughly, pear-shaped. It measures 13 in. in length and 20½ in. in transverse circumference. It is a characteristic example of its kind, greyish-white in colour, rough to the feel, open and vesicular in structure, with numerous large, elongated vesicular gas spaces. The central portion of a second specimen, also forwarded by Mr. Payne, has precisely the same features. The specimens in each case occurred on the southern side of Cape Banks, and were found high up among the sandhills, where, Mr. Payne thinks, they must have been buried for years.

The occurrence of drift-pumice in this locality was quite unexpected and is difficult to explain. Although the Millicent and Mount Gambier volcanic fields are not very distant from Cape Banks, no pumice is known to occur on either of these fields, and if there was, there is at present no running water that might account for their transportation to the coast. Neither is pumice known to occur along the

Victorian coast. Mr. Herman, the Director of the Geological Survey of Victoria, has courteously replied to my enquiries on this subject as follows: "I do not know, nor do any of my staff whom I have been able conveniently to consult, know of any pumice on the south coast of Victoria. I rang up Professor Skeats, who also does not know of any, neither do we know of any deposit *in situ* in Victoria which approaches the character of a true pumice."

Professor Liversidge (5) records pumice from New Guinea, New Britain, and from the Pacific, the last-named being examples washed up on the coast of New South Wales. He says, "Masses of pumice are frequently cast up on the beach along the coast of New South Wales, and at times are also found in the harbours, and they are not infrequently picked up within the Sydney Harbour. (6) The source of this pumice is, of course, a foreign one, and doubtless it is derived from more than one of the volcanic centres of the Pacific, but which of them does not as yet appear to be very clear. It is always water-worn, and at times more or less coated with *serpulae*, and has evidently been long in its travels across the sea. It is stated to be more abundant after an easterly gale, and is found more often on the north side of the inlets along the coast than in other situations; in size the pieces vary from quite small fragments to pieces 9 or 12 in. through. . . . It would be very interesting to trace the limits of the distribution of pumice along the Autralian coast, and I trust that someone will undertake this duty."

The following replies to some enquiries made by me have been received from Mr. Charles Hedley, of Sydney, who is intimately acquainted with the coast of New South Wales:—"Your note about the pumice is very interesting, and I hope that you will put it on record. On this coast, from Sydney to Jones Strait, pumice is very common. On the coral islands of The Barrier it may extend continuously along the beach, at high-tide level, in lumps the size of a cricket ball to a marble. The pieces you describe are unusually large. There is material in your pumice for some interesting deductions."

In the absence of any known local source from whence these pieces of pumice can have been derived, it is natural to think of them as having been sea-borne. But there are difficulties in readily accepting this explanation. The condition of the specimens does not suggest a long sea voyage. Whilst somewhat water-worn, they have not suffered that extent of

(5) "The Minerals of New South Wales," etc., 1888, pp. 250, 255, 258.

(6) Professor David informs me that one piece washed up in Sydney Harbour measured 3 ft. in length.

erosion that might be expected to have occurred during a protracted sea journey. Moreover, the specimens submitted to me give no evidence of marine life that might have become parasitically attached to the floating pumice, such as algae growths, *Serpula*, or *Balanus*. Neither of these considerations are, however, fatal to the theory, as the amount of wear is dependent on contact with hard substances floating in the water or the amount of attrition suffered on the beach before the pumice-stone came to rest; and many of such sea-borne stones are found equally destitute of marine growths. So far, however, the negative evidence is in the direction of a short voyage or no voyage at all.

Again, the ocean currents that prevail along the southern coasts of Australia are not supposed to have a direction that would bring floating matter, by a direct path, from a region where pumice is supposed to occur. The Antarctic current, influenced by the strong westerly winds, takes a north-easterly direction, and becomes a wide-spread "drift"; one branch, going northward, follows the coast of Western Australia, and the other takes an easterly course along the southern shores of the continent.

Under date March 25, 1916, Mr. Payne writes: "With regard to currents, I have picked up quite a dozen bottles containing letters, memos., flags, etc., thrown overboard by our soldier boys, and quite a number have come from the Great Bight to a spot known as the 'drift,' or 'desert,' between Lake Bonney and the sea, about 2 or 3 miles north of Cape Banks, and north of where the 'Admella' was wrecked. The 'drift' is a great place for all kinds of wreckage, etc., from the sea." Also under date August 6, 1917, I received particulars from Mr. Payne of a "current paper" thrown overboard on September 26, 1916, in lat. 40° 17′ S., and long. 126° 58′ E. (south of the Great Bight), and was picked up 10 miles to the north of Cape Banks on July 26, 1917, the maximum time for the journey being fourteen months.

There is probably some reason why such unusual quantities of floating material should accumulate on the beach a few miles north of Cape Banks, and which has given the locality the name of the "drift." Some chartographers represent the great easterly drift, to the south of Australia, as bifurcating on the western side of Tasmania, one branch making a westerly turn, forming a large eddy to the south of the Great Bight, while another section, after hugging the western coast of Tasmania, passes eastward through Bass Strait. There is probably a neutral zone between the two currents, one going west and the other going east, and would coincide with a geographical position very close to Cape Banks. The parting of the currents may well account for the quantity of debris cast up at the spot known as the "drift" mentioned by Mr. Payne.

The localities from which the pumice may have originated (judging from its known geographical occurrences) are New Zealand, the Pacific Islands, the Eastern Archipelago, or, possibly, a sumbarine volcano of unknown position. That pumice of the size found near Cape Banks should have been lost overboard by a passing ship is also not thought to be probable.

Mr. Hedley suggests that the specimens came from the Malay Archipelago, round the Leeuwin. The northerly drift on the western side of the continent is against this view, but it is not impossible for a floating object, starting, say, from the Sunda Strait, and being caught in the equatorial current, to make the round of the Indian Ocean, and, coming south, enter the west wind drift, and so reach the southern shores of Australia. But that is a very long journey, and if that were a source of pumice drift we might expect that it would be found on shores more to the westward than Cape Banks.(7)

It might again be suggested that a strong easterly wind blowing through Bass Strait for several days would probably have the effect of temporarily destroying the west wind drift, and by reversing the current bring in the drift from the Pacific through the Strait and as far westward as the southern limits of South Australia.

Ocean drifts that are dependent on prevailing winds vary with the winds. They may be weak or strong, shift their position, and even become for a time reversed, according to seasonal variations. Pumice is a common stone in New Zealand, and is likely to find its way at times to the sea. The Pacific current that comes down the eastern coast of Australia, and encircles the Tasman Sea, may possibly bring pumice to its southern limits where it makes its return bend. If under such circumstances a slight westerly drift sets in from the Tasman Sea, extending to the western side of Tasmania, any floating matter would then be brought within the range of the drift that follows the southern coasts of Australia, and might in this way become the carrier of pumice from the east.

The examples obtained from Cape Banks possess certain characteristics which should assist in their identification. The

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(7) After the above was written a public notice was given of a bottle, thrown overboard from a troopship at Colombo, having been picked up on the beach near Cape Jervis.—See *The Register*, June 10, 1919.

stones are exceptionally open in their texture. The gas spaces (over and above the usual small, elongated spaces which give pumice its characteristic features) are often large, measuring from 1 to $3\frac{1}{2}$ in. in length and up to $\frac{1}{2}$ to 1 in. in transverse diameter, giving the stone a particularly light and open appearance. These are useful features for comparison, and now that attention has been called to this subject, it is hoped that observers will be on the look out for further evidences that may be of interest bearing on this subject.

SCORIACEOUS LAVA.

The specimen forwarded to me by Mr. Payne is black-coloured, glassy, very open in texture, with numerous rounded gas vesicles, identical in appearance with the scoriaceous lava of Mount Gambier and Mount Schank. Mr. Payne picked up examples of this kind on the beach both on the northern and southern sides of Cape Banks, and states that "the largest piece was about the size of an ordinary loaf of bread." The sea has washed the bases of the volcanic vents in the neighbourhood of Millicent since these volcanoes were in eruption, but there is nothing to indicate that these scoriae were actually derived from this source. There are igneous rocks on the Victorian coast, a little beyond the South Australian border, and it is possible that the specimens may have come from that direction; if so, it would be a further evidence of an occasional westerly drift along the coast.

ASPHALTUM (BITUMEN).

This substance has a very wide distribution along the southern coast of Australia, extending from Tasmania on the one side to near Bunbury, in Western Australia, on the other. A typical specimen was included in the beach specimens forwarded by Mr. Payne. It is an angular fragment, 5 in. in long diameter, with the usual pitch-like lustre, and is in all respects similar to many others that have been noted and described, and frequently raised delusive hopes as to a local occurrence of mineral oil[8] in the vicinity where these fragments have been found. The specimens that have been obtained over this very wide area possess very uniform characteristics, which make it probable that they have had a common origin. Dr. Wade has said,[9] "I am firmly

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[8] See L. Keith Ward: "The Possibilities of the Discovery of Petroleum on Kangaroo Island and the Western Coast of Eyre Peninsula," Geol. Sur. S. Austr., Bull. No. 2, 1913, p. 13. Also Dr. Arthur Wade: "The Supposed Oil-bearing Areas of South Australia," Geol. Sur. S. Austr., Bull. No. 4, 1915, p. 33.

[9] *Loc. cit.*, p. 34.

convinced by the evidence that the material originates from beds now covered by the sea, beds thrown down by the great fault system known to exist, protected to some extent by the deep sea deposits, and lying south of the continental shelf. As a surmise, I should say that just as the great trough faults of the Dead Sea area have exuded bitumen in places, seen by myself, so the bitumen found on these coasts may be at present escaping from the similar fault planes mentioned."

Another suggestiton as to its origin may be ventured. The very wide distribution of this substance indicates that ocean currents must be concerned in its distribution, and the wide distribution also suggests that the source is relatively distant. The geology of Kerguelen Island is not well understood, but it is known that beds of Tertiary Age, including coals of poor quality, occur there.(10) It is a region that has been greatly disturbed during Tertiary times, and it is within the range of possibility that conditions may have arisen that were favourable for the distillation of the carbonaceous material into hydrocarbons in parts of this coalfield. Dr. Wade's bitumen-exuding faults may be situated near Kerguelen rather than the southern coast of Australia. It is further to be noted that Kerguelen is in the direct line of the west wind drift, the waters of which are carried up the Western Australian coast as well as along the southern coast of Australia and around the island of Tasmania. If the bitumen originated at Kerguelen the outcrops are probably submarine in position.

FOSSIL RESIN.

Two fragments of a fossil resin, broken from a larger mass, were included in the samples sent by Mr. Payne. The example is yellowish in colour and banded. It is rather remarkable that lumps of resin are frequently found on the coast where the pieces of asphaltum occur. At the Brecknell Sandhills, on the southern coast of Kangaroo Island, I found the two in association. Dr. Wade refers the resin to the species "retinite," a variety of copalite. These resins have no genital relationship to the mineral oils, but they may have had a similar geographical origin as that of the asphaltum waifs. If Kerguelen Island be the source, then we must assume that the resins have been derived from beds of carbonaceous material that have not undergone destructive distillation, whilst those that have yielded the bituminous product, we may assume, have been subjected to such a change.

(10) See Tate: "On the Occurrence of Marine Fossiliferous Rocks at Kerguelen Island," Trans. Roy. Soc. S. Austr., v. 24 (1900), p. 105.

TORBANITE (KEROSENE SHALE).

A fragment of this mineral (sawn by Mr. Payne from a larger portion) also formed a part of the collection from Cape Banks. It is brownish-black in colour, has a dull lustre, and burns freely when a lighted match is applied to it. It is identical with the mineral torbanite which is mined at Hartley and other places in New South Wales, where it is used for the production of mineral oil, and is also sometimes exported. There can be no doubt that the piece in question has come from some vessel trading along the coast, and which by some means had fallen overboard. The Government Geologist, Mr. L. Keith Ward, mentions two other instances in which the same mineral substance has been found on the South Australian coast; one of these was on the beach at The Frenchman, Eyre Peninsula, and the other at the head of the Great Bight.(11)

III. Salt a Cause of Mechanical Disintegration of Rocks in Arid Regions.

When visiting Stuart Creek pastoral station in 1904, by the kindness of Mr. W. Oliffe, the manager of the station, I was taken over some extensive opal deposits on the run. These were situated to the northward of Pidleeomina Waterhole, in the neighbourhood of Charlie's Swamp, about 30 miles to the south-eastward of the head station. The opal deposits occur in the upper portions of the cretaceous clays, and are distributed over a strip of country several square miles in extent. They occur usually as thin reticulating veins, or as cylindrical bodies, which in some examples reach a diameter of 12 in. The opal lacks "fire," and is therefore of the common variety, but some of the specimens are beautifully tinted, of various colours, and translucent, resembling the fancy jellies produced by culinary art.

A very fine example that was exhumed in my presence was in the form of a tree trunk, 2 feet in circumference, possessing some indication of woody structure. The outer portions are milk white, shading off to a delicate pink, and the centre consists of transparent opal of a saffron colour. A fair-sized segment of this opalized tree was secured and brought to Adelaide, but in a short time the greater portion of the specimen cracked and fell to pieces. A few of these splintered fragments were about an inch in diameter, but the greater part of the disintegrated opal consisted of an innumerable assemblage of small splinters. This intimate

(11) *Loc. cit.*, p. 21.

disintegration of a compact and apparently pure opal rock was an unexpected occurrence. On examination it was found that an efflorescence of salt covered all the planes of fracture, and this is suggestive of the cause of the disintegration. The effect of frozen water in disintegrating and fracturing absorbent bodies by expansion is well known. This property of expanding when passing from a state of solution to that of crystallization is characteristic of most solvent substances, and, in the case before us, it appears that a certain amount of salt solution was taken up by the opal at the time of its consolidation. Whilst the opal was buried in the soil it retained its quarry-water, or "sap-water," to use a quarryman's term, but when placed in the cabinet desiccation followed, the water evaporated, and the salt crystallized out, producing internal stresses that caused a general rupture of the mass.

This action is known to be operative in all dry regions where the surface waters are mostly mineral solutions and subjected to alternate conditions of imbibition and desiccation. What has occurred in the case of opal may be expected to occur also in most other rocks under similar conditions, especially those of an open texture, such as sandstones, shales, clays, etc., many examples of such chemico-mechanical disintegration were noted in the region referred to.

IV. Nodular Barytes of Peculiar Forms from Central Australia.

Barytes (barium sulphate), or "heavy spar," occurs in South Australia under a variety of forms. In Mitcham quartzite quarries it has been obtained in well-formed tabular orthorhombic crystals, and also of lamellar structure and translucent. In some parts of the Mount Lofty Ranges it occurs in veins with a granular crystallization, as in the barytes mine near Blumberg. It not infrequently forms the gangue in mineral lodes, as at the New Burra Copper Mine, south-east from Kooringa. It also occurs sporadically as nodules in limestones and clays. These nodular forms are interesting from the variety of shapes they assume. At the Brighton limestone quarries nodules of barytes are not at all uncommon. Some of these have mammillary forms, white to brownish in colour, columnar and radial in structure, with a smooth porcelain-like surface, and in some examples attain a large size. One such obtained by me from these quarries is hemispherical in shape, with the appearance as though a viscous liquid had been poured out of some vessel—weighs 14 lbs.

Certain kinds of clay beds develop these nodules of barytes. In the Permo-carboniferous glacial clay at Black Point, Hallett Cove, there is a layer in which a large number of barytes sand-crystals occur.(12) The crystals, which have incorporated sand grains in the process of crystallization, form clusters that have a lenticular or subglobular shape.

The clays of the interior of Australia in some cases carry nodules of barytes. The commonest form which these concretions take is that of a flattened cake, which has given them the colloquial name of "buns." Mr. F. R. George, of the Mines Department, obtained some of these baryte "buns" when leader of the Government North-West Prospecting Expedition in 1904. Mr. W. T. Chapman,(13) the assayer at the Adelaide School of Mines, who analyzed one of these nodules, states that "the specimens were obtained in the tablelands about 50 miles west of Coward Springs railway station, and occur as nodules somewhat resembling coprolites. Mr. George states that the nodules vary in weight from half an ounce up to about 3 lbs. They are of a grey colour. An analysis made by this department resulted as under:—

	Per cent.
Water	0·39
Silica	0·43
Alumina	1·92
Ferric oxide	0·56
Sulphuric acid	33·82
Baryta	62·00
Strontia	0·13
Lime	0·14
	99·39

I have recently received from Mr. George Warren, of Springfield, two examples of these "buns." They were obtained on the Anna Creek Run, about 60 miles to the south-westward of the head station. They are known to occur over an area of about 12 square miles, distributed over a flat, on the northern side of a ridge of low hills consisting of white clay-like rock, which is capped by a hard layer of desert sandstone. The specimens are in considerable numbers, and vary in size from a florin to a disk of 1 ft. in diameter.

Whilst on a visit to Stuart Creek cattle station, in the Lake Eyre district, in 1904, I came upon a white clay bank that was strewn with barytes nodules of quite a different shape from the "buns." They might be compared in appearance to a ball of stout cord that had been wound and intertwined upon itself. The thickness of the cord-like casts varies

(12) See Mawson: "Mineralogical Notes," Trans. Roy. Soc. S. Austr., v. 31, 1907, p. 119.

(13) Report School of Mines and Industries, 1904, pp. 73, 74.

in different specimens, but is uniform throughout in the case of each individual specimen. Mr. W. T. Chapman kindly undertook to make an analysis of one of these, with the following results:—

	Per cent.
Sulphur tri-oxide	32·67
Barium oxide	60·42
Calcium oxide	0·10
Strontium oxide	0·06
Alumina	2·78
Ferric oxide	0·34
Magnesia	0·08
Silica	3·24
Water	0·71
	100·40

It will be noted that the two analyses are closely similar; the most marked differences are in the slightly higher proportions of silica and alumina in the second instance, probably arising from a small amount of clay being incorporated with the barium sulphate in the nodules. They are non-crystalline and amorphous in texture.

These singular nodules are undoubtedly casts, and have taken their shape from the cavities in which they were formed. Their resemblance to coiled earthworms is very striking, and suggests their probable origin. When holes are dug in garden ground during a period of drought it is not unusual to find at a considerable depth earthworms coiled up within a little chamber in the dry earth. This chamber corresponds to the hibernaculum, or shelter, into which hibernating animals retreat during the winter, but in the case of the earthworm the deep-seated cavity gives protection, not from the frosts of winter, but from the heat and prolonged dryness of an Australian drought. Among the nodules collected by me were some that appear to be of an intermediate form between the annelid-like knob and the bun-like disks. Both kinds may have formed in cavities formerly occupied by annelids, the difference being that in some cases the cavity has preserved the true outline of the former occupant, while in others it has not.

The source from whence the barytes has been derived cannot at present be definitely determined. Barium salts are not infrequently found in saline waters, and the sulphates of barium and lime are often found in association, as occurs in the regions from which our specimens have been collected. In the case of the nodules, the baryta would probably form, in the first instance, a soluble bicarbonate, and then by a chemical reaction with some soluble sulphate be converted into barium sulphate. Why the barytes should show a preferential selection of these empty annelid chambers, as is assumed in these notes, is not very apparent, except on the general principle that most minerals in solution show a tendency to undergo precipitation on reaching a cavity in the rocks.

DESCRIPTION OF PLATE IX.

Fig. 1. Cast of vermiform-like object, entwined. Slightly under natural size.

Fig. 2. Cast of, apparently, two objects of a similar kind, closely adjacent or intertwined with each other. Slightly under natural size.

Fig. 3. Cast of similar object, showing irregular twisting. Natural size.

Fig. 4. Cast in which the coils are more regularly arranged in a spiral form. Natural size.

Fig. 5. Another example, in which the coils are wound at right angles to each other. The specimen is a fragment showing fracture at both extremities. Natural size.

Fig. 6. In this specimen the coils are wound around a central axis in one plane, having a discoidal form. A head-like termination of the coil is seen at the upper margin. This example forms an intermediate type between the worm-like casts on the one hand and the discoidal "buns" on the other. Natural size.

Figs. 1, 4, 5, and 6 agree in the diameter of their respective coils; and figs. 2 and 3 also agree with each other in this respect, being somewhat smaller in diameter than the others mentioned. In the two examples shown in figs. 2 and 3, slight constrictions occur in the body whorls (especially where the latter make an acute turn), which may have been caused by a succession of small bulgings of an annulated soft body as the result of longitudinal pressure. This feature, while quite distinct in the objects, is not well shown by the photographs.

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A Review of the Genus *Loricella* (Order Polyplacophora), with Notes on Features Previously Unnoted and Description of a New Species.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read May 8, 1919.]

Plate X.

The only recorded species of the genus *Loricella* was described by H. Adams and Angas in P.Z.S., 1864, p. 193, under the name of *Lorica angasi*, but later Pilsbry, in Man. Con., pt. 56, p. 238, very wisely separates it from that genus, and proposes the generic name of *Loricella* for its reception, distinguishing it from the genus *Lorica* as follows: "Sinus in tail valve a mere wave; jugal sinus lobed; girdle widest in front, not cleft behind"; but adds the note, "I have not seen this species, which is here figured for the first time from drawings made by Emerton for Carpenter."

An examination of a fair series makes it necessary to modify this generic description. The sinus in the tail valve in most specimens is considerably more than "a mere wave," although certainly not as deep as in the genus *Lorica*, and Dr. Pilsbry is quite in error in stating that the girdle "is not cleft behind," for in all my specimens from New South Wales, Victoria, Tasmania, and South Australia the girdle is very distinctly cleft, though only for half the width of the girdle. The cleft in the girdle probably did not show clearly in the dried specimens that Carpenter was dealing with, and this fact somewhat misled Pilsbry. This cleft and the character of the tail valve show some affinity with the genus *Lorica*, but on the other hand the large head and small foot, together with its markedly distinct girdle suggest that this relationship may be more seeming than real.

I therefore propose that instead of treating it as a section or subgenus of *Lorica*, as is done by Dr. Pilsbry (Man. Con., pt. 56, p. 233), it should be elevated to full generic rank.

As Adams and Angas' type of *Loricella angasi* came from Rapid Bay, South Australia, that name will have to be retained for the South Australian species. It is remarkable that in the original description no mention is made of the row of long, branching, coarse hairs, or of the strange spear-headed spicules attached to them, which are a prominent feature on the girdle of the South Australian form, and which is described herein for the first time. The only explanation is that the type was a worn specimen that had been washed ashore.

Dr. H. A. Pilsbry, whom I had the pleasure of meeting in Philadelphia last year, on looking at my specimens, was much interested in this strange feature, and considered that it well justified the separation of the South Australian form from that found in the other States.

Owing to the imperfections of both figure and descriptions, it is necessary to append a full description. As far as I am aware, *Loricella angasi* has only been figured in Dr. Pilsbry's famous monograph on Polyplacophora, pl. 51, fig. 9, the drawings of which were made by Emerton, for Carpenter, Dr. Pilsbry having no specimens to examine. In that figure short hairs are shown on the anterior portion of the girdle, but Dr. Pilsbry appends a note, "The hairs shown in the girdle, in fig. 9, are foreign to it."

LORICELLA ANGASI, H. Adams and Angas.
(Proc. Zool. Soc., 1864, p. 193.)

General appearance.—Shell broad, carinated; when alive the whole of shell is usually covered with limy encrustations and growing algae; when these are cleaned off the lateral areas are seen to be strongly raised and covered with close wavy ribbing. The pleural areas, closely covered with longitudinal wavy riblets; girdle, broad, the anterior portion is double the width of the posterior and is crenulate at margin, but in adult specimens this crenulation in the anterior portion is produced in a number of flattened finger-like processes, up to 4 mm. in length, and extending beyond the margin of the girdle.

Colour.—The anterior valve and lateral areas are terra-cotta, with the exception of valve 2, in which the lateral area is the same colour as the pleural area; in the pleural and dorsal areas the lighter markings are dull white, tinged with olive, and the darker markings vary from brownish-olive to light-brownish-olive. The girdle, while for the most part olivaceous, the margins and various patches are rosaline-purple, but this may be due to a red alga. Inside of valves white.

Anterior valve.—Very large and broad, strongly convex in the middle, apex recurved, the whole valve covered with closely-packed wavy riblets. The posterior margin finely serrated. The inside has 8 slits nearly equidistant, teeth finely pectinated, and on the upper side fluted.

Posterior valve.—This is the smallest of the valves, the mucro terminal, and much elevated; the posterior half of this valve is recurved, diagonal ridges strongly raised, and the dorsal ridge well marked. The whole valve covered with wavy longitudinal ribbing, with transverse growth lines.

Central valves.—Lateral area strongly raised and sculptured with closely-packed wavy ridges similar to the anterior valve, broken at irregular intervals by deep sulci following the growth lines; also in some of the valves the ribbing shows a subpustulose tendency; the posterior margin is finely serrated. Pleural area and dorsal area covered with closely-packed wavy longitudinal ribbing, which is decussated or bridged in the dorsal area and partly in the pleural area; eaves prominent; insertion plates fluted on upper side and very strongly toothed with sharp saw-like teeth; sutural laminae much produced; sinus broad and lobed.

Girdle.—In dried specimen 8 mm. wide in front, or without the flattened appendages, 5 mm. in front and half that width behind, cleft for half its width at tail, very closely beset with solid, irregular, minute scales. But the most marked feature is a large number of coarse, branching, brown hairs or spicules up to 4 mm. in length, placed in an irregular double row, spaced from 2 to 3 mm. apart in the anterior half, but hardly present in the posterior half. Each branch of these hairs has an ovate, spindle-shaped terminal, reminding one of a white stiletto, but they are too broad to be described by that term, and may be better described as sharply-pointed white cylinders or spear-heads, which are at their base twice the thickness of the hair to which they are attached. These strange white spicules are clustered thickly at the base of and along the centres of the flattened finger-like processes, before referred to; these are sessile, rising straight out of the girdle. There seems to be some relation between these spicules and the protruding portions of the girdle, as they and the hairs to which they are attached are only present opposite these. There are a few scattered about the girdle not in the main double row.

Measurements.—The specimen described in the foregoing is 67×41 mm. Another, taken at the same time, now in Mr. May's collection, measures 68×47 mm.; and one I found washed up on the beach at Aldinga Bay is 68×48 mm. When alive the girdle would add somewhat to the foregoing measurements.

Habitat.—I first took this shell alive at Marino in 1897, in a deep hole at lowest tide, and I believe no other was found at this locality until March 7, 1917, just twenty years later, when I found the two of which measurements are given above, both in the same hole, adhering to the upper side of a rock at lowest spring tide. All three were so densely covered with growth that they were most difficult to detect. I have twice found specimens washed ashore at Aldinga Bay, and Adams and Angas' type came from Rapid Bay, a little further down the gulf. Dr. Verco dredged a few specimens in the same gulf, so we may conclude that it is a fairly deep-water species.

Comparisons with other specimens.—I have one that I found washed up at Aldinga Bay, measuring 35×28 mm. dry, in which all the valves except 2 and 8 are rosy-pink; valves 2 and 8 are greyish, and only tinged with pink; the girdle is rosy-pink, except where it is opposite valves 2 and 8, where it is blotched grey and white. The characteristic spicules, before described, are present in all my South Australian specimens. The sculpture in the smaller one is subpustulose in some of the ridges, especially the anterior margin of the lateral areas; the posterior margin is more strongly toothed than is the case with the larger specimens. Dr. Torr has several of the smaller size that show the same pustulose character in the sculpture. A specimen 30 mm. in length, dredged in St. Vincent Gulf, exhibits the same "spear-headed" hairs, and a small one, 23 mm. long, preserved in spirit, collected at Aldinga Bay, has the girdle well clothed with hairs terminating in similar "spear-head" spicules.

Remarks.—All specimens examined, collected by Dr. Torr, Dr. Verco, and myself, show the "spear-headed" spicules, and none of those examined from the other States exhibit this character.

LORICELLA TORRI, n. sp.

Differs from *Loricella angasi*, H. Adams and Angas, in that the white, "spear-headed" spicules on the girdle, and attached to the coarse hairs in that species, are absent in this.

The coarse hairs on the girdle are branching, and are, where perfect, transparent at their apices, but the transparent portions are the same width as the hairs and evidently the growing points thereof, and are very different from the broad, "spear-head" processes of *Loricella angasi*. The Sydney shell shows more raised and stronger ribbing. The anterior valve has 8 or 9 distinct rays, or coarse ribs, in addition to the closely-packed wavy ribbing. In one specimen in my collection from Sydney Harbour, the closely-packed wavy ribbing is almost absent, and in this one the ray ribs on the anterior valve, and the anterior and posterior margins of the lateral areas, consist of rows of elevated pustules. I think it possible that this character is more or less common to all juvenile specimens from New South Wales, and that with age these prominent tubercles are either eroded or absorbed. All the specimens that have come under my notice are more olivaceous than the South Australian shell.

Habitat.—The type I collected in shallow water at low tide at the Quarantine Station, Sydney, New South Wales, in November, 1918. I am presenting same to the South Australian Museum. It appears fairly common at Port Jackson, and frequents much shallower water than is the case with the South Australian species. I actually found one on a large rock several feet above low-water mark. I have one dredged by Mr. Gabriel in 5 fathoms, at Western Port, Victoria, measuring 33×22 mm., in which the ray ribbing of anterior valve is well defined, but the closely-packed intermediate ribbing is hardly discernible, except near the margin; one of the coarse hairs on this specmen is 9 mm. long. Dr. W. G. Torr kindly showed me his Victorian specimens, which are similar to mine.

Tasmanian form.—Both Mr. W. L. May (of Tasmania) and Dr. Torr have been good enough to lend me their Tasmanian shells for the purposes of this paper. Mr. May writes that it is rare at Port Arthur. These Port Arthur specimens show a considerable divergence from most of the New South Wales shells, and are approached most nearly by the dredged specimen, before referred to, from Western Port, Victoria. The largest shell from Port Arthur is in Mr. May's collection, and measures 41×31 mm., has practically no decussation on dorsal or pleural area, but the smaller shell shows it to some extent; the riblets on the anterior valve are not as strong and the tail valve is more elevated than the New South Wales type. But the small shell from Sydney, before referred to, diverges from the type quite as much in these respects. I therefore do not feel justified in separating the Tasmanian Port Arthur shell from the New South Wales and Victorian ones; they all show the coarse, branching hairs on the girdle, without the strange "spear-head" processes that are present in the South Australian species.

Remarks.—The sculpture in this species shows a good deal of variation. Speaking generally, the ribbing is coarser and more defined in the northern shells and less conspicuous in the Tasmanian. But these characteristics are hardly sufficiently persistent to justify the making of a subspecies. It is just possible that there may be two shells in New South Wales, in which case one might be justified in separating the Tasmanian form. If there are no intermediates the small shell I have referred to might well be a second New South Wales species.

In conclusion.—In none of these specimens from New South Wales, Victoria, and Tasmania are the flattened finger-like processes margining the girdle developed beyond the incipient stage, and it is quite possible that this character may be peculiar to the adult shells of the South Australian species, but without the examination of a much larger amount of material from the other States I hesitate to quote this character as one of the distinguishing ones of the South Australian shell.

The measurements given in this paper show that the adult South Australian shell is much larger, often double the size, of its congener.

I am suggesting the name of *torri* for this species, after my friend Dr. W. G. Torr, to whom I am indebted for a good deal of material I hope to deal with in a future paper.

Addendum.

Since writing the foregoing Dr. J. C. Verco has sent me his stereoscopic microscope, and with the aid of this splendid instrument the following additional observations have been made:—

The so-called scales, with which the girdle is clothed, are of a distinct and peculiar character. The statement by Carpenter, published by Dr. Pilsbry (Man. Con., pt. 56, p. 239), that they "resemble grains of wheat set on end," is a very good one; they are bilobed, and shaped like the blunt or broad end of a grain of wheat, patches of them being level, almost like a cobble pavement; other patches are irregular, many standing up for more than half the length of the "wheat-grain" above the normal level. These bilobed, grain-like scales are, most of them, transparent and glassy; others, again, are opaque and white, but still with a glass-like appearance.

Between these "wheat-grains" the strange "spear-heads" push through and look like a cylindrical pointed spear-head made of porcelain, and are, I estimate, eight times the length of the scales.

Later, as the "spear-head" is pushed forward, a pale-brown, horny-looking tube, or stalk, is produced, which is heretofore described as a coarse hair, for want of better term, which, as it lengthens, buds. First the porcelain "spear-head" is produced, behind which the horny tube-like stem widens by the addition of an extra flute, ultimately becoming a distinct branch. In one or two instances a single stalk has branched six times and been furnished with six "spear-heads." These side branches are of a considerable length, often several times the length of the spear-headed apex. I believe the branches do not again bifurcate, although they appear to do so, due to the fact that three or four of these stalks come through the same aperture in the girdle, usually side by side rather than in a circle, as do the spicules in Acanthochitons.

The tubes, or coarse hairs, are pale horn-colour, highly polished, as if varnished, transversely striated; in some cases the striae are near together, but more usually forming somewhat distant rings for the whole length of the tube. In a few instances these striae are absent; in others the sulcae are broader and placed at greater distances, suggestive of segments or the knodes of a plant.

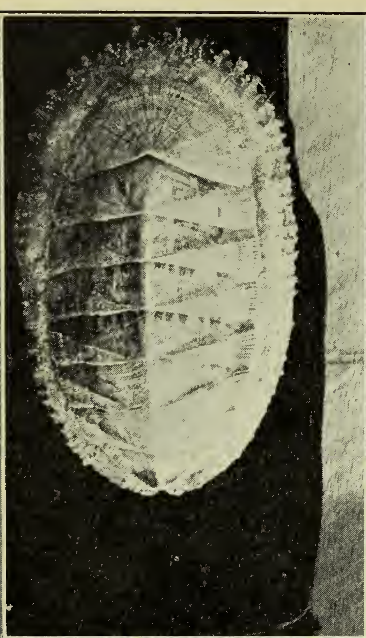

Fig. 1.

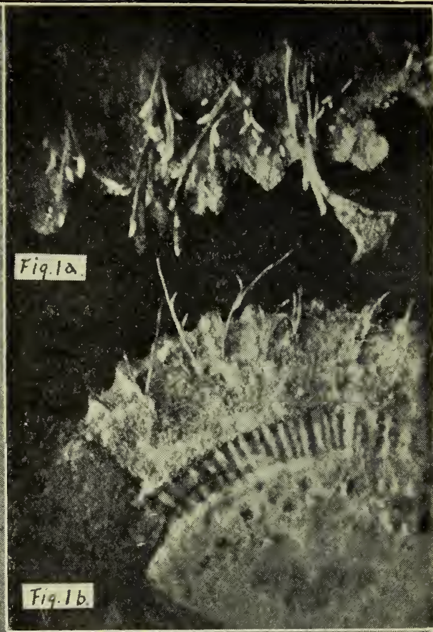

Fig. 1a.

Fig. 1b.

Fig. 1c.

Fig. 1d.

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The spear-heads vary a good deal, both in size and shape. Some are long and lanceolate, sharply pointed; others are globose and blunt; many are oblique, slightly scimitar-shaped; all are equally white and glossy.

As before stated, the longer hairs, or tubes, take their rise in clusters fairly equidistant midway across the girdle, and are placed opposite the strange finger-like processes, those nearest the shell measuring up to 4 mm. in length, but becoming shorter and shorter as the margin of the girdle is approached until along the centres of the finger-like processes they are nearly all unstalked, and form a closely-packed row of porcelainous spear-heads, some still partly buried in the girdle. Along the front of the finger-like processes the spear-heads are small and scattered, not adhering to the mid-line, as is the case further back.

To the question, What is the function of the strange coarse hairs, or tubes, and their peculiar apices, and what purpose do they serve? I can find no definite answer. I do not think their purpose is either that of decoration or protection, for in life the shell and girdle are covered with growth. Also, it is most strange that the allied form occuring in the other States should not have similar spear-headed terminals to the hairs; possibly they do have them at an early stage, and dispense with them in the adult form, though in the specimens examined there is nothing to suggest this.

One is struck with the points of similarity between the genus *Loricella* and the North American genus *Placiphorella*, belonging to the family Mopaliidae. Mr. S. Stillman Berry, in his valuable paper on "Chitons taken by the United States Fisheries steamer 'Albatross'" (U.S. Nat. Mus. Proc., vol. 54), figures several of this genus which exhibit the following similarities: The girdle is much wider in front than behind, the foot is short and broad, and for the size of the shell small; the girdle is adorned with remarkable hairs, although these are structurally very different, but in pl. 9, fig. 6, he shows the presence of some minute spicules that are somewhat similar, though much smaller, to the "spear-heads" on *Loricella angasi*.

I have presented the type of *Loricella torri* to the South Australian Museum.

DESCRIPTION OF PLATE X.

Fig. 1. Shell of *Loricella angasi*, Ad. and Ang., ×⅞, showing in girdle, slit, fringed margin, and spicules, p. 60.
,, 1*a*. Girdle of same, ×6, showing finger-like processes and spear-headed spicules.
,, 1*b*. Girdle and part shell of *Loricella torri*, n. sp., ×6, p. 62.
,, 1*c*. *Loricella angasi*, Ad. and Ang., ×2, underside showing animal.
,, 1*d*. Spear-headed spicules and girdle margin of same, ×20.

Notes on Australian Polyplacophora, including Descriptions of Two New Genera, a New Variety, and the Description and Proposed Recognition of Mr. Bednall's Stenochiton pilsbryanus.

By Edwin Ashby F.L.S., M.B.O.U.

[Read July 11, 1919.]

Plate XI.

ISCHNOCHITONIDAE.

Genus Stenochiton.

Zostericola, n. subgen.

Differs from *Stenochiton (sensu stricto)* in that the shell is short and broad instead of being elongated and narrow. It possesses the highly polished and unsculptured surface and minute girdle scales so distinctive of the true *Stenochiton*. It also lives on the same order of plants *(Fluviales)* or sea grasses.

The writer foreshadowed the establishment of this genus in the paper on *Stenochitons* (Trans. Roy. Soc. S. Austr., vol. xlii., 1918), and included the subgeneric name of *Zostericola* in the distribution list published in the same number of the Transactions.

The name *Zostericola* is derived from the name of the genus of plants upon which it is said to have been found, and upon which it no doubt lives.

Type *Stenochiton pilsbryanus*, Bednall.

Zostericola pilsbryanus, Bednall.

Introduction.—In my monograph on the genus *Stenochiton*, mentioned above, I referred to the impossibility of reconciling any of the known species with Mr. Bednall's descriptions and drawings of *Stenochiton pilsbryanus* (Proc. Mal Soc., vol. ii., pt. 4, 1897). I trusted that the type would have reached Mr. Iredale in London safely, as only by reference to the type could the matter be cleared up. Mr. Iredale writes me (February 16, 1919), "I think you are right in naming the shell that has been called *pilsbryanus*. I queried it, as it did not agree with Bednall's figures at all. However, no *Stenochiton* seemed like that figure. The type seems missing, as the specimens I have marked 'type' do not agree with the figure, nor have I seen the dissections." Thus no help towards the elucidation of the problem is likely to come from the late Mr. Bednall's collection, the material now being in the hands of Mr. Iredale, and reported upon by him as above.

When in Philadelphia last year Dr. Henry A. Pilsbry showed me some of the material that Mr. Bednall had sent him (at the time the description of *S. pilsbryanus* was written) as being the new shell. I easily identified in the material shown to me the three species *S. juloides*, Ad. and Ang.; *S. cymodocealis*, Ashby; and *S. posidonialis*, Ashby; all very small and juvenile.

It is therefore fairly evident that Mr. Bednall's drawings and descriptions were made from more than one specimen covering more than one species. I think it not unlikely that there was even a fourth species represented, as I did not see all the material. I therefore propose to refer the species I am describing hereunder to Mr. Bednall's species for the following reasons:—

(1) I am anxious to retain the names of my friend Dr. Pilsbry and my late friend Mr. Bednall as associated with the interesting genus of *Stenochiton*.

(2) It is desirable to keep our list of species free from those that are impossible of identification.

(3) The form I am describing corresponds most closely with the figure of the shell in Mr. Bednall's paper.

(4) Mr. Bednall's shell was practically from the same locality, "Troubridge Shoal, St. Vincent Gulf, on *Zostera*." Tapley Shoal is about 6 miles from Troubridge.

General appearance.—Broad and short, glossy, rounded, without sculpture; the anterior valve unusually broad, the last five valves tapering very slightly towards the posterior. The general contour of the shell closely resembles that of *Terenochiton matthewsianus*, Bednall; at a distance of a couple of feet it might easily be mistaken for that species.

Colour and markings.—In the dried specimen with the animal inside the anterior and posterior valves are antique brown (Ridgway's colour standard), shading in the centre valves to semi-transparent creamy-white, sparsely mottled with pale olive-green. A number of reticulate whitish markings commence at the posterior margin of the dorsal area, and spread fan-like anteriorwise. When disarticulated, and the animal cleaned away, the shell is very transparent. The brown anterior and posterior portions become pale-creamy and olivaceous, and the central valves transparent white and pale olive. Two wavy (broadly V-shaped) bands traverse both the pleural and lateral areas, also other olivaceous markings are present.

Anterior valve.—Unsculptured; under a high power the valve is seen to be covered with whitish spots, suggesting regular decussation, but the brownish-olive mottling so generally covers the valve that in many parts the white spots are indistinguishable. The shell is convex, evenly rounded and arched, about twice as broad as long, teeth well defined, with rounded, slightly wavy edges, eaves well developed, teeth propped or fluted, slits 16, inside whitish and glassy.

Posterior valve.—Unusually broad for this valve, being only slightly less broad than the median valves, mucro slightly anterior, posterior slope evenly rounded but steep, convex. The portion of shell anterior to mucro is distinguishable from the posterior part, being smooth and slightly paler in colour; growth lines are visible on the posterior portion, also a slight ridge divides the portions, starting at the mucro and running diagonally to the suture. Behind the mucro is another half-moon-shaped shallow ridge, making a sort of false mucro. Inside the shell is white and transparent, multifissate. I counted 9 clearly-defined slits with square, broad-ended apices in the small terminal broken portion, but did not disarticulate the other and larger part of this valve. The teeth are round-edged, and are fluted or propped on the inside as in the anterior valves, eaves distinct.

Median valves.—Uniformly smooth, glossy, and unsculptured; the anterior margin of the lateral area is slightly raised, in some of the valves, especially in valve 2. The dorsal area barely distinguishable, but is slightly raised and flatly beaked. Under a low power 4 lateral, wavy, longitudinal, olivaceous bands are easily seen; one valve has six of these bands on either side. When disarticulated and cleaned and seen under a high power some additional markings are revealed. The dorsal and pleural areas are very distinct from the lateral, being covered with longitudinal wavy lines of a pale green tinge; these to a certain extent merge into one another, giving the reticulate appearance before referred to. This system of marking also covers the broad and flat beak; the broad interspaces are white. The lateral area is evenly covered with pale greenish spots, which suggest small pustules, but I am unable to discover any rising in the shell. In some lights, especially daylight, the white interspaces look like white spots and the olivaceous markings like interspaces. The sutural laminae are large, produced to about half the width (longitudinal) of the shell, and separated by a wide sinus; teeth fairly sharp, not rounded as in the anterior and posterior valves, and I can find no sign of propping; 2 well-defined slits; inside transparent and glossy. The eaves under a high power are numerously notched, these being too shallow to term slits. The median valves vary in length, but are fully three times as wide as long, *i.e.*, the longitudinal measurement is one-third that of the lateral one.

Girdle.—Very narrow, and thickly clothed with minute, irregular, flattened scales, which do not appear to imbricate. Darkish blotches are noticeable opposite each suture.

Measurements.—The shell in the dried specimen is $5\frac{1}{2}$ mm. by 3 mm.; it is more than likely that a live specimen would measure 6 by $3\frac{1}{2}$ mm.

Locality.—I am indebted to Dr. Torr for the specimen described above, and he has loaned it to me for the purposes of this paper. He had it from the collection of the late Professor Ralph Tate. It is labelled in his handwriting, "Tapley Shoal, living on *Zostera.*" This shoal is about 6 miles from Troubridge lighthouse, south of Yorke Peninsula, in South Australia.

Type.—The type will remain in Dr. Torr's collection, but he has informed me that it will ultimately be placed in the South Australian Museum.

A second specimen, measuring just under 4 mm. by about 2 mm., and therefore half as wide as long, was collected by myself at Marino, probably on *Posidonia*, on February 19, 1910. These are the only two specimens that up to the present have come under my notice. This being a well-preserved, although a diminutive one, its colouration is more likely to be normal than is the case with the type. I therefore append a description.

General colour.—Serpentine green (Ridgway's Colour Standards, pl. xvi.). The valves 2 to 4 have the dorsal area outlined with a broad V-shaped white mark. The posterior and apical portions of anterior valve are white. The sides are broadly and irregularly banded with white. The girdle has a broad darkish blotch at the sutures; the two opposite the sutures of the anterior valve are black; there are seven irregularly-spaced blotches in front of same valve.

Shell.—The shell is more beaked than is the case with the type, and there is a slight elevation of the dorsal area near the beak in the first four valves. Starting at the posterior margin of the beak are a few shallow, circular elevations, which die away towards the middle of the anterior portion of the lateral area. These elevations are only seen in some lights with a high-power lens. The whole shell is highly polished and transparent.

PLAXIPHORA MATTHEWSI, Iredale.

(Proc. Mal. Soc. Lon., vol. ix., June, 1910, pp. 96-100.)

Frembleya matthewsi, Iredale (Dis. List. Austr. Polyplacophora, Ashby: Proc. Roy. Soc. S. Austr., vol. xlii., 1918, p. 85).

I notice this season that each of the three small specimens of the above shell that have fallen to my lot during this summer's collecting have a remarkable feature present on the girdles, previously unnoticed. On reference to my cabinet I find that this feature is present in all my specimens, which include the following localities: Marino, Cape Jervis, Encounter Bay, and Port Lincoln.

New feature.—The feature referred to is the presence of a large number of slender processes, which for want of a better term we will call spicules, surmounted with strange porcelainous heads. These are not cylindrical, as in *Loricella angasi*, and which were described in my earlier paper of this year, but are flat on one side and rounded on the other, and are curved like the blade of an oar or scull, but sharply pointed. The surface is highly polished and white, in some lights, showing a few transverse lines; the stalk, bristle, or spicule, as it is previously called, is in fully-developed specimens long and slender and much curved (sickle shaped) when dry. The size of these heads varies considerably; some are fully half the length of the stalk that supports them, others again are supported on long stalks and have shorter heads; all the heads are broad-based, curved, and pointed at apex. They take their rise chiefly near the outer edge of the girdle, but many are sessile, only the porcelainous blade can be seen pushing out of the girdle amongst the short ordinary spicules which form the girdle fringe.

Girdle spicules.—The species under discussion has three forms of spicules—if these oar-headed processes can be termed spicules at all. There are the long, coarse, dark brown spicules or bristles that take their rise in bunches at each suture; these are taper-pointed, like a needle. Then there are a great many short, transparent, rather blunt-pointed spicules that form the fringe of the girdle. Lastly, there are these organs that I have termed oar-headed spicules, the stalks of which are semi-transparent and pale brown.

Comparisons.—While all the specimens I have collected exhibit oar-headed spicules, I have two, given me by Mr. W. L. May, of Tasmania, from Port Arthur in that State, that show no such spicules, which of course may be due to careless handling, but although Messrs. May and Iredale refer this Port Arthur form to the species under review, there are certainly differences both in the girdle and in the sculpture, so that further investigation may not unlikely prove them distinct. Mr. May is endeavouring to obtain some fresh material. Then, again, I have a single shell that I collected at Port Lincoln, which is strongly carinated, but otherwise both in girdle and sculpture approaches the Tasmanian shells, and in this specimen also there is no evidence of the strange oar-headed spicules.

Family MOPALIIDAE, Pilsbry.

Kopionella, n. gen.

Differs from *Plaxiphora*, Gray—

(1) In having peculiar oar-headed girdle bristles or spicules.

(2) In having an elevated, recurved tail valve with terminal mucro.

(3) The minor differences detailed hereunder.

Differs from *Frembleyana*, H. Ad.

(1) In having peculiar oar-headed bristles or spicules.

(2) In the slits in the median valves being centrally situated and sinus, especially in tail valve, being much narrower.

(3) The minor characters detailed below.

Type.—Plaxiphora matthewsi, Iredale. The specimen described herein is being presented to the South Australian Museum.

Description and comparisons of further differences.—For purposes of this comparison *Plaxiphora albida* is used as typical of the genus *Plaxiphora*. In *P. matthewsi*, Ire., the upper side of the tail valve is very distinct from *P. albida*, Blain., in that the anterior and posterior margins of the tegmentum are so folded over as to form strongly-raised ribs; the mucro is terminal, much raised, and slightly recurved, as in *Loricella*. Inside the sinus is comparatively narrow and deep, whereas in *Plaxiphora* the sinus is wide. In the median valves of *P. matthewsi* the tegmentum of the upper-side is folded over to the inside, and forms there a strongly-raised rib, extending from side to side; in the anterior valve this folding forms a still deeper and sharper ridge. While there is the infolding in the *Plaxiphora*, this characteristic ridge is not formed. The teeth of the anterior valve are much more cleanly cut and less clumsy and thick than is the case in the *Plaxiphora*. The slits in the median valves show a striking feature in that that portion abutting on the slit is carried upwards under the eaves in two pillars.

Affinities.—It is a little difficult to know where the proposed new genus should be placed. Dr. Pilsbry points out (Man. Con., vol. xiv., p. 312) that the genera *Placiphorella* and *Mopalia* are separted from the *Plaxiphora* in that the tail valve of the latter is unslit, with the additional character in the former of "peculiar girdle bristles"; now the species under review has the tail valve unslit, as in *Plaxiphora*, but has, on the other hand, a striking character in its "peculiar girdle bristles."

I pointed out in my paper on *Loricella* some points of similarity between that genus and *Placiphorella*. Since writing my description and preparing figures of the new features noted in *P. matthewsi*, I have noticed Messrs. Iredale and May's remarks on this species in their valuable paper (Proc. Mal. Soc., vol. xii., pts. ii. and iii., Nov., 1916, p. 101), where they say, referring to *P. matthewsi*, "Receipt of well-preserved specimens from Tasmania shows that the species has no close relationship with *Frembleya*, the animal being obviously different. This is now being investigated, but in the meanwhile a nearer ally from a superficial examination might be *Loricella*."

The outward appearance of the tail valve certainly suggests *Loricella*, and the strange girdle bristles do still more so, but the unslit tail valve and the non-emarginate girdle show a closer affinity with the Mopaliidae, Pils. For the present I think we must leave the suggested new genus under Plisbry's family Mopaliidae, but future research may necessitate some revision of this family and that of the Liolophurinae.

Rhyssoplax torrianus, H. and H., var. klemi, nov.

Amongst the specimens of the above chiton collected by Dr. Torr and Mr. Klem at Corny Point, Yorke Peninsula, is a rather striking variant from the normal form. The usual deep, longitudinal sulci, edged with black, which traverse the pleural areas, are reduced in this specimen on some valves to three, on others four on each side, and the similar black dashes on the dorsal area vary from one to two on each side. Again, the sulci are hardly developed at all, and the black lines are most of them mere dashes on the posterior portion only, of the pleural areas. The general effect is rather striking, the shell looking decidedly bare of markings and sculpture. The specimen is in Dr. Torr's collection.

This variety appears sufficiently distinctive to deserve a name, and therefore I suggest that it be known as var. *klemi*, after the gentleman who was co-worker with Dr. Torr at the time it was collected.

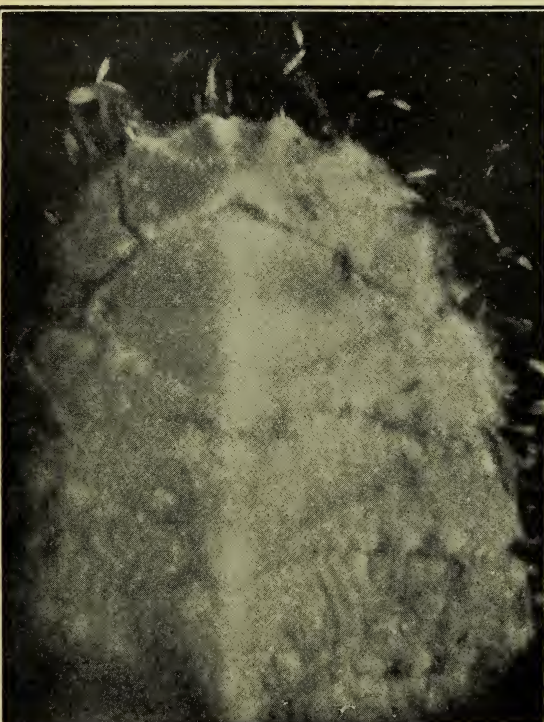

Fig. 1.

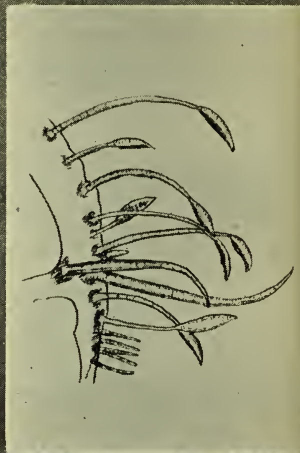

Fig. 1a.

Fig. 2.

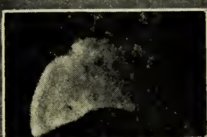

Fig. 2a.

Fig. 2b.

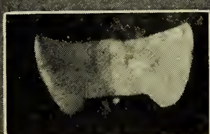

Fig. 2c.

Fig. 3

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ANISORADSIA MAWLEI, I. and M., subspecies SAUNDERSI, Ashby. (Trans. Roy. Soc. S. Austr., vol. xlii., 1918.)

In my "Notes on South Australian *Polyplacophora*" I gave a brief description of a new chiton, giving it the name of *saundersi*, and placing it, with some doubt, as a subspecies of *Anisoradsia mawlei*, I and M. Since my return from America my friend Mr. W. L. May has supplied me with some splendid specimens of that species, and I can now authoritatively say that I was wrong in placing it in that genus. I am sending the type to Mr. Iredale for his comments, as in 1917 I sent him a second specimen collected at the same time and place.

DESCRIPTION OF PLATE XI.

Fig. 1. Portion of shell and girdle of *Kopionella*, n. gen., *matthewsi*, Iredale, ×25, showing oar-headed spicules in girdle, p. 71.

,, 1*a*. Girdle of same, ×100, showing oar-headed spicules, sutural spicules, and fringe spicules.

,, 2. Shell of *Zostericola*, n. gen., *pilsbryanus*, Bednall, ×9, p. 66.

,, 2*a*. Anterior valve of same.

,, 2*b*. Median valve of same.

,, 2*c*. Inside of median valve of same.

,, 3. Shell of *Rhyssopplax torrianus*, H. and H., var. *klemi*, n. var., ×4½, p. 72.

NOTE.—The enlargements are only approximate.

A New Species of *Aganippe* from Kangaroo Island

By R. H. Pulleine, M.B.

[Read July 11, 1919.]

Plate XII.

Aganippe rainbowi, n. sp.

♀. Described from living specimen. Cephalo-thorax, 5 mm. long, 4·5 mm. broad.

Cephalo-thorax:—Obovate, nearly as broad as long, black or very dark brown, shining, entirely devoid of hairs except two or three stiff ones between the eyes.

Pars cephalica:—Elevated, arched, distinct segmental groove.

Ocular area:—Twice as broad as long, raised, arched, and provided with bristles.

Clypeus:—Narrow, sinuate, sloping forward, weakly indented at middle.

Pars thoracica:—Broad, fully curved at sides, sloping backwards, well-marked radial grooves.

Fovea:—Deep, short, procurved.

Marginal band:—Hardly sinuate, bare of hairs.

Eyes:—Front row very slightly recurved, the laterals equal in size or slightly larger than medians, are elevated on black bases, looking forwards and outwards. The medians, separated by rather more than their diameter from the laterals, are not elevated, and are separated from each other by one-half the diameter of a median eye. Posterior row procurved. The laterals are the larger, nearly equal in size to the antero laterals. They also are raised on elevated bases, looking backwards and outwards. The medians are small and not elevated, their inner border is convex, and their flat outer border is in contact with the base of the corresponding postero lateral. The distance between the postero medians is exactly that of the extreme outward limit of the antero medians.

Legs:—Similar in colour to thorax; relative lengths, 4, 1, 2, 3; the two anterior pairs armed with long black spines, 5 metatarsi, and tarsi of 1 and 2 scopulate. Tarsal claws well developed. Two posterior pairs less robust, clothed with long stiff hairs and an occasional spine.

Palpi:—Concolourous with legs, robust, clothed with stiff hairs and bristles, tarsal joint scopulate.

Falces:—Black, shining, well domed, forward. Teeth of rastellum minute, shining, brown. Fang long, curved.

Maxillae:—Warm, yellowish-brown, furnished over greater part with regularly-set short dark spines, and sparsi thin black hairs. Inner-margin clothed with dense long silky hairs or reddish-brown colour.

Labium:—About as broad as long, beset with about 20 short stout black spines in its central area.

Sternum:—Pale yellowish - brown, slightly arched, sparsely clothed with black hairs; broadly pyriform with well-marked margin. Posterior sigilla, circular away from margin.

Abdomen:—Dark brown, short, as broad as long, densely clothed with dark hairs, raised on papillary bases, giving the surface a markedly shagreened appearance. No dorsal design apparent. There are two well-marked circular lateral pits near the anterior margin of the dorsum, which slightly overhangs the cephalo-thorax. Under-surface lighter towards centre, clothed as on upper-surface with hairs arranged more or less in transverse lines. Posterior lung sacs large, transversely ovate, sparsely clothed with fine curved black hairs.

Spinnerets:—Concolourous, superior pair slightly longer than inferior pair and about half as broad at the base.

♂. Described from dried specimen. Cephalo-thorax, 4 mm. broad, 4 mm. long; abdomen, 4 mm. long.

Cephalo-thorax:—More circular than in the female, flatter, less elevated in front.

Fovea:—Short, procurved, radial markings indistinct.

Eye:—Formula identical with that of female, but eye area not bristled. Whole surface of thorax finely granular instead of polished, well-marked sinuate marginal border.

Legs:—More slender, lengths 4, 1, 2, 3; armature of strong spines, clothing less marked, no tibial mypophysis.

Palpi:—Brownish-black, no tibial apophysis, tibial joint large and inflated, unarmed, and sparsely clothed. Bulb concolourous, highly polished, stigma narrow, twisted, terminating in filiform style.

This is much the smallest species of *Aganippe* yet discovered. Several females and one male were collected in May, 1919, at American River, Kangaroo Island, South Australia. American River, so called, is really a deep bay nearly dividing Kangaroo Island in two.

The species was found close to the main settlement in rubbly clay banks, just above high-water mark, and at high tides the nests must be very close to, if not in actual contact, with the salt water. The nests are abundant and in places crowded together, so that a few cubic inches of clay will contain several nests.

The male, which unfortunately became dried, was in a nest like the females.

The largest nest taken is 6 cm. in total depth, straight, and densely lined. The aperture, which has a lumen of 8 mm., is closed by a stout, circular door with an attachment of one-fourth its circumference to the tube. The door is flat on the under-surface and roughly heaped up on the outer-surface. The total width of door 15 mm. wide, 11 mm. from hinge to front. In one nest twenty young were found with the female, but in none were egg-cases found. Another nest contained the complete cocoon of a leaf-cutting hymenopter.

Apart from its small size, the characteristics of this species are the dense spiny armature of the anterior two pairs of ambulatory legs and the palpi.

Types 1 (male) and 2 (female) in Australian Museum, Sydney; 2 (female), co-type in South Australian Museum, Adelaide.

DESCRIPTION OF PLATE XII.

Aganippe rainbowi, n. sp.

Fig. 1. Female, dorsal view.
,, 2. Female, ventral view.
,, 3. Male, palpus, lateral view.
,, 4. Nest, closed.
,, 5. Nest, open.

Fig. 1.

Fig. 2.

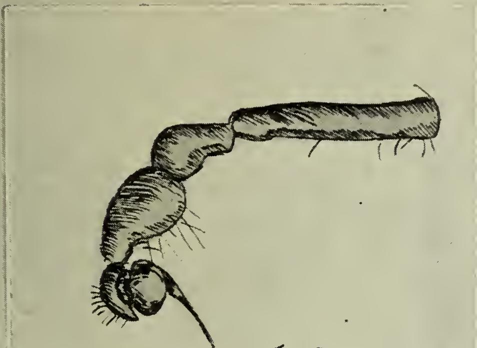

Fig. 3.

Fig. 4.

Fig. 5.

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Notes on the Occurrence of Aboriginal Remains below Marine Deposits at the Reedbeds, Fulham, near Adelaide.

By S. A. White, C.M.B.O.U.

[Read July 11, 1919.]

In 1893 Mr. William White, of the Reedbeds, conceived the idea of forming a small lake as a sanctuary for water-fowl and other birds. For this purpose he leased a piece of ground from his younger brother (now deceased) situated close to what was once a large swamp, and only a few hundreds of yards from the sand-dunes near Henley Beach South. This part of the country has been in the possession of the family from the first, my grandfather, the late John White, having settled there prior to the proclamation of the Colony in 1836.

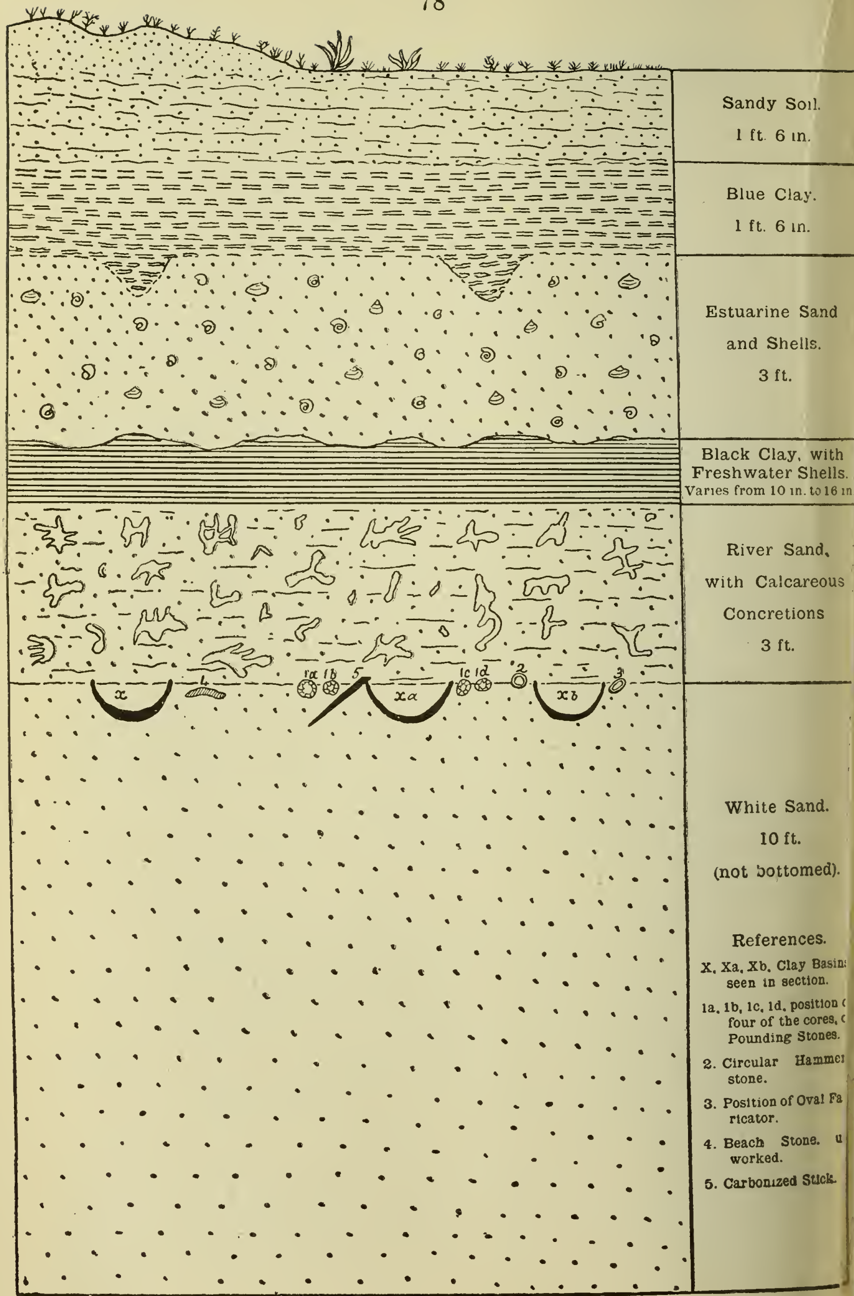
The excavation required in the formation of the artificial lake was carried out entirely by hand labour and hand tools, and the excavated materials were carted to one side and tipped, making a considerable mound around the lake. The cost of labour alone amounted to over £1,500, in addition to the personal costs and years of hard work done by the owner.

The locality where the work was carried out was swampy, being in the channel of the flood waters which sometimes came that way from the River Torrens, and yielded a swamp vegetation, especially the "cutting grass" *(Cladium filum)* that was used in the olden days for thatching.

The following is a statement of the various beds passed through in making the excavation: —

	Ft.	In.
1. Alluvial soil	1	6
2. Blue clay, very slimy and difficult to remove. At the bottom of this clay there were pockets of seaweed, some of which were quite decayed while other parts were well preserved ...	1	6
3. Hard, rusty-coloured sand, sometimes cemented together with sea shells	3	0
4. Hard black clay on fairly level bed	0	10-16
5. A peculiar formation of "swamp-stone," occurring in denticulated or stalactitic concretions, in yellow sand	3	0
6. Pure white sand (not bottomed)	10	0

As soon as the white sand was reached several clay-lined basins were exposed. The clay was from half an inch in thickness at the rim to 2 inches, or more, towards the bottom of the depression. Close to one of these basins was a length of black


Sandy Soil.
1 ft. 6 in.
Blue Clay.
1 ft. 6 in.
Estuarine Sand
and Shells.
3 ft.
Black Clay, with
Freshwater Shells.
Varies from 10 in. to 16 in.
River Sand,
with Calcareous
Concretions
3 ft.
x
4
1a 1b 5
xa
1c 1d
2
xb
3
White Sand.
10 ft.
(not bottomed).
References.
X, Xa, Xb, Clay Basin
seen in section.
1a, 1b, 1c, 1d, position
four of the cores,
Pounding Stones.
2. Circular Hamme
stone.
3. Position of Oval Fa
ricator.
4. Beach Stone.
worked.
5. Carbonized Stick.

carbonized wood, that was inclined towards the basin. This was probably the remains of a spear handle or pointed stick of hardwood that had been thrust into the sand alongside what, I believe, to have been a dipping-place for water by the aborigines.

Close to these dipping-places, and but slightly embedded in the surface of the white sand, were five cores of quartzite, that gave evidence of having been flaked by human hands. Four of these lay in pairs, quite close together, just as if the owners had laid them down after using them, probably for grinding their food.

The excavation was carried down another 10 feet, through the white sand, but as this bed was of the nature of a quicksand, great difficulties were met with in its removal, for when left for a few hours the sand would cave in and reach its former level, so that after a depth of 10 feet was reached in this bed the work was stopped without reaching its bottom.

It may be said that the benevolent intentions of the owner of the ground were to some extent realized. The surroundings were planted with a variety of native shrubs and trees which afforded both shelter and food for the birds, and these soon took advantage of this sanctuary, where they nested and became exceedingly tame, as did also the land and water snakes, which made friends with their human protector, whom they came to recognize. In the course of time the proximity of population and frequent raids of trespassers nullified the main objects for which the lake had been established.

The clay basins, which I suppose to be dipping-places of the aboriginals, were all on the same level, two were fairly close together, while the third was further apart. I closely examined the hard clay to discover, if possible, finger-prints, but without success. Anyone seeing these basins could form no other idea but that they were made by man.

I have never seen anything resembling this kind of construction by the aboriginals of Australia, but strange to say, at a place called Kisimayu on the East Coast of Africa near the Somali Land border and right on the coast, I found some years ago natives making mud-lined basins in the sand to hold water. These were very like the ones described in this paper, only for shape, the African basin being much longer than they were wide, while two of the Australian ones were almost circular in shape, the third being a little depressed on the sides. The clay which composed these basins was dark in colour and very hard, the sand had drifted into all three, and it was only when a workman cut through one that their presence was made known. On discovering a second one the sand was cleared away, but the basin evidently had cracks in it, and would not stand its own weight, and fell to pieces. The carbonized wood was very distinct, and the outline of the spear or pointed piece of wood could be followed quite easily, but as soon as an attempt was made to remove it from its bed in the sand it fell to pieces.

The large round hammer-stone and the smaller one with chipped sides and ends were found in the white sand and were elevated some 6 or 8 inches above the level of the clay basins and the chipped cores, or grinding-stones, but in a line with them and on the extreme right of the sketch-plan. I think it is quite possible that this raised position upon which the two stones worked by the natives rested was due to the sand being forced up from below, for, as I have already said, when the water level in this sand bed was reached, in spite of 2 or 3 feet of sand having been taken out, in a few hours it had risen to its original level. There were no shells seen in this white sandy bottom, although sea-shells were met with in numbers higher up.

In the early days, when the blacks were numerous on the Adelaide Plains, they pulled up the roots of flags and pounded them between stones prior to cooking. One strangely-shaped stone which may have been used by the aborigines, added to the objects already described, were all that remained to indicate the occupation of the ground by a tribe of blackfellows that must have long since disappeared.

I have to thank Prof. Howchin, F.G.S., for his advice and interest in this subject. The Professor was good enough to accompany me and view the site of the excavation, and I am pleased that he will add his valuable scientific views upon the subject.

The section shown in the accompanying diagram is based on particulars entered in my note-book at the time of the excavation, and is drawn to scale.

Supplementary Notes on the Occurrence of Aboriginal Remains discovered by Captain S. A. White at Fulham (described in the preceding Paper), with Remarks on the Geological Section.

By Prof. Walter Howchin.

[Read July 11, 1919.]

Remarks on the Beds passed through in the Sinking.

The particulars supplied by Capt. S. A. White relate to a vertical section of over 20 feet. Samples of several of the beds passed through have been kindly placed at my disposal for examination by the author of the paper, and the following remarks have reference to their geological features. The numbers prefixed to the paragraphs correspond to the respective beds in Capt. White's descriptions.

Bed No. 2.—The blue tenaceous clay, underlying the surface soil, probably represents the settlement of fine clay in the flood waters of the River Torrens when the ground was slightly above sea level, or the stage when the salt and fresh waters commingled; the pockets of sea-weed in the lowest portions of this clay give evidence of this.

Bed No. 3.—This bed, 3 feet in thickness, represents the characteristic marine sands and estuarine fauna which form the banks of the Patawalonga, in the nature of a raised sea bed. In the sample submitted to me I observed the following mollusca:—*Ampullarina quoyana*, *Trochoconchlea constricta*, *Risella melanostoma*, and *Nassa pauperata*, all of which are common estuarine forms in the adjacent waters. The matrix is a slightly-cemented, somewhat coarse sand, mottled with iron stains. This bed gives evidence that the estuary of the Patawalonga Creek formerly reached this far north, about half a mile beyond its present limits. Its upper surface has been rucked by two channels of erosion subsequently to its deposition.

Bed No. 4.—Beneath the raised sea bed, as described above, is an indurated black clay with its upper surface showing a plane of erosion, varying in thickness from 10 inches to 16 inches. This is evidently a freshwater deposit, laid down in marshy ground that carried an extensive vegetation of some kind. No plant remains can be detected in the main body of the clay, but near the top of the deposit a somewhat lighter-coloured clay occurs in which are seen the shells of the freshwater snail, *Limnaea*. When a portion of the black clay was placed in water it passed down to an impalpable black mud, and after washing, left a residue of exceedingly fine white sand, mixed with black granules of a carbonaceous kind.

Bed No. 5.—Only the stalactitic concretions were available for examination from this geological horizon. The particular example shown me by Capt. White is 8 inches in length and numerously branched, reticulated and denticulated. Its composition is that of a fine sand calcareously cemented. Nodules and variously-shaped concretions of this kind commonly occur in deposits of fine alluvial sand, and can be found under such conditions in the banks of the River Torrens near Adelaide. They were also present in the alluvial bed, exposed under marine deposits, in the excavation made for Fletcher's Graving Dock.(1) The bed containing these nodules at the reedbeds is undoubtedly of freshwater origin, probably laid down as river wash.

Bed No. 6.—The white sand which formed the lowest bed in the section, and was not bottomed, has all the appearance of a wind-blown sand. It contains no organic remains, is of uniform grain, and is practically free from any cementing agent. In the excavation it had the character of a running sand which flowed in as fast as it was shovelled out and stopped all further sinking. It was probably formed as an ancient sand dune, the base of which is below the present sea level.

The Stone Implements.

The stones showing aboriginal workmanship were of three kinds: pounding-stones or cores, a hammer-stone, and a fabricator.

1. *Pounding-stones.*—There are five belonging to this class, and these exhibit certain features in common, having a flat base and are roughly chipped in a way that might make them convenient for handling. The general form is very like the cores that are left after flakes have been struck off for making knives or scrapers, but the chippings have been too irregular and ill-shaped for such a purpose. Capt. White's suggestion that they may have been used for crushing, or pounding, is therefore probable, although the flat faces give no sign of wear.

Lithologically these pounding-stones belong to two kinds of siliceous rocks. Four of these have been obtained from boulders of quartzite washed down from the hills in the vicinity of Adelaide. The fifth is a siliceous rock, of coarser grain, and the cement consists of colloid silica. The four first-mentioned are of Cambrian age and are of metamorphic origin, while the last-named is of Recent age and formed part of the consolidated sands of the older drainage system of South

(1) Howchin: "Remarks on a Geological Section at the new Graving Dock, Glanville, with special reference to a supposed Old Land Surface now below Sea Level" (Trans. Roy. Soc. S. Austr., vol. x. (1887), p. 31).

Australia. One of the quartzite specimens, the smallest of the four, shows conchoidal fracture in the flat face and has been carefully chipped into an almost circular outline at the base.

2. *Hammer-stone.*—This is a very siliceous quartzite, $3\frac{1}{4}$ inches in diameter, circular in outline, thick, and flattened on two sides. Weathering has removed what was probably small granules of kaolin that were interspersed with the quartz grains, leaving the stone somewhat open. It is also bleached to a white colour, probably the result of deoxidation through contact with vegetable matter in the beds. It gives evidence of extensive use on the edge which has been worn back to a flat face about an inch in width.

3. *Fabricator.*—This tool is an oval-shaped, flattish pebble, $2\frac{3}{4}$ inches in the greater diameter, the parent rock being the very fine-grained quartzites that make a prominent feature at Sellick Hill. This class of stone, on account of its fine grain and conchoidal fracture, was a favourite stone with the aborigines of the Adelaide tribe for making their implements. It occurs on the beach and in the paddocks along the coast between Sellick Hill and Marino. The example found in the Reedbeds section is perfectly typical in its evidence of wear. The edge is much worn, especially a little aside from the obtuse ends of the stone, arising from the manner of its use in striking off flakes, and there is also considerable wear on the two flat faces at right angles to the former. After extensive use these fabricators assume a cruciform outline. No stone flakes, knives, or other worked stones were found where these implements occurred, but the presence of this fabricator proves that such definitely shaped stones were in use at the time to which the remains belong.

4. *Casual Stones.*—Two stones of an indefinite character were found at the same place. One a rough chip of weathered quartzite, circular in outline and having a diameter of $2\frac{1}{2}$ inches. The other, a flat, water-worn, elongated stone, about 6 inches in length and $1\frac{3}{4}$ inches in breadth, belonging to the purple-slates series of the Upper Cambrian. Stones of this kind are common as beach stones on the local shores; it gives no signs of having been used in any way, but it could only have occurred in the position in which it was found except by human agency.

The Age of the Aboriginal Remains.

The mean level of the site on which the excavation was made, according to official figures, is at or about high-water level. The situation is near the western margin of the flood waters of the River Torrens over the area known as the Reedbeds, and about half or three-quarters of a mile to the northward of the highest position of the Patawalonga Creek. From Capt. White's section it is seen that at present there is three feet of blue-clay and alluvium at the site covering the estuarine deposits. It is probable that the silt laid down by the flood waters of the Torrens is responsible for damming back the tidal waters of the Patawalonga to the extent mentioned above.

The position in which the aboriginal remains were found, *viz.*, 10 feet from the surface, places them either at or a little below low-water mark, while immediately above them is a fluviatile bed, 3 feet or more in thickness, capped by a fresh-water lagoon deposit. Following these river and swamp conditions we find an incursion of the sea over the area which resulted in the laying down of 3 feet of estuarine sediments.

At the time of the human occupation of the site, neither the river nor the sea had covered the locality, which was occupied by sand drifts, and it was on these sand hills that the aboriginals were camped. As the ground was excavated by Mr. White, sen., in these blown sands to a depth of 10 feet below present low-water mark, there seems very clear evidence of a sinking of the land to the extent of several feet, at least, since the aboriginal camp was occupied.

Evidences of alternations of level on the coast are supplied at other places. The interbedding of marine and freshwater beds at Glanville *(loc. cit.)* may be compared with the section now described, both of which show that, within recent times, the land has stood higher than it does at present.

No evidence of aboriginal remains have been noted, hitherto, in South Australia other than in the most superficial deposits. The case before us appears to have a higher antiquity than any previously noted. The suggestive points are:—*(a)* The sand hills in which the aboriginals formed their camp are now below sea level; *(b)* in the interval separating that time from the present there have been several important changes in the physical condition of the neighbourhood, the sand hills gave place to a river course, the sediments of which have since developed stalactitic concretions; after which, the river stage passed into that of a swamp; then followed an incursion from the sea; and, in more recent times, the area has been covered with mud laid down by the stagnant waters of the Torrens. These successive changes require a considerable length of time for their accomplishment and an undoubted antiquity for the human remains. At the same time it must be noted that the materials used by the aborigines of that day, as well as the types of implements and the methods of manufacture, are identical with those adopted by the latest representatives of the race.

A Contribution to the Study of Habronemiasis: A Clinical, Pathological, and Experimental Investigation of a Granulomatous Condition of the Horse—Habronemic Granuloma.

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[Read August 15, 1919.]

Plates XIII. to XV.

Contents.

A.—Introduction.

In 1916 the present writer recorded the occurrence in Australia of a granuloma which, in his experience, was most frequently found affecting the external genitalia of the horse. The condition was found to be of rather infrequent occurrence. It was first observed in 1912, and from this time onwards an occasional specimen was obtained. It was not until the early part of 1914 that the granuloma was found to be due to a larval Nematode.

These preliminary observations were recorded, and up till that time no record of the occurrence of the condition in Australia had been made.

The condition was described under the name of habronemic granuloma, and the opinion was expressed that it was none other than the granulomatous affection found commonly in the horse and ass in various parts of the world, and known usually as "summer sores," or "granular dermatitis." An hypothesis was advanced that a biting fly was in some way responsible for the introduction of the larvae into or beneath the skin of the animal, and as a larval *Habronema* had been described as occurring in *Stomoxys calcitrans*, it was thought that this fly was incriminated.

The present communication recapitulates the original observations, and records further observations and experiments. After an investigation into the life-histories of the three species of *Habronema* found in the stomach of the horse, and after an experimental investigation of the cause and nature of the tumours, the original hypothesis has now to be considerably modified.

Since the disease was first recorded as occurring in Australia, Lewis and Seddon (1918) have recorded the occurrence of the condition in the region of the conjunctiva of horses in Victoria.

Place (1915) in a previous publication had attempted to prove that the occurrence of malignant neoplasms in the orbit of the horse was commonly associated with the presence of larval Nematodes in this situation, and although he incriminated a larval *Habronema*, there was no record of the worm having been isolated and identified.

A further macroscopic and microscopic study of the granuloma occurring in horses in the northern parts of Australia, and commonly called "swamp cancer," has been made, and the observations are outlined below.

The literature bearing on the subject of "summer sores" and other similar conditions is reviewed and discussed in the following paper.

Macroscopic and microscopic examinations of a granuloma found affecting horses in the Solomon Islands are also recorded below.

B.—Granulomata as found in Southern Australia.

Distribution.—Up to the present these granulomata have only been met with by the present writer in the northern parts of Victoria and in South Australia (the only parts of Australia in which the writer has worked).

On the whole they appear to be more common in South Australia than Victoria. There is no reason to believe that they do not occur elsewhere in Australia, but it is probable that they are to be found more commonly in the warmer parts.

Occurrence.—These tumours have only been met with during the summer and autumn months of the year. They occurred in stable-fed animals, and a large proportion of the cases have been stallions which have been kept in the stable for longer periods than ordinary working horses.

Site.—The tumours are found most frequently upon the glans penis at the urethral orifice, but also quite commonly on the sheath. When they occur elsewhere they are found most commonly on the limbs. Only two cases where the lesions have occurred in parts other than the penis and sheath have come directly under the writer's notice. In these cases the tumours were situated in the metacarpal region and in the region of the hock, respectively, and were accompanied by lesions in the usual site.

In February, 1917, through the courtesy of Mr. H. R. Seddon, Melbourne University Veterinary School, the writer had an opportunity of examining a specimen of similar character taken from the *membrana nictitans* and lower eyelid of a horse. Mr. Seddon was informed by the sender that lesions were fairly frequently observed in this situation.

Lewis and Seddon (1918) have recorded the occurrence of similar lesions in the conjunctiva of the horse.

There seems to be no doubt that, as the knowledge of the characteristics of these granulomata becomes more widespread, they will be found to occur quite frequently in situations other than the external genitalia.

Duration.—The tumours appear fairly suddenly, and grow rapidly for the first two or three weeks. From this time onward they gradually enlarge, and they usually show no tendency to disappear, although there is some evidence to show that occasionally the lesion may be quite transient. Most of the tumours met with have been removed surgically, so that there has been little opportunity of observing the duration under natural conditions. In one case, however, the tumours persisted for several months, and, although decreasing in size, did not completely disappear even during the winter.

Clinical examination.—Typical tumours of several weeks' duration are recognized by their situation, their tough fibromatous nature, and by the appearance of small yellowish points lying beneath the mucous membrane or the unpigmented epithelium or, if ulceration is present, in the floor of the ulcer. They are found to be attached to and involving the skin. Lesions of only several days to two or three weeks' duration are more difficult of recognition, for they have not developed the characteristic yellowish points. Ulceration has rarely occurred at this stage. A history of a more or less sudden appearance, without any evidence of injury or bacterial infection, may help one in making a diagnosis.

Macroscopic examination.—The tumours may be single or multiple, and those of some weeks' duration are usually ulcerated on the surface.

When situated on the glans penis they vary in size from that of a pea to larger than that of a walnut. The largest specimen examined measures 5 cm. in length, 2·5 cm. across the broadest portion, and 2 cm. in depth. The tumours on the sheath attain a greater size, one specimen measuring 6·5 cm. across the larger diameter, 4·5 cm. across the smaller diameter, and 2 cm. in depth. Much smaller tumours, varying in size from that of a lentil to that of a pea, and showing a single yellowish caseous area in the centre, are sometimes seen, and are usually multiple.

On section of a typical tumour of several weeks' duration it is seen that the tissue is tough, firm, and fibrous, greyish to pinkish in colour, and contains scattered throughout the mass irregular, yellowish, caseous areas varying in size from points just visible to the naked eye to areas about 1 mm. in breadth by 4 or 5 mm. in length, or even larger. In tumours from the penis these caseous areas lie closer to the urethral than the external surface.

At times these caseous areas may contain some calcareous deposit. They may be situated closely together or scattered sparsely throughout the tumour and, in the older lesions, may be fairly easily enucleated. On enucleation it is seen that in each individual lesion they have much the same consistence and colour, but vary in form. Those from an older lesion are irregular in shape, yellow in colour, and hard, often presenting a branching appearance.

The points of caseous tissue seen on a cross section are found to be parts of a larger area. No transition between an early, small, and an old, large caseous area is to be found, nor is there any evidence of a young bud or extension.

On section of an early lesion, one of two to four weeks' duration, it is seen that the tissue is less tough and pinker in colour. On careful examination small, pale-yellowish, caseous areas are seen scattered throughout. These are much smaller, paler, and softer than the areas seen in older lesions, and are enucleated with difficulty.

The rather denser nature of the tissues in the glans penis apparently prevents the tumours reaching the size they attain in the looser tissues of the sheath, and, likewise, the tissue reaction is greater in the tumours from the latter situation.

The appearances of the lesion removed from the metacarpal region of the case mentioned above vary somewhat from those found in lesions from the penis and sheath. Beneath the ulcerated surface there is dense, sclerosing, fibrous tissue extending 5 mm. in depth, which has probably resulted from treatment with antiseptics. Beneath this is looser fibrous tissue containing translucent, greyish areas, somewhat circular in shape, and containing sometimes a yellowish point.

The lesions observed by Lewis and Seddon were of the nature of a granuloma, involving the inner canthus of the eye and the membrane associated as a rule with irritation of the cornea and lacrymation. Yellowish necrotic areas were seen in the submucous, and sometimes the subcutaneous tissues. They were found on both surfaces of the membrana and in the skin of the lower lid and palpebral portion of the conjunctiva.

Microscopic examination.—The microscopic picture is typical, but varies with the age of the lesion. In the older lesions, where it may be impossible to demonstrate any casual organism, the tumours nevertheless present quite a characteristic histological picture.

In a section of a tumour from the glans penis it is seen that the epithelium is usually ulcerated about the summit of the growth. The ulcerated surface consists of ordinary granulation tissue, in which are many capillary blood vessels and a marked infiltration of the tissues with eosinophile leucocytes. At times caseous areas are seen on the ulcerated surface. At the edge of the ulceration the *stratum corneum* is seen to be slightly thickened, while the *rete mucosum* shows hypertrophic changes, anastomising processes dipping deeply into the *cutis vera*. The *rete mucosum* at this point is usually slightly infiltrated with eosinophile leucocytes. The epithelium covering the tumour in the other situations sometimes shows slight hypertrophic changes, but it is otherwise normal in appearance. The *cutis vera* is normal in these situations, except for a slight invasion with eosinophiles. Immediately under the *cutis vera* the eosinophilic infiltration is seen to be very marked. The eosinophiles may be so numerous as to fill all the lymph spaces, leaving only a more or less fine connective tissue stroma supporting them. There is an increase in the small blood vessels with well-defined walls. There is hyperplasia of the fixed connective tissue cells. Roughly circular areas, consisting of embryonic connective tissue cells with some mononuclear leucocytes, but with few or no eosinophiles, are seen.

The caseous areas vary slightly in size; they have well-defined margins and take acid stains intensely. Tissue reaction round these areas appears to depend on their age. There is a proliferation of the fixed cells and commonly a marked epitheloid cell reaction with the formation of multinucleated cells. Sometimes there is a well-defined fibrous capsule. The nuclei of the cells within the areas show some pyknosis, and the chromatim remains for some considerable time. The protoplasm of the cells is apparently fused. All tissues are included in this necrosis, and the indistinct forms of blood vessels and connective tissue strands can be detected. In some of the areas a calcerous deposit may be seen. More or less in the centre of the necrotic areas are seen either circular or ovoid spaces containing *dêbris* and a few leucocytes. These represent the spaces at one time occupied by, and the remains of, a larval Nematode, and may appropriately be termed "worm canals." Larvae or *dêbris* are not found in all sections. This may be due either to the fact that the section does not necessarily cut that portion of the necrotic foci containing the larvae or to the complete disintegration of larvae or *dêbris*.

In some of the earlier lesions the larva is often to be seen distinctly. It is easy to demonstrate the clear, homogenous, finely-ridged cuticle, the musculature lying beneath, and the primitive alimentary canal. The section may be transverse, oblique, or longitudinal, and there may be more than one section of the larvae in a necrotic area. In one area seven transverse or oblique sections were seen. These probably represent as many individual larvae. For the most part, however, only one worm is seen in each necrotic area, and it is always more or less twisted and curved.

In other parts of the section the worm is found surrounded by only a small necrotic area. Often oblique and transverse sections of the worm are seen extending in a more or less regular line across the field of the microscope, representing the twisting and curving of one organism.

In some lesions examined many larvae have shown marked degeneration with a well-developed necrosis of the surrounding tissues, while other forms have been well preserved, and have caused little or no necrosis of the tissues. This suggests that, in some cases, the larvae have made their appearance in the tissues not by one massive invasion, but by smaller invasions repeated over a certain period of time. For the most part, however, all larvae in a given lesion appear to be in approximately the same state of preservation or disintegration. All the larvae seen in the different lesions examined have apparently been dead, but the retrogressive processes vary markedly in extent in different tumours.

In the older lesions it is not possible to determine the exact nature of the material contained in the circular or ovoid spaces in the necrotic areas, but in the light of the knowledge gained from examining earlier lesions, there can be no doubt that the material is the *débris* of a larval Nematode.

It must be insisted here that in the older lesions one may be unable to detect any degenerated larvae, or even the spaces which they at one time occupied. This fact renders it important that the histopathological picture in all its variations should be thoroughly studied and understood. If this is done a diagnosis can usually be made, in spite of the fact that no casual organism can be demonstrated.

The foregoing descriptions of the microscopic appearances apply equally to tumours from the penis and from the sheath, except that in the latter situation the tissue reaction is far more marked and the necrotic areas more diffusely scattered throughout the tumour. In both situations there may be marked endothelial proliferation in the intima of the arterioles. This is often seen in the deeper parts of the tumour. Sometimes there is thrombosis of the vessels. The necrotic areas, however, are in no way associated with the vascular changes, but are apparently due entirely to decomposition products originating in the degenerating larva.

The microscopic appearances of the lesion from the metacarpus vary somewhat from those described above. The tumour consists throughout of dense fibrous tissue, in which areas of embryonic connective tissue cells with an infiltration of mononuclear leucocytes appear as islands. These areas are usually somewhat circumscribed, and in some of them are found degenerated larvae with slight surrounding tissue necrosis and the formation of multinucleated cells. There is a diffuse infiltration of all the tissues with eosinophile leucocytes. There is little formation of new tissue apart from the areas of hyperplastic connective tissue cells and some thickening of the dense subcutaneous connective tissue.

The following is the description of the microscopic appearances of the conjunctival lesions observed by Lewis and Seddon:—"From a study of the earliest lesions examined, *viz.*, those of Case I., the parasites appear to occur primarily in lymph spaces. Only odd parasites or portions (in section) are found apart from the necrotic material. The presence of the parasites gives rise to small-celled infiltration as a tissue reaction, followed by an aggregation of neutrophile leucocytes and eosinophiles followed by necrosis of cells. While necrosis is in progress around the parasites one finds at the periphery of the mass large fibrous tissue cells massing together along with giant cells. The tissue between the areas is composed of typical granulation tissue, with eosinophiles and proliferation of endothelial cells and fibroblasts. There is also in one section some ulceration of the epidermis and some warty condition of the epithelium similar to what is met with in other ulcerative conditions."

It will be seen from this description that the change is essentially the same as that described above, varying mainly in the degree of tissue reaction.

The larval Nematode.—On account of the difficulty of obtaining early lesions, few opportunities of minutely examining larvae have arisen. However, larvae have been separated out from the tissues, and most of the important characteristics have been determined.

The method has been to separate the small necrotic areas from the tissues of an early lesion. These have been softened with pepsin or trypsin, washed, then lightly crushed between two glass slides, dehydrated and cleared with carbol-absolute alcohol. By gently moving and pressing the cover-slip placed over the portion of crushed tissue, one has been successful in forcing the larva out of the canal it occupies. The larva has never been removed unbroken, but by piecing the broken portions together the main external characteristics have been clearly defined.

As far as can be judged the larva is approximately 3 mm. long by 40 μ to 53 μ broad. The anterior extremity tapers slightly at the head, which is rounded. The mouth is surrounded by thin prominent lips. The posterior extremity tapers and terminates in a pointed tail, which is rounded at the tip to form a small bulb furnished with minute spines. The anus opens at about 83 μ from the point of the tail. The tail is curved rather sharply backwards. There are apparently no transverse striations of the cuticle, but in sections fine longitudinal ridges are seen. These longitudinal ridges are only seen in transverse sections of the larva. The internal anatomy of the larva has not been accurately determined. The oesophagus is long, and the intestine occupies the main part of the body cavity.

The description of the larva as found by Lewis and Seddon agrees closely with the above. They do not mention the occurrence of fine longitudinal ridges in the cuticle, but in the specimen shown the present writer by Mr. Seddon these longitudinal ridges were plainly to be seen. Their presence, as will be shown later, is of importance in the identification of the larva.

From the foregoing it will be seen that the worm is an immature Nematode, and that it closely resembles the sixth larval stage of *Habronema muscae* as described by Ransom (1913).

There is little or no direct evidence as to the mode of entry of the larvae. As *Habronema muscae* was the only species the life-history of which had been determined, it became necessary to determine the life-histories and morphology of the other two species of *Habronema* before it was possible to attempt to identify the species of larva responsible for the production of the lesions.

Observations on the life-histories of the three species of *Habronema* were therefore made, and these will be outlined before the mode of entry and specific identification of the larva are discussed.

Obsrvations on the Life-histories of the Three Species of *Habronema*.

Since Carter first described the presence of a Nematode worm in the head of a house-fly in 1861, many other workers have observed and recorded a similar occurrence.

Ransom (1913) has shown that the embryos of *Habronema muscae* are taken up by the larvae of *Musca domestica*, that they develop through larval stages in the fly larvae and pupae, and that the final larval stage of the worm is reached in the adult fly, and is usually found situated in the head and proboscis.

Linstow, in 1875, described a Nematode larva in the head of *Stomoxys calcitrans* which resembled the larvae found in *Musca domestica*, but which he named *Filaria stomoxeos*. Harvey Johnston (1912) recorded the finding of a larva resembling that of *H. muscae* in *Stomoxys calcitrans*, and a similar larva in *Musca vetustissima*.

Ransom expressed the opinion that the larvae found by Linstow and others in *Stomoxys calcitrans* might possibly be the larva of *Habronema microstoma*.

At the time of starting these experiments nothing more than the above was known of the life-histories of the three species of *Habronema* found commonly in the stomach of the horse.

In attempting to determine the species of the larva found in habronemic granulomata it became necessary to learn more of the life-histories of the three species of *Habronema*. In the latter part of 1916 experiments were started with this end in view, and also to obtain material for animal experimentation. The experiments had gone to show that under artificial conditions both *Habronema muscae* and *H. megastoma* develop through their larval stages in *Musca domestica*. At that time it was not possible to take the experiments any further.

Towards the end of 1917 the work was taken up again, when it was found impossible to pass *H. megastoma* through *Stomoxys calcitrans*. The work was proceeding when it was learned that Hill, working at the Melbourne University Veterinary School, had confirmed the above findings, and had found, further, that *Habronema microstoma* developed through its larval stages in *Stomoxys calcitrans* and rarely in *Musca domestica*, while *Habronema muscae* showed no development in *S. calcitrans*. Nothing further of Hill's work has been learned, and up to the time of writing (March, 1919) his work has not been published.

The experiments were continued during 1918 and the early part of 1919.

Method.—For the purpose of obtaining embryos, stomachs taken from horses killed at the Zoological Gardens, Adelaide, were examined. In all, considerably over one hundred stomachs were examined.

In the preliminary experiments carried out in 1916 stomach contents showing numerous embryos of *Habronema muscae*, and in which no other species were found, were mixed with horse-dung and exposed in the stables for about two hours to allow flies to deposit their eggs thereon. The dung used in the experiments was previously found to be free from embryos capable of developing in *Musca domestica*. Dung from the same animal was used in experiments with *Habronema megastoma*, and the contents of the submucous tumours were used to supply the embryos.

In the later experiments sterilized dung was used, and the embryos were obtained from the gravid female after specific identification. In the case of experiments with *Habronema megastoma*, embryos were also obtained by collecting the contents of the submucous tumours after these had been thoroughly scraped and washed in running water for several hours, only the contents from the deeper portions of the tumours being used.

For the purposes of the experiments both *Musca domestica* and *Stomoxys calcitrans* were bred artificially and the cultures kept going in the laboratory.

The culture of *Stomoxys calcitrans* was kept going for twelve months, when it was allowed to die out. The flies maintained their vigour and size throughout this period. They were fed daily on a rabbit, and were allowed to deposit their eggs on fermenting lawn clippings taken from a lawn where contamination by horse-dung was excluded.

Musca domestica was fed on a mixture of horse serum, sugar, and water, and was allowed to deposit its eggs on sterilized horse-dung. It was found most convenient to use these artificial cultures of the flies, for in this way experiments could be made during that time of the year when specimens are difficult to obtain in the field, and also, the number of fly larvae developing in a given culture could be more easily regulated. As in most of the experiments an attempt was made to obtain flies heavily infested with larvae, it was important to regulate the number of fly larvae developing in a culture.

The stomachs were sometimes examined a few hours after removal, but for the most part not until twenty-four hours, and sometimes as long as forty-eight hours, after removal. The worms were always found to be alive and active, although in those collected from stomachs examined from twenty-four to forty-eight hours after removal, activity had considerably decreased. This loss of activity was an advantage when specimens had to be examined microscopically. Only on one or two occasions was a stomach found in which no worms could be detected. A complete examination for the presence of all possible species was not made, but a rough idea was usually obtained of the number of species present. Only in one case was *Habronema microstoma* found to be present in very large numbers without any other species. It was found to be more commonly present than was at first expected, and in most of the stomachs examined could be found, although often only very few specimens were present. *Habronema muscae* was found to be present in most of the stomachs examined, and usually in large numbers. This worm was found to be more closely associated with the mucous membrane than *Habronema microstoma*, and quite commonly the head of the parasite was buried in the gastric glands. This parasite is usually orange-coloured, and sometimes more red, suggesting the presence of blood in the body of the worm. Chemical tests for blood were obtained with extracts from these worms.

Habronema megastoma was found to be of infrequent occurrence, and less commonly met with than the other species. Sometimes one would obtain two or three stomachs consecutively which contained *H. megastoma*, and then many stomachs would be examined before obtaining another specimen. It was not until after a large number of stomachs had been examined that it became obvious that *H. megastoma* was more rarely met with than *H. microstoma*, *H. muscae* being the most common, and usually found in each stomach examined.

For the purposes of the subject under investigation it was considered that any detailed study of the adult forms was unlikely to give any useful information.

No detailed study of the development of the worm larvae in the fly larvae, pupae, and adults was made, as, of necessity, a limit had to be placed on the scope of the investigation.

The following is a brief outline of the observations made on the embryos and larvae of the three species of *Habronema* and examination of adult flies:—

The Life-history of *Habronema muscae* (Carter, 1861).

Ransom has already shown that embryos of *Habronema muscae*, passed along with the faeces of the horse, gain entrance to the larvae of *Musca domestica*, probably through being swallowed by the fly larvae. The embryos gain the body cavity, where they pass through their larval stages, and have usually reached the final larval stage (sixth stage of Ransom) at or soon after the hatching of the adult fly. This final larval stage was the first stage to be observed in the stomach of the horse.

Ransom's work consisted mainly in the examination of adult flies, pupae, and larvae for the presence of larvae of *Habronema*. He assumed that all larvae found in the head and proboscis of adult flies were larvae of *Habronema muscae*. It is possible, however, that some of the specimens he observed may have been larvae of *Habronema megastoma*.

The experiments undertaken in 1916 under artificial conditions confirmed Ransom's conclusions.

Embryos of H. muscae.—Embryos that have been passed out from the female have been found to be enclosed in a thin shell which is closely applied to the body except at the posterior end, where it is distinctly seen held away by the curved tail. The embryos are only slightly motile. They measure from 80 μ in length by 12 μ in width to 110 μ in length by 6·6 μ in width. When these embryos are collected from the stomach contents or from the gravid female and placed in saline they live for many days, depending on light, temperature, and bacterial growth. They rarely show any tendency to leave the shells. When placed in tap water the majority of the embryos are found to be free in twenty-four hours.

Adult flies.—At first the observations were confined to the study of the development of *H. muscae* in *Musca domestica*. In the preliminary experiments it was found that approximately 100 per cent. of the flies hatching out showed larvae situated, almost invariably, in the head and proboscis. These larvae were found to resemble the sixth larval stage of *H. muscae*, as described by Ransom. As many as eight larvae were found in the head and proboscis of one fly.

In the later experiments the examination of flies that had just hatched often showed the presence of larvae in an early stage of development, measuring approximately 400 μ long, and being situated in the abdomen, and usually encysted. In from five to seven days these larvae were found to have developed into the final larval stage, and to have migrated to the head and proboscis. As many as from thirty to forty larvae have been found in the head and proboscis of these flies.

For the most part larvae found in the head and proboscis have been of the final larval stage of development, but occasionally larvae of an earlier stage of development have been found along with those in the final stage.

The flies often showed a marked paralysis of the proboscis, although they were still able to feed.

The time occupied in development from the deposit of the eggs to the hatching of the adult flies was usually from fourteen to eighteen days.

Flies bred in sterilized horse-dung, with which had been mixed an emulsion of embryos in normal saline solution, usually showed the presence of larvae in the great majority of those hatching out. On three occasions, however, no larvae were present in any of the flies hatching out. On two of these occasions the emulsion of embryos was made in tap water, and on one occasion in saline solution. On each of these occasions the eggs were obtained from flies caught in the laboratory. There was never any failure of development of larvae in the strain of *Musca domestica* kept going by artificial cultivation.

All attempts to obtain any development of embryos of *H. muscae* in *Stomoxys calcitrans* failed.

Larvae of H. muscae.—Attention was practically confined to the study of the final larval stage. These larvae obtained from the head and proboscis of flies were found to measure from 2·58 mm. to 2·87 mm. long, the majority measuring 2·7 mm. The maximum width was found to vary from 50 μ to 66·6 μ. The head was rounded and the body tapered slightly from about the posterior part of the oesophagus. The tail was pointed and possessed a small rounded tip furnished with minute spines. The anus was open and situated 83·3 μ from the point of the tail. The pharynx was 43·3 μ long; the nerve ring 130 μ from the anterior end of the body, and the anterior portion of the oesophagus 133 μ to 140 μ long.

The larvae were embedded in paraffin and sectioned. On transverse section the cuticle was found to be traversed by fine longitudinal ridges. These numbered from forty to forty-two, as near as could be determined; started immediately behind the head and ended near the tail.

Experiments were undertaken to determine the power of the larvae to leave the proboscis of the fly. Flies were placed in an inverted wide-mouthed Florence flask. The mouth of the flask was surrounded by gauze, which also surrounded the mouth of a test tube situated several inches below and containing sugar dissolved in water. This test tube was kept filled with the solution, which was examined from time to time for the presence of larvae. The flies drank freely of the solution, but at no time were any larvae found to have escaped into the solution.

In one case two flies kept overnight in a test tube containing a small amount of sugar solution were found to be dead the following morning. Two active larvae were found in the solution. It is not possible to say whether the larvae left the proboscis during the life of the fly or after its death. Dead flies have been placed in saline solution, and later larvae have been found in the solution.

In making a careful removal of the proboscis from the head it has sometimes been observed that the larvae will escape through the lips of the proboscis. This is probably due to rupture of the proboscis during handling rendering it possible for the larvae to escape from their situation in the muscular portion into the food canal.

Experiments were made to determine whether larvae are capable of penetrating filter paper. A short test tube was filled with saline solution, or a mixture of saline and horse serum, and a folded filter paper (very small size) was fitted into the mouth of the tube. Larvae were placed in the fluid contained in the cup formed by the folded paper. This preparation was kept at room temperature or 37° C. for twenty-four hours in a moist chamber, and the fluid in the test tube examined for the presence of larvae. On one occasion two larvae were found in the fluid. This finding could not be confirmed after repeated experiments.

The larvae were found to remain alive in saline solution or horse serum for forty-eight hours, and sometimes up to seventy-two hours.

Larvae were found to remain alive in the bodies of dead flies for several days if loss of moisture was prevented.

THE LIFE-HISTORY OF *Habronema megastoma* (Rudolphi, 1819).

The methods adopted in this investigation have already been mentioned. The embryos were sometimes obtained from the contents of the submucous tumours and sometimes from the gravid female.

Embryos of H. megastoma.—The embryos are enclosed in a thin shell or membrane. They are doubled on themselves in the shape of the letter U, the tail coming to lie close to the head. The shell measures from 43·3 μ to 53·3 μ long by 11·6 μ to 13·3 μ wide. The widest portion of the embryo measures 6·6 μ.

The embryos when placed in saline solution and tap water behave in the same way as those of *H. muscae.* When they do break away from the shell they remain bent in the shape of the letter V or the letter L. They are only very slightly motile. When taken from the gravid female the shell is less resistant than in those born under natural conditions. This has been found true of the embryos of all three species.

Adult Flies.—In the main the results of the observations were the same as in the case of flies infested with the larvae of *Habronema muscae.* The rate of development of the larvae appeared to depend upon the temperature at which the culture was kept. During the warmer weather flies hatching out often showed larvae at or near the final stage of development. At other times larvae were found in a very early stage of development. In one case flies hatching out in seventeen days showed larvae measuring from 272·7 μ to 409 μ in length. These larvae were present in the abdomen, and the majority were encysted. From four to five days later these larvae had developed into the final larval stage. The atmospheric temperature was high during this latter period. When the final larval stage was reached few or no larvae remained in the abdomen, but migrated to the head and proboscis. Many of the flies died suddenly, probably through injury to the central nervous system by the migrating larvae. The parasitism was very heavy, from fifty to sixty larvae being present in a single fly. The proboscides of many of the flies were seen to be paralyzed. When these flies were examined some days later the larvae were found to be less active than when first making their appearance in the head and proboscis.

It has been observed that if flies die when the larvae are in an early stage of development these larvae quickly die, but if the final larval stage has been reached the larvae live for two or three days, provided that desiccation is prevented.

Larvae in an earlier stage of development have at times been found in the proboscis along with larvae in the final stage of development.

Failure to produce an infestation of flies occurred in exactly parallel circumstances as in the case of the experiments with *Habronema muscae.*

All attempts to obtain any development of embryos of *Habronema megastoma* in *Stomoxys calcitrans* failed.

Larvae of H. megastoma.—Larvae obtained from the head and proboscis of flies were found to measure from 2·07 mm. to 2·5 mm. long by 60 μ to 66·6 μ wide. The larvae had the same general appearance as those of *H. muscae*, but in a few specimens a circular ridge posterior to the lips was observed. The pharynx was 60 μ long; the nerve ring 116·6 μ to 126·6 μ from the anterior end of the body, and the anterior portion of the oesophagus 80 μ to 90 μ long. The anus was open and situated from 80 μ to 90 μ from the tip of the tail, which was pointed, and possessed a small rounded tip furnished with minute spines. On transverse section the cuticle was found to possess fine longitudinal ridges to the number of 40 or 42, as near as could be determined.

Observations on the power of the larvae to leave the proboscis of the fly gave the same results as those given in the case of *H. muscae.*

Experiments made to determine the power of the larvae to penetrate filter paper gave negative results.

The Life-history of *Habronema microstoma* (Schneider, 1866).

The methods adopted at this investigation have already been mentioned. The embryos were obtained from the gravid female. Fermenting lawn clippings were used as a breeding ground for *Stomoxys calcitrans*, and an emulsion of the embryos in saline solution was added to this material.

Embryos of H. microstoma.—The embryos when taken from the gravid female are usually very active, and they remain active for some days in normal saline solution. They measure from 90·9 μ to 122·8 μ in length, and are enclosed in a thin shell or membrane. When placed in saline solution and tap water, respectively, they behave in the same way as those of *H. muscae.*

The embryos may live for some days when passed out naturally with the faeces of a horse. The faeces of a horse were previously examined, and found to contain embryos of *H. microstoma.* These faeces were kept for ten days, and then *Stomoxys calcitrans* allowed to deposit its eggs on the material. Flies hatching out from eighteen to nineteen days later contained larvae.

Adult flies.—The rate of development of the worm larvae within the developing larvae and pupae of *Stomoxys calcitrans* appears to depend largely upon temperature. Flies bred at a low temperature, 20° to 22° C., and taking about thirty days to hatch out, show larvae in the earlier stages of development situated usually in the abdomen. Flies bred at a higher temperature, 25° to 26° C., develop more quickly, from seventeen to twenty days, and when hatching out show larvae in the final stage of development, mostly situated in the head and proboscis, with only a few in the abdomen. Those larvae situated in the abdomen are usually in an earlier stage of development.

If larvae in the final stage of development are found in the proboscis of newly-hatched flies, when flies of the same batch are examined a week to ten days later the larvae present are often dead.

If the development of the fly larvae has been delayed it is noticed that when the adult fly hatches out many dead and degenerating worm larvae are present. This was noticed, for example, in a culture in which the fly larvae developed quickly and the adult flies hatched out in from seventeen to twenty days. Some of the fly larvae, however, developed more slowly, and the adult flies hatched out in from thirty to thirty-four days. It was in these flies hatching out later that dead and degenerating worm larvae were found.

For the most part, newly-hatched flies showed larvae in the earlier stages of development situated in the abdomen. These larvae developed into the final stage in from five to seven days, and migrated to the head and proboscis. Larvae in an earlier stage of development have at times been found in the proboscis along with larvae in the final stage of development. The larvae were situated in the muscular portion of the bulb of the proboscis, and numbered from thirty to forty.

At no time did one fail to produce an infestation of *Stomoxys calcitrans* with larvae of *H. microstoma*.

Attempts to produce an infestation in *Musca domestica* usually gave negative results, but in one case there was an aberrant development of larvae of *H. microstoma* in *M. domestica*. In this case many of the flies examined showed embryos and larvae in varying stages of development. The development was distinctly aberrant, the larvae presenting appearances very different from those seen in *Stomoxys calcitrans*. Many of the forms present resembled embryos just escaped from the egg-membrane, only were somewhat longer. None of the embryos developed into the thick, nucleated larvae as seen in the normal development. The longer forms were all dead and degenerating. The measurements of some of these longer forms were 151·5 μ, 318 μ, and 424 μ long respectively. Unfortunately, the preparations were lost through an accident before a more complete examination could be made.

The subject was not pursued any further, for at the time it was thought that it had little bearing on the matter under investigation.

Larvae of H. microstoma.—Larvae obtained from the head and proboscis of *Stomoxys calcitrans* were found to be distinctly shorter than the larvae of the other two species. They measured from 1·5 mm. to 2 mm. in length by 41 μ to 58 μ wide. The larvae had the same general appearances as those of the other two species. The pharynx was 43·3 μ long; the nerve ring was 110 μ from the anterior end of the body, and the anterior portion of the oesophagus was 116·6 μ long. The anus was open and situated 66·6 μ from the tip of the tail, which was pointed, and possessed a small rounded tip furnished with minute spines. On transverse section the cuticle was found to be homogenous and smooth, lacking all appearance of longitudinal ridges.

Observations on the power of the larvae to leave the proboscis of the fly gave the same results as those obtained in the case of the other two species.

The following observation made during the winter is of interest.—Proboscides were removed at the bend just posterior to the bulb. These were placed in saline solution in sealed chambers. One set was left at room temperature, 20° C., for one hour, and when examined no larvae had left the proboscis. Another set was placed in the incubator at 37° C. for one hour. When examined the saline solution contained many extremely active larvae. The first set which had been left at room temperature was then placed in the incubator at 37° C. for one hour. On examination the saline solution was found to contain extremely active larvae. The proboscides were then examined, and only an occasional larvae was found to have been unable to leave the proboscis.

Experiments made to determine the power of the larvae to penetrate filter paper gave negative results.

Summary and Discussion of the Salient Observations.

Habronema muscae was found to pass through its larval stages in *Musca domestica*, but showed no development in *Stomoxys calcitrans*. *H. megastoma* was found to possess a similar life-history.

H. microstoma was found to pass through its larval stages in *S. calcitrans*, and show sometimes an aberrant development in *M. domestica*.

The larvae of *H. muscae* and *H. megastoma* were found to possess very similar appearances. *H. megastoma* was usually slightly shorter than *H. muscae*, possessed a longer pharynx and a shorter anterior oesophagus, and the nerve ring was situated nearer the anterior end than in *H. muscae*. Both species of larvae possessed longitudinal ridges in the cuticle.

It is doubtful if these small differences in the appearances of the two larvae would prove sufficient for the purpose of differentiating larvae taken from granulomata, as in this case the larvae usually show some retrogressive changes and examination is more difficult.

Larvae of *H. microstoma* were found to be shorter than the larvae of the other two species, and the absence of longitudinal ridges in the cuticle offers a means for absolute differentiation between this larvae and those of the other two species.

Escape of the larvae from the proboscis of flies was found to depend upon rupture of some portion of the organ, probably the thinner citinous membrane on the interior surface of the labium. When this rupture was produced artificially the larvae rapidly made their escape into any moisture at hand, provided the temperature was sufficient to produce activity in the larvae. The escape of larvae from the proboscis under natural conditions was not demonstrated.

The larvae when developed into the final stage migrated to the head and proboscis. This may suggest that the larvae abandon the intermediate host in somewhat the same manner as Filaria larva do, but observations do not lend support to this suggestion. The migration to and situation in the proboscis of flies seems to be a common feature in the development of Nematodes. For example, Patton and Cragg (1913) have observed the development of the embryos of a species of *Oxyuris* in *Musca nebulo*. The embryos are ingested by the fly larvae, and the worms undergo their evolution in the pupae. When the flies hatch out they are infested with adult parasites, which cause paralysis of the proboscis on account of their accumulation in this situation.

The larvae apparently do not possess the power of penetrating the structures in the proboscis of flies. Rupture of the proboscis appears to depend upon the pressure exerted by the larvae, which pressure would be in direct proportion to the number of larvae present and their activity. Nor do the larvae appear to be capable of penetrating other objects such as filter paper.

Larvae do not appear to live in saline solution, horse serum, or water for longer than two or three days, and rarely as long as seven days. The longevity of the larvae outside the body of the fly may depend to some extent on the period of time elapsing between their development into the final stage and their escape or removal from the proboscis.

Observations on the worm embryos suggest that these normally do not leave the egg-membrane, and their *rôle* is a passive one.

Animal Experimentation.

Preliminary experiments carried out in 1916 and 1917 with the final larval stage of both *Habronema musca* and *H. megastoma* had proved somewhat disappointing. The object of the experiment was to determine if possible which species of larva was responsible for the production of the granulomata. As the escape of the larvae from the proboscis of the fly appeared to be largely a matter of chance, it was decided to inoculate the larvae into the subcutaneous tissues of an animal. The larvae were obtained by dissection of the heads and proboscides of flies, and placed in a sealed pipette held vertically and filled with normal saline solution. When the larvae had gravitated to the end of the column of saline at the capillary end of the pipette the saline was removed, except for a small drop which contained the larvae. An incision was made through the skin of a horse and the larvae inoculated into the subcutaneous tissues. In each case a very small granuloma resulted, which on microscopic examination showed an infiltration of the tissues with eosinophiles, some hyperplasia of the fixed cells, and the formation of multinucleated cells. No necrotic areas were produced.

It was conceivable that keeping the larvae in saline solution for one or two hours before inoculation had rendered them more vulnerable to the activity of the tissue cells and fluids, and that their more rapid destruction in the body had prevented the occurrence of necrosis. In later experiments larvae were either allowed to escape from the proboscis directly into the tissues of experimental animals, or a mixture of equal parts of normal serum and saline was used as a medium of inoculation. The larvae were only allowed to remain in this fluid for about thirty minutes before being used.

The preliminary experiments made in the latter part of 1916 and the early part of 1917 were seven in number, and the animal used was the one designated as *pony* in the later experiments outlined below. These preliminary experiments were made as follows:—

Experiments with *Habronema muscae*:—

(1) Embryos of *H. muscae* were placed in moist sawdust and the mass applied to the shaved skin of a horse.

(2) Six larvae from the proboscis of a fly were placed on the shaved skin of the animal, the site being moistened with saline solution.

(3) Four larvae were placed in the conjunctival sac.

(4) Seven or eight larvae were placed beneath the skin of the animal.

(5) Experiment (4) repeated.

(6) Experiment (4) repeated on a rabbit.

Results.—No evidence was obtained suggesting that the embryos or larvae were capable of penetrating the skin. There was no evidence of any change in the tissues of the conjunctival sac following the instillation of the larvae. A slight induration was produced at the site of inoculation of the larvae. One area was removed, and the microscopic examination revealed the changes in the tissues mentioned above. No change was produced in the tissues of the rabbit following inoculation.

Experiments with *Habronema megastoma:*—

Only one experiment was made. In this larvae were placed beneath the skin, as in experiments with *H. muscae.* The tissue reaction was the same in this case as with *H. muscae.*

In the following experiments two animals were used throughout. For the purpose of identification one will be called *pony* and the other *mare.*

1. Experiments with *H. microstoma:*—

(a) Feeding experiments with *Stomoxys calcitrans*—

Flies heavily infested with larvae were placed in a flask, the mouth of which was covered with gauze. These flies were placed on a shaved area of the skin of the *mare,* and held in position for about one hour. These experiments were made in the month of June, 1918, the weather being cool. The flies did not bite very readily. After the feeding operations the site was seen to be somewhat swollen, which swelling had increased slightly by the following morning, but rapidly disappeared during the day. Another site was selected, and the experiment repeated on the following day with the same results.

The experiment was repeated on the *pony* with the same results.

Some months later, December, flies were placed in a cage which was placed over a shaved area of the skin of the *mare* and kept in apposition for two hours by means of bandages. This experiment gave the same result as the previous experiments.

The result of the experiments was a complete failure to produce a granuloma by this method.

It was observed that the proboscides of many of the flies were paralyzed, and that the flies had to a great extent lost their desire and ability to bite. They fed more readily on a rabbit, but not so readily as the normal flies.

(b) Larvae placed in the skin of the horse—

It was observed that when the proboscis was removed from a fly and placed in normal saline solution kept at 37° C., the larvae rapidly left the proboscis.

It was decided to determine the ability of the larvae to penetrate the subcutaneous tissues of the horse. Two small incisions were made in the skin of the *mare.* The incision was not so deep as to pass right through the *corium.* Two proboscides were placed in each wound. The edges of the wound were drawn together by means of adhesive plaster. The following morning, about twenty hours later, the proboscides were removed and the wound again protected by a covering of adhesive plaster. There was a marked swelling around each wound and a collection of pus in the wound. The purulent discharge completely disappeared twenty-four hours after the removal of the proboscides, but the tumefaction of the tissues persisted. In seven days' time a hard granuloma about twice the size of a pea was present at each site. One site was removed for microscopic examination, and the other left for further observation. Microscopic examination showed marked infiltration of the tissues with eosinophiles, hyperplasia of the fixed cells, and the formation of multi-nucleated cells. Only one necrotic area was detected, but no larvae could be seen associated with this. No larvae could be found in any of the sections made. The other area left for further observation gradually disappeared.

This experiment was repeated in every detail on the *pony*. Two small granulomata resulted. One removed twelve days after inoculation showed the same histological picture as the one from the *mare*, but no necrotic areas or larvae were detected in any of the sections.

These experiments were carried out during September, when the weather had become warmer.

As the leaving of the proboscides in the wound for twenty hours had produced a purulent discharge, it was decided to considerably reduce this time in future experiments.

About six weeks later four proboscides were placed in a wound in the skin of the *mare*. These were removed from five to six hours later. There was a marked swelling present, the area having a diameter of 4 cm. The tissues were very tense, and there was some blood-stained exudation from the wound. The swelling increased during the next twenty-four hours, but in another twenty-four hours it was much reduced. Seventy-two hours after inoculation only a slght thickening was detected. The site was removed for microscopic examination. In sections the larvae were found to have penetrated the tissues for some distance from the line of incision in the skin. They were surrounded by leucocytes, the nuclei of which showed fragmentation and pyknosis. There was oedema of the tissues, accumulation of leucocytes in small areas and around the blood vessels. There was infiltration of the tissues with eosinophiles.

During December the same experiment was repeated on the *pony*. Two wounds were each inoculated with three proboscides, which were removed six hours later. One site was removed six hours after inoculation. Microscopic examination showed that there was dilatation of the vessels with oedema of the tissues. The tissues were infiltrated with polymorphs and eosinophiles. Larvae were found some distance from the site of inoculation and surrounded by leucocytes.

The other area was removed ten days after inoculation. There was present a hard nodule about the size of a Barcelona nut. Microscopic examination showed the usual inflammatory reaction with giant-cell formation. There were a few necrotic areas present, with which were associated degenerating larvae.

(c) Larvae placed on a scarified area of skin—

An area of the skin of the *pony* was lightly scarified, and two proboscides placed on the moist surface. The experiment gave a completely negative result, healing taking place without any tumefaction of the tissues.

Several attempts were made to inoculate the larvae beneath the skin by means of a hypodermic needle and syringe. It was found to be difficult or impossible to determine whether the larvae had been successfully inoculated, and as only a fleeting infiltration of the tissues occurred after inoculation, the method was abandoned.

2. Experiments with *H. muscae*:—

(a) Larvae placed in the skin of the horse—

Six proboscides of *Musca domestica* heavily infested with larvae were placed in an incision in the skin of the *mare*, and removed five to six hours later. Tumefaction of the tissues was produced, which increased during the twenty-four hours after inoculation, and then gradually subsided. About a week later a swelling about the size of a Barcelona nut was present. This rapidly reduced in size and completely disappeared.

The day following the first inoculation another inoculation was made with the same results as the first.

Some days later three more inoculations were made. After the primary tumefaction of the tissues had disappeared in from twenty-four to forty-eight hours no abnormality could be detected.

These experiments were repeated on the *pony*. In all, three inoculations were made. Only a slight primary tumefaction of the tissues resulted which disappeared in about thirty-six hours, leaving only a very slight thickening, which completely disappeared in from fourteen to twenty-one days.

(b) Larvae added to the conjunctival sac—

About the same time as the above experiments were made larvae were placed in a pipette containing a mixture of equal parts of normal horse serum and normal saline solution. The larvae were then added along with a small quantity of the mixture to the conjunctival sac (off side) of the *mare*. The conjunctiva remained normal in appearance, and no excessive lacrymation was produced.

The experiment was repeated on the *pony*. The following morning a slightly excessive lacrymation was present, which, however, disappeared during the next twenty-four hours. The conjunctiva remained normal in appearance.

(c) Larvae placed on a scarified area of skin—

An area of the skin of the *mare* was lightly scarified, and the proboscides placed on the moist surface, and kept in place by the aid of adhesive plaster. The tissues showed very slight tumefaction twenty-four hours later, which rapidly disappeared.

This experiment was repeated with the same result.

It was also repeated on the *pony*, and no reaction was produced.

(d) Larvae placed on a moistened area of skin—

A shaved area of the skin of the *mare* was moistened with the serum and saline mixture, and a proboscis containing larvae placed on this. The following morning there was the merest suggestion of an elevation in the skin, but it was not observed the following evening. This experiment was repeated with the same result.

There was no reaction produced in the tissues to suggest that the larvae has penetrated the skin.

3. Experiments with *H. megastoma*:—

(*a*) Larvae placed in the skin of the horse—

Proboscides of *Musca domestica* heavily infested with larvae were placed in three incisions in the skin of the *mare* and removed from five to six hours later, when there was present a marked inflammatory oedema of the tissues. One area was removed five hours after inoculation for the purpose of microscopic examination. Larvae were found to have made their way into the subcutaneous tissues, where leucocytes had commenced to surround them.

The other two sites were left for further observation. After inoculation the primary tumefaction reached a maximum in about forty-eight hours, and had a diameter of from 6 to 7 cm. This gradually subsided, and in nine days' time one site was removed, when there was present a granuloma about the size of a small walnut. Microscopic examination showed an intense infiltration of the tissues with eosinophiles, hyperplasia of the fixed cells, the formation of multinucleated cells, and the presence of necrotic areas containing degenerating larvae.

The other granuloma persisted for about three weeks, when it gradually disappeared.

The experiments were repeated on the *pony*. Proboscides were placed in three incisions in the skin and removed from five to six hours later, when there was marked inflammatory oedema of the tissues. This increased during the next twenty-four hours, but had very much decreased in forty-eight hours after inoculation.

One area was removed six hours after inoculation. Microscopic examination showed that the larvae had made their way into the subcutaneous tissues, where they were surrounded by leucocytes.

The other two areas were left for further observation. In forty-eight hours after inoculation the swelling had almost disappeared, and in three or four days' time there was little or no thickening of the tissues.

(*b*) Larvae added to the conjunctival sac—

Larvae were added to the conjunctival sac (near side) of the *mare*. Twenty-four hours later no reaction had been produced. In three or four days' time excessive lacrymation was present. In a further three days the conjunctiva was injected and somewhat swollen. Small yellowish "tubercles" were to be seen on the membrana. These persisted for over a week, but in a fortnight's time had entirely disappeared. Epiphora continued, however, for about six weeks.

The experiment was repeated on the *pony* with exactly the same results.

(*c*) Larvae placed on a scarified area of skin—

Larvae were placed on three scarified areas of the skin of the *mare*. Larvae were added to one of the scarified areas on three consecutive days. In no case was any reaction produced.

This experiment was repeated on the *pony*, two scarified areas being made. No reaction was produced.

(*d*) Larvae placed on a moistened area of skin—

Larvae were placed on two moistened areas of the skin of the *mare*. No reaction was produced.

The experiment was repeated on two areas of the skin of the *pony* with the same result.

4. Experiments with embryos:—

Embryos of the three species kept in saline and tap water, respectively, were added to sterilized horse-dung or sawdust and placed on shaved areas of the skin of the two horses.

In no case was any reaction produced in the skin of the animals.

5. Summary and discussion of the experiments:—

Experiments have shown that larvae of *H. microstoma* are capable of making their way into the subcutaneous tissues of the horse through an incised wound in the skin. A certain number of these larvae appear to be rapidly destroyed and removed by phagocytes. Others are not so rapidly destroyed, when they produce a necrosis of the surrounding tissue and cells. As the larvae disappear they do not appear to leave any worm canals in the necrotic areas. In the experiments a tissue reaction was produced which is essentially the same as that seen in granulomata occurring under natural conditions. No granulomata were produced after allowing flies to bite the horse. When larvae were added to a lightly scarified area of skin they appeared to be incapable of penetrating the tissues; at least no tissue reaction which might suggest such a penetration was produced.

Larvae of *H. muscae* possessed the power of making their way into the subcutaneous tissues, but only a very slight tissue reaction was produced, and this quickly disappeared. When they were added to the conjunctival sac they produced no reaction. The larvae did not appear to be capable of penetrating the lightly scarified skin, nor the moistened, uninjured skin.

Larvae of *H. megastoma* produced a typical granuloma in one animal, but failed to produce the same reaction in the other animal. The microscopic appearances of the granulomata produced were exactly similar to those seen in lesions occurring under natural conditions. Those larvae that were not rapidly destroyed and removed produced typical necrotic areas in which the degenerating larvae persisted for some time, and after their disappearance very definite worm canals were produced. The lesion, however, did not possess a marked chronicity. The larvae produced a conjunctivitis in both animals. They did not appear to be capable of penetrating the moistened or scarified skin.

The granulomata produced with larvae of both *H. microstoma* and *H. megastoma* were comparatively small, and showed little chronicity. Likewise, the conjunctivitis produced by the larvae of *H. megastoma* was not of a very severe character. The larvae of *H. megastoma*, when they produced a granuloma, appeared to be better preserved than those of

H. microstoma found in the granulomata produced by the latter.

Under the conditions of the experiment the embryos of all three species appeared to be incapable of penetrating the skin of the horse.

In these later experiments the results obtained in the preliminary experiments were confirmed, *viz.*, larvae of *H. muscae* produced no conjunctivitis and no typical granuloma in the skin, and the larvae of *H. megastoma* produced no typical granuloma in the skin of the *pony*.

The experiments have shown that the larvae of all three species are capable of making their way into the subcutaneous tissues when the injury in the skin has been deep enough to include the *corium*. This migration in the tissues is probably assisted by the oedema present. The larvae, however, do not migrate for any great distance from the point of entry, in the experiments only up to about 1 cm. The larvae do not appear to be able to penetrate the tissues when the injury is confined to the superficial epithelium.

Considering the number of larvae inoculated, the number of necrotic areas produced was small. This appears to be explained by the probable escape of some of the larvae, but more particularly by the early destruction of some of the larvae. Tissues removed from five to six hours after inoculation with larvae have shown the larvae surrounded by neutrophile leucocytes, which attack and apparently quickly remove them. Some of the larvae, however, appear to offer more resistance or attract few or no neutrophile leucocytes. These neutrophile leucocytes are not found in the tissues removed from five to seven days after inoculation. The fact that certain larvae of the same species appear to offer more resistance to the attack of neutrophile leucocytes, or show less positive chemotaxis, leads one to expect that certain strains or varieties of the same species would be more likely to produce granulomata under natural conditions.

Discussion.

That these larval Nematodes are the cause of the granulomatous reaction there appears to be no possible doubt.

Microscopical examination demonstrates that the larvae soon after their introduction undergo degenerative changes. There results an infiltration of the tissues with eosinophile leucocytes and some proliferation of the fixed cells. Mononuclear leucocytes are also attracted to the site. These changes cause a tumefaction of the tissues which later usually gives rise to a pressure necrosis in the skin or mucous membrane. As the degenerative changes in the larvae progress there results a necrosis of the tissues in their immediate vicinity, giving rise to the typical caseous areas.

These changes represent the characteristic appearances of the granuloma, and, apart from bacterial infection of the ulcerated surface, there is no reaction present which would not be produced by the presence and degeneration of the larval Nematode.

This evidence is almost sufficient to prove that the larvae are the essential cause of the granuloma, and that they cannot be regarded as an epi-phenomenon. Added to this evidence is the failure to demonstrate by any conceivable method the presence of any bacterium, mould, or protozoon, except a mixed variety of bacteria on the ulcerated surface.

Experimentally it has been shown that larvae of *Habronema* are capable of producing a granuloma very similar to that found under natural conditions. This fact, taken with the above evidence, is sufficient to prove that the presence of the larvae in the cutaneous, subcutaneous, or submucous tissues is the essential cause of the lesion.

It is interesting to note that there is no essential difference between the tissue reactions seen in these tumours and those seen about many of the caseous areas to be found commonly in the internal organs of most herbiverous animals.

The fact that, although the larvae die out soon after the first appearance of the lesion, the tumour goes on enlarging, and may exist for some considerable time, is of extreme interest.

This gradual enlargement of the tumour consists of an enlargement of the necrotic areas and an increased tissue production. There is no increase in the number of foci as, for example, occurs in actinomycotic granulomata, except in the case of re-infection or super-infection.

The growth of the tumour is due mainly to the fact that the substances which originate in the degenerating or autolysing larvae, and which apparently causes the death of the tissue cells, very slowly penetrate to the outside of the necrotic tissue, and thus cause a slow but gradual enlargement or extension of the necrosis. This, of course, is limited, and the maximum amount of necrosis is produced in a certain time, according to various conditions which are difficult to measure.

Once the larva becomes surrounded by necrotic tissue, the diffusion outwards of the autolytic products is impeded. The autolytic products would, therefore, become concentrated towards the centre of the necrotic area, and their slow diffusion to the outside would tend to produce a gradual extension of the necrosis, even after the complete disappearance of the larva. The continued presence and enlargement of the necrotic areas would produce a corresponding tissue reaction, and so the tumour would continue to enlarge or grow.

The chronicity of the tumour is due mainly to three factors, whilst in some cases there is a fourth. In the first place the slow diffusion of the necrosis-producing substance, which probably has its origin in the degenerating or autolysing larva, tends to produce a slow development of the necrosis, and to maintain it for some time. Secondly, the type of necrosis is that which is not readily absorbed or removed. The types of necrosis, or the characteristic changes of necrosis, depend mainly upon the intracellular enzymes. The necrosis-producing substance in this case must lead to an early destruction of the autolytic enzymes of the cells, thus preventing further degenerative changes in the dead cells.(1) Thirdly, because of the lack of chemotactic substances no neutrophile leucocytes enter to remove the dead tissue. Fourthly, there is the possibility of a super-infection. If a tumour has resulted from an infection of a wound, or after ulceration of a tumour has taken place, the possibility of the entry of fresh larvae must be considered. This super-infection has been very distinctly observed in tumours examined from cases occurring in the British Solomon Islands.

There seems to be no doubt that the presence of the larvae in the subepithelial tissues is accidental. The larvae apparently have no power of completing their life-history, for even in the earlier lesions they always show retrogressive changes, while in the older lesions one may be unable to detect anything but a few worm canals, empty or containing a granular *débris*.

However, soon after their introduction the larvae must exhibit some progressive movement, for they penetrate to some depth into the subepithelial tissues, and, in the looser tissues, such as are found in the sheath, they become more dispersed. But this power of penetration is distinctly limited, and the larva is soon unable to maintain its life, probably on account of an inability to obtain a suitable food supply.

The larva cannot correctly be called a parasite, for a parasite may be defined as a living organism which takes up its abode on or within other living organisms for the purpose of obtaining food.

(1) That absorption of dead tissue depends mainly upon the completeness or incompleteness of the destruction of the intracellular enzymes is illustrated by the following experiment:—Two pieces of fresh normal tissue, one heated to 100° C., and the other untreated, when placed in the abdominal cavity of the same species undergo very different changes. The unheated tissue soon undergoes autolytic changes and is absorbed, whereas the heated tissue, although dead, undergoes no autolytic changes, and is very slowly absorbed.

There seems to be little doubt that the larva present in the lesions belongs to the genus *Habronema*.

In tracing the evolution of these tumours from the earliest recognizable lesion, and taking into consideration their situation in or just beneath the skin or external mucous membranes, it seems reasonable to assume that the larvae are introduced from without and are not carried to the surface from within. A point to be decided is whether larvae of *Habronema* can enter the submucosa of the external mucous membranes or the subcutaneous tissues, and so make their way to the alimentary canal, or not. If the larvae are capable of doing this, as larvae of *Ankylostoma* are, then it is remarkable that they should so often be held up in the submucous or subcutaneous tissues. There is nothing to suggest that this is a common or even probable mode of invasion.

Experimental observations have shown that, although larvae are capable of migrating in the subcutaneous tissues for some little distance from the point of entry, this migration is very limited, and the larvae are soon surrounded by leucocytes. It would appear, therefore, that the presence of the larvae in the submucosa of the conjunctiva, and of the urethra or the subcutaneous tissues, is an accidental phenomenon.

All the larvae found in the tumours have presented the same appearances, and must be regarded as being of the same stage of development. There is nothing to suggest that the larvae have passed through any developmental stages in the tissues of the horse.

As the larvae found in the granulomata are in the same stage of development as those found in the head and proboscis of adult flies, it would appear that flies are in some way responsible for the production of the lesions. This is also suggested by the fact that the granulomata only occur at that time of the year when flies are present in abundance.

Observations on the life-histories of the three species of *Habronema* have shown that *H. muscae* develops through its larval stages in *Musca domestica*, but it is not capable of such development in *Stomoxys calcitrans*, at least under experimental conditions; *H. megastoma* has the same life-history as *H. muscae; H. microstoma* develops through its larval stages in *Stomoxys calcitrans*, and shows, sometimes at least, an aberrant development in *Musca domestica*.

Harvey Johnston (1912) has recorded the finding of a larva somewhat resembling that of *H. muscae* in *Musca vetustissima* in Queensland, so it seems possible that these species may be capable of developing through their larval stages in other flies, particularly Muscids. Nothing, however, is at present known about the possible development of these species in other flies, and as it would appear that the usual mode of development is as outlined above, the possible association of *Musca domestica* and *Stomoxys calcitrans* with the production of the lesions must be considered.

The affection, as it has been observed by the present writer and by Lewis and Seddon, is most commonly situated in or about mucous membranes, *viz.*, the mucous membrane of the urethra and that of the eye. Lesions are found, nevertheless, in other situations as on the sheath or the limbs.

Why should these lesions be more commonly found in mucous membranes? The first explanation which suggests itself is that *Musca domestica* is attracted to these situations in search of moisture and food. Should larvae escape from the proboscis during feeding operations, there would be sufficient moisture present on the mucous membrane to prevent desiccation. Under these conditions it is possible for the larvae to penetrate the mucous membrane should they desire to and be capable of so doing.

Larvae found in the lesions resemble those of *Habronema muscae* and *H. megastoma*, the cuticle of both these forms possessing longitudinal ridges, but not those of *H. microstoma*, the cuticle of this form showing no longitudinal ridges.

H. megastoma is found in tumours situated in the submucosa of the stomach of the horse. It is generally believed that it perforates the gastric mucous membrane, probably when in the larval stage. In its normal situation the parasite would live on the products of the tissues rather than on the semi-digested material in the alimentary canal. It is, therefore, a parasite of tissues rather than of the contents of the alimentary canal.

From a theoretical consideration one would expect the larva of *H. megastoma* to possess the instinctive desire to penetrate mucous membranes, and, further, to be able to maintain its life in the submucous tissues of the urethra and conjunctiva or the subcutaneous tissues longer than the larvae of the other two species. This suggests that the larva of *H. megastoma* is more likely to produce a habronemic granuloma than the larvae of the other two species. Experimental evidence also suggests that the larva of *H. megastoma* more readily penetrates the conjunctiva of the horse and sets up a granulomatous reaction, and also that it more readily sets up a granulomatous condition in the subcutaneous tissues than the larvae of *H. muscae*.

Although the experimental evidence suggests that the larva of *H. muscae* does not readily penetrate the conjunctiva or produce a granulomatous reaction in the subcutaneous tissues, it is not possible to say that it is never responsible for the production of a habronemic granuloma.

Clinical and experimental observations suggest that the production of a habronemic granuloma depends in some degree upon the susceptibility of the animal. It seems possible that the presence in the subcutaneous tissues of larvae of any of the three species of *Habronema* may set up a typical granuloma, provided the animal possesses a susceptibility to the particular species present.

Experimentally it has been shown, for example, that the presence of larvae of *H. microstoma* in the subcutaneous tissues may set up a granuloma with typical caseous areas, whereas, in the same animal, the presence of larvae of *H. megastoma* or *H. muscae* may produce nothing more than an acute inflammatory oedema, which quickly disappears, and is followed by no subacute or chronic changes.

It seems possible, further, that certain tissues may react in such a way as to produce a habronemic granuloma, while other tissues in the same animal show no such reaction. The larvae of *H. megastoma*, for example, may set up a habronemic conjunctivitis, but when present in the subcutaneous tissues of the same animal little or no reaction is produced (*vide* experiments).

Assuming that larvae of *H. megastoma* are responsible for the production of habronemic granulomata, it seems possible that certain varieties of the same species are more likely to produce these lesions than other varieties. Certain varieties, for example, may possess more vigour in penetrating mucous membranes or moist surfaces, or they may possess greater powers of adaptation. The same may be true for the larvae of the other two species.

It is possible that habronemic granulomata may be due to the larvae of some unrecorded species of *Habronema*, though it does not seem very probable.

The fact that habronemic granulomata are to be found in situations other than external mucous membranes led to the advancement by the present writer of an hypothesis that *Stomoxys calcitrans* was probably responsible for the inoculation of the larvae into the tissues of the horse. It has now been shown that *S. calcitrans* is the intermediate host of *H. microstoma*, and that in the final larval stage the larvae of this species show no longitudinal ridges in the cuticle. This larva cannot, then, be responsible for the granulomata observed by the present writer in Southern Australia. It is possible that *S. calcitrans* may be the intermediate host of some other species of *Habronema*, the larva of which shows longitudinal ridges in the cuticle; but there is probably no necessity to fall back on such an hypothesis as this. It seems possible that *S. calcitrans* infested with larvae of *H. microstoma* may inoculate these larvae into the skin of a horse with the production of a granuloma. It has been shown experimentally that larvae of *H. microstoma* are capable of producing a typical granuloma in the subcutaneous tissues. The occurrence of such a granuloma under natural conditions, however, has not been definitely observed in Southern Australia by the present writer, although the lesion taken from the metacarpus may possibly have been due to these larvae.

As far as can be ascertained the granulomata observed on the sheath and limbs have not resulted from infection of a wound. In no case has there been a history of a previous wound. It is possible that small wounds may have been overlooked, but it must be conceded that the sheath is a very uncommon site for wounds.

These granulomata appear about the sheath and limbs, sites commonly attacked by *Stomoxys calcitrans*. When one or more of these flies bite they often produce some swelling in the skin, and an exudation of blood or serum occurs through the puncture wound. It seems possible that *Musca domestica* when coming to feed upon this exudate may contaminate the site with larvae of *Habronema*. The larvae would find sufficient moisture to prevent their desiccation, and would probably be able to make their way through the puncture wounds into the skin and subcutaneous tissues.

Wounds would often present ideal conditions for contamination by larvae and their subsequent penetration into the deeper tissues. It is probable that this method of infection does occur, but there seems to be no doubt that it is not the only method of infection.

Habronemiasis is so common in horses that it is rare to find a stomach free from one or other of the three species. This being so, it is remarkable that habronemic granulomata should be of such infrequent occurrence in Southern Australia and other temperate countries. There are several possible reasons for this:—(1) *H. megastoma* is not as common as the other species. It has been suggested that larvae of *H. megastoma* are probably the commonest cause of habronemic granulomata. In the experience of the present writer *H. megastoma* is the least common of the three species to be found in the stomach of the horse. This fact would tend to lessen the frequency of the occurrence of the granulomata if larvae of *H. megastoma* are the causal organisms. (2) The escape of larvae from the proboscis of flies is not a common occurrence. It would appear that the larvae may escape from the proboscis of *Musca domestica* when that fly comes to feed on moist surfaces. The escape of the larvae from the proboscis appears to depend upon the rupture of certain structures in the proboscis. This rupture appears to depend directly upon the number of larvae present and their activity. Unless conditions are such as to allow of the development of a large number of larvae in the fly, and the temperature is high enough to produce marked activity in the larvae, then it would appear that the escape of larvae from the proboscis is not very likely to occur. Experimental observations have shown that the escape of larvae from the proboscis is not of frequent occurrence. (3) All animals do not appear to be susceptible. (4) It seems possible that certain strains or varieties of the same species are more likely to produce lesions than others.

In each granuloma examined there have been a large number of larvae or necrotic areas present. This indicates that there is usually a massive infection at one point. Superinfection has not been found to be of common occurrence. Only in one tumour examined was this suggested by the fact that larvae showing marked retrogressive changes were present along with others showing very early retrogressive changes. Massive infection at one point, therefore, does occur, and is probably explained by the fact that the larger the number of larvae present in the proboscis of a fly the more likelihood of rupture of the proboscis and the escape of the larvae.

Tumours on the glans penis have always been found at the urethral orifice. This suggests that flies are attracted to the moisture about the meatus, and that the larvae after escaping from the proboscis make their way through the mucous membrane of the urethra, and not through the modified skin covering the glans penis. This is supported also by the fact that the necrotic foci are found close to or involving the urethral mucosa while they may be relatively a considerable distance from the external surface.

C. Granulomata as found in Northern Australia.

General.—A granulomatous affection of horses, commonly known as "swamp cancer," and described by Lewis (1914) under the name of equine granuloma, is found in the northern or tropical portions of Australia. The condition has been thoroughly described by Lewis, who studied it in the field, and also conducted some experimental work in an attempt to artificially produce the disease.

The present writer was impressed with the great similarity between this condition and the granulomata observed in Southern Australia. On request, specimens of "swamp cancer" were kindly supplied by Mr. J. F. McEchran and Mr. C. G. Dickinson.

Macroscopic examination.—Macroscopic examination shows the tumours to vary very little from the granulomata already described. The most marked variation is in the very large size these tumours attain in the north of Australia and their great chronicity. A point to be emphasized is that in the early lesions the necrotic areas are small, pale in colour, and soft, while in the older lesions they are larger, darker in colour usually, and harder. It is evident that the growth of the tumour depends upon an enlargement of the necrotic areas and an increased tissue reaction, *i.e.*, the number of necrotic areas does not increase as the tumour grows.

The necrotic areas when separated out from the surrounding tissues are seen to have an irregular, bosselated surface with some marked irregularities or "branchings." These necrotic areas are typical of "swamp cancer" as of the granulomata described above.

Ulceration of the surface is much more extensive in "swamp cancer" than in the granulomata observed in Southern Australia.

Microscopic examination.—The histological picture is essentially that of a granuloma. There is an increased production of fibrous tissue, which varies with the age and size of the lesion. The tumour is extensively invaded with eosinophile leucocytes. There are collections of mononuclear cells, and an epitheloid (endothelial) cell reaction with, at times, the formation of many multinucleated cells. Necrotic areas occur throughout the tumour, and in the older lesions they are more or less encapsulated. When ulceration of the surface is extensive, neutrophile leucocytes are attracted to the part.

This histological picture is almost identical with that described in the present communication for habronemic granulomata occurring in Southern Australia. The only variation is due to the earlier and more extensive ulceration and secondary infection of the superficial parts of the tumour. This gives rise to an infiltration of the tissues with neutrophile leucocytes, which are found mainly in the more superficial parts of the lesion, but are not seen attacking the caseous areas. The tissue reaction is very marked, being greater the larger the tumour.

The caseous areas have the same microscopic appearance as those already described, but calcification has not been observed in "swamp cancer."

No very early lesion has been examined, so that it has not been possible to demonstrate any larval Nematode. In some cases spaces resembling worm canals have been observed.

Possibly, however, these are blood vascular spaces that have been included in the necrotic area.

The smallest lesion examined was one with a diameter approximately 2 cm. and a depth of about 6 mm. It was raised and had an ulcerated surface. Microscopically there was an extensive invasion of the tissues by eosinophile and neutrophile leucocytes, which were more crowded together in some areas, towards the centre of which typical necrosis had occurred. There were only very few necrotic areas present. The tissues were oedematous and haemorrhagic. The epidermis was in parts oedematous, and invaded by leucocytes. This change had led to ulceration with the formation of a vascular granulation tissue. Towards the edge of the lesion the epidermis showed considerable hypertrophic changes, the epithelium dipping deeply into the subcutaneous tissues, and showing numerous small processes. This hypertrophic change in the epithelium indicates an irritation of some standing. The necrotic areas were sometimes ill-defined and diffuse, and there was no attempt at encapsulation. Multinucleated cells were seen in several parts of the section.

The whole lesion was examined in serial section and no larvae were discovered. The lesion, although a very small one, was probably of several weeks' standing, and not as early as might be assumed from its size. A consideration of the hypertrophic changes in the epithelium, which must have been of several weeks' duration, led to this conclusion.

It may be mentioned here that there is a granulomatous condition affecting horses in the Solomon Islands known under the name of "swamp cancer." This condition is discussed elsewhere, and must not be confused with the "swamp cancer" of Northern Australia.

Discussion.

There is a great similarity between the macroscopic and microscopic pathology of "swamp cancer" and habronemic granuloma as observed in Southern Australia.

The condition is undoubtedly a granuloma, and is due to a reaction on the part of the tissues to an invasion by some organism. It belongs to that type of reaction most commonly seen in animal tissues that have become invaded by some larval or adult verminous parasite. The reaction is so similar to that seen in some habronemic granulomata as to suggest that the condition is due to a similar cause. No larvae have been found in the tissues, but this is not proof that they have not been there at some time, and that the tumour is not the result of the invasion. At the same time there is no proof that larvae are responsible for the reaction.

Attention has already been drawn to the fact that the tissue reaction and necrosis found in habronemic granulomata are essentially the same as those found quite commonly in the internal organs of herbiverous animals following the death in the tissues of migrating parasites. Experience leads one to believe that a granuloma containing necrotic foci, showing a marked eosinophilic invasion and the formation of multinucleated cells, is due to the reaction of the tissues against an invasion by a larval or adult metazoan parasite, usually a Nematode. There seems to be no reason to suggest that "swamp cancer" offers an exception.

It is now known that these lesions in the skin and external mucous membranes of the horse are most commonly due to a larval *Habronema*, and there is strong presumptive evidence that "swamp cancer" is due to a similar larva.

It has already been shown that in older lesions larval *Habronema* cannot be demonstrated. It is difficult in a country like the Northern Territory of Australia to obtain early lesions, for the animals are not under constant supervision. Lesions that have been sent to the present writer and described as early lesions have been found on examination to be small lesions, but of some standing. It seems almost certain that many of these small lesions would never develop into the large, chronic lesions. Their small size appears to depend upon the few necrotic areas present and a resistance on the part of the animal which is apparently absent in those animals which develop large, chronic lesions.

Experimentally it has been shown that larvae belonging to all three species of *Habronema* are capable of penetrating the tissues for some distance from the point of entry. At least two of these can set up a chronic irritation which leads to the formation of a granuloma containing necrotic foci. Experimentally it has also been shown that apparently the tissues of some animals offer a strong resistance to the presence of these larvae, and are capable of quickly destroying them before they are able to produce much reaction. It will be seen, therefore, that the possibility is that "swamp cancer" may be due to any one of the three species of *Habronema*. Evidence is not in favour, however, of the probability of "swamp cancer" being due to larvae of either *H. muscae* or *H. megastoma*. These two forms pass through their larval stages in *Musca domestica*, and as this fly is not usually to be found far afield, it seems probable that it is in no way associated with the occurrence of "swamp cancer." It seems more probable that *H. microstoma* may be the species responsible for the lesion. As this species passes through its larval stage in *Stomoxys calcitrans* there is more chance of horses in the field becoming inoculated with these larvae than with those of the other two species. It has been shown experimentally that larvae of *H. microstoma*, although being able to set up a typical reaction with necrosis, quickly disappear in the tissues. If "swamp cancer" be due to the larval form of *H. microstoma*, it seems possible that this is one of the reasons for the failure so far to demonstrate the presence of any larvae in the tissues. Also, as the presence in the skin of larvae of *H. microstoma* would apparently depend upon their inoculation by *Stomoxys calcitrans*, a super-infection would at least be uncommon; therefore, one would not expect to find larvae only a few days old in an ulcerated lesion, as is possible in those due to the larvae of other species of *Habronema*. If "swamp cancer" is due to the final larval stage of *H. microstoma* as seen in *Stomoxys calcitrans*, then the probability of its demonstration in the lesions would appear to be somewhat remote.

It seems possible also that "swamp cancer" may be due to other species of *Habronema* carried by some other form of muscid such as *Musca vetustissima*, which may be found further afield than *Musca domestica*. If *M. vetustissima* were responsible one would expect to find lesions in the conjunctiva. As far as one is aware these have not been observed, nor have the lesions been observed on other external mucous membranes. Lesions have, however, been observed on the sheath and limbs, sites commonly attacked by *Stomoxys calcitrans*, so that the suggestion that this fly may be responsible seems more likely to be true than the latter suggestion.

The observations and experiments made by Lewis are of importance. He has shown that "swamp cancer" occurs on those parts of the body commonly attacked by *Stomoxys calcitrans*. He has discussed the possibility of "swamp cancer" being due to a verminous infection, but has come to the conclusion that it is improbable. He believes that the eosinophilia observed in the lesions is due to the reaction of the breaking-down epithelium, and calls the reaction a local eosinophilia.

General eosinophilia may or may not be demonstrable, but in any case the eosinophile leucocytes found in the lesion have to be brought there by the circulating blood. Lewis is not very clear on the distinction he wishes to draw between a general and a local eosinophilia. Apparently he claims never to have found eosinophile leucocytes in the vicinity of verminous parasites. This is contrary to the experience of the present writer. It may be granted, however, that the presence of eosinophile leucocytes in a tissue is not always indicative of the presence of a verminous parasite.

Lewis is also of the opinion that the evidence is strongly opposed to the possibility of flies acting as the carrier of the infection. This conclusion is based on the fact that the number of biting flies in the Territory is considerable, but he has observed no preference on the part of the flies as to the portion of the horse to be attacked, whereas "swamp cancer" lesions occur mainly about the legs and abdomen. He states, however, that the biting flies present are chiefly Tabanidae, and it is on observation of the presence and habits of these flies that he draws his conclusions.

Lewis concludes that the probability is that the virus which causes the lesions "is normally a habitant of the swamps." There seems to be some evidence to suggest that in swampy districts horses are more prone to the affection. This may possibly be explained, however, by the fact that in such areas horse dung is liable to remain longer in a moist state and be more attractive as a breeding ground for *Stomoxys calcitrans*. He has demonstrated that the condition is not contagious. His attempts to obtain micro-organisms by cultural methods failed, and all attempts to reproduce the lesions artificially by inoculation of portions of tumours from horse to horse gave negative results. These results are important, and are not incompatible with the hypothesis that the lesions are due to some verminous infection.

Lewis himself admits that "the inability to reproduce the disease artificially from horse to horse suggests one of two things—either the presence of an intermediate host or carrier is necessary, or the appearance of the causative agent in the horse is an accidental phenomenon. . . ." These conclusions actively support the above hypothesis, for if the lesions are due to a larval *Habronema*, the presence of an intermediate host or carrier is necessary, and, moreover, the appearance of the causative agent in the horse is, as far as we know, an accidental phenomenon.

"Swamp cancer" occurs in horses in the field, but when these animals are brought in and placed on "hard food," Lewis informs us, the tumours gradually disappear. If the granulomata are due to a larval *Habronema*, this result is not very surprising, for in this case there is present no virus or micro-organism capable of multiplication in the tissues and of causing a progressive infection. If "swamp cancer" is due to a mould parasite, or some virus that is capable of multiplication in the tissues, this result is remarkable. If this be the case, it is also remarkable that necrotic areas do not increase in number and occur in all stages of development. Further, the failure of Lewis to transmit the disease from horse to horse can be taken as very strong evidence against the probability of the condition being due to some micro-organism or virus capable of multiplication in the tissues.

"Swamp cancer" certainly shows a variation in non-essential characteristics from habronemic granulomata as seen in Southern Australia, but this is possibly due to several factors. In the first place, it is unlikely that "swamp cancer" is due to an invasion of larvae of either *H. muscae* or *H. megastoma.* In the second place, horses running in the field, where the natural grasses are not always very nutritious, are likely to react differently from those kept on a highly nutritious diet ("hard food"). In the third place, the climatic conditions would have a decided effect on the nature of the reaction to an invasion by a larval *Habronema.*

In a previous publication the opinion was expressed that "swamp cancer" is almost certainly a variation of the affection observed in Southern Australia. After a more extensive experience in the examination of specimens, and after certain experimental studies, this opinion is still held.

In conclusion, it may be said that there is strong presumptive evidence to suggest that "swamp cancer" as observed in the northern parts of Australia is due to the invasion of the tissues by a larval *Habronema*, and that the species responsible is possibly *H. microstoma*, in which case it would most probably be introduced into the tissues by *Stomoxys calcitrans.*

D. Similar Granulomata as found Outside Australia.

1. "Summer Sores."

This affection was first described, in 1850, by Bouley. Rivolta, in 1868, isolated a worm from the sores, and called it *Dermofilaria irritans.* Laulanié confirmed this discovery in 1884. Since that time many observations on "summer sores" have been published. The literature bearing on the subject has been reviewed by Railliet (1915).

The affection has been variously named "summer sores," "granular dermatitis," "estival sores," "granular sores," and "esponja."

A typical lesion shows a granulomatous sore possessing small caseous nodules varying in size from that of a grain of millet to that of a pea. The lesions show variations in character according to the country in which they occur, climate and other conditions, but the presence of the caseous nodules is characteristic. Resistance to treatment, chronicity, and an accompanying pruritus are also characteristic features of the affection. The parts most commonly affected are the extremities, but the head and chest, and also the conjunctiva, are frequently the sites of lesions.

The condition has been described as occurring mainly in India, Africa, and tropical America.

For the most part the descriptions both of the pathology and the associated larvae have been neither very accurate nor full.

Railliet in his report deals extensively with the researches of Descazeaux, who studied the condition in Brazil. Descazeaux conducted some careful observations, and his contribution has considerably advanced our knowledge of the affection.

The following is a brief summary of the description as given by Descazeaux:—

"Summer sores" appear during the summer; during the winter these tumours disappear totally or in part, to reappear on the first return of heat. Three to 4 per cent. of horses and mules were found affected. The parts of the body most affected are the external surfaces of the extremities, the canon, the knee, and the lateral and superior parts of the neck. The condition is found in two stages. In the first stage the tumour is only inflammatory. Old lesions will again become active. The tumours are circular, non-adherent, and 1 to 1·5 cm. in thickness. In the second stage (15 to 20 days) the circular tumour varies in extent up to 30 cm. in diameter and 2 to 5 cm. in thickness; it is very fibrous and adherent to subjacent tissues, the superior part of the tumour being ulcerated. The tumour presents a tendency to enlarge. The surrounding skin is thickened, indurated, and elevated by a number of nodules, which soon ulcerate and become confluent. The ulcerated surface becomes covered by granulations. Pruritus is intense. The sores last six to nine months, and resist all treatment. Cold acts favourably upon them, and in the first months of the winter, if they are not very extensive, they may completely heal. If the sore is only in the first stage it will disappear in from four to six days.

Pathological Anatomy.—At first the "Esponja" has the characteristics of an inflammatory tumour; it is very vascular and easily excised. Later the tumour becomes hard, fibrous, and infiltrated with calcareous "grains." On the cut surface these "grains" are seen to vary in size from that of a pin's head to that of a pea, and they enucleate very easily.

Microscopical.—The tumour in the first stage shows roughly three layers or areas—a deep layer formed by loose fibrous tissue and vascular spaces; a middle layer with little fibrous tissue but a considerable infiltration of leucocytes and eosinophiles; a superior layer formed chiefly of thickened fibrous tissue. In the middle, parasitic caseous areas are seen. These are oblong or round, measuring from 800 μ to 900 μ in length by 300 μ to 400 μ in breadth.

The worms are found in these necrotic areas, and vary from two to five in number. Some areas present a central cavity which was primarily occupied by the parasite. In tumours of the second stage it is difficult to find typical parasitic "tubercles." The tumours consist mainly of dense fibrous tissue. Sometimes the *débris* of a parasite is seen.

Descazeaux also gives a description of the "parasite" which as Railliet has shown, he wrongly considered to be a mature female. This parasite he calls the "constant parasite," and describes it as being from 2·4 to 2·8 mm. long by 45 to 50 μ broad, body filiform, terminating posteriorly in a blunt point furnished with bristles; cuticle striated longitudinally. In one sore he found, on dissecting the superficial part, five examples of a larva which he calls the "inconstant parasite." This is described as being 900 μ long by 25 μ broad, cuticle smooth, anus at the base of the tail, and vulva at the posterior third of the body.

Railliet draws attention to the occurrence of cutaneous lesions in which larvae have been found, but which differ from the "constant parasite" of Descazeaux. He recalls that Ercolani met with embryos of a Nematode in a horse on which were found "umbilicated crusts" about 1 cm. broad and very adherent. The crusts implicated the entire thickness of the skin, and were localized at the lower surface of the body along the *linea alba*, where there were also many bare patches. In these crusts Ercolani found a small Nematode, which was characterized by keeping its caudal extremity doubled under the body and making frequent movements of abduction. He called the worm *Trichina uncinata*. Unfortunately no dimensions were given. Railliet remarks that Haubner described this condition under the name of "placoregma," and that the affection, which has also been described by Cadeac, presents a very marked resemblance to "summer sores."

Railliet mentions that Buffard found embryos in oedematous plaques which somewhat resembled the lesions of dourine. These embryos measured 80 to 90 μ long by 3·5 to 4 μ broad. Buffard believed these to be the embryos of *Filaria papillosa (Setaria equina)*, but Railliet shows that he was mistaken.

Railliet believes that the embryos found by Ercolani and Buffard are embryos of *Habronema*.

Further, Railliet believes that the "inconstant parasite" of Descazeaux is an early larval stage of *Habronema*, resembling stage 2 of *H. muscae*, as described by Ransom.

Fayet and Moreau described a larva measuring 2·5 to 3·5 mm. long by 50 to 90 μ broad, which possessed longitudinal striations, but spines on the caudal extremity were not mentioned. Railliet believes that if the larva really lacked the covering spines at the tip of the tail it would fall into one of the stages between 3 and 5 of *H. muscae*, as described by Ransom.

The main part of Railliet's paper deals with the classification of the larval Nematode found in "summer sores." The fact that the larva possesses a spinous tip at the end of the tail has enabled Railliet to definitely place it in the superfamily Spiruroidea. The larva corresponds closely to the sixth larval stage of *Habronema muscae*, as observed by Ransom in *Musca domestica*.

After discussing the findings of the various authors, Railliet comes to the conclusion that the Nematode of "summer sores" is none other than a larva of Spiroptera of the genus *Habronema*. His general conclusions are as follows:—

1. The parasite of verminous dermatitis is an embryo or a larva of *Habronema*, which it is rational to ascribe to one of the three species of the genus living in the stomach of the horse.
2. The clinical forms of the affection vary in a certain measure with the stage of evolution of the parasite and with the climate.
3. It is probable that the infection of the horse occurs from without inwards by contact with manure, which harbours the embryos of *Habronema* rejected with the excrements, and that these embryos evolve in the skin as they do normally in the body of the fly.
4. It is possible also that the larvae escape from the proboscis of the fly in contact with the sores.

More recently van Saceghem (1917) published a summary of some observations he had made on "granular dermatitis" as it occurs in equines at Zambi, Lower Congo. He found that the condition occurs only in animals kept in stables. The bedding was changed and the dung removed regularly from these stables.

The disease is never localized in the hindquarters, but always in the fore quarters, on the legs, and the inner canthus of the eye. Lesions in other situations are rare. Equines which are allowed to live at liberty never present the disease. In a stable where several horses were affected with "summer sores" he found that 20 per cent. of *Musca domestica* were infested with a Nematode larva 2·5 mm. long by 65 μ broad. The larva possessed an elongated, pointed, anterior extremity, and a blunt posterior end studded with bristles. The larvae showed no longitudinal striations.

The larvae found in the sores were 50 μ broad, and showed marked longitudinal striations. The lesions usually show a large number of calcified larvae and a few living ones. He says that there is thus a massive infection at a single point, and it is not very probable that these larvae are all conveyed during one short period of time to the same point.

In a later communication, van Saceghem (1918) records the results of some experiments, and concludes that flies are the vectors of the *Habronema* larvae, and that the larva found in the verminous nodules is an aberrant larva of *H. muscae*.

In his earlier communication he says that in a few *post-mortem* examinations made at Zambi no specimens of *H. megastoma* were found. His conclusion was that *H. megastoma* was either absent or very rare at Zambi. In his experiment he, therefore, deposited larvae of *Musca domestica* on a freshly voided mass of dung from a horse "known to be infected with *H. muscae*." When the adult flies hatched out they were found to be infected with larvae in a proportion of 70 per cent. Larvae isolated from some of these flies and transferred on to the hair or shaved skin of a horse were found to die off rapidly and show no tendency to pierce the skin. When deposited on wounded surfaces covered with serous fluid they executed movements, and showed a marked tendency to become lodged in small crevices. He also deposited larvae in the inner canthus of the right eye of a horse which was kept isolated within an enclosure surrounded by fine mosquito netting. The animal subsequently became affected with conjunctivitis, and verminous nodules developed on the *membrana nictitans*. The left eye, which served as a control, showed no change.

A further experiment was conducted in which two wounds were made in the skin of a horse; one wound was protected against flies and the other was left uncovered. The animal was placed in a stable in which 20 per cent. of the flies were infested with *Habronema* larvae. The unprotected wound became the seat of intense irritation, which caused the horse to bite itself. The wound became transformed into a characteristic "summer sore."

Discussion.

There can be no doubt that the etiology of the tumours found in Southern Australia and of those found elsewhere, and usually called "summer sores," is the same. The larvae found in "summer sores" appear to be identical with those found in Southern Australia. Fayet and Moreau, Descazeaux and van Saceghem have all described the presence of longitudinal ridges in the cuticle, which also characterizes the larvae found here. Unfortunately the descriptions of the larvae have been very inaccurate, and in many cases they have been regarded as adult forms. It was not until recently that the etiology of the condition was established by Railliet in his interpretation of the work of Descazeaux.

Although there are certain variations in the characters of the lesions, for the most part they are fairly constant. Those lesions in which embryos have been found do not appear to resemble a typical "summer sore" very closely. Railliet believes that the clinical form of the malady may be in agreement with the stage of evolution of the parasite.

There appears to be very little evidence to support Railliet's theory, *viz.*, that the lesions are due to the penetration of the skin by embryos which develop as erratic parasites in an abnormal situation in undergoing an analagous development to that which they accomplish normally in the body of the fly. It has been shown experimentally that the final larval stage can produce a typical reaction, so, at least, this aberrant development does not appear to be necessary.

It is possible that embryos may either penetrate the skin or become lodged in sores, where they may set up a tissue reaction, but there is no experimental evidence to support this assumption.

Even if we assume the possibility of embryos of *Habronema* setting up a certain type of lesion in the skin, there appears to be little or no evidence to suggest that such embryos are capable of developing through their larval stages in this situation. Further, there is no proof that the embryos found by Ercolani in the one case, and by Buffard in the other, are embryos of *Habronema.*

Embryos of *Habronema* are to be found in the faeces at all times of the year. If these embryos leave the faeces, and in penetrating the skin and their subsequent evolution they set up a typical "summer sore," it is difficult to explain (1) the seasonal occurrence of the tumours and (2) the massive infection at one point.

The life-history of the three species of *Habronema* is of that type which involves a simple alternation between two hosts—one a vertebrate harbouring the adult and the other an invertebrate harbouring the larval stage. From a theoretical consideration it seems reasonable to assume that it is improbable, should this alternation be broken, that the worm would be able to carry on its development.

Before Railliet's theory can be accepted it will require the support of more clinical and experimental evidence.

The "inconstant parasite" of Descazeaux, believed by Railliet to be an early larval form of *Habronema* resembling stage 2 of *H. muscae* as described by Ransom, is not definitely a larval *Habronema.* It was described by Descazeaux as a "larve strongyloide." He described the anus as being open and situated at the base of the tail and a vulva situated at the posterior third of the body. The larva is 900 to 950 μ long by 25 μ broad. It will be seen that the larva is approximately only half the width of a *Habronema* larva. From an early stage resembling that of stage 1 of Ransom the growth of *Habronema* larvae is mainly in length, the width or diameter remaining approximately constant throughout. The presence of an open anus at the base of the tail is against its being a *Habronema* larva. A larval *Habronema* has a closed anus with a very prominent anal operculum in the early stages, and only in the final larval stage is the anus open. It seems possible that the form may be an aberrant larva of *H. microstoma*, as is sometimes seen in *Musca domestica*. It is also possible that the larva does not belong to the genus *Habronema*. Railliet has taken the presence of this larva in one sore examined by Descazeaux as evidence in favour of his theory that embryos of *Habronema* are capable of developing through their larval stages in the skin of the horse. If the form is a larval *Habronema* it is certainly aberrant, but there is no proof that it has developed from an embryo in the skin of the horse. There is no proof, moreover, that the form is a larval *Habronema*. It is doubtful, then, that this finding really can be taken as supporting Railliet's theory.

Further, there is little support for Railliet's theory to be found in the fact that Fayet and Moreau did not describe the presence of a spinous tip to the tail of the larva they found. In all other respects their larva resembles that usually found in "summer sores," and it is probable that they failed in common with others to detect the spinous tip.

The fact that larvae at an earlier stage than the final are sometimes present in the proboscis of a fly must not be overlooked. Should these earlier larvae be present in the proboscis along with larvae in the final stage, and should the larvae escape from the proboscis, it is possible that these earlier larval stages may be present in a lesion along with the later stages. Therefore, the finding of larvae of an earlier stage could not be taken as proof of development of the larvae in the tissues of the horse.

Van Saceghem's observations and experiments strongly suggest that flies play an important *rôle* in the production of the lesions. His experiments have shown that the larvae of *Habronema* when placed in the inner canthus of the eye are capable of setting up a typical habronemic conjunctivitis. He showed, further, that an open wound may develop into a typical "summer sore" if the animal is placed in an environment where flies are heavily infested with larvae. This is strong presumptive evidence in support of his conclusion that the larvae in the wound escaped from the proboscis of the fly when the latter came to feed upon the raw surface.

Larvae found by him in "summer sores" were 50 μ in diameter, and showed marked longitudinal striations in the cuticle, whereas those found in flies caught in a stable were 65 μ in diameter and showed no longitudinal striations. He does not mention what means were taken to determine the presence or absence of longitudinal striations. In sections of a lesion a transverse section of the larva would clearly reveal the presence of the longitudinal striations in the cuticle. Unless transverse sections were made of the larvae isolated from the flies longitudinal striations could not have been demonstrated. If all means were taken to determine the presence or absence of these striations then, one may assert with confidence, that the larvae isolated from the flies by van Saceghem were neither larvae of *H. muscae* nor *H. megastoma*, but the larvae of some other species probably not yet described, although there is a possibility that they may have been the larvae of *H. microstoma*.

There is no proof that the larvae used by van Saceghem in his experiments were the larvae of *H. muscae*, as he claims. His experiments are valuable in demonstrating that the final larval stage of *Habronema* is capable of producing a typical lesion, but they do not help in the specific determination of the larva responsible.

It is interesting to note that Descazeaux records the fact that a typical "summer sore" may develop without any pre-existing wound or sore in the skin ("dans certains cas on observe des tumeurs parasitaires sans qu'il soit possible de déceler la moindre lésion cutanée"). Railliet mentions that Lingard in studying "bursati" in India observed the presence of the characteristic *kunkur* in some cases before the formation of any ulcer. Van Saceghem observed that on parts of the body where "summer sores" were subsequently set up an intense pruritus was manifested before the appearance of the visible lesion ("J'ai pu observer très souvent qu'au niveau des régions où va se déclarer une plaie d'été, avant l'apparition des lésions visibles, l'animal souffre d'un prurit intense qu'il manifeste en se mordant jusqu'au sang").

It is possible that these observations may show that a "summer sore" does not always result from the infection of an ordinary wound. The conclusions already reached with regard to the probable mode of infection are, therefore, not inconsistent with the facts as gathered from other parts of the world. It seems probable that the larvae responsible for the production of a "summer sore" are either that of *Habronema megastoma* or *H. muscae*, although there is a possibility that some unrecorded species may also be responsible.

2. "*Swamp cancer*" *in the Solomon Islands.*

Through the courtesy of Mr. John Scott, the present writer has had an opportunity of examining specimens of a granuloma that is commonly found affecting horses in the Solomon Islands.

The following information has also been kindly supplied:—About 75 per cent. of horses in the Solomon Islands suffer from a form of "swamp cancer," which attacks the pasterns only. The tumours vary in shape and size from those showing a flat, raised surface with a diameter of about 1 inch to those showing a rounded surface and a size somewhat larger than a cricket ball. The lesions do not appear to cause the animals any pain. They are very chronic and may last for years. They do not appear to occur at one time of the year more than another. The animals, for the most part, are grass fed, worked through the day and turned out in the horse-paddock at night. Horses running at pasture appear to be affected in about the same proportion as those at work. The horses are mostly used for saddle work. The district is comparatively dry, but is subject to very heavy dews. The area is threaded with tidal lagoons, usually closed at the mouth. Horses having no access to swamps or waterholes are commonly affected. The animals are never more distant than a mile from habitations.

The macroscopic appearance of the tumours is very similar to that of habronemic granulomata. The surface is usually ulcerated. The tumour is very dense and tough, and on section is seen to contain numerous yellowish, caseo-calcareous nodules, not usually larger than a millet seed. These necrotic areas are more numerous than seen in tumours occurring in Australia. A vertical section of one tumour, with an area of approximately 10 sq. cm., contained approximately 140 necrotic areas, some more or less sclerosed.

The microscopic picture is very similar to that described as found in habronemic granulomata in Australia. The differences are due to the more chronic nature of these tumours. The fibrous tissue is dense and sclerosed. The tissues are infiltrated with eosinophile leucocytes. Many of the necrotic areas have been absorbed and their place taken by fibrous tissue. This process is seen in various stages. There is a marked tendency for the occurrence of a deposit of calcareous material in the necrotic areas. Larvae showing a cuticle with fine longitudinal ridges are seen in various stages of degeneration.

It is apparent that the larvae present are not all of the same age. Many appear to be well preserved and of recent advent, while others have completely disappeared, leaving only the worm canals in the necrotic areas. The necrotic areas are also in various stages of absorption. It appears, therefore, that the chronicity of the tumour depends upon a repeated invasion of the tissue by larvae.

Portions of larvae have been obtained from lesions, and in the better preserved specimens the characteristic spinous tip at the caudal extremity has been observed. It appears, therefore, that the tumour is a habronemic granuloma.

Discussion.

It is remarkable that such a large percentage of horses becomes affected. As far as is known to the present writer there is no previous record of animals becoming affected to anything approaching the extent of 75 per cent.

Another point of interest is the fact that lesions occur in animals that are not at any time confined to the stable. This is contrary to the usual experience. The animals, however, are not at any time far distant from habitations, so that one would expect to find *Musca domestica* in numbers in their surroundings.

The fact that the tumours occur only in the one situation is of extreme interest. It is not possible, at present, to determine the exact reason for this. It is possible, however, that the animals may be subject to injuries about the pastern, probably due to some rough, cutting grass. It is remarkable, nevertheless, that wounds in other parts of the body do not develop into habronemic granulomata.

The occurrence of lesions in one situation only does not suggest that biting flies are in any way responsible.

The larvae bear the same characteristics as those found in Australia and elsewhere.

3. *"Leeches"* and *"Bursattee."*

"Leeches."—In North America there exists a granulomatous affection of equines commonly known as "leeches."

According to many writers the lesions are to be found on the limbs and those parts of the body which are liable to come in contact with water when animals are standing in swamps. The disease has been little investigated, and a considerable confusion has existed as to the pathology of the condition, with the result that it has been described as cancer, and numerous other pathological conditions have been included under this name.

There seems to be no doubt that the older writers were wrong in classifying this condition as a malignant neoplasm. It is now generally recognized that the condition is a granuloma, though so little is known of its pathology that many lesions of different etiology are probably still classified under this popular name "leeches." Hutyra and Marek (1913) classify the condition as a malignant hyphomycosis, although the evidence upon which the classification rests seems to be of rather an insecure nature. No conclusive evidence has been produced demonstrating the condition to be a mycosis.

Fish (1897) came to the conclusion that the condition was due to a fungus. His report deals with a histological investigation of two cases, and a historical account of a supposed similar disease (Bursattee) occurring in India.

He describes a granuloma containing characteristic hard caseous areas with an irregular or bosselated surface. He describes the nodules or caseous areas as being generally irregularly cone-shaped and variable in size, revealing on section a very dense structure the framework of which forms a close reticulum. Within the meshes of .the reticulum are what appear to be leucocytes in various stages of disintegration, and free nuclei. He says that it would appear, therefore, as if the framework of the nodule were composed of a mycelial net, which in the course of development has become more or less calcified. He describes and figures the mycelium. The tissue surrounding the nodule shows the presence of numerous leucocytes. These he speaks of as being "spore-laden," but his figures are more helpful than his interpretations, and leave no doubt that he is describing nothing but an eosinophile leucocyte. He also mentions the finding of giant cells in many of the sections.

The interpretations of Fish cannot be accepted without considerable reservation. From his figures one has no difficulty in recognizing his "spore-laden leucocyte" as an eosinophile leucocyte, and likewise his "mycelial threads" appear to be nothing but strands of fibrous tissue in varying stages of degeneration.

The granuloma Fish describes is similar in all essential characteristics to "swamp cancer" and the more chronic granuloma observed in Southern Australia.

Lewis has already agreed that "leeches" and "swamp cancer" are probably the same disease.

It seems reasonable to conclude, therefore, that under the term "leeches" is described a granuloma closely resembling "swamp cancer" in its macroscopic and microscopic appearances, and that it is probably a habronemic granuloma.

"*Bursattee*".—"Bursattee," or "Bursati," is the name applied to a granulomatous condition affecting horses in India. This condition is classified by Hutyra and Marek as a hyphomycosis and described along with "leeches."

The morbid symptoms are said to consist in the appearance of very firm nodules under the skin of the lips, the nasal alae, neck, the body and limbs, and, finally, also in the nasal cavities. The characteristic areas, or *Kunkur*, are present in the granulation tissue.

It is extremely difficult to discuss the condition, for most of the descriptions were given in the early or middle part of the nineteenth century, when any knowledge of pathology was not general.

De Haan and Hoogkamer (1903) have described a similar disease occurring in the Sunda Islands. This article is referred to by Hutyra and Marek. Unfortunately the present writer has had no opportunity of consulting the original article.

These authors have claimed that the condition is due to a fungus, but appear to have produced no experimental evidence in support of their conclusions.

Several of the older writers have described lesions as occurring on the mucous membrane of the mouth, but it would appear that they are describing lesions of different character from those occurring on the external surfaces of the body. Also, lesions are described as occurring in the internal organs. Since caseo-calcareous masses are not uncommon in the internal organs of all herbiverous animals, there seems to be no justification in the conclusion of many writers that these masses are "internal lesions" of "Bursattee."

One is forced to the conclusion that under the name of "Bursattee" lesions due to may causes have been described. Nevertheless, there appears to be no doubt that the majority of the lesions described as occurring on the external surface of the body possess characteristics closely resembling those of habronemic granulomata as seen mainly in tropical regions.

Hayes (1906) mentions some very interesting points in connection with the occurrence of the disease. He says, "Although bursattee was very prevalent in Indian stables, say, thirty years ago, it is now comparatively rare; owing, apparently to improved sanitary arrangements, of which the supply of purer water has been the most important factor in the prevention of this disease. It is practically unknown among horses whose stable management, feeding, and watering are properly attended to." This statement is one of some importance, for the association of dirty stables with the appearance of habronemic granulomata is now well recognized. A further observation by Hayes also supports this interpretation. He says, "Horses that have had this disease and remain in the condition under which they have contracted it, are almost certain to suffer from its recurrence. . . ." This is also the case in the occurrence of habronemic granulomata, and is explained by the fact that the animal carries the potential cause of the disease, *viz.*, adult forms of *Habronema.*

Hayes says that the fetlock joints (especially), yard, sheath, front of chest, face, lips, and tongue are the usual points of attack.

In this connection it is interesting to note that the penis and sheath are commonly affected, as is found to be the case in Southern Australia.

Argyle (1910) described the occurrence of bursattee lesions on the corners of the mouth, sheath, and in two cases on the penis at the urethral orifice. In the same year (1910) Hodgkins described a case of bursattee showing lesions on the sheath, breast, fetlocks, internal canthus of both eyes, and the urethral orifice.

Holmes (1915) has come to the conclusion that the disease is probably a mycosis somewhat resembling sporothrichosis of the horse and mule described by Carougeau in Madagascar.

He admits that he is unaware of recorded cases of transmission of the sore from horse to horse. He says that there is not sufficient evidence to prove that Nematode embryos are present in bursati lesions, or that bursati sores or tumours are caused by such embryos.

There may be no evidence to prove that Nematode embryos or larvae are present in the lesions, but this negative evidence is not proof that the lesions are not due to the presence of larvae at some time. It has already been shown that it may be impossible to demonstrate larvae in habronemic granulomata of more than three or four weeks' standing, providing there is no reinfection. In the majority of the lesions collected from animals in Southern Australia examined by the present writer, no larvae have been found. In many of them it has been difficult to demonstrate even any worm canals, but in a series of tumours from early to late one can trace the gradual disappearance of the larvae. Therefore, one is not justified in claiming that a granuloma possessing the macroscopic and microscopic appearances of a chronic habronemic granuloma is not due to a larval *Habronema*, simply because the larva cannot be demonstrated. Experimental evidence suggests that the larvae of *Habronema microstoma*, although setting up a typical granuloma, disappear very rapidly. It seems possible that many of the granulomata in which no larvae can be found may be due to larvae of *H. microstoma*. The bursattee lesions described by Argyle and by Hodgkins, however, appear to be very similar to the habronemic granulomata, as seen in Southern Australia, and to "summer sores." The lesions were found on the mucous membranes of the eye and penis, respectively. This suggests that they, at least, would not be due to larvae of *H. microstoma*, but to the same species as the larvae responsible for "summer sores" and the lesions found in Southern Australia.

A review of the literature bearing upon these two diseases reveals the fact that these granulomata possess characteristics that are common to habronemic granulomata. They possess such a striking resemblance to habronemic granulomata that it is probable they possess a similar etiology.

E. Nomenclature.

These granulomata have been known for many years under various local names. The cause of the affection having been determined, it became necessary to introduce a more specific designation. Railliet introduced the term *cutaneous habronemiasis.* He says, "Le parasite de la dermatite granuleuse vermineuse est un embryon ou une larve d'*Habronema,* qu'il est rationnel de rapporter à l'une des trois espèces de ce genre vivant dans l'estomac du cheval. L'affection mérite donc d'être désignée sous le nom *d'habronémose cutanée.*"

The disease Habronemiasia is an infection of the stomach of the horse by one or all three species of the genus *Habronema.* The infection consists of the development of larvae into adults which become associated with the mucous lining of the stomach or with the submucosa, and this term would include any other phenonema incidental to the infection. By analogy, the term cutaneous habronemiasis should mean the development of larvae into adults in the cutaneous or subcutaneous tissues where a true parasitism would develop. An infection of this nature does not appear to occur, and certainly it does not occur in the granulomatous conditions that have been discussed. If Railliet's theory that the embryos of *Habronema* develop through larval stages in the cutaneous tissues be proved, it is doubtful even then that the designation cutaneous habronemiasis would be correct.

Ankyostomiasis is the disease caused by species of the genus *Ankylostoma.* The disease is a toxaemia resulting in a progressive anaemia, and is due to an infection of the intestine by the worm. When the larvae of these worms enter the skin they may give rise to a dermatitis. It would not appear to be correct to name this dermatitis cutaneous ankylostomiasis.

Following the same lines of reasoning it does not appear to be correct to give the designation cutaneous habronemiasis to the granulomatous condition produced in the external mucous membranes and cutaneous tissues by the larvae of the genus *Habronema.*

The term habronemic granuloma has been used by the present writer as the designation of the granulomatous condition arising after the invasion of the external mucous membranes or cutaneous tissues by larvae of the genus *Habronema*. It is believed that this term is more likely to be correct than the term introduced by Railliet.

F. General Summary.

A granulomatous condition found most frequently affecting the external mucous membranes of the horse in Southern Australia has been found to be due to the presence of a larval Nematode of the genus *Habronema*. These granulomata are found less frequently on the sheath, limbs, and probably other situations. The tissue reaction following the introduction of the larva gives rise to a tumour presenting a characteristic macroscopic and microscopic appearance. The larva is often very difficult to demonstrate, and is only to be found in lesions of up to about three weeks' duration. In lesions of longer standing there is usually no evidence whatsoever of the presence of the larva, but occasionally the spaces it once occupied are to be seen. The larva is incapable of living in the submucous, cutaneous, or subcutaneous tissues, and, therefore, its presence in these tissues appears to be quite accidental. Evidence suggests that these larvae are introduced from without, and that they are deposited on moist surfaces during the feeding operations of *Musca domestica*, which fly acts as the intermediate host of both *Habronema muscae* and *H. megastoma*. When deposited on the external mucous membranes the larvae appear to be capable of pushing their way through the membrane and of entering the submucosa. When lesions occur on parts other than the external mucous membranes, the moisture necessary to prevent desiccation of the larvae appears to be most usually supplied by an exudation of blood or serum. This would follow some injury to the skin of the animal, either in the form of ordinary wounds or in the form of small puncture wounds made by biting flies such as *Stomoxys calcitrans*.

After a consideration of the life-histories of the three species of *Habronema*, it appears that the larva responsible for the production of these lesions is most commonly that of *H. megastoma*. It seems possible that the larvae of the other two species may also cause similar lesions. The results obtained by animal experimentation go to support these conclusions.

The macroscopic and microscopic appearances of a granuloma commonly called "swamp cancer" which affects horses in Northern Australia are essentially the same as those found in the granulomata occurring in Southern Australia. Evidence suggests that this granuloma is possibly due to the larva of

Habronema microstoma, which would probably be inoculated by *Stomoxys calcitrans*.

A granulomatous condition found commonly in the horse and ass in various parts of the world, and known as "summer sores," or "granular dermatitis," has the same etiology as the granulomata observed in Southern Australia.

Examinations have been made of a granuloma which affects the region of the pastern of the horse in the Solomon Islands, and it has been found to be a habronemic granuloma.

Under the names "Leeches" in North America and "Bursattee" in India are described granulomata affecting equines. These granulomata possess characteristics that are common to habronemic granulomata. No larvae have been found in the tumours, and the etiology still remains somewhat obscure. They possess, nevertheless, such a striking resemblance to habronemic granulomata that it seems probable that they possess a similar etiology.

G. Prophylaxis and Treatment.

Prophylaxis should be in the direction of (1) ridding horses of the adult forms of the genus *Habronema* which are located in the stomach, and (2) in the destruction of horse dung or its use in agriculture. Of these two methods the second is more likely to bring success than the first, and in time should accomplish what is aimed at in the first.

Excision of the lesion will usually be found the best method of treatment. Should the lesion be ulcerated and of such a size as to be inoperable it is advisable to keep the surface covered by some application which will protect it against flies and possible super-infection. The lesion may reduce in size under this treatment and become amenable to surgical treatment.

Addendum.

Since this paper was submitted an opportunity has arisen of examining the published record of the work performed by Hill (1918), of which work reference has already been made. In so far as they deal with the life-histories of *Habronema muscae*, *H. microstoma*, and *H. megastoma* the present writer's results, in the main, agree with and confirm those obtained by Hill. Hill, however, concludes definitely that *Musca domestica* "occasionally (possibly only accidentally) acts as an intermediary" host of *H. microstoma* (p. 44). His records of experiments 7 to 11, 13 and 14, where larvae of *Musca domestica* were allowed to develop in sterilized faeces to which larvae of *H. microstoma* had been added, show that of 28 fly larvae, approximately 193 pupae and approximately 196 adults examined, only two larvae were found to contain one worm embryo each (experiments 7 and 8), and one adult one malformed larva (experiment 14). In further experiments (Nos. 15 and 16) larvae of *H. domestica* were allowed to develop in sterilized faeces to which larvae of both *H. muscae* and *H. microstoma* had been added.

In experiment 15, of 28 flies examined 15 were found infested with worm larvae. In Table 5 particulars are given of 6 larvae obtained from these flies. Hill believes that 4 of these larvae, specimens 3-6, are larvae of *H. microstoma*. The evidence in favour of these larvae being those of *H. microstoma* is not entirely convincing, particularly as the final larval stage was not observed, and the present writer doubts the correctness of Hill's conclusion.

Nevertheless, one does not doubt the possibility of *M. domestica* acting as an intermediary host of *M. microstoma*, but more evidence is required before proof of such is established.

In commenting on the present writer's preliminary observations, Hill (p. 62) casts doubts upon the results obtained in the experiments with larvae of *H. megastoma*. In these preliminary observations the opinion was expressed that it would be difficult or impossible to differentiate with absolute certainty between the final larval stage of *H. muscae* and that of *H. megastoma*.

Hill, unfortunately, failed to appreciate the fact that this opinion was expressed from the point of view of the possibility of differentiating larvae obtained from habronemic granulomata, and he further missed altogether the reference to the fact that differences had been observed, particularly with regard to the length of the oesophagus. His inference, therefore, that the present writer was not dealing with pure cultures cannot be held to be correct.

The fact that Hill (p. 64) failed to satisfy himself as to the specific determination of larvae obtained from conjunctival lesions, but considered they resembled those of *H. megastoma* more closely than those of *H. muscae*, seems to support the conclusions outlined in the present communication, *viz.*, that it would be difficult or impossible to differentiate between the final larval stage of *H. muscae* and *H. megastoma*, except under the best conditions of preservation, etc., and that evidence is in favour of the probability that larvae of *H. megastoma* are more often responsible for the production of habronemic granulomata than the larvae of the other two species.

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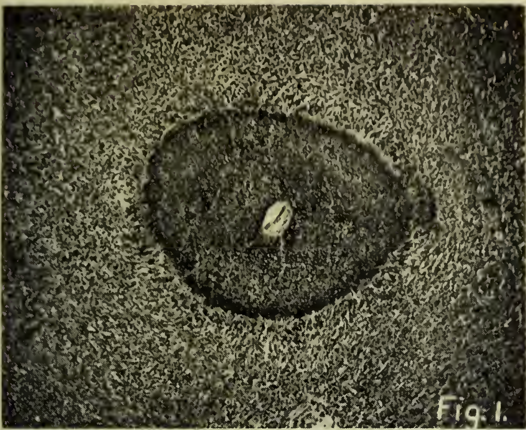
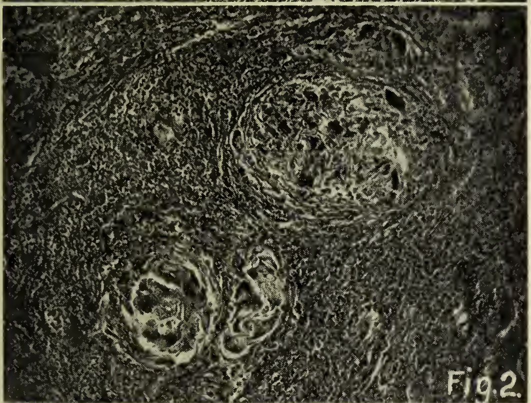


Fig. 1.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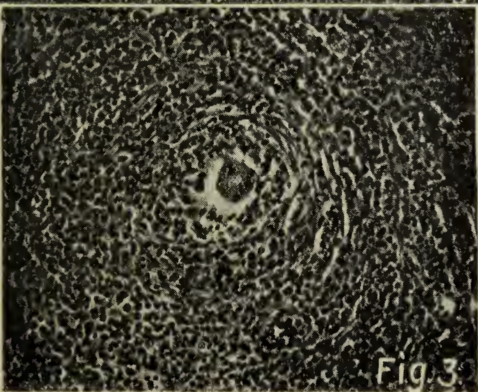
Fig. 3.

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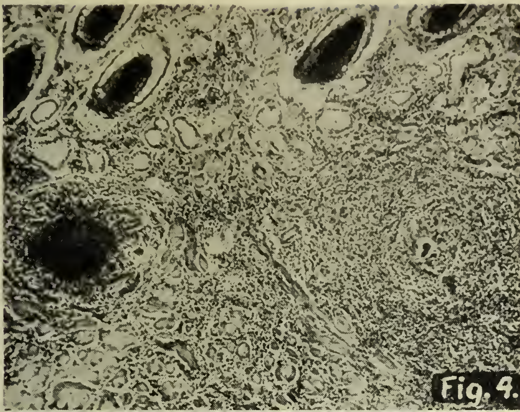

Fig. 4.

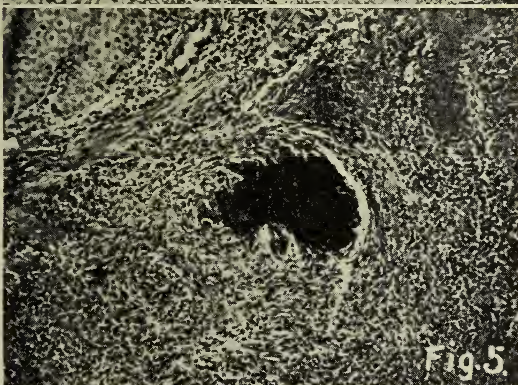

Fig. 5.

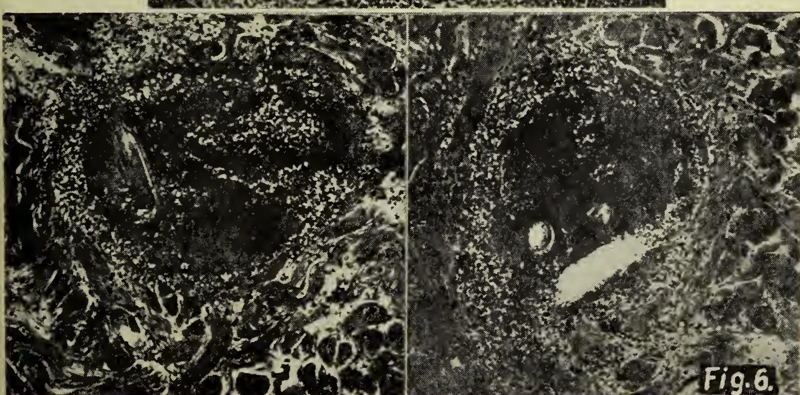

Fig. 6.

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Fig. 7.

Fig. 8.

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DESCRIPTION OF PLATES.

Plate XIII.

Fig. 1. Photo-micrograph of a section from a lesion produced under artificial conditions by larvae of *Habronema megastoma*. A typical necrotic area is seen with a worm canal in the centre containing a degenerating larva. Tumour removed nine days after inoculation.

Fig. 2. Photo-micrograph of another portion of the section used for Fig. 1. The formation of multinucleated cells is well illustrated.

Fig. 3. Photo-micrograph of another portion of the section used for Fig. 1. A degenerating larva with no surrounding necrosis of the tissues is illustrated.

Plate XIV.

Fig. 4. Photo-micrograph of another portion of the section used for Fig. 1. A small necrotic area is seen, and close to it a degenerating larva with only slight necrosis of the surrounding cells.

Fig. 5. Photo-micrograph of a section from a lesion produced under artificial conditions by larvae of *Habronema microstoma*. A necrotic area is seen with a degenerating larva at its lower edge. Tumour removed ten days after inoculation.

Fig. 6.—Photo-micrograph of a section removed six hours after inoculation with larvae of *Habronema microstoma*. Larvae are seen surrounded by leucocytes.

Plate XV.

Fig. 7. Photo-micrograph of a transverse section of the bulb of the proboscis of *Stomoxys calcitrans* showing the situation of the larvae.

Fig. 8. "Swamp cancer" in the Solomon Islands. Lesions on both fore-legs of the animal are well shown.

Photo by John Scott.

The Phaestos Disk: Its Cypriote Origin.

By A. Rowe,
Author of "An Ancient Egyptian Coffin in the Australian Museum," etc.

[Read August 15, 1919.]

Plates XVI. to XXII.

The Phaestos Disk has been an enigma to archaeologists and philologists ever since it was found in Crete in 1909, for a good many attempts have been made to determine the country of its origin and to unravel the meaning of the pictorial characters appearing on it, without success. However, the present writer believes that he has at last discovered the real provenance of the Disk, and this brochure contains the results of his provisional investigations.

By far the most satisfactory paper that has yet been compiled on the matter is that which was published by Professor R. A. S. Macalister in the "Proceedings of the Royal Irish Academy," (1) and I unhesitatingly accept most of this savant's identifications of the objects represented by the signs. Since Professor Macalister's paper was written references to the Disk have appeared in various other publications, but none of them can be said to have thrown much new light upon the problem.

For the convenience of those not intimately acquainted with it, it may be mentioned that the Disk was brought to light by Dr. Pernier, of the Italian Mission, who discovered it in a part of the palace at Phaestos under circumstances which led him to believe that it was made no later than the seventeenth century B.C. It is a disk of refined clay, about $\frac{3}{4}$ in. in thickness and $6\frac{1}{2}$ in. in diameter, and is covered with hieroglyphs on both faces, the words (which are separated by vertical lines) running in a continuous spiral from the edge to the centre. The characters are not inscribed on the Disk, but impressed by means of specially engraved stamps, so that each individual hieroglyph is always exactly similar to others of its kind in detail and appearance. Attention must be drawn to the important fact that the clay used is not Cretan; this was

(1) Vol. xxx., sec. C, p. 342. A copy of this paper has kindly been sent to me by its author.

established beyond all doubt by Dr. McKenzie, the well-known authority on remains of Minoan Crete.(2)

It has been generally postulated in the past that our Disk text contains a language akin to Lykian, but Professor Hempl(3) thinks it contains a form of early Greek. At the present stage of my investigations I am unable to prove whether or not the script is in either of these languages; but however, as we shall see presently, it seems more probable that the speech it represents was that of the autochthones of Cyprus, and that it may even possess a few Ionian or Assyrian words.

There is another point on which agreement has not been reached, and that concerns the direction in which the inscription is actually to be read. With the exception of Macalister and Hempl, scholars have asserted that the text was written from the centre outwards, but the reason for their statements is not at all clear, since the general rule to be followed in translating hieroglyphical writings is to read *towards* the direction in which the characters, such as men, animals, birds, etc., face. There is no evidence in the Disk to justify a departure from this rule.

In accordance with the procedure adopted by previous writers on the subject, I first tried to decipher the inscription with the aid of some Anatolian language, but made no headway. Knowing, of course, that the text was not Minoan, I looked among various other early Mediterranean writings for help, with the result that when I came to examine the linear characters of Cyprus I was at once struck with the great similarity which exists between certain of these and certain of the Disk pictorial characters.

I immediately followed up the clue thus afforded me, and in the accompanying plates, as well as in my detailed descriptions of certain signs to be given hereafter, will be seen analogies which, I think it must be allowed, prove beyond all doubt that the home of the Phaestos Disk is in Cyprus, and also that the pictographs on it are but archetypes of not a few characters of the later syllabary of the island.

Now as the object is said to have been found in the Cretan Middle Minoan III.(4) strata, this means that if its date is the

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(2) All remains of the pre-Homeric period of Crete (*i.e.*, the era before the advent of the iron-using Indo-Europeans in B.C. 1200) are termed "Minoan," after the name of the mythical king Minos, who is supposed to have once ruled in that island. The Minoan Age is really the Bronze Age of Crete, and is divided into three eras, *viz.*, Early Minoan, Middle Minoan, and Late Minoan. See Table A.

(3) "The Solving of an Ancient Riddle—Ionic Greek before Homer." Harper's Magazine, January, 1911.

(4) See Table A.

same as that of the remains discovered with it, it was made, as Dr. Pernier thought, somewhere about B.C. 1600.

We shall, however, have to forego all ideas of such an early antiquity for the Disk, as many of the signs it contains are but portraits of various animate and inanimate objects of the period of Assyrian predominance in Cyprus, *i.e.*, from about B.C. 700 to 650, when the island was governed by rulers mainly from Greece, doubtless Ionians.(5) In view of the fact that it has always been regarded as being at least a thousand years older than this era, my assertion might at first perhaps be taken to be a rash one, but I feel confident that after the reader has made a careful study of the comparisons given in this brochure, he will agree with me both as to the dating of the Disk and as to the country of its origin.

How it came to Crete we shall probably never know. Nor shall we know how it came to be interred among pottery and other remains of the last era of the Middle Minoan period. That the interment was not accidental is quite evident, but the circumstance is really one that has been lost in the mists of antiquity. In passing, it might be as well to mention that the burial of objects of a given period in tombs, dwellings, etc., of an older date was not unusual among various nations of the past; one calls to mind the vases of Chinese manufacture found in the sepulchres of Ancient Egypt.

Mr. M. Markides, the Curator of the Cyprus Museum, has kindly forwarded me particulars of the earlier and later forms of Cypriote scripts. The earlier form, termed Cypro-Minoan, from the fact that it was imported into the island by the Minoans of Crete, was in use in the Late Bronze Age (B.C. 1500 to 1200). Shortly afterwards, probably in the Period of Transition from Bronze to Iron (B.C. 1200 to 1000), Greek-speaking settlers from Greece proper, especially from Arcadia, introduced the Greek language into the island; but it seems that no inscriptions were made by them until about the eighth century B.C., when, according to Mr. Markides, the old Cypro-Minoan signs, which had been adapted for writing the new tongue, were used. This system of writing is known as Later Cypriote, and was in vogue, in the later centuries, side by side with the Greek alphabet, down to the Middle Hellenic Age.

So far there have been recovered only about 32 Cypro-Minoan signs, and I must point out that by no means all of them can be traced in the 60 linear characters of the Later Cypriote script; this circumstance certainly indicates that the

(5) For details of Cypriote history, see Table B.

Graeco-Cypriote islanders of the eighth century before our era had more than one source to draw from when compiling their syllabary, and one of these sources must have been Assyria, in certain aspects of its culture, as no inscription in the Later Cypriote script can be dated, I suppose, earlier than about the commencement of the period of Assyrian influence. I do not mean to postulate, however, that some of the new signs actually were taken from the cuneiform characters, but that the later script was pictorial in origin; certain of the older Cypro-Minoan signs (such as the building-sign, No. 1, pl. xviii.) being identified and written in their original hieroglyphical forms, and others (such as the pointed helmet-sign, No. 37, pl. xxi.) being made under Assyrian influence. This is, I believe, the way in which the new script, of which that on our Disk is a typical copy, came to be evolved; but it evidently very quickly fell into the debased style, which we know so well from the remains of the later periods of the history of Cyprus, mainly, I suppose, as a result of the more simple linear systems of writing which were spreading over the Mediterranean basin at the time. We may perhaps gather from the peculiarity that the Disk text was "printed" by means of specially engraved stamps, that the use of the new hieroglyphical script was confined to objects of clay.

From what Professor Myres states we learn that, although the majority of the inscriptions written in the Later Cypriote script can be read with the aid of Greek, not all of them can, and it is just possible that the ones we cannot decipher contain the speech of the indigenous inhabitants of the island.

The chances are that if the Phaestos Disk had never left Cyprus it would have vanished long ago, for according to Professor Sayce,(6) the fact that "no written tablets have been found by excavators in Cyprus is not surprising. In an island climate where heavy rains occur the unbaked tablet soon becomes hardly distinguishable from the earth in which it is embedded."

Particular attention is directed to the following Disk signs, the characteristics of some of which show an evident connection with those of certain objects of admitted Cypriote origin:—

Building.—(1) This is undoubtedly the equivalent of the Cypriote linear sign, "Si." Professor H. Darnley Naylor, of the Adelaide University, has suggested to me that the pictorial character represents either a dwelling of the terra-mare type or perhaps a treasure-house. The Greek language shows the

(6) "Archaeology of the Cuneiform Inscriptions," London, 1908, p. 183.

"Si" of the Cypriote in such words as $\sigma\acute{\iota}\mu\beta\lambda o\varsigma$ (beehive), which might be used metaphorically for "treasure-house"(7); and in $\sigma\tilde{\iota}\tau o\varsigma$ (corn), and its compounds, which could readily suggest a barn. As we have to consider the possibility of some of the Disk signs being developed on the acrophonic principle from, among others, Ionian words, we must not, at this juncture, altogether reject any help from Greek sources. In Assyrian the word for treasure was "NIṢIRTU," and that for treasure-house "BIT-NIṢIRTI." The later linear sign is inscribed on a thick, heavy slab of copper,(8) figured on p. 15 in "Excavations in Cyprus" (Murray and others, Brit. Mus., 1900), so, as it is in this case, evidently a kind of treasury or foundry mark, the identification of the character with a treasure-house cannot be far wrong. On the other hand, however, it is certainly possible that houses of the lake-village type were erected in Cyprus in early times, in view of the fact that the island contains many marshes, notably those formed by the waters of the river Pedia.

Yoke.—(2) This identification was suggested to me by the President of the Society, Sir Joseph Verco, and I have every reason for believing it to be the true one.

Crested Head.—(3) As an ideograph, or even as a determinative, this sign must equal "Head," "Chief," and the like; the hieroglyph of a man's head is used in this sense in ancient Egyptian writing. The Assyrian for "head" was "ḲAḲḲADU." The value of this crested head in helping us to ascertain the age and home of the Phaestos Disk is all important. In the British Museum publication, "Excavations in Cyprus," there is depicted a beautiful ivory casket of the period of Assyrian influence in Cyprus.(9) On one side of this is sculptured a debased form of a typical Assyrian frieze, showing a king riding in a two-horse chariot, driven by a charioteer. The monarch is engaged in the pastime of slaughtering wild bulls with his bow and arrow. But what is of special interest to us is the attendant on foot who is following behind the chariot, and who is armed with an axe. This man has a crested head-dress similar in every respect to that portrayed on

(7) Compare the "Treasuries" of Mycenae and Orchomenos.

(8) Dr. Murray says that its weight is 81 lb. 10 oz., and that an analysis made by Professor Church shows 98·05 per cent. of copper. Cyprus, of course, was the home of the copper-working industry in ancient times.

(9) See Table B of my paper. It is evident that Mr. Hall ("Ancient History Near East," 1st ed., p. 66, note 3), in dating the casket to about three centuries before this time, has overlooked the fact that the object must belong to the Assyrian era.

the Disk. Dr. Murray says of him *(op. cit.*, p. 13):—"It is noticeable that on our ivory the attendant wears a helmet identical in shape with that worn by the enemies of the Egyptians in the sea-fight figured by Rameses on the temple at Medinet Abou." These are, of course, the Philistines and the Zakkala, and the resemblance between the crested helmets of these races and the crested helmet on the Disk has led other scholars to believe that there is a Philistine element in the inscription. With this, however, one cannot now agree. Attention may also be directed to another relic of the Assyrian period of the island, and this is the magnificent silver patera from Amathus.[10] Here are seen warriors with crested helmets like those of the Disk, and round shields, attacking a fortress, one or two of the defenders of which also wear the same sort of helmet.[11]

Now the head and shield signs are at the commencement of 13 words in the inscription on the Disk, but, subtracting instances where some of these words have been written more than once, we get ten individual words prefixed by the hieroglyphs in question. There is no doubt that these two signs are ideographic determinatives, and indicate that the characters following them in the same word contain the proper name of a "Chief of the Shield," *i.e.* (probably), a commander-in-chief of an army, whose office was something like that held by the "SHUPARSHAKU" (military commandant) appointed over districts conquered by Assyria. In Assyrian cuneiform it was the custom in the majority of instances to place a determinative at the commencement of the word to which it referred, and not at the end of it, as in the case of ancient Egyptian. The scribes who made up the Phaestos Disk text seem then to have followed the *methods* of their cuneiform-using colleagues, and as a matter of fact it appears to me that the whole of the pictorial text was made mainly under Assyrian direction, although, as we have already seen, the words it contains are evidently not, so far as most of them are concerned, Semitic ones.

Sargon II., King of Assyria, received tribute in B.C. 715 from the seven Ionian Kings of Cyprus, who set up in their island a figure of the Assyrian king as an emblem of their vassalage; and his grandson, Esarhaddon, had homage paid to him in B.C. 673 by ten Cypriote princes, nine Greeks, and

(10) Figured in "Cyprus," di Cesnola, London, 1877, pl. xix.

(11) See also the helmet worn by the sphinx on the ivory object (No. 1126), illustrated in pl. ii., "Excavations in Cyprus."

one Phoenician. The names of these latter rulers are as under:—

GREEK RULERS.(12)

Assyrian form of Names.	Greek Form of Names.	City ruled over.
1. Ê-KI-IS-TU-SU	AIGISTHOS	IDALION
2. PI-LA-GU-RA-A	PYTHAGORAS	CHYTROI
3. KI-I-SU	KEISOS (OR, KISSOS)	SALAMIS
4. I-TU-U-AN-DA-AR	ETEWANDROS	PAPHOS
5. Ê-RE-Ê-SU	HERAIOS	SOLOI
6. DA-MA-SU	DAMASOS	KOURION
7. AD-ME-ZU	ADMETOS	TAMASSOS
8. U-NA-SA-GU-SU	ONESAGORAS	LEDRA
9. PU-SU-ZU	PYTHEAS	NURE (APHRODISION)

PHOENICIAN RULER.

10. DAMUSI, of the city of KARTIKHADASTI (KITION).

The question now arises: Can we identify these ten princes with the ten "Chiefs of the Shield" whose names are given on the Disk? It is quite possible that we can. We know for certain that the former lived towards the end of the Assyrian era on the island of Cyprus, and we have every reason for believing that the men mentioned on the Disk lived at some part of the same era. This being the case, it is hardly probable, I take it, that in such a short space of time, and in the same island, there were two different lots of men to the same number whose names were important enough to be placed on record.

As the princes of Cyprus at this time were mostly Ionians, it may well be that the crested head-dress shown on the Phaestos Disk and other Cypriote remains of the Assyrian period is a typically Ionian one. It does not follow, however, that when we can decipher the names of the ten "Chiefs of Shields" we shall find them Greek ones. As the inscription doubtless contains, in the main, the indigenous speech of Cyprus, it may just as well possess the native names which we must assume would be given to their rulers by the autochthones of the island, much in the same way as the Ptolemies had native prenomens bestowed upon them by their Egyptian subjects.

Woman.—(5) There is no doubt whatever that this sign is the equivalent of one of the symbols employed for the Later Cypriote "E." The linear character has preserved only the pendant breasts and skirts of the original sign. In words 24 and 47 the character is used as a determinative prefix indicating the name either of a queen or of a goddess, and in

(12) See Hall, "Ancient History Near East," p. 496.

word 59 it appears that we are to read the first two signs as "Chief Woman."

Rosette.—(8) This is clearly the archetype of the later 8-pointed star-shaped sign. In two words, 28 and 31, it is associated with a pictograph of an uncovered head possessing either a brand or mark on the cheek, or perhaps an ear-ring; a head similar to this is seen on the wall of the fortress mentioned above; in which case it probably typifies that of a slain captive. Now in the "Handbook of the Cesnola Collection of Antiquities from Cyprus" (13) is figured the beardless head of a male votary wearing a frontlet decorated with rosettes, the figure being of the Assyrian period of the island.(14) Are, therefore, the uncovered head and rosette on the Disk associated with the word for "votary"? On the lid of the ivory casket already referred to there are several 8-petalled rosettes. The sign is probably a direct importation from Assyria.

Boat.—(9) This may be compared with the models of Cypriote boats figured in di Cesnola's work.

Skin.—(12) This is something like the coverings placed over the horses in the chariot illustrated on the casket.

Glove.—(13) Some scholars have called this sign a cestus, but I believe it to be a glove. I communicated this suggestion to Professor W. J. Woodhouse, of Sydney University, who subsequently informed me that the character probably represented an archer's glove with a loose thumb, such as was worn by Hittite warriors. A close examination of the sign as shown in the photograph of the Disk at the end of "Scripta Minoa," vol. i., will show that Professor Woodhouse's identification doubtless is correct, for the loose thumb is there quite clearly depicted. The Later Cypriote sign, "Ke" (said by Evans to be an outline picture of a hand), may have been taken from this glove sign, for the "thumb" in the linear character is shown at right angles to the "fingers," as if to indicate that it was loose. The Assyrian for "hand" was "KATU." It might be of interest to add that the old Persian for glove was "KARBUL"; the latter word occurs in the inscription of Darius the Great at Nakshi Rustam, where we read of "Cimmerians who wear gloves on their hands." (15)

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(13) J. L. Myres, Metropolitan Museum of Art, N.Y., 1914, p. 194.

(14) Myres, *op. cit.*, p. 193, mentions that rosette frontlets were worn by Assyrian courtiers of the early seventh century B.C. Disks in the form of rosettes were also a feature of Assyrian planet gods in the same century. *Cf.* the "Relief of Molthai from the Age of Sennacherib," son of Sargon II., who ruled from B.C. 705-682, figured in "The Civilization of the East," Dr. Hommell (Temple Primers, J. M. Dent & Co., 1900).

(15) "Records of the Past," vol. v., pp. 151, 152.

Sheep's Head.—(19) This is remarkably like the porcelain rhyton in the form of a ram's head depicted on p. 33 and pl. iii. of "Excavations in Cyprus."

Lotus.—(26) This plant was quite commonly painted on Cypriote objects, and seems to have had a religious significance. Compare the sacred lotus tree shown on p. 95 of "Handbook of Cesnola Collection."

Cypress Tree.—(29) Professor Macalister's identification of this sign as the picture of a cypress tree is a very good one, for conventional trees of this description were a special feature of ancient Cypriote art, and in certain mould-pressed terracottas they are depicted in the centre of a ring dance in which votaries, both male and female, take part. It would appear, therefore, that the cypress was a sacred tree; in some terracottas it is degenerated into a mere club-shaped column [16] very much like the sign on the Disk. In words 1, 26, 30, 38, and 39 on the Disk it is associated with the "man" sign.

Pointed Helmet.—(37) In this sign we have another striking proof of the Cypriote origin of the Disk. Professor Myres ("Handbook," pp. 143 and 195) shows us two figures of the period of Assyrian influence, both wearing helmets of this description; the first figure is a votary, and the other a bearded male, evidently a warrior. Myres mentions that this particular head-dress is peculiar to Cyprus, and has not been found elsewhere.

Virama Mark (see pl. xxi.).—In words 1, 3, 15, 16, 19, 21, 22, 27, 34, 37, 49, 51, 52, 55, and 57 there will be observed a scratch or mark placed against the last sign; this scratch, according to Hempl *(op. cit.)*, is in form and position identical with the virama mark of Sanskrit, Venetic, and early Runic writing. It was used, in the three latter scripts, to eliminate the vowel sound from the last syllable in a word, thus reducing the syllable to a simple consonantal character.

So far, with some few exceptions, I have made no real attempt to decipher any of the words printed in the inscription on the Disk; but if we can regard the signs in words 15 and 21 as pure ideographs they may be read "horse-man," *i.e.* (probably), "charioteer." Similarly, in word 30, the first sign on account of the compact nature of the tree it represents, *i.e.*, a

---

[16] "Cyprus Mus. Cat.," p. 151 (Nos. 5305-5314). See also reference on p. 86 (No. 1656) to the bearded man with long hair dancing in front of a cypress or large thyrsos, represented on an Attic red-figured lekythos of the Hellenic period of Cyprus.

cypress, doubtless indicates "close," and the like; hence the group in question might equal "close-man," or "confidential-man." These renderings, although purely conjectural, will be appreciated by those who have a knowledge of the hieroglyphical writings of ancient Egypt.

On looking at the "Catalogue of the Cyprus Museum," (17) I was at once struck with the great resemblance which exists between the arrangement of the Later Cypriote signs in graffiti marked on two black-glazed vases (Nos. 1,952 and 1,954), and the arrangement of similar-shaped signs to be found in words 14, 20, 53, and 60 on the Disk; the two graffiti are figured in pl. xxii. of this paper. In these instances the linear signs read from left to right, and must be transliterated, according to the details of Cypriote script forwarded to me by Mr. Markides, as "NA-O-TE." No classical scholar could fail to notice that this is like the Greek word ναύτης "sailor," or one cognate thereto. The last sign in the group is the debased form of the "ship" hieroglyph.

The chief drawback the present writer has had to suffer from is the lack, in the Commonwealth, of books bearing on or giving complete information on the phases of Cypriote archaeology, and he has perforce had to make the best use he could of the undermentioned works, all of which, with the exception of di Cesnola's, which is in some respects out of date, are, of course, to be relied on in the main. Most of them have already been referred to in the text:—

(1) "Cyprus: its Ancient Cities, Tombs, and Temples." di Cesnola, London, 1877.

(2) A reference to Cypriote language in the article on "Alphabet," in Encyclopaedia Britannica, 11th ed. (plate facing p. 729).

(3) "Handbook of the Cesnola Collection of Antiquities from Cyprus." J. L. Myres, Metropolitan Museum of Art, New York, 1914.

(4) "A Catalogue of the Cyprus Museum." J. L. Myres, Oxford, 1899.

(5) "Formation of the Alphabet" (Petrie), British School of Archaeology in Egypt, Studies Series, vol. iii., London, 1912.

(6) "Scripta Minoa," vol. 1. A. J. Evans, Oxford, 1909.

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(17) J. L. Myres, Oxford, 1899, p. 90. The graffiti figured in pls. xviii., xix., xx., and xxi. of my paper are also taken from the page referred to.

(7) "Excavations in Cyprus." Dr. Murray and others, British Museum, London, 1900.

(8) "Annual Report of the Curator of Antiquities of Cyprus, 1916." M. Markides, Nicosia, 1917.[18]

Some of the authorities mentioned are by no means in agreement as to the values of certain Later Cypriote signs, as will be quite evident from an examination of the examples given in my plates, and it must be understood that so far as the *values* given by di Cesnola are concerned, these are incorrect in a few cases, which is not surprising when we remember that his work was compiled nearly half a century ago.

At some date in the future I hope to be in a position to attempt a transliteration, if not a translation, of the whole of the text on the Disk, but I am satisfied for the present in being able to show that, apart from the testimony afforded by my equations of the Disk signs with the Later Cypriote signs, the evidence I have quoted from sources other than that of the linear writings of Cyprus is sufficient in itself to prove that the Phaestos Disk was made there during the period of Assyrian predominance.

My thanks are due to Professor H. Darnley Naylor, of the University of Adelaide (who brought the Disk under my notice), and to Professor W. J. Woodhouse, of the University of Sydney, for the kind help and assistance afforded me during my investigations into the problem of the Disk. I must also express my gratitude to Mr. Markides, the Director of the Cyprus Museum, for the great trouble he has been put to in making for my use a copy of his list of the Later Cypriote signs, and for forwarding much valuable information on all the types of ancient writings used in Cyprus. The encouragement given me by my close friend and fellow-archaeologist, Mr. T. D. Campbell, has been of no little aid to me in the compilation of this Paper. Except where otherwise indicated, I alone am responsible for the opinions set out herein.

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[18] A copy of this Report was kindly sent to me by Mr. Markides.

APPENDIX.

Contents.

Table A.

THE PREHISTORIC AGES OF CRETE, THE CYCLADES, AND GREECE.

Period of non-Aryan Culture.

CRETE.	CYCLADES.	GREECE. South.	GREECE. North.
Early Bronze Age. (Central date c. b.c. 3000.)			Stone Age.
Early Minoan I.	Early Cycladic I.	Stone Age.	In Thessaly, Boeotia, and Phokis, which *may* have been inhabited by Aryan - speakers, the use of stone existed longer than in South Greece. The later era of North Greece is chalcolithic (*i.e.*, bronze and stone were used side by side), and continued so until the Early Iron Age. (See "Aegean Arch.")
Early Minoan II.	Early Cycladic II.		
Early Minoan III.	Early Cycladic III.		
Middle Bronze Age. (Central date c. b.c. 2000.)			
Middle Minoan I.	Middle Cycladic I.		
Middle Minoan II.	Middle Cycladic II.		
Middle Minoan III.	Middle Cycladic III.	Bronze Age. Mycenaean I.	
Late Bronze Age. (From c. b.c. 1600-1200.)			
Late Minoan I.	(Cycladic culture now absorbed in that of Crete, and termed "Late Minoan" accordingly.)	Mycenaean II.	
Late Minoan II.	——		
Late Minoan III.	——	Mycenaean III.	

Period of Aryan Culture.

Early Iron Age.
(Commencement c. b.c. 1200.)

With the advent of the iron-using Indo--European speakers from the North the Bronze Age culture of Crete, the Cyclades, and Greece concludes, and the Homeric period commences. The Phaestos Disk was discovered among Middle Minoan III. objects.

[This table, which is entirely original in form, is compiled solely from particulars given in "Scripta Minoa," A. J. Evans, and "Aegean Archaeology," H. R. Hall, London, 1915. For the sake of convenience I have omitted the Stone Age periods of Crete and the Cyclades.]

TABLE B.

PREHISTORIC AND EARLY HISTORIC AGES OF CYPRUS.

DATES, B.C.	
?	STONE AGE.
	(Left few traces in Cyprus.)
	BRONZE AGE.
3000-2000.	Early Bronze Age.
2000-1500.	Middle Bronze Age.
1500-1200.	Late Bronze Age. (Parallel to XVIII. Dyn. of Egypt).
	IRON AGE.
1200-1000.	Early Iron Age. (Transitional from Bronze to Iron.)
1000- 750.	Middle Iron Age. (Geometrical, with iron weapons.)
750- 500.	Late Iron Age. (Graeco-Phoenician. The period of Assyrian predominance, artistic and political, was from c. 700-650 B.C.; but the *influence* of Assyria "may have begun a little in advance of the Assyrian protectorate. It may have lasted from 750-650 B.C." [Myres, "Handbook of Cesnola Collection"]).
	HELLENIC AGE.
500-300.	Early Hellenic Period.
300- 50.	Middle Hellenic Period.
50 B.C.-400 A.D.	Late, or Graeco-Roman Period.
	BYZANTINE AGE.
400 A.D.-1200 A.D.	(Under the Byzantine Emperors Cyprus became the seat of an Archbishopric.)

[This table is compiled solely from particulars given in the "Handbook of the Cesnola Collection of Antiquities from Cyprus," J. L. Myres, Metropolitan Museum of Art, New York. The Phaestos Disk belongs, I believe, to the period of Assyrian predominance.]

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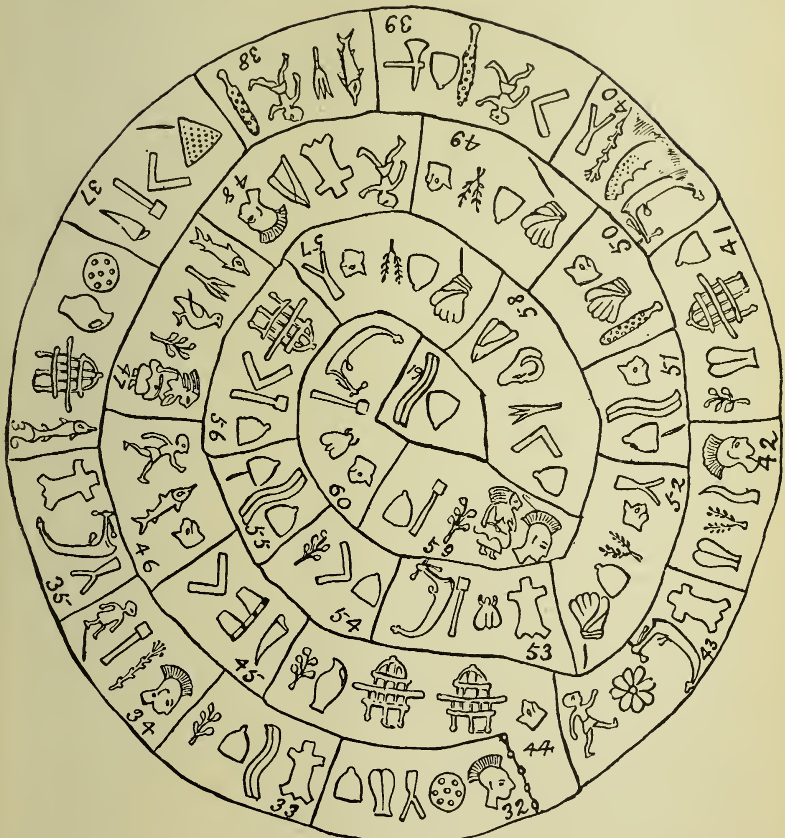
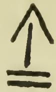
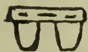


HUSSEY & GILLINGHAM LIMITED PRINTERS & PUBLISHERS ADELAIDE, SO. AUS.

DISK SIGNS		PORTRA	ɅR TO DISK SIGNS EVANS	MARKIDES
	1	"Treasury, "Lake Dw	 SI	 SI
	2	"Yoke" { Si re or	 MI	 MI
	3	"Crested I		 FO VO
	4	Head of " or "Cap		 PO
	5	"Woman," "Goddess'		
	6	"Man wal		 I
	7	"Child"		 Y
	8	"Rosette"	 E	
	9	"Boat"		 TE
	10	"Bird flyin		 KA
	11	"Bird settli		 PO

A. R. del.

ɅSSEY & GILLINGHAM LIMITED PRINTERS & PUBLISHERS ADELAIDE, SO. AUS.

DISK SIGNS	PORTRAITS OF	LATER CYPRIOTE SIGNS SIMILAR TO DISK SIGNS					
		MYRES	DI CESNOLA	PETRIE	ENCYC. BRIT.	EVANS	MARKIDES
1	"Treasury," or "Lake Dwelling"	SI				SI	SI
2	"Yoke" {Sign is reverse way up on the disk}			M		MI	MI
3	"Crested Head"	VO PI	K				FO VO
4	Head of "Votary," or "Captive"	PO					PO
5	"Woman," or "Goddess"	E					
6	"Man walking"	(Graffito)	I		I		I
7	"Child"		U	U			Y
8	"Rosette"					E	
9	"Boat"	(Graffito)	DE THE TI				TE
10	"Bird flying away"			T	JO KA		KA
11	"Bird settling down"			B			PO

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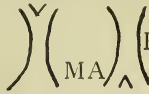
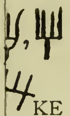
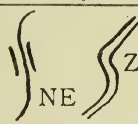
DISK SIGNS		PORTRAI	R TO DISK SIGNS EVANS	MARKIDES
	12	"Hide of so Animal"		 MA FA
	13	"Archer's G	 Cypro-Minoan Later KE Cypriote	 KE
	14	"Water"		 NE ZO
	15	"Fortress"		 FE
	16	"Cat's Head		
	17	"Bow"		 ZO
	18	"Axe"	 TA	 TA
	19	"Head of W Sheep, or Go		 MO
	20	Uncertain		 JA RA
	21	"Pillar"	 NA	 NA

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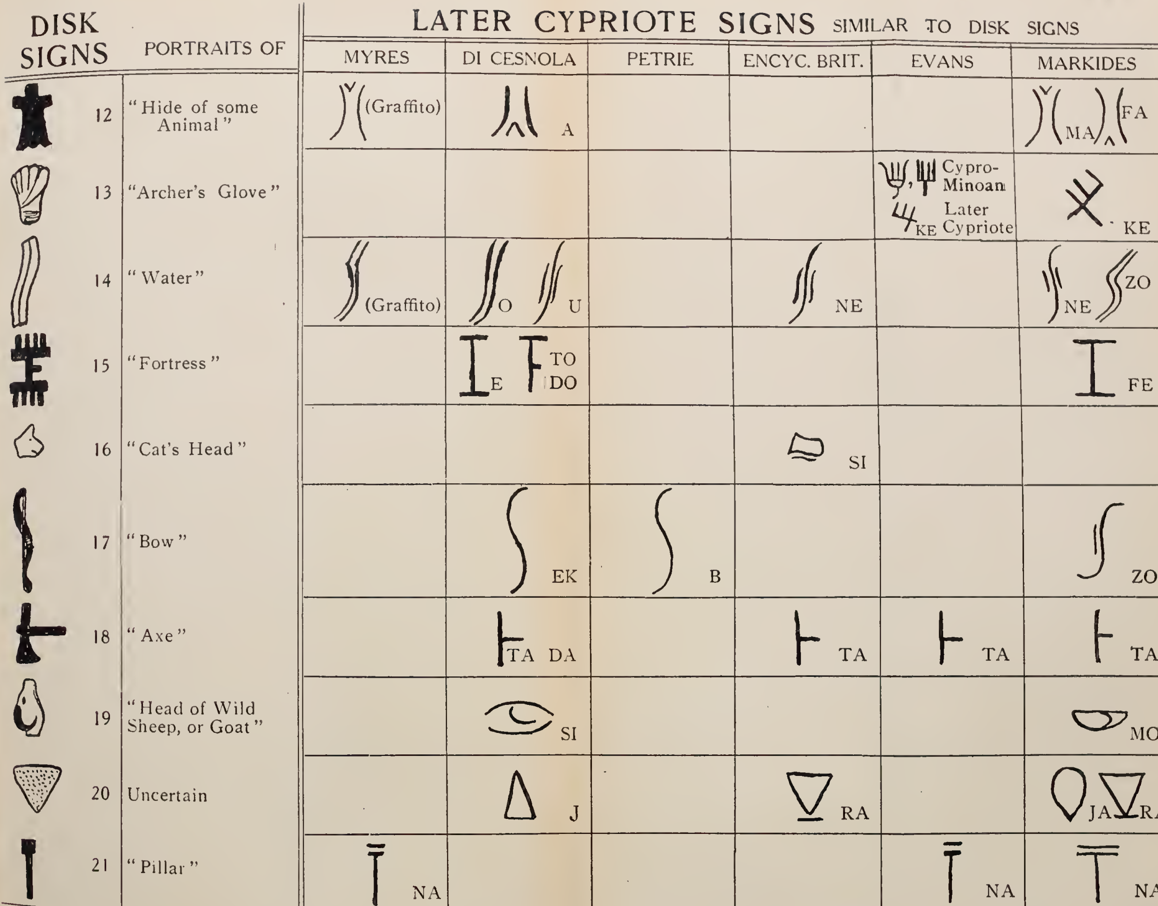

DISK SIGNS		PORTRAITS OF	LATER CYPRIOTE SIGNS SIMILAR TO DISK SIGNS: MYRES	DI CESNOLA	PETRIE	ENCYC. BRIT.	EVANS	MARKIDES
	12	"Hide of some Animal"	(Graffito)	A				MA FA
	13	"Archer's Glove"					Cypro-Minoan KE Later Cypriote	KE
	14	"Water"	(Graffito)	O U		NE		NE ZO
	15	"Fortress"		E TO DO				FE
	16	"Cat's Head"				SI		
	17	"Bow"		EK	B			ZO
	18	"Axe"		TA DA		TA	TA	TA
	19	"Head of Wild Sheep, or Goat"		SI				MO
	20	Uncertain		J		RA		JA RA
	21	"Pillar"	NA				NA	NA

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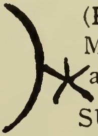
DISK SIGNS		PORTRAI	R TO DISK SIGNS EVANS	MARKIDES
	22	"Plant," or	 O  O	 O .  PA
	23	"Pig's Head (Hempl) "Leather Cu (Macalis		 RI
	24	"Bee," or "I		 RO
	25	"Fish"		 RA
	26	"Lotus," or "Lily" (Hei		 SE
	27	"Phallic Or		 XE
	28	"Mason's Sc		 LI
	29	"Cypress T		
	30	"Horn"		
	31	"Lunar Sigi		 (Evidently Moon and Star) SU

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LATER CYPRIOTE SIGNS SIMILAR TO DISK SIGNS

DISK SIGNS	PORTRAITS OF	MYRES	DI CESNOLA	PETRIE	ENCYC. BRIT.	EVANS	MARKIDES
22	"Plant," or "Tree"	(Graffito)				O O	O PA
23	"Pig's Head" (Hempl) "Leather Cutter" (Macalister)				RI		RI
24	"Bee," or "Moth"		OU				RO
25	"Fish"	(Graffito)	R				RA
26	"Lotus," or "Lily" (Hempl)			A	A		SE
27	"Phallic Organ"	(Graffito)	NA	PH			XE
28	"Mason's Square"	LE					LI
29	"Cypress Tree"		L(O)				
30	"Horn"		U		NE		
31	"Lunar Sign (?)"		KI				(Evidently Moon and Star) SU

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R TO DISK SIGNS

DISK SIGNS		PORTRAI	EVANS	MARKIDES
	32	"Wind Inst ment (?)" =		 SA
	33	"Cap (?)"		 RE
	34	"Hoof"		 SE
	35	"Dagger in		 VO
	36	"Pipes (?)"	 KO	 KO  KO

DISK SIGNS CYPRIOTE SIGNS.

SIGNS		PORTR TRAITS OF	
	37	"Cyprio period o e" influenc	Supposed Virama-mark :– 
	38	"Shield period o ne" influenc	
	39	"Jug" ow." Perhaps r." See "Anc. Near East" l), Pl. XXVII. enician war-)	

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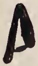
DISK SIGNS		PORTRAITS OF	LATER CYPRIOTE SIGNS SIMILAR TO DISK SIGNS					
			MYRES	DI CESNOLA	PETRIE	ENCYC. BRIT.	EVANS	MARKIDES
	32	"Wind Instrument (?)" = Pipes	 (Graffiti)	 S				 SA
	33	"Cap (?)"		 GO				 RE
	34	"Hoof"		 S	 S			 SE
	35	"Dagger in Case"			 V			 VO
	36	"Pipes (?)"		 KO	 G	 KO	 KO	 KO  KO

DISK SIGNS POSSESSING NO SATISFACTORY RESEMBLANCE TO THE LATER CYPRIOTE SIGNS.

SIGNS		PORTRAITS OF	SIGNS		PORTRAITS OF	SIGNS		PORTRAITS OF
	37	"Cypriote Cap of period of Assyrian influence"		40	"Thistle"		43	"Tree"
	38	"Shield (?) of period of Assyrian influence"		41	"Ring" (see Brit. Mus., "Evcavations in Cyprus")		44	"Bone"
	39	"Jug"		42	"Captive"		45	"Arrow." Perhaps "Oar." See "Anc. Hist. Near East" (Hall), Pl. XXVII. (Phoenician war-ship)

Supposed Virama-mark :–

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S.

From Phaestos D' J. L. Myres.

SIGN NO. 6 (MAN) :e (Plate VIII.).

SIGN NO. 38 (SHIAge (p.136).

lenistic Age (p.92).

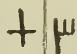
p.151).

WORDS 14, 20, 53, m left to right) on

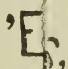
 NA-O-TE:

WITH

392).



E. SE: =



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MISCELLANEOUS EQUATIONS.

From Phaestos Disk.	From "Catalogue of Cyprus Museum" J. L. Myres.
SIGN NO. 6 (MAN):	 On Cypriote scarab of Late Iron Age (Plate VIII.).
SIGN NO. 38 (SHIELD):	(a)  On lenticular bead of Late Iron Age (p.136). (b)  Dotted ornament on figure of Hellenistic Age (p.92). (c)  Painted shield held by warrior (p.151).
WORDS 14, 20, 53, & 60:	Compare the Cypriote graffiti (reading from left to right) on Vases Nos. 1952 & 1954 (p.90):- (1)  NA-O-TE: (2)  NA-O-TE:

A TYPICAL INSCRIPTION IN LATER CYPRIOTE CHARACTERS, WITH TRANSLITERATION, ETC.
(From "Handbook of Cesnola Collection," Myres, p.392).

E. TE. VA. DO. RO: TO: PA. PO: BA. SI. LE. VO. SE: =

'Ετεάνδρου τοῦ Πάφου βασιλέως,

i.e., "Of Eteandros the king of Paphos."

A. ROWE. del.

DESCRIPTION OF PLATES.

Plate XVI.

The Phaestos Disk—Face "A." Date c. 700 b.c.
Provenance—Cyprus.

Plate XVII.

The Phaestos Disk—Face "B."

Plate XVIII.

Later Cypriote Signs similar to Phaestos Disk Signs.

Plate XIX.

Later Cypriote Signs similar to Phaestos Disk Signs *(contin.)*.

Plate XX.

Later Cypriote Signs similar to Phaestos Disk Signs *(contin.)*.

Plate XXI.

(a) Later Cypriote Signs similar to Phaestos Disk Signs *(concluded)*.

(b) Phaestos Disk Signs unlike Later Cypriote Signs.

Plate XXII.

(a) Equations of miscellaneous Cypriote Drawings, etc., with Phaestos Disk Signs

(b) A typical inscription in Later Cypriote Characters, with transliteration, etc.

The Occurrence and Origin of Certain Quartz-Tourmaline Nodules in the Granite of Cape Willoughby.

By C. E. Tilley, B.Sc., A.I.C., Demonstrator in Geology and Mineralogy, University of Sydney.

(Communicated by Professor Walter Howchin.)

[Read July 11, 1919.]

Plates XXIII. and XXIV.

CONTENTS.

I. Introduction.

The present paper is devoted to a short description of an occurrence of some remarkable aggregates composed essentially of quartz and tourmaline with felspar, which are developed in a mass of aplite intrusive into the granitic headland of Cape Willoughby, Kangaroo Island. The paper really forms part of a more extensive study of the petrology of the Cape Willoughby granite and its allied intrusions. The publication of these data is reserved for a later date.

After a review of the occurrence, and reference to previously published descriptions of similar aggregates at other localities, the probable mode of origin of the nodules is outlined.

II. General Description of the Occurrence.

Cape Willoughby consists of a large mass of granite intruded into a series of quartzites, quartz-mica-schists, and mica-schists of probably Cambrian Age. The granite is an even-grained rock consisting of quartz, microcline, plagioclase (oligoclase-andesine), and biotite. Under the microscope the accessories are seen to be muscovite, apatite, and zircon. The most striking feature of the rock is the presence of subidiomorphic crystals of quartz showing a remarkable blue opalescence. This granite occupies an area of approximately two square miles, and has a coastline length of about five miles.

Into this granitic mass are intruded a highly interesting series of aplitic and pegmatitic rocks which are obviously genetically related to the granite. The series comprises microcline aplites and a number of albite pegmatites (albitites), *viz.*, quartz and muscovite albitites. These rocks traverse the granite in the form of dykes, and also as irregular masses, and represent the later stages of the crystallization of the granitic magma.

The microcline aplite intrusive mass is the home of the quartz-tourmaline nodules now under discussion. This aplite, known as the "Pink Aplite," occurs as a large intrusive mass along the coast adjacent to the Cape Willoughby Lighthouse. Its intrusive nature is well marked, the junction with the granite being well defined. The mass shows a rather variable texture throughout its extent. The greater part is of very fine grain, but in part this grades into a coarser variety, in which are developed phenocrysts of blue quartz, and the ferromagnesian mineral biotite also makes its appearance.

The aplite has been fissured, and along these fissures quartz veins have been intruded. Associated with these veins occurs a zone of altered aplite consisting essentially of quartz and a light-greenish mica. This is a greisen. A further pneumatolytic change is the production along fissures of white kaolin.

At the south end of the mass there are developed, in the very fine-grained variety, numerous patches, in cross section roughly hexagonal to elliptical. On examination these patches, or nodules, are seen to consist mainly of quartz and tourmaline.

The minerals recognized in the aplite are quartz and felspar. Microscopically the minerals present are quartz, microcline, plagioclase (albite), and, as accessories, biotite, much chloritized, and muscovite. Kaolin and secondary mica accompany the felspars as alteration products. In the fine-grained varieties of aplite, biotite and muscovite are usually absent, the development of these minerals being relegated to the coarser varieties.

The aplite is remarkable for the presence of occasional granophyric phenocrysts of quartz and microcline, and micrographic intergrowth of these two minerals is displayed, more especially in the coarser varieties. In parts of the finer-grained types the fabric approaches the type "granulitic," characteristic of some aplites.

III. The Quartz-tourmaline Nodules.

These nodules, on account of their mineralogical composition, resist the attack of the normal agents of weathering and, as a consequence, stand out in relief from the aplite in which they are enclosed. They occur apparently quite irregularly arranged in the mass, but appear with few exceptions to be confined to the finer-textured variety of the aplite.

In section, as seen on the rock face, they appear more or less elliptical, although some are really hexagonal. The form taken by the majority of the nodules is, however, an ellipsoid. In size they are slightly variable, but the greater number have diameters, approximately, of 2 in., or slightly less.

A number of thin sections of these nodules was cut, and microscopical examination showed them to consist, essentially, of quartz, felspar, and tourmaline. The nodules show the general texture of the surrounding aplite. Tourmaline is abundant, and is characteristically developed in the act of replacing the microcline and albite felspar. All stages of replacement can be traced, from the initial stages to complete replacement. Minute arms of tourmaline stretch, at intervals, through the felspar, isolating portions of the one felspar from each other, in just such a way as to prove the development of tourmaline from the felspar. The tourmaline shows strong pleochroism, and is of blue colour of varying shades, tending to brownish-green. This is the blue aluminous tourmaline characteristic of felspar derivation.(1) Minute amounts of muscovite may be associated with the tourmaline.

The process of replacement described is well shown in the microphotos which accompany this paper. Quartz is present in clear grains with minute inclusions, and the felspar still unreplaced is heavily dusted with kaolin. Some quartz, especially towards the centres of the nodules, is probably secondarily produced during pneumatolysis. In some nodules the amount of replacement of felspar grains by tourmaline becomes more complete as the centre is approached. At the centre the remnant of a felspar grain may only be represented by a shred at the periphery, or a shred in the interior of the tourmaline grain. The proportion of quartz in such cases may increase at the centre, suggestive of silica being derived from the felspar interaction.

Nodules somewhat similar to those just described have been previously noted by investigators of the Tasmanian Geological Survey. Waller(2) noted their occurrence in an aplite from Mount Heemskirk, Tasmania. More recently L. L. Waterhouse has also described similar nodules in the

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(1) *Cf.* Mem. Geol. Surv. Eng. and Wales, 1909, p. 65; Scrivenor: Quart. Journ. Geol. Soc., vol. lix., 1903, p. 151.

(2) Waller: Report on the Tin Ore Deposits of Mount Heemskirk, Geol. Surv. Tas., Sept., 1902, p. 4.

Stanley River District,[3] and has examined in more detail those occurring in the Mount Heemskirk acid intrusives.[4] The descriptions given by these two investigators agree, fairly closely, with the nature of the occurrence at Cape Willoughby.

The presence of small amounts of cassiterite, the absence of felspar from the centre, and the frequent presence of a central cavity, seem to be the principal points of distinction between the Tasmanian and Willoughby examples.

In discussing the origin of these nodules, both writers reach the conclusion that the nodules represent segregations of quartz and tourmaline. To quote Waterhouse,[5] "They are due to the operation of magmatic differentiation in the original magma, the minerals now forming these nodules having gradually segregated and solidified as cooling proceeded."

Apparently, similar nodules are developed in aplites associated with the granitic batholith of the Elkhorn District, Montana, as described by Barrell.[6] Knopf also describes nodules from aplite in the same region, but south of Montana city.[7] These aplites are regarded as differentiates of the same batholith of quartz-monzonitic type, common to the Elkhorn and Helena Districts. The nodules contain quartz orthoclase, and tourmaline; but in neither case is the relationship of the tourmaline to the felspar clearly indicated. Both Barrell and Knopf evidently regard them as segregations from the liquid aplitic magma; *e.g.*, Knopf states, "The tourmaline-quartz-orthoclase segregations are regarded as imprisoned and congealed globules of this final differentiate."

In the case of the Cape Willoughby nodules, the view that they are segregation products of earlier crystallization cannot be accepted. Microscopic and other evidence tends to show that they are, indeed, strictly pneumatolytic products. In the slides is to be seen the very act of replacement of felspar by tourmaline. The texture and composition of the nodule, apart from the presence of the tourmaline, suggests that the nodule has developed *in situ*. It has been mentioned above that the nodules are almost entirely relegated to the finer-textured variety of the main aplite. Similar circumstances surround the Tasmanian occurrences, where Waterhouse, in referring to their occurrence, says,[8] "In the field

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(3) L. L. Waterhouse: Bull. No. 15, Geol. Surv. Tas., 1914, p. 28.

(4) L. L. Waterhouse: Bull. No. 21, Geol. Surv. Tas., 1916, p. 71.

(5) *Loc. cit.*, p. 28.

(6) J. Barrell: 22nd Ann. Report U.S.G.S., 1901, pp. 542, 543.

(7) A. Knopf: Bull. 527, U.S.G.S., 1913, pp. 34, 35, 53.

(8) *Loc. cit.*, p. 29.

these nodules were not observed in the coarser-grained granite; they appear to be confined to the finer-grained varieties"; and again,[9] "Their home is in the fine-grained tourmaline granite and the white granite, and it is in the former that they undoubtedly reach their maximum development."

The author, after consideration of the occurrence at Cape Willoughby, suggests that the following processes have co-operated in their production:—

The crystallization of the main mass of granite was followed by the production of fissures and joints as a result of contraction through cooling. Into these fissures was injected the still liquid residue of the magma enriched in mineralizers, and forming what are now the aplites. The sudden injection of a highly fluid mass charged with volatile products, primarily water with other mineralizers, would, the fissure being spacious enough, provide an avenue of temporary escape for the more volatile products. A magma of this nature is thus characterized by a remarkable mobility of equilibrium. It is possible that, at this stage, the principal mineralizer, water, was present, partly as a gas, below its critical temperature.[10]

The increased magma space thus originating through fissuring, the resultant effects are:—

(1) A reduction of pressure due to expansion of the gas phase; concurrently a reduction of the concentration of the volatile components in the liquid magma.
(2) An increase in the viscosity of the silicate liquid due to reduction of the active mass of the mineralizers in the liquid.
(3) Increasing the crystallization temperatures or freezing points of the silicates in solution.

[It is to be noted here that a lowering of freezing point generally accompanies a reduction of pressure, but this effect must be enormously outweighed by the decreased fusibility (solubility) consequent on diminished concentration of volatile components. This latter effect apears to have been ignored or denied by some petrologists, *e.g.*, Schweig[11] even

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(9) *Loc. cit.*, No. 21, p. 73.

(10) It does not follow from this that the temperature was below 370° C.—the critical temperature for pure water. A gas dissolved in a mixture of non-volatile components has a higher critical temperature than it possesses in the pure state. This elevation of the critical temperature is analogous to the elevation of boiling point by dissolved substances.

(11) M. Schweig: Neues Jahrbuch Beil., Bd. 17, 1903, p. 516, *et. seq.*

develops an hypothesis of differentiation of volcanic rocks in large part based on the lowering of freezing point accompanying reduction of pressure due to ejection of magmas. The phenomenon of resorption, common in phenocrysts of hypabyssal and volcanic rocks, has also been attributed by some writers to a reduction in pressure consequent on injection or eruption. There can be little doubt that this lowering, which never exceeds a few degrees per 1,000 atmospheres,(12) is enormously overweighed by the decreased fusibility consequent on removal of volatile components.(13)]

Owing to the loss of volatile constituents and to a minor degree of changing temperature, equilibrium would be violently disturbed, and the residual magma conditions would become unstable. Some of the components of the fluid previously near or at their freezing point would then become undercooled,(14) and with a magma of aplitic composition the spontaneous crystallization of quartz and felspar would ensue.

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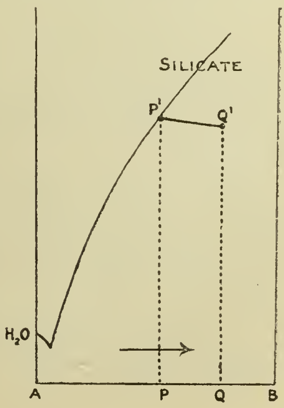
(12) Uniform pressure, of course, is postulated here. The differential effects of uniform and non-uniform pressure are discussed in detail by Johnston and Adams. Amer. Jour. Sci., 35, 1913, 205.

(13) G. Morey: Jour. Amer. Chem. Soc., pt. i., 36, 1914, 215. The influence of water at a high temperature on the melting point of silicates is well exemplified in the work of Morey on "New Crystalline Silicates of Potassium and Sodium, their preparation and general properties." The case is instanced of potassium silicate which when dry melts at 1015° C., yet yields in the presence of water in a closed vessel at temperatures of 500° C. to 400° C. perfectly fluid (liquid) solutions containing 8-25% water. The results of these experiments at high temperatures and pressures are definite, and in full agreement with the existing physico-chemical theory as applied to solutions at ordinary temperatures and pressures. There can be little doubt, therefore, that the melting depression is dependent on the concentration of the volatile component.

(14) This undercooling is clearly shown diagrammatically in the temperature-concentration freezing point curve of a binary solution water-silicate, where P = original composition of the magma and Q= changed composition of the magma. P^1 represents the magma of composition P starting to crystallize, or near the point of crystallization. The point Q^1 represents the temperature and composition of the magma which is thus undercooled, with respect to the silicate, although the temperature has but slightly changed. The illustration is, of course, purely diagrammatic, and is not complete for the solution in question (water-silicate).



On account of the viscosity the actual size of the crystals would be small, for diffusion currents would not move sufficiently rapidly to supply the growing crystal.

The conditions above described probably represent the "labile" state of undercooling, as described by Ostwald and Miers.[15] The micropegmatite, on this view, represents the composition of the hypertectic rather than the eutectic point.

Near the summit of the fissure chamber, crystallization would be initiated, as this is the point of maximum undercooling due to the combined effects of cooling and of diminished volatile components in the liquid magma.

Concurrently with the initiation of crystallization, at the top of the fissure chamber, the reduction in pressure of the volatile phase would initiate the formation of bubbles of gas or vapour, predominantly, water dissolved in the liquid magma and other volatile mineralizers, among which were compounds of boron (boric acid). These would originate throughout the depth of the fissure chamber and, viscosity permitting, would gradually rise in the magma chamber, enlarging both by reduction in pressure during upward movement and, possibly, by coalescence of two or more bubbles. At this stage the magma chamber is pictured as filled with a more or less viscous silicate liquid, crystallization having developed at its summit and, forming a network of crystals, gradually extending downwards, and, at the same time, ascending bubbles of gases (mineralizers) present in its lower layers. With the removal of anhydrous minerals at the crystallization level, additional gases would probably be set free. The bubbles, in ascension, on reaching the network of solid crystals of quartz and felspar would attach themselves to these in the form of bubbles. The gases released on crystallization would do likewise.

The fissure magma is now pictured as a partially fluid mass containing a network of crystal silicates, some of which are enveloped in bubbles of the gas phase. It is probable that these might occupy definite restricted horizons of the fissure chamber. The volatile components present in the gas phase are assumed to have been, predominantly, water and boric acid.

With a further reduction in temperature these mineralizers take up an active rôle and enter upon a destructive stage. The felspar becomes unstable, and in an interaction with boron compounds tourmaline is produced *in situ*, the felspar being partially or completely replaced, according to

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(15) *Vide* the numerous papers by Miers and his co-workers. References to these are quoted by A. Harker, Natural History of Igneous Rocks, p. 208.

the concentration of the active gases. Quartz would, of course, be unattacked; but silica would probably be released in the interaction with felspar. With a still further reduction, the remaining gases would be dissolved or condensed. The process would have initiated before final and complete consolidation took place, and the accompanying excess of alkalies, from the felspar interaction, would diffuse into the still liquid residue, partly surrounding the gaseous bubble.

For the Cape Willoughby quartz-tourmaline nodules the following data are in accord with the hypothesis outlined in the previous pages for their manner of origin:—

(1) The pneumatolytic origin of the tourmaline.

(2) The development of the nodules in, and their practical relegation to, the finer-grained variety of the red aplite.

(3) The composition and texture of the nodule in which the tourmaline is replacing the felspar is identical with that of the associated aplite.

(4) The general ellipsoidal character of the nodules.

As denoting their manner of origin, it is suggested that the name "Pneumatolith" be attached to such pseudo-segregations occurring in rocks, and which owe their existence primarily to pneumatolytic processes.

From the published descriptions of the Montana nodules previously noted, the exact relationship of the tourmaline to the orthoclase felspar associated with it is not clear, but the description of Barrell [16] is suggestive of the tourmaline being of pneumatolytic origin.

A study of the literature on the mode of occurrence of tourmaline indicates that this mineral does, occasionally, appear pyrogenetically. This is especially so where it is present as an accessory uniformly distributed through granites or aplites. It is, therefore, possible that segregations of quartz and pyrogenetic tourmaline can occur.

Through the kindness of Mr. W. H. Twelvetrees, Government Geologist of Tasmania, I have been able to obtain a number of nodules from the Heemskirk District for microscopical examination. A number of these have already been described by Waller and Hogg. [17]

The sections examined by the writer consist essentially of quartz and tourmaline, felspar being absent. Macroscopically it has been recognized in one nodule, and is represented by kaolin.

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[16] *Loc. cit.*, Sup., p. 543.

[17] Waller and Hogg: Papers Proc. Roy. Soc. Tas., 1902, pp. 143-156.

On slicing the nodules a number of empty cavities occur on the face and are distributed throughout the nodule. Whether these represent the spaces originally occupied by felspar is not clear. Under the microscope, the quartz is seen to have crystallized in well-developed crystals. Numerous sections are shown as hexagonal or rhombic. This idiomorphism of the quartz is the most striking characteristic of the slides. Consequently the tourmaline is present as grains moulded on the quartz. In some cases the moulding is developed as to yield a rude type of poikilitic fabric. Occasionally the tourmaline may also be developed in prismatic idiomorphs. The pleochroism of the tourmaline is strong, the characteristic variation being from bluish-green to light-brown yellow. In any one grain the colour variation may be considerable; this variation is, usually, irregularly developed in patches. The colour may also vary zonally.

The origin of these Tasmanian nodules is not as clearly demonstrable as of those already described from Cape Willoughby, in which the process of pneumatolysis is actually seen in progress. The evidence so far revealed, however, is that the Tasmanian nodules are essentially of miarole origin. On this view come into line:—

(1) The striking idomorphism of the constituent quartz.
(2) The presence of a central cavity in many of the nodules.
(3) The very general occurrence of cassiterite, either as a trace or in appreciable amount, and, in some nodules, of fluorite.

The nodules are thus referable to a comparatively late stage in the crystallization of the aplitic magma, rather than representing early segregation products. The associations (2) and (3), noted above, are regarded as strong evidence of their late miarole-pneumatolytic origin. The origin thus outlined, while not identical with that described for the Cape Willoughby examples, is closely analogous to it.

Summary.

I. The quartz-tourmaline nodules are developed in a mass of aplite intruding the Cape Willoughby granite.

II. The nodules consist essentially of quartz, tourmaline, and felspar (microcline and albite). The tourmaline is in process of replacing the felspar, and is evidently of pneumatolytic origin.

III. The mode of origin of the nodules is discussed, and it is shown that they cannot represent segregations of earlier formed crystals from the aplitic magma.

Fig. 1.

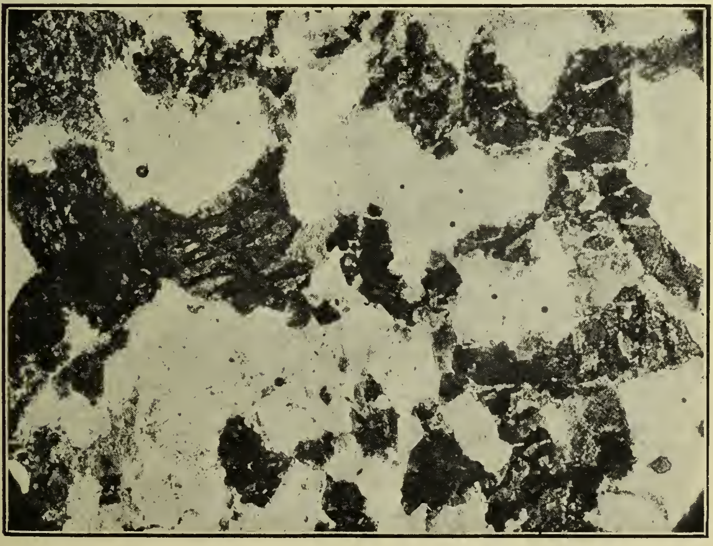

Fig. 2.

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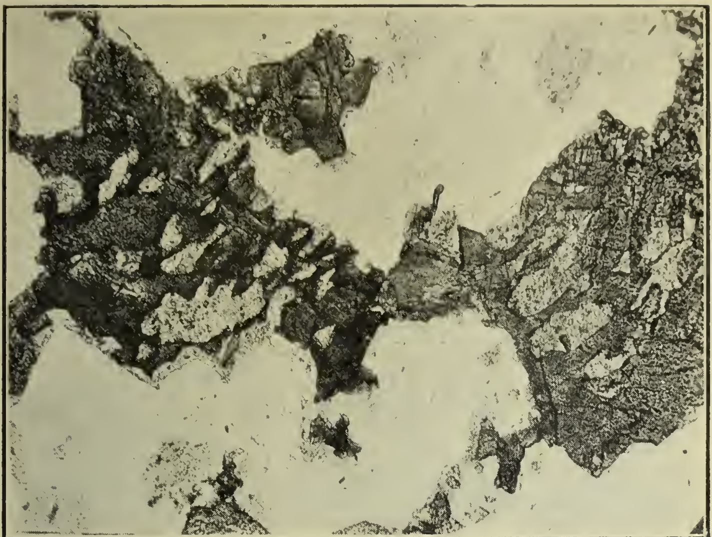

Fig. 1.

Fig. 2.

HUSSEY & GILLINGHAM LIMITED, PRINTERS & PUBLISHERS ADELAIDE, SO. AUS.

IV. A mode of origin, *in situ*, is suggested which is in harmony with the evident pneumatolytic replacement that has occurred.

V. As denoting their manner of origin, it is suggested that the name "Pneumatolith" be attached to such pseudo-segregations occurring in igneous rocks and which owe their existence, primarily, to pneumatolytic processes.

VI. The evidence of the Tasmanian nodules, while not as clearly delineated as in the Cape Willoughby examples, is strongly suggestive of miarole origin. Their formation is then referable to a late stage in the crystallization of the magma. The origin is distinct from the hypothesis of "segregation," and is closely related to the origin described for the Cape Willoughby nodules.

The author is indebted to Mr. W. R. Browne, B.Sc., for helpful discussion during the preparation of this paper.

DESCRIPTION OF PLATES.

Plate XXIII.

Fig. 1. Photograph of a typical quartz-tourmaline nodule. The general ellipsoid shape of the nodule is apparent. A portion of the aplite is attached to its upper rear surface. Natural size.

Fig. 2. Section of a quartz-tourmaline nodule showing the replacement of felspar by tourmaline. The tourmaline can be seen as a network through the felspar, isolating sections of the one felspar from each other. Magn. × 45 diameters.

Plate XXIV.

Fig. 1. Another section. The clear areas are quartz. Magn. × 45 diameters.

Fig. 2. A portion of fig. 1 enlarged to show the replacement of the felspar by the strings of tourmaline. Magn. × 80 diameters.

Notes on Some Miscellaneous Coleoptera, with Descriptions of New Species.—Part V.

By Arthur M. Lea, F.E.S., Museum Entomologist.

[*Contribution from the South Australian Museum.*]

[Read September, 12, 1919.]

Plates XXV. to XXVII.

Many interesting ants'-nest species are recorded in the present part, this being especially due to the efforts of Mr. J. S. Clark, in Western Australia, and Mr. F. Erasmus Wilson, in Victoria; others were also received from Messrs. W. and E. F. du Boulay (sons of the late F. du Boulay), from New South Wales and Western Australia; E. H. Zeck, New South Wales; H. W. Brown, Western Australia; R. J. Burton, A. H. Elston, and B. A. Feuerheerdt, South Australia; and F. P. Dodd and H. Hacker, Queensland.

Mr. Clark paid much attention to nests of the common twig-mount ant, *Iridomyrmex conifera*, Forel,(1) which builds mounds of small leaves and twigs that may often be fired. Shortly after he began the examination of the nests he wrote of them:—"To date I have taken home fourteen nests, ants and all, and have very carefully sieved the lot. I cannot tell you all I have found, but I have 16 specimens of *Cryptodus*, 28 *Articerus*, 7 Scydmaenidae, 2 Ptinidae, 2 (?). I feel very pleased so far, as all the specimens, except *Cryptodus*, are quite new to me. I have also examined carefully six deserted nests of the same ants, but, except the *Cryptodus*, have found nothing. With this nest I find little in the top, or mound part of the twigs; I lift it right off, and drop it into a bag, then dig the ground out a foot deep into other bags, and number all the same, and I find that most of the beetles, etc., are on the top of the ground just under the twigs, and extending not more than three inches underground." Mr. Clark subsequently examined many other nests of the species, and found in them many other true inquilines, some of which are here recorded; but he also obtained other specimens that are certainly not true inquilines, his thorough method of search rendering it probable that some of the specimens taken in the nests were victims of the ants; nevertheless, it is desirable to put on record the names of such specimens. Recently he wrote:—"I was sieving twig-mound nests most of the

(1) Name received from Prof. Wheeler.

holidays, and from two nests took 13 *Chlamydopsis inquilina*, 4 *Enasiba tristis*, 10 *Scydmaenus*, but I have not tried to count the various *Articerus*, *Ectrephes*, and Staphylinidae." Many of his takings of the Staphylinidae I hope to record at a later date; he also took some remarkable small flies and bugs.

Having recent occasion to examine many of the large wheat-stacks in New South Wales, Victoria, and South Australia, several introduced species of beetles, not previously recorded from Australia, were found in greater or less abundance; for the names of several of these I am indebted to Mr. G. J. Arrow, of the British Museum.

HYDROPHILIDAE.

Pseudohydrobius flavus, n. sp.

Flavous, some parts tinged with red. Upper-surface polished, under-surface subopaque, and very finely pubescent.

Head with small and rather dense punctures, clypeus with still smaller punctures, its suture distinct only at sides; labrum very small. Apical joint of maxillary palpi slightly longer than the subapical. *Prothorax* with slightly larger punctures than on head. *Elytra* with slightly larger punctures than on head, and with series of somewhat larger ones. Length, 3-4·5 mm.

Hab.—New South Wales: Blue Mountains (Blackburn's Collection), Wentworth Falls (A. Simson), Mount Victoria, Wollongong, Sydney, National Park (A. M. Lea), Richmond River (A. J. Coates); Queensland: Stradbroke Island (J. H. Boreham and H. Hacker), Mapleton (Hacker), Cairns (F. P. Dodd and Lea). Type, I. 8214.

Much smaller and paler than *floricola*, but with similar outlines; and, like that species, it may be taken from flowers (especially of the genus *Leptospermum*) producing nectar in abundance. The seriate punctures on the elytra are close together and moderately distinct, but not in striae, but there is a distinct sutural stria from the middle to the apex.

PSELAPHIDAE.

Leanymus mirus, n. sp.

Pl. xxv., figs. 1-3.

♂. Light castaneous, antennae (eleventh joint excepted) somewhat darker. Moderately clothed with short, pale pubescence.

Head with three small foveae or large punctures triangularly placed: two between eyes and one in front. Antennae long, first joint cylindrical, about as long as three following combined, second—tenth subequal in length, the ninth and tenth slightly increasing in width, eleventh about as long as ninth and tenth combined and much wider. Palpi with two spiniform processes on apical joint, one on the penultimate, and two on the antepenultimate. A spiniform process also on the cardo of the maxillae. *Prothorax* strongly and evenly convex; punctures very minute. *Elytra* strongly convex; with a deep stria on each from middle of base to middle of disk, where it abruptly terminates; punctures sparse and small. *Metasternum* with a conspicuous oblique process on each side of middle. *Abdomen* with apical segment encroached upon by pygidium, this with a small fovea and several feeble nodes. Front *legs* with a spine on coxa and trochanter, femora rather stout, tibiae thin and bisinuate; middle tibiae thin, the hind ones thin and with a deep apical notch. Length 1·8-2 mm.

♀. Differs in having somewhat shorter antennae, metasternum unarmed, under-surface of abdomen not encroached upon by pygidium and legs somewhat shorter, with the front tibiae no more sinuous than the middle ones, and the hind ones not notched.

Hab.—Queensland: Cairns district (A. M. Lea). Type, I. 10650.

The processes on the metasternum are joined together at the base, at the apex each is obtusely bifid, although the cleft is very feeble on some specimens. From some directions the terminal joint of the antennae of the male appears to be regularly ovate, from others it is seen to be somewhat produced on one side of the base. The figures of *L. palpalis* (2) will give a good general idea of this remarkable insect, but it differs from that species in being smaller, apical joint of antennae paler than the preceding ones, and none black, armature of the metasternum notched, front tibiae bisinuate and hind ones notched. As on that species both sexes have the front coxae and trochanters armed. The notched hind tibiae even more clearly indicate the affinity of the genus with *Palimbolus (Didimoprora)*, near which, despite the very different palpi, it was referred from the only other known species by Raffray; the spiniform process is so near the other part, however, that the notch could be easily overlooked. Five specimens were obtained by sieving fallen leaves at Malanda, of which one is a female, 94 other specimens, all males, were obtained at lights.

ARTICERUS SUBCYLINDRICORNIS, n. sp.

Pl. xxv., fig. 4.

♂. Dark castaneous, disc of elytra paler. Moderately clothed with short, pale pubescence, denser on metasternum

(2) Proc. Linn. Soc. N.S. Wales, 1900, pl. x., figs. 5 and 6.

than elsewhere; a few hairs on abdomen, and a conspicuous fascicle on each side of base of its upper-surface, its excavated portion glabrous.

Head rather stout and finely granulate, with a vague median line; with a short subtriangular projection from mouth. Antennae not much longer than head, feebly dilated from near base to apex, circular in transverse section. *Prothorax* subquadrate, front angles rounded off, with a fairly large top-shaped fovea, surface granulate as head. *Elytra* densely and finely punctate; subsutural striae distinct. *Abdomen* with a wide and deep excavation at base of upper-surface, the excavation widely and shallowly encroaching on middle of convex portion; its under-surface incurved from apex to base, apex strongly encroached upon by pygidium, which is foveate. *Prosternum* with a conspicuous median keel between apex and coxae. Metasternum unarmed. *Femora* moderately stout, unarmed; front trochanters feebly dentate; tibiae thickened at apex, the middle ones feebly produced at inner apex. Length, 2-2·25 mm.

♀. Differs in having slightly shorter antennae, under-surface of abdomen evenly convex, the pygidium non-foveate, metasternum less depressed posteriorly, its clothing no denser than elsewhere, and the legs unarmed.

Hab.—Western Australia: Swan River, many specimens from nests of *Iridomyrmex conifera* (J. S. Clark). Type, I. 10626.

In size and general appearance somewhat resembling *A. cylindricornis*, but there are many differences of the head, under-surface, and legs, the antennae are shorter and stouter, and are feebly dilated from the base to the apex. The metasternum of the male is flattened and somewhat depressed posteriorly, its dense clothing causes the flat space to appear conspicuously triangular, and at each corner of the base of the triangle there is a feeble fascicle that has the appearance of a small tooth. The feeble armature of the legs (confined to the middle tibiae and front trochanters) is very unusual in the males of *Articerus*.

Articerus wilsoni, n. sp.

Pl. xxv., figs. 5 and 6.

♂. Castaneous, some parts slightly darker than others, basal half of antennae darker than apical half. Clothing as described in preceding species.

Head very short, part in front of eyes slightly wider than long, a shallow depression in middle between eyes, on each side of which is a minute black elevation; surface finely granulate. Antennae circular in transverse-section, basal half narrow and lightly curved, then strongly dilated with the apex truncate. *Prothorax* subquadrate, front angles rounded off; with a large median fovea from base to near apex; basal half granulate, apical half punctate. *Elytra* with dense and moderately strong punctures, becoming smaller posteriorly; subsutural striae distinct. *Abdomen* with a wide and deep excavation at base of upper-surface, the excavation semicircularly encroaching upon middle of convex portion; its under-surface strongly incurved from apex to base. *Metasternum* ridged along middle, the ridge terminating near apex in a small acute tooth. Front *tibiae* with a feeble tooth near inner apex; middle femora stouter than the others; trochanters strongly dentate, tibiae with a small outer tooth near middle, and a narrow flange at the outer apex, inner apex with an acute tooth almost in line with the flange; hind legs thinner than the others and unarmed. Length 2-2·25 mm.

♀. Differs in having the under-surface of abdomen convex, and the metasternum and legs unarmed.

Hab.—Victoria: Eltham, in nests of ants under stones, July and August, 1918 (F. E. Wilson). Type, I. 10627.

One of the most distinct species in the genus. In my table it would be associated with *A. hamatipes*, on account of the middle tibiae, but the armature is very different: on that species it consists of a conspicuous dentiform flange about the middle, on this species there is a small median tooth, but the apex is armed both internally and externally; the tooth of the front tibiae is feeble and invisible from most directions, it is also partly concealed by clothing. The fascicles on the upper-surface of the abdomen are rather larger than usual, and on its under-surface there are some small, median ones that from some directions look like small teeth. The two minute black spots between the eyes are fairly distinct; similar spots may be traced on most species of the genus. The only female examined has been returned to Mr. Wilson, together with one of the males.

Articerus mesosternalis, n. sp.

Pl. xxv., figs. 7 and 8.

♂. Rather dark castaneous, disk of elytra somewhat paler. Clothing as described in *subcylindricornis*.

Head moderately long and (except for eyes) almost parallel-sided, densely granulate. Antennae rather thin and cylindrical, circular in transverse section, apical portion slightly dilated and truncate. *Prothorax* subquadrate, front angles rounded off; with a comparatively small and narrow medio-basal fovea; granules as on head, but punctate about apex. *Elytra* densely punctate; subsutural striae distinct.

Abdomen with a large deep excavation at base of upper-surface, its middle semicircularly encroaching upon middle of convex portion; under-surface slightly incurved from apex to base, apex encroached upon by pygidium, the latter with a subtriangular fovea. *Mesosternum* with an acute subconical process between coxae. Metasternum convex along middle, but unarmed. Middle *tibiae* with a small subtriangular process at inner apex, legs otherwise unarmed. Length, 1·75 mm.

Hab.—Western Australia: Beverley, from a nest of a small black *Iridomyrmex* (E. F. du Boulay). Type (unique), I. 10644.

Somewhat like *A. femoralis* on an enlarged scale, or *A. subcylindricornis* on a reduced one; from both readily distinguished by the armed mesosternum. From some directions there appears to be a feeble shining median line on the head.

Articerus duboulayi, Waterh.

Pl. xxv., figs. 9 to 12.

Mr. E. F. du Boulay has recently taken at Beverley specimens of a species that appears to be *duboulayi;* they differ in some respects, however, from the original description and figure (it is to be noted also that the figure differs in some respects from the description). In the figure the fovea on the pronotum only represents its deepest part, it really occupies about half the width, and more than half the length of that segment. The antennae and front legs agree from some directions with the figure; but, as noted by Waterhouse, the former look very different from other points of view. The femora of the male were described as "much incrassated in the middle and somewhat compressed" but they are not so figured, and on the males before me it is only the middle femora that are much incrassated, and they are also bidentate. The hind tibiae from some directions agree with the description, but from others they are seen to be armed with a tooth behind the insertion of the tarsi, as a result, from some directions, the apex appears bifid; the apical portion is also clothed with golden hairs. The front and hind trochanters are briefly dentate, the middle ones are unarmed. The metasternum is ridged along the middle, the ridge becoming acute posteriorly, and shortly before its apex armed with a small tooth, on each side of the ridge the surface is strongly depressed. The under-surface of the abdomen has a depression on each side of the base, with a ridge between; between the apex of the ridge and the pygidium is another depression; there are also a few small fascicles. The female differs from the male in having antennae shorter, straighter, and without subapical notch, metasternum and under-surface of abdomen evenly convex, and the upper-surface of the latter less conspicuously notched at the sides, legs unarmed and middle femora no stouter than the others. The strongly-inflated middle femora of the male associates the species with *tumidus* in my table, but the two species are otherwise very dissimilar.

Articerus constrictiventris, Lea.

Specimens of this species have recently been taken by Mr. R. J. Burton in South Australia (Murray River) and by Mr. W. W. Froggatt in New South Wales (Hay). The male, hitherto unknown, differs from the female in having the pygidium encroaching upon the under-surface of the abdomen, and this is widely, shallowly, and somewhat irregularly depressed along the middle; the metasternum is convex along the middle, the convexity abruptly declivous posteriorly, and marked at its summit by a short process that is almost concealed by golden pubescence, the front tibiae are armed by a minute apical tooth, and the hind ones have a long apical bristle (both middle tibiae are missing from the only male before me).

Articerus pascoeus, Sharp.

Mr. E. F. du Boulay has taken several specimens of this species in ants' nest at Beverley (Western Australia). In my table the male is noted as having "front tibiae conspicuously armed at apex." This is the case when both tibiae and tarsi may be seen clearly, but when the tarsi are pressed close to the apical tooth the latter might easily be mistaken for the former. Mr. Clark also took a specimen from the nest of a species of *Cremastogaster* near the Swan River.

Articerus curvicornis, Westw.

Specimens taken by Mr. F. P. Spry at Coburg and by Mr. H. W. Davey at Ararat (both in Victoria) differ from the normal form of *curvicornis* in having the antennae noticeably thinner, the prothorax somewhat wider, with the fovea somewhat shorter, and the oral seta of the male shorter, the clothing in general has also a more sericeous appearance; but I can find no positive characters of the legs that would warrant their specific separation.

Articerus foveicollis, Raffr.

Mr. J. S. Clark has taken specimens in abundance in nests of *Iridomyrmex conifera* about the Swan River, that probably belong to this species, despite some apparent discrepancies. In the description the antennae are noted as "capite plus duplo longiores," and they are so figured; but on the specimens before me, on careful measurement, they are seen to be less than twice as long as the head; they are also less conspicuously narrowed to the base than in the figure; the head is of peculiar shape, but the figure rather exaggerates the basal enlargement. In both sexes the four front femora are moderately angulate, the hind ones feebly so. The male differs from the female in having the antennae slightly longer, the prothoracic hump slightly more pronounced, the under-surface of abdomen incurved from apex to base (instead of strongly and evenly convex) with the pygidium encroaching upon it; the middle trochanters have an acute spine, and the middle tibiae have a short produced spur at the inner apex. In my table it would be associated with *fortnumi*, which is a much smaller and otherwise very different species.

ARTICERUS NITIDICOLLIS, Raffr.

Mr. F. E. Wilson has taken two females of this species in Victoria (Lorne) in October, in nests of *Ectatomma metallicum*, and of a small black species of *Iridomyrmex*.

A. FORTNUMI, Hope. *Hab.*—Parachilna, Mount Lofty Ranges.

A. DILATICORNIS, Westw. *Hab.*—Fern Tree Gully, Coburg.

A. DENTIPES, Lea. *Hab.*—Parachilna.

A. IRREGULARIS, Lea. *Hab.*—Coburg.

Now knowing *duboulayi*, *foveicollis*, and the male of *constrictiventris* additions to my table[3] of males may be given as follows:—

a.
- *r.* Pronotum highly polished ... ... *nitidicollis*
- *rr.* Pronotum subopaque ... ... *constrictiventris*

dd.
- *s.* Eyes on widest portion of head ... ... *fortnumi*
- *ss.* Eyes on narrowest portion (excluding neck) of head ... ... *foveicollis*

ff.
- *t.* Antennae gradually increasing in width from near base ... ... *hamatipes*
- *tt.* Apical half of antennae suddenly becoming much thicker ... ... *wilsoni*

gg.

ggg.

Metasternum unarmed posteriorly.
- *u.* Mesosternum with an acute projection between middle coxae ... ... *mesosternalis*
- *uu.* Mesosternum not so armed ... ... *subcylindricornis*

B.
- *v.* Antennae no longer than head ... ... *tumidus*
- *vv.* Antennae as long as head and prothorax combined ... ... *duboulayi*

[3] *Ante*, 1918, pp. 242, 243.

TRICHOPTERYGIDAE.

Rodwayia intercoxalis, n. sp.

Pl. xxv., fig. 13.

Dark castaneous, apical portion of elytra, abdomen, antennae, and legs much paler. Length, ·6 mm.

Hab.—Queensland: Cairns district, from nests of ants (F. P. Dodd). Type, I. 10682.

The outlines and punctures of this species are practically the same as in all others of the genus, and in agreement with the comments on *ovata*,(4) and the clothing consists of very short depressed pubescence, giving the upper-surface a finely sericeous appearance as on most of them; but it is darker than any other species; the abdomen is not entirely covered by the elytra, and the apical parts of the latter in consequence appear considerably paler than those parts that cover the former, but the colour of the elytra, apart from this, seems to gradually become paler from the base to the apex. The intercoxal process of the prosternum, which at first glance appears to be black, is wider than in any other described species of the genus, and its front end (the sides of which, however, I have been unable to see clearly on any of the specimens examined under the microscope) appears to be without the flange-like processes of the other species; its hind end is more obtusely notched than in any other species, except *ovata*, and each side is finely margined. The host ant is a reddish stinging species of the genus *Amblyopone* or near thereto.

Rodwayia orientalis, Lea.

I recently took this species at Glen Innes (in abundance from nests of *Camponotus nigriceps* and of *C. aeneopilosus)*, Peak Hill (from nests of *Camponotus novae-hollandiae* and of a small black hairy *Iridomyrmex)*, in New South Wales; and at Brisbane (from a nest of *C. aeneopilosus)*, Mungar Junction (form a nest of *Ectatomma metallicum)*, and Mount Tambourine (from nests of *E. metallicum* and *Polyrhachis ammon)*, in Queensland.

Rodwayia minuta, Lea.

Mr. E. L. Savage took a specimen of this species from an ants' nest on Mount Lofty in April, 1917; this being the only specimen of the genus I have seen from South Australia, although it has been repeatedly searched for in nests of species of *Polyrhachis*, *Ectatomma*, and *Iridomyrmex*, in which specimens may be obtained in abundance in New South

(4) Tas. Nat., 1907, p. 16.

Wales, Victoria, and Tasmania. I also took many specimens of *minuta* from the nest of a small variety of *Ectatomma metallicum*, on Mount Tambourine in Queensland.

HISTERIDAE.

Chlamydopsis inquilina, Lewis.

Many specimens taken by Mr. J. S. Clark about the Swan River from the nests of *Iridomyrmex conifera* appear to belong to this species; they agree well with the original description, but differ from the figure subsequently given in having the elytra across the epaulettes wider than any other part, instead of (as in the figure) narrower than across the middle; the difference may be sexual or due to inaccuracy of the figure. The deep notch in each epaulette, combined with the inconspicuous punctures and striae on most of the upper-surface, and the strongly and evenly elevated sides of prothorax, render the species extremely distinct.

In a note on the species[5] a letter from Mr. Lewis was quoted recording the type as from Liverpool, in New South Wales; in the original description it was noted as from "Australia," and taken by du Boulay. Liverpool was probably noted in error, for, so far as I am aware, the late Mr. F. H. du Boulay was never there, whereas he did a lot of collecting from ants' nests in Western Australia.

Chlamydopsis comata, Blackb.

Mr. Elston has presented to the Museum a specimen of this fine species; he obtained it from a nest of *Ectatomma metallicum* (adjacent to a termite's nest) on the Mount Lofty Ranges.

Chlamydopsis excavata, Lea.

Mr. W. du Boulay took two specimens of this species (now first recorded from the mainland) from a nest of *Ectatomma* at Hunter Hill (near Sydney) in October.

Chlamydopsis tuberculata, Lea.

Three specimens of this species were taken at Lorne (Victoria) by Mr. F. E. Wilson, from nests of a small black species of *Iridomyrmex;* one specimen was presented to the South Australian Museum, and another to the National Museum.

Chlamydopsis agilis, Lea.

A specimen of this species was taken at Nairne (South Australia) by Mr. W. L. Burton, from a nest of *Ectatomma metallicum.*

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(5) Proc. Roy. Soc. Vict., 1912, p. 72.

CHLAMYDOPSIS LATIPES, n. sp.

Pl. xxv., fig. 14.

Dark castaneous-brown, some parts (the metasternum and abdomen quite) black.

Head immersed in prothorax when at rest, face with shallow reticulate punctures. Antennae moderately long; scape curved at base, greatly dilated towards apex, outer portion with punctures as on face; funicle short, apparently six-jointed; club long and subcylindrical. *Prothorax* strongly transverse, front margin lightly elevated behind head, then with a strong oblique elevation to each side, sides scarcely elevated and somewhat sinuous, with a subconical tubercle in middle; with dense reticulate punctures; a narrow submarginal line at base. *Elytra* about as wide as long; most of surface shining and with minute (scarcely visible) punctures; epaulettes strongly raised and with punctures somewhat as on prothorax, a strongly elevated process between each epaulette and the suture, the process wide at the base, pointed at the apex, and with a conspicuous fascicle of golden red bristles, meeting a similar fascicle on a strong median elevation, the fascicles crossing a deep transverse subbasal impression, but between it and base a less depressed space with rounded outlines; outer walls with strong striae. *Prosternum* and mesosternum with punctures as on pronotum; metasternum shining, with a narrow median line; with small and not very dense punctures. *Abdomen* with punctures as on metasternum, pygidium and propygidium subopaque, and with much denser punctures. *Legs* long; femora densely punctate, grooved on one side throughout their length; tibiae wide and compressed, grooved on lower edge to fit into femora, with a shallow groove on inner side on the upper half for reception of tarsi, the grooves with an irregular fringe of setiferous granules, front ones dilating to about basal third, where there is a small tooth, then slightly diminishing to apex; the other tibiae wider and without the tooth, but otherwise somewhat similar. Length, 3·6 mm.

Hab.—Western Australia: Mount Henry, from a nest of ants *(Dolichoderes (Hypoclinea) scabridus*, Mayr.[6]), J. S. Clark. Type (unique), I. 10675.

With the reticulated pronotum and polished parts of elytra as in the Tasmanian *excavata*, to which it is closer than to any other known species, but much larger, and basal parts of elytra, including the epaulettes and their clothing, very different, tibiae even more dilated, etc. The tubercle on the pronotum is quite distinct when viewed from the side,

(6) Name received from Prof. Wheeler.

but is much smaller and otherwise different to that of *tuberculata*. When the head is extracted from the prothorax it may be seen that the latter has a large excavation or fovea, partially invisible from above, for the reception of each antenna. At first glance the elytra appear to have two large, round, deep foveae, but this is due to the crossing of the fascicles over the subbasal excavation, and to the sinuation of the epaulettes at the sides of this, where also there are membranes with stiff bristles, these somewhat shorter than the fascicles; the excavation is without lateral openings, but there is a shallow depression (representing them) on each side, to which the striae are directed.

CHLAMYDOPSIS STRIATIPENNIS, n. sp.

Pl. xxv., fig. 15.

Black; elevated front margins of prothorax, antennae (club infuscated), and legs reddish-castaneous.

Head immersed in prothorax when at rest; face with shallow reticulate punctures. Antennae not very long; scape curved at base, thickened to apex, with punctures as on face; funicle short, apparently six-jointed; club moderately long and subcylindrical. *Prothorax* strongly transverse, front margin narrowly elevated behind head, then more strongly elevated and curved to margins, narrowest at base; with dense reticulate punctures, in places becoming substriate. *Elytra* about as wide as long, closely but sharply striated; base much and suddenly wider than prothorax; epaulettes strongly raised, and crowned with stiff reddish bristles; subbasal impression not very large (in comparison with other species), its deepest part highly polished, not indicated on the sides; tips with numerous short setae. *Prosternum*, mesosternum, and parts of metasternum and abdomen with dense subreticulate punctures, elsewhere with small ones. *Pygidium* and propygidium with dense reticulate punctures, and numerous short setae. *Legs* long; femora thin, grooved for partial reception of tibiae; front tibiae rather thin at base, then strongly thickened, a small tooth marking the termination of the tarsal groove; middle tibiae slightly longer, rather less stout, and with the dentiform projection almost obsolete; hind tibiae longer, still less stout (but with the apical half still fairly thick), and without a dentiform projection. Length, 2·75 mm.

Hab.—Victoria: Lorne, from a nest of a small black *Iridomyrmex* in October (F. E. Wilson). Type (unique), I. 10676.

A strongly striated species, readily distinguished from all others of the genus by (in combination) great width across the shoulders, compared to the prothorax, epaulettes crowned with stiff reddish setae (not attached to a membrane), and by the greatly thickened front and middle tibiae. In my table it would be associated with *ectatommae*, which is a much smaller species, with very different legs. The elytra are strongly striated throughout, except at the bottom of the subbasal depression, the striae are mostly longitudinal, but many are oblique or sinuous, and a few near the base are transverse; on the outer walls they are not all directed towards a central point.

Chlamydopsis carinicollis, n. sp.

Black, antennae and legs castaneous.

Head immersed in prothorax when at rest; face with shallow reticulate punctures, and with two short longitudinal carinae, each ending in a small subconical tubercle. Antennae rather short; scape curved, strongly thickened, with punctures as on face; funicle short, apparently six-jointed; club long and subcylindrical. *Prothorax* strongly transverse, front margin lightly elevated and bilobed behind head, thence to sides strongly elevated and curved, sides behind where the margins join almost parallel, a narrow carina from apex to middle, a small tubercle on each side of and in line with its end, between each tubercle and the basal angles a short transverse carina, two small medio-basal tubercles; with dense, reticulate punctures. *Elytra* not much wider than prothorax, slightly wider than long; epaulettes moderately elevated; with a fairly large subbasal depression, extending almost to but not opening on to outer walls, and with a golden membrane overhanging it from the inner end of each epaulette, a narrow transverse carina on each at the apical third, extending to the outer wall but not to the suture; punctures, almost throughout, much as on pronotum. Middle parts of *metasternum* and of abdomen shining and with rather small but distinct punctures, rest of under-surface reticulate and subopaque. *Propygidium* with a short longitudnal carina, and with a transverse one at its junction with pygidium. *Femora* rather long and thin; tibiae strongly compressed, front ones with a strong tooth in middle, thence rapidly diminishing to each end, middle ones somewhat similar but the tooth less projecting, hind ones with greatest width slightly beyond the middle, the space between it and base quite straight (on the other tibiae it is distinctly curved), tarsal grooves on oblique outer edge. Length, 2 mm.

Hab.—Victoria: Beaconsfield, from a nest of *Aphaenogaster longiceps*, in July (F. E. Wilson). Type (unique), I. 10677.

A suboblong black species, with a median carina on the pronotum as in *serricollis* and *pygidialis*, to which it is allied, but from both of which it differs in many respects. Seen obliquely from behind the middle portion of the basal depression appears to have some coarse punctures, the parts beyond the membranes appear to be almost circular and highly polished.

Chlamydopsis compressipes, n. sp.

Castaneous.

Head immersed in prothorax; face with shallow reticulate punctures. Antennae rather short; scape curved, its apical half thick, with punctures as on face; funicle short, apparently six-jointed; club subelliptic. *Prothorax* strongly transverse, front margin slightly elevated behind head, thence to sides strongly elevated and lightly curved, sides feebly elevated and slightly curved, middle gently elevated and with a short feeble transverse carina; with shallow, reticulate punctures. *Elytra* slightly but distinctly wider than long, suddenly much wider than prothorax; epaulettes raised and rounded, with punctures as on pronotum, close to the inner side of each epaulette a narrow ridge conspicuously elevated above it, a small upright fascicle between its hind end and the margin; basal depression wide, deep, and semidouble, its ends partly concealed in places; with elongate, subreticulate punctures in middle, changing to simple striae; outer walls with numerous striae, all converging to a rather large but shallow fovea. Most of *metasternum* and of abdomen shining and with small punctures, rest of under-surface, pygidium, and propygidium opaque and with punctures as on pronotum. *Legs* long, thin, and compressed. Length, 2·25 mm.

Hab.—Queensland: Mount Tambourine, taken from a nest of ants in December (H. Hacker). Type (unique) in Queensland Museum.

At first glance fairly close to *epipleuralis*, with which it would be associated in my table of the genus, but readily distinguished therefrom by the epaulettes and tibiae; on the present species each epaulette is conspicuously raised, and at its greatest elevation is not disconnected with the part behind it, and its side has a round fovea not connected with the basal depression, although in line with it; the inner process near each epaulette is also terminated by a narrow ridge elevated above it; the tibiae have the outer outline gently rounded off, instead of angulate in middle; *pallida*, with somewhat similar tibiae, has very different epaulettes. The elytra are distinctly wider than long, and at the base are much and suddenly wider than the prothorax; the legs, and especially the tibiae, are strongly compressed, so that although fairly wide they are thin, with the outer part of each tibia semi-transparent. From the species, *atra*, previously recorded from Mount Tambourine, it is distinct by its pale colour, and very different epaulettes and legs.

COLYDIIDAE.

Euclarkia, n. g.

Head irregular, about as long as wide. Eyes small and lateral. Antennae short, stout, three-jointed, first joint small and almost concealed, second very short, third cylindrical, its apex truncated. Palpi small, only apical joint of each exposed. *Prothorax* subquadrate, strongly costate. *Scutellum* small. *Elytra* closely applied to prothorax, strongly costate; epipleurae rather wide and parallel-sided to base of abdomen, thence narrowed to apex. *Metasternum* elongate; episterna rather narrow and parallel-sided. *Abdomen* composed of five segments, first and fifth subequal in length, second much shorter, third slightly shorter than second, and fourth than third. *Legs* short and fairly stout; front and middle coxae moderately separated, the hind ones more widely so; femora edentate; tibiae angularly dilated to beyond the middle, and then strongly narrowed to apex; tarsi with claw-joint almost as long as the rest combined, claws simple.

This remarkable genus is clearly allied to *Kershawia*, and in general appearance the species described below quite strongly resembles *K. rugiceps* on a small scale; with antennae removed there is no strong distinguishing feature. The antennae at first glance appear to be but one-jointed, but a very small basal joint (invisible from above) may be seen, and a second one applied like a thin disk to the base of the third, the latter has its apex slightly concave, and filled with sensitised pubescence as in so many inquilines. The mandibles are tightly clenched on all the specimens before me. Only four distinct tarsal joints are visible. The elytral episterna and base of abdomen on each side are somewhat depressed for the partial reception of the hind legs when at rest. Wings are present.

Euclarkia costata, n. sp.

Pl. xxv., fig. 16.

Rather narrow, depressed, opaque, with dense punctures all over. Brown or black.

Head truncated in front, sides incurved from between antennae to eyes, beyond each of these a subconical projection, and then narrowed to base; surface with about eight small elevations. *Prothorax* with six narrow costae from base to apex, the two median ones somewhat incurved at middle, the outer one on each side marginal. *Elytra* with narrow costae on prothorax; with geminate rows of rather strong punctures. Length, 3-3·75 mm.

Hab. — Western Australia: Swan River, from nests of the twig-mound ant, *Iridomyrmex* (J. S. Clark). Type, I. 10651.

Euclarkia costata, Lea.

About half of the specimens are of a dingy black, the others vary to a rather light brown, but the apical half of the antennae is usually paler than the basal half, the two shades of colour being frequently rather sharply defined. On the elytra (counting the sutural thickening as the first) the second costa is continuous from base to apex, but near the apex is joined by another representing the third and fourth, these joined together slightly beyond the middle, the fifth is joined to the third at the base, but its apex is free and subapical, the marginal costa is strongly curved at about the basal third; the sutural costae appear as one, except near the base, where they narrowly diverge. A very slow-moving species, of which Mr. Clark obtained numerous specimens by sieving. It is one of the most interesting of the many curious species recently taken by him from nests of the twig-mound ant.

MYCETOPHAGIDAE.

Litargus balteatus, Lec., Proc. Ac. Phil., 1856, p. 14.

Mr. Froggatt and I obtained numerous specimens of this species in some damp wheat bags at Enfield, near Sydney. I am indebted to Mr. G. J. Arrow for the name of the species, now first recorded as occurring in Australia.

SCARABAEIDAE.

Bolboceras quadrifoveatum, n. sp.

Pl. xxv., fig. 17; pl. xxvi., fig. 44.

♂. Castaneous, tips of some processes black. Underparts densely pilose.

Head with a strong, erect, densely punctate central horn; front face of clypeus semicircular and vertical, each side narrowly carinate, and just before the canthus appearing as a small subconical tubercle; mandibles not notched near apex. *Prothorax* with four strong processes projecting forwards, and almost equi-distant at their tips, front margin with a narrow impression across middle, becoming foveate at each side, front angles acutely produced; with a large deep fovea close to each submedian horn; with a few large punctures about middle, becoming crowded towards and on sides; basal gutter with punctures throughout. *Scutellum* impunctate. *Elytra* with small punctures in striae, of these the thirteenth and fourteenth very close together near base. Front *tibiae* with six teeth, hind pair with two wide carinae. Length, 20-21 mm.

Hab.—Queensland: Chillagoe (J. S. Clark). Type, I. 10659.

The apex of the prothorax is bifoveate, the foveae, however, lateral, but as the hind tibiae are not multicarinate Blackburn no doubt would have referred it to the first sub-group of group two, and it would there be associated with *froggatti* and *armigerum*, from the description of the former it differs in being smaller, and with the median processes of the pronotum closer together than in *tenax*, instead of more distant; from *armigerum* it differs in having the lateral processes of the head much shorter and the median horn much longer, the discal foveae of the prothorax are also considerably larger, but the horns are somewhat the same; with the heads removed specimens of the two species would probably be thought to belong to but one species; *tenax*, also with four transversely placed horns, has them more widely separated, the foveae smaller and deeper, and the cephalic horn bifid. The cephalic horn is about as long as the distance across the canthi; the prothoracic horns are somewhat compressed laterally, and rather obtusely pointed, the median ones are shorter than the one on the head, and somewhat longer than the lateral ones; in addition to the large punctures on the prothorax there are numerous minute indistinct ones. A second specimen is considerably darker than the type; its head and prothorax being dark brown.

Bolboceras bispinicolle, n. sp.

Pl. xxv., figs. 18 and 19; pl. xxvi., figs. 45 and 46.

♂. Pale castaneous, tips of some projections black. Under-parts densely pilose.

Head gently concave in middle, with two feeble sub-nodular elevations near base, in front with two strong spines projecting forwards and upwards, a narrow carina connecting the spines, and another connecting each with the canthus; mandibles gently incurved near apex, the right one notched.

Prothorax widely declivious but not excavated in front; about one third from base with two strong curved spines or thin horns, at the outer base of each a large fovea shallowly connected with the small sublateral one; sides finely and acutely serrated; a few punctures obliquely placed behind each eye near apex, some at sides and others in basal gutter, elsewhere impunctate. *Scutellum* impunctate. *Elytra* with narrow punctures in striae. Front *tibiae* with five teeth, hind ones with two wide carinae. Length, 19 mm.

♀. Differs in having the head with more numerous punctures and granules, front face of clypeus crowned with four equi-distant subtriangular elevations; prothorax unarmed, with coarse irregularly distributed punctures, sublateral foveae smaller and the median ones absent, and with a rather short (not the width of the head) transverse bisinuate carina about one-third from apex.

Hab.—Western Australia: Geraldton (J. S. Clark). Type, I. 10660.

Allied to *frontale*, and with the head of the male somewhat similarly armed, but the spines of the prothorax are thinner and more divergent, and the large foveae or excavations are differently placed: on the present species each is subbasal and encroaches upon the hind part of a submedian spine, its nearest part to the margin being about twice its width; on *frontale* the excavations are considerably larger, some distance from the median armature, and each opens out on to a front angle; the females of the two species are very similar. The head of the male before and behind the frontal spines has numerous small subobsolete granules, elsewhere it is smooth and almost or quite impunctate.

Bolboceras triunum, n. sp.

Pl. xxv., fig. 20; pl. xxvi., fig. 47.

♂. Pale castaneous, tips of some projections infuscated or black. Under-parts densely pilose.

Head mostly flat, smooth near base, rather densely granulate elsewhere, front face of carina short, its middle crowned with a small tooth, this connected by a carina with a smaller tooth just above each antennal notch; each mandible with an almost rectangular notch, the front edge truncated. *Prothorax* with three rather small elevations arising from a fairly large common base, the median one carinated in front, a curved carina feeble but well defined and close to base in middle, and obscurely ending on each side between the elevations and the small sublateral fovea; sides finely and rather obtusely serrated; punctures crowded towards sides, irregular in front and sparse elsewhere.

Scutellum with minute punctures. *Elytra* with small round punctures in striae, of the latter the thirteenth and fourteenth conjoined near base. Front *tibiae* with six teeth; hind ones with two wide carinae. Length, 16-17 mm.

Hab.—Western Australia (J. S. Clark). Type, I. 10658.

Allied to *trituberculatum*, and with the head very similar, but the three prothoracic elevations much smaller, closer together, in line with each other (instead of the median one considerably in advance of the others) and arising from a common base.

Rhopaea.

The species of this genus, although of large size, are very difficult to separate on superficial examination, and this difficulty is increased by the considerable variation that appears to be common in the individuals of several species. Thus *verreauxi* varies in a fashion that is almost exactly paralleled by *magnicornis* and *assimilis* (with the antennae missing it would be difficult, I believe often *impossible*, to be sure of the identity of specimens of these species); *morbillosa* is closely resembled by *mussoni*, *rugulosa*, and *polita; hirtuosa* by *decipiens*, etc. But the table given by Blackburn [7] readily permits of the genus being split up into distinct and easily recognizable groups.

Rhopaea nigricollis, n. sp.

Pl. xxv., fig. 22; pl. xxvi., fig. 49.

♂. Of a dingy and rather pale castaneous-brown, sterna and parts of legs darker, head, prothorax, and scutellum black, antennae flavous. Closely covered with short, depressed, ashen pubescence, mixed with a few longer hairs, these fairly numerous on prothorax; sterna densely pilose.

Head rather strongly convex and with crowded punctures between eyes, becoming much larger and sparser on clypeus. Antennae ten-, flabellum seven-jointed, first joint of the latter very little shorter than the others. *Prothorax* apparently about twice as wide as long, sides strongly rounded and obtusely serrated, all angles rounded off, median line shallow and incomplete; with crowded but not very large punctures, and with some larger ones scattered about. *Scutellum* with crowded punctures. *Elytra* with vague remnants of discal costae; with small dense punctures, often finely wrinkled or transversely confluent, and with numerous considerably larger and deeper ones. *Pygidium* densely punctate and shagreened. Front *tibiae* strongly tridentate, the second tooth much nearer the first than third. Length, 18-20 mm.

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[7] Trans. Roy. Soc. S. Austr., 1911, p. 189.

Hab.—Western Australia: Beverley (E. F. du Boulay). Type, I. 10792.

The sides of the prothorax are obscurely diluted with red. There is a rather dense fringe of hairs overlapping the base of the scutellum. The prothorax measures 8 × 5 mm., but to the eye it appears twice as wide as long. Of the species referred to AA, in Blackburn's table, it differs from *soror* in being much smaller and darker, prothorax with larger punctures, and third joint of the antennae of different shape; *heterodactyla* is a larger and paler species, and its third antennal joint has a spiniform process; in *hirtuosa*, *pilosa*, and *australis* the clothing of the head and prothorax is very different; in *assimilis* the third joint of the antennae is much longer, and the fourth of very different shape; from the description of *laticollis* it differs in having the prothorax no wider than in *pilosa*, the smaller elytral punctures not more strongly impressed than the smaller ones of that species, the size is smaller, colour darker, and clothing different. In general appearance it is like a small dark *verreauxi*, but its flabellum has one more joint than in that species. It is the first true species of the genus to be recorded from Western Australia.

RHOPAEA DECIPIENS, n. sp.

Pl. xxv., fig. 21; pl. xxvi., fig. 48.

♂. Of a uniform and rather pale castaneous, some marginal parts and the tibial teeth darker. Clothed with fine, depressed, pale pubescence, some longer hairs scattered about on elytra, and becoming dense on parts of head and prothorax; sterna densely pilose.

Head strongly convex and with crowded punctures between eyes, becoming much larger and sparser on clypeus. Antennae ten-, flabellum six-jointed. Apical joint of maxillary palpi long, and with a narrow opaque furrow. *Prothorax* moderately long (5·5-7·5 mm.), sides strongly rounded and obtusely serrated, hind angles obtuse but not rounded off, base lightly bisinuate; median line short and féeble; punctures crowded but sharply defined. *Scutellum* with crowded punctures. *Elytra* with dense punctures of two kinds: small, shallow, and often transversely confluent ones, and considerably larger and deeper ones. *Pygidium* shagreened and with dense punctures. Front *tibiae* strongly tridentate, the second tooth slightly nearer the first than third. Length, 20-23 mm.

Hab.—New South Wales: Forest Reefs (A. M. Lea). Type, I. 4535.

On one of the specimens the sides of the prothorax and the pygidium are infuscated, but this appears to have been caused by partial decomposition. There is a dense fringe of hairs, similar to those on the sterna, overlapping the base of the scutellum. The flabellum at first glance appears to be but five-jointed, as the produced part of its basal joint is much shorter than that of the following one, and from some directions is concealed. To the naked eye the elytra appear to have vague remnants of discal costae, but these disappear under a lens. One of the specimens before me bears Blackburn's name label "*Rhopaea hirtuosa*, Blackb." and in fact it strikingly resembles that species, but it belongs to a different section of the genus, as the flabellum, including the first short one, consists of but six joints, instead of seven. Of the males of the group AAA, it is distinguished from *verreauxi* by the shorter third joint of antennae, with the produced part of the fifth longer and more acute, the apical joint of the palpi is also much narrower; *mussoni* has the ramus of the fifth joint considerably longer and wider, and the palpi different; *rugulosa* has the upper-surface almost glabrous; from the description of *dubitans* it differs by the sides of the prothorax not being angular in the middle; by the table the third joint not "considerably longer than wide" should distinguish it from *consanguinea*.

Paralepidiota cavifrons, n. sp.

Pl. xxvi., fig. 50.

♂. Pale flavo-castaneous, elytra and antennae paler, tibial teeth blackish. Head, prothorax, and scutellum with snowy-white, rounded or elliptic, depressed scales, becoming thinner and more or less setiform on elytra, abdomen, and parts of legs; sterna and parts of legs with dense, whitish hair.

Head strongly convex, and with rather large and dense punctures, becoming smaller and sparser in middle of base. Clypeus bilobed, margins strongly elevated. Antennae ten-, flabellum seven-jointed, first joint of the latter about one-fifth shorter than the others. Apical joint of maxillary palpi wide, with a wide shallow median depression. *Prothorax* strongly convex, sides widely rounded and finely serrated, all angles obtuse; punctures sparser than on head, and much sparser about middle. *Elytra* slightly dilated to beyond the middle, apices obliquely truncated; punctures fairly dense and moderately large, becoming smaller and sparser in parts, discal costae lightly defined. *Pygidium* rather strongly margined, apex feebly bilobed; punctures rather numerous. Front *tibiae* strongly tridentate, hind tibiae with unequal spurs at apex, the larger one dilated to beyond the middle, and then narrowed to apex. Length, 20-21 mm.

Hab.—Queensland: Chillagoe (J. S. Clark). Type, I. 10783.

Smaller and duller than *lepidoptera* and with two more joints to the flabellum. The white scales are fairly dense, but nowhere overlapping on parts of the head and prothorax, and many of them do not arise above their containing punctures. There is a dense fringe of long pale hairs over the base of the scutellum. The sides of the clypeus are strongly but not suddenly elevated, leaving a flat portion a little more than one-third of the median width, and about two-thirds of the length, the flat part with larger but sparser punctures than on the sloping ones.

Lepidiota froggatti, Macl.

Pl. xxvi., fig. 51.

Large specimens of this species are larger (up to 42 mm.) than any other specimens I have seen of the allied genera, such specimens have the femora and tibiae entirely black, and the hind femora have the setiferous punctures nowhere dense, and there is a comparatively wide space (about the median third) from which they are quite absent. The whole of the upper-surface is densely covered with short depressed setae, and there is a fringe of long hairs at the apex of the prothorax. Some specimens from the Coen River are smaller (29-34 mm.), clothing of the upper-surface somewhat sparser (not altogether due to abrasion), hairs of the metasternum of a rusty red, and with the antennae, palpi, and legs (tibial teeth excepted), more or less reddish; the setiferous punctures of the hind femora are more numerous but not dense.

var. stradbrokensis, n. var.

Pl. xxvi., fig. 52.

A specimen from Stradbroke Island (taken by Mr. Hacker in October, 1911) in the Queensland Museum, probably represents a variety of the species; it is much smaller (26 mm.), no part (except the tibial teeth) is quite black, and the hind femora are densely covered with setiferous punctures, and their lower edge is finely serrated; the preapical callosities of the elytra are rather more pronounced; there is also no fringe of long hairs at the apex of the prothorax, and this is certainly not due to abrasion, as the clothing is in perfect order.

Systellopus ater, n. sp.

Pl. xxvi., fig. 53.

Black and shining. Under-surface and legs with black or blackish hairs.

Head convex and almost impunctate at base, flat and with crowded punctures elsewhere. Clypeus semicircular in front, with margins lightly upturned; hind suture conspicuous, outcurved in front, incurved at sides. Labrum on the same plane as clypeus and rather more strongly upcurved in front; with an irregular row of strong punctures in front. *Prothorax* strongly convex, sides strongly rounded, hind angles widely rounded off; along middle and across a fairly wide space near base impunctate, elsewhere with rather small but sharply-defined punctures, irregularly distributed and nowhere crowded. *Scutellum* semicircular, with rather numerous punctures. *Elytra* with shoulders, sides, and apex rounded; sutural stria distinct, with several feeble geminate striae; much of the surface finely wrinkled, and with small scattered punctures. *Pygidium* impunctate along middle, finely asperate elsewhere. *Legs* short and thick; front tibiae strongly bidentate, hind pair about as long as the apical width. Length, 25 mm.

Hab.—Australia (J. S. Clark). Type (unique), I. 10791.

The species has the robust build of many female Dynastides, to which subfamily at first glance it appears to belong; but the clypeus, labrum, tibiae, etc., are in exact agreement with *Systellopus obtusus;* from which it differs in its high polish and much greater size, characters which also distinguish it from the description of *validus*. Both antennae and five of the tarsi have been broken, but the species is so distinct that I have not hesitated to describe the type. It was sent by Mr. Clark as from Chillagoe in Queensland, but as he had an accident with a box and some labels were mixed, the locality may be doubtful, and the specimen may have really been taken in Western Australia.

Haplonycha marginipennis, n. sp.

Pl. xxvi., fig. 54.

Dark castaneous-brown with an opalescent gloss; head and parts of legs black. Head with fairly numerous long hairs between eyes, and very numerous on two basal joints of antennae, prothorax completely fringed with long hairs, narrowly on sides and base, widely in front; sterna densely clothed with dark hair, in parts almost sooty, pygidium sparsely clothed and with a thin marginal fringe; elytra with two fringes.

Head smooth at base, with crowded and coarse punctures elsewhere. Clypeus with sides strongly narrowed to the front, which is strongly upturned; front face with dense punctures. Antennae nine-, club three-jointed; fourth joint slightly longer than third and fifth. Penultimate joint of maxillary palpi distinctly longer than antepenultimate, and slightly longer than apical. *Prothorax* widely transverse, sides strongly rounded, front angles produced and acute, hind ones rounded off; punctures rather small and not very dense, but becoming denser in front and on parts of base. *Scutellum* punctate on basal half. *Elytra* slightly dilated to beyond the middle; discal costae fairly well defined and bounded by geminate rows of punctures, the interstices with punctures much as on prothorax; suture briefly mucronate. *Pygidium* with dense punctures at base, small and sparse elsewhere. Front *tibiae* strongly tridentate. Length, 22 mm.

Hab.—Western Australia: Eradu (J. S. Clark). Type (unique), I. 10787.

Commencing near the base of each elytron there is a dense even fringe projecting downwards; from the base itself there is another fringe, but of longer and sparser hairs or setae mostly projecting outwards. The basal joint of the hind tarsi is fully as long as the second, but from most directions it appears to be slightly shorter. It is much the build of *solida*, of Blackburn's Group 4, whose elytra have similar double fringes, but the prothorax is rather densely clothed in front, and at the base has the long hairs characteristic of Group 2; in the table of that group it would be associated with *latebricola*, from which, as from all others of the group, it may be distinguished by its clothing.

Haplonycha suavis, n. sp.

Pl. xxvi., fig. 56.

Flavous and brightly iridescent, head, some marginal parts, and teeth of front tibiae reddish. Sterna moderately densely clothed with whitish hair.

Head smooth at extreme base, but with crowded punctures elsewhere. Clypeus widely rounded and strongly upturned in front. Antennae nine-, club three-jointed; fourth joint the length of third and slightly shorter than fifth. Penultimate joint of maxillary palpi slightly shorter than the adjacent ones. *Prothorax* widely transverse, sides strongly rounded in middle, front angles produced and not very acute, hind ones obtuse, but not rounded off; punctures very minute. *Scutellum* impunctate at apex. *Elytra* slightly dilated posteriorly; with rather small and not very dense punctures, geminate rows and discal costae ill-defined; suture not mucronate. *Pygidium* with fairly numerous punctures, except at apex. Front *tibiae* strongly bidentate; two basal joints of hind tibiae subequal. Length, 17 mm.

Hab.—Western Australia: Geraldton (J. S. Clark). Type (unique), I. 10789.

The upper-surface at first appears to be glabrous, but on the pronotum there is some very short evenly-distributed pubescence (continued on to the base of the elytra), that is scarcely visible from above, but fairly distinct from the sides; the pygidium has somewhat larger (but still very short) pubescence, and a weak marginal fringe; the elytral fringe is long at the base but very short at the apex. The punctures on the head, although crowded, are nearly all sharply defined, they are just as dense in front of as behind the clypeal suture, but become sparser and smaller on the front of the clypeus; on the prothorax they are very indistinct, unless the surface is wet, but from some directions they appear like minute reddish dots. From the sides, in certain lights, the elytra appear to have faint vermiculate impressions, connecting two or more punctures, but sometimes traceable almost from base to apex; from most directions, however, they are invisible. There is a median remnant of a longitudinal carina on the pygidium. Between the second tooth and the base of the front tibia there is a feeble undulation, but it could not fairly be regarded as a tooth. As the penultimate joint of the palpi is slightly shorter than the antepenultimate, the species cannot be referred to Blackburn's Group 4, and failing that it can only be referred to Group 7; in the table of that group it would be associated with *testaceipennis*, from which, as from all others of the group, it is distinguished by the very fine pubescence of the pronotum; the punctures between the eyes are also very much denser and coarser than on that species. In general appearance it is like *neglecta*, or a very small specimen of *ruficeps* (of Group 1), *marginata* (of Group 3), and *griffithi* (of Group 5).

Haplonycha nigra, n. sp.

Pl. xxvi., fig. 55.

Black and shining, antennae (basal joint excepted), palpi and parts of tarsi more or less reddish. Upper-surface glabrous, except for a few hairs at sides of prothorax, and for a fringe of long hairs at sides of elytra; under-surface with long rusty-red hair, dense on sterna, sparser elsewhere.

Head smooth at base; with crowded punctures elsewhere but becoming sparser and sharply defined towards apex of clypeus. Clypeus with rather strongly elevated margins. Antennae nine-, club three-jointed; fourth joint slightly longer than the adjacent ones. Penultimate joint of maxillary palpi slightly longer than the antepenultimate, but distinctly shorter than the apical one. *Prothorax* widely transverse, sides strongly rounded, front angles strongly produced and acute, hind ones rounded off; with dense and fairly large sharply defined punctures, becoming crowded in places. *Elytra* slightly dilated to beyond the middle, suture not mucronate; punctures fairly large and dense, becoming crowded posteriorly, geminate rows and discal costae well defined. *Pygidium* with dense subasperate punctures, becoming crowded in corners, and sparse at apex. Front *tibiae* strongly tridentate; basal joint of hind tarsi longer than second . Length, 18·5 mm.

Hab.—Western Australia: Kuminin (E. F. du Boulay). Type (unique), I. 10793.

The punctures between the eyes are so crowded that part of the surface has a vermiculate appearance; the clypeus from behind appears to be truncated in front, but from directly above it is seen to be gently rounded. The penultimate joint of the palpi from some directions appears slightly longer, but from others no longer than the antepenultimate, hence, as the pronotum and pygidium are black, there need be no hesitation in referring this species to Blackburn's Group 8; from the species of that group he somewhat doubtfully identified as *gagatina*, Burm., it differs in being much larger, prothorax shining, with strong well-defined punctures, and the pygidium also with stronger punctures; from *funerea* it differs in the much coarser punctures of the entire upper-surface and pygidium, and the elytra without a conspicuous margining membrane; they have, however, an extremely short fringe projecting downwards that could be easily overlooked.

GLOSSOCHEILIFER BIDENTATUS, n. sp.

Pl. xxvi., figs. 57 and 58.

Reddish-castaneous; club of antennae and elytra flavous, suture base and margins of the latter darker. Upper-surface glabrous, except for a few long hairs in latteral gutters of prothorax; elytra with a short dense fringe of golden setae projecting downwards, and with a straggling fringe of long reddish hairs projecting outwards; sterna with dense whitish hair, rest of under-surface more sparsely clothed, the hairs darker, stiffer, and many arising from minute granules.

Head with fairly dense and not very large, but sharply defined punctures, coarser on basal half of clypeus than elsewhere. Clypeus gently rounded in front, margins moderately upturned. Labrum conspicuously produced and upturned in front. Antennae nine-, club three-jointed. Penultimate joint of maxillary palpi shorter than the adjacent ones. *Prothorax* strongly transverse, sides strongly rounded, front angles produced and acute, hind ones completely rounded off; punctures small and not very dense. *Elytra* slightly dilated to beyond the middle; punctures not very dense or large but sharply defined, geminate rows and discal costae feeble; suture not produced at apex. *Pygidium* strongly convex, punctures dense in places, not very large but more or less asperate. Front *tibiae* very strongly and acutely bidentate; basal joint of hind tarsi slightly shorter than second. Length 16-19 mm.

Hab.—Western Australia; Swan River and Geraldton (J. S. Clark). Type, I. 10790.

On the Swan River specimen, the larger of the two under examination, there are tufts on the front tarsal joints, probably indicating that it is a male; the shape of the labrum of the Geraldton specimen is not exactly the same as on the other, but it has the appearance as of being slightly malformed. At first glance the species appears to be quite an ordinary *Haplonycha*, like *testaceipennis*, *jungi*, *gracilis*, etc.; but with the produced labrum considered by Blackburn as sufficient to found the genus *Glossocheilifer;* its bidentate front tibiae readily distinguish it from *addendus* and *labialis;* in appearance it is fairly close to the former. Disregarding the labrum and associating it with *Haplonycha*, it would be referred to Group 6 or 7, probably the former.

Glossocheilifer addendus, Blackb.

Recorded by Blackburn as probably from Western Australia. Mr. J. S. Clark has taken specimens at Geraldton, and both of us from near the Swan River.

Stethaspis squamosus, n: sp.

Pl. xxvi., figs. 59 and 60.

Coppery-green or coppery-purple, elytra, antennae, palpi, and legs more or less reddish. Irregularly clothed with white scales; tip of pygidium and parts of under-surface and of legs with long white hairs.

Head rather wide, rather lightly convex, with not very numerous but sharply-defined punctures of moderate size. Clypeus with hind suture strongly triangularly produced backwards, middle strongly convex, margins moderately elevated, front truncate; punctures denser and larger than on rest of head. Antennae nine-, club four-jointed and rather small, second joint almost as long as three following combined, fifth acutely produced on one side. *Prothorax* apparently twice as wide as long, sides finely margined, subparallel on basal half, thence oblique to apex, base with a conspicuous median lobe, the hind angles almost rectangular, apex gently arcuate, the front angles subarcuate, with an obtuse impunctate median line on basal half, elsewhere with punctures slightly smaller and usually sparser than between eyes. *Elytra* gently dilated to beyond the middle, apex widely truncate; each with fourteen deep striae, containing rather small punctures; interstices regular, strongly convex and impunctate; a fine marginal membrane not extending to base. *Pygidium* and propygidium with small, dense, sublaminate punctures. *Mesosternum* with a strong process produced to front of front coxae, flat on lower-surface, arcuate above, and truncate at apex. *Legs* rather short, front tibiae strongly bidentate. Length, 14-16 mm.

Hab.—Queensland: Cairns district (F. P. Dodd, H. H. D. Griffith, and A. M. Lea). Type, I. 4840.

One specimen bears a note by the late Rev. T. Blackburn, "Not *Xylonychus*, probably female of gen. nov. very near *Colymbomorpha*," but as there appear to be only females of the species before me, I think it desirable to refer them to *Stethaspis* (=*Xylonychus*), from all the species of which they may be distinguished by the dense scales at the sides of the under-surface; the intercoxal process of the mesosternum is more produced than in *eucalypti*, being almost as in *Phyllocoerus purpurascens*. The elytra have a slight metallic gloss, but their margins are conspicuously metallic. The scales are wide, and conspicuously dense, white, and overlapping at the sides of the under-surface, and on the middle of the propygidium, they are almost as dense on the sides of the pronotum, but individually narrower; on the rest of the upper-surface they are sparser and subsetose in character; on the elytra they are confined to the striae, on the pygidium and the rest of the propygidium they are fairly dense; there are usually three long hairs on each side of the prothorax. On the type there are seven punctures on the scutellum, but on the other specimens they are more numerous.

In a recent letter Mr. G. J. Arrow remarked, "It seems to me quite unnecessary to make a new genus for *S. squamosus*; we have four specimens of it, from Kuranda; they include both sexes, but the antennae of the male scarcely differ from those of the female."

Colymbomorpha splendida, n. sp.

♂. Brilliant purplish-green with a coppery gloss; front of head, sides of prothorax, propygidium, pygidium, under-surface, and legs (hind tibiae and parts of tarsi excepted) flavous, with a coppery-green gloss. Upper-surface glabrous, under-surface almost so.

Head with sparse and small, but sharply-defined punctures. Clypeus about twice as wide as long, front truncated, disc rather strongly convex; punctures at apex and sides denser and stronger than between eyes. Labrum on the same plane as clypeus, narrow, apex gently incurved. Antennae nine-, flabellum six-jointed, the rami each about as long as the clypeus is wide. *Prothorax* not twice as wide as long, base much wider than apex, front angles produced and almost equilaterally triangular; hind ones strongly produced, sharply angular and slightly embracing shoulders, base strongly bisinuate; punctures sparse and minute, becoming larger, although still sparse, on sides. *Scutellum* highly polished and impunctate. *Elytra* each obliquely truncated at apex, outlines continuous with those of prothorax; with rather strong, regular striae, containing shallow punctures, but these becoming more distinct towards base; interstices impunctate. *Metasternum* and hind coxae with rather large sparse punctures; intercoxal process of mesosternum obtuse and vertical in front. Front *tibiae* tridentate, apical tooth acute and moderately long, second small but acute, third very feeble. Length (♂, ♀), 9-11 mm.

♀. Differs in being slightly wider, abdomen more convex, legs shorter, antennal rami much shorter, and the fourth joint without one, so that the flabellum consists of but five joints, and the hind tibiae not entirely dark.

Hab.—New South Wales: Dorrigo (W. Heron and H. J. Carter from R. J. Tillyard). Type, I. 4851.

Differs from *lineata* in colour, in the polished and glabrous surface (the only clothing consists of a few stiff bristles on parts of the under-surface and legs) in the clypeus, etc.; the intercoxal process of the mesosternum is strong and well produced, but its front face is thick and rounded off; in *lineata* it is produced to an almost knife-like edge between the front coxae. In *Phyllococerus purpurascens*, which Blackburn considered[8] should be referred to *Colymbomorpha*, the intercoxal process is not produced with a knife-like edge between the front coxae, but as a truncated process above them. In *C. lineata* the front of the clypeus is evenly rounded and conspicuously upturned, so that, when viewed from behind, the labrum is almost concealed, but on the present species it appears to be attached to the clypeus as in the Systellopides. By the characters noted by Blackburn,[9] in dividing the Melolonthides into subtribes, this species would be referred to the Systellopides, in this agreeing with *Phyllotocus*, although both genera differ in many particulars from the members of that anomalous group.

SERICESTHIS SUTURALIS, Macl., formerly SCITALA.

Scitala pruinosella, Brenske.

Blackburn (who also associated it with *pruinosella)* has commented upon the bad condition of the type of *suturalis* (it

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(8) Trans. Roy. Soc. S. Austr., 1911, p. 175.

(9) *L.c.*, 1905, p. 276.

has lost five of its tarsi, both antennae, and all the palpi); but there is a specimen of the species in the South Australian Museum from Mackay, it has nine-jointed antennae, but the fifth and sixth joints are so thin and closely applied to the three-jointed club that it is difficult to see them clearly, the rami of the club are about the combined length of the two apical joints of the palpi, the basal joint of the hind tarsi is not much, but distinctly, longer than the second.

Phyllotocus ruficollis, Macl.

P. sericeus, Macl.

There are three specimens in the Australian Museum standing as types of *sericeus*, and all are of the species tabled by Blackburn (10) as *ruficollis*, although he was dubious as to his identification of that species; the type of *ruficollis* was badly stained, but was partially cleaned for description. It is certainly not the species Blackburn identified and tabled as *australis*, (11) and which he thought might be *sericeus*.

Phyllotocus variicollis, Macl.

Correctly identified and tabled by Blackburn. (12)

Phyllotocus bimaculatus, Er.

On the typical form of this species each elytron has a pale, completely-enclosed spot of variable size, on the basal half; on Tasmanian specimens the spots are usually smaller than on mainland ones.

var. nigripennis, n. var.

Mr. H. J. Carter and I recently obtained at Strahan (Tasmania) numerous specimens that differ from the typical form in having the elytra entirely black; the paler parts are also of a brighter red.

var. basalis, n. var.

Mr. Aug. Simson obtained at Wentworth Falls (New South Wales), in company with typical specimens, numerous others in which two-fifths of the base of the elytra are pale, the dark part is usually, but not always, advanced along the suture to the base.

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(10) Trans. Roy. Soc. S. Austr., 1898, p. 24.

(11) *L.c.*, p. 23.

(12) *L.c.*, pp. 23 and 24.

var. INSULARIS, n. var.

Mr. H. Hacker obtained on Bribie Island (Queensland) three specimens that are more highly polished than usual, they have only the apical two-fifths of the elytra infuscated (and not very deeply so) and a slight infuscation about the scutellum; they are also smaller (5·5-6 mm.) than the typical form.

PHYLLOTOCUS MACLEAYI, Fisch.

This species occurs in abundance on eucalyptus and other blossoms in New South Wales, Victoria, and Tasmania.

var. ASSIMILIS, Macl.

This was considered by Blackburn as a variety only of *macleayi*, and such is my own opinion.

var. PALLIDUS, n. var.

Six specimens taken between Karoonda and Peebinga (by Mr. G. E. H. Wright), one from Murray Bridge (by Mr. H. H. D. Griffith), and one from Lyndoch (by Mr. J. G. O. Tepper), differ from the typical form in being entirely pale.

PHYLLOTOCUS LURIDUS, Macl. (formerly CHEIRAGRA).

As the claws to the four hind legs of this species are long, thin, and simple the species by Blackburn's generic table of the Sericides must be referred to *Phyllotocus*. Although Macleay said "The male and female differ very little," both specimens (presumably the types) standing under the name in the Macleay Museum are males, each having three long antennal rami. The species occurs in Queensland (Mapleton and Blackall Range) as well as in New South Wales, and all those before me are more or less brightly iridescent, the elytra are flavous with the suture, and a variable amount on each side infuscated or black, each of the hind femora has a wide tooth or subtriangular flange at the middle.

PHYLLOTOCUS OCCIDENTALIS, Blackb.

This species occurs in South Australia (Karoonda to Peebinga) as well as in Western Australia; in commenting upon the types Blackburn remarked that the apices of the elytra were "almost devoid of fuscous shading"; some of the specimens in the museum are entirely devoid of it; such specimens may be readily distinguished from the variety *pallidus*, of *macleayi*, by the completely rounded off hind angles of the prothorax, and by the bidentate, instead of tridentate, front tibiae.

var. APICIFUSCUS, n. var.

Two specimens from Karoonda to Peebinga (G. E. H. Wright), and one from Mindarie (South Australia), have the apical fourth of the elytra deeply infuscated (almost black), they may be readily distinguished from the typical form of *macleayi* by the basal angles of prothorax and by the front tibiae.

PHYLLOTOCUS, sp.

An entirely pale specimen (from Edithburgh in the Blackburn collection) combines characters of two species, as the hind angles of the prothorax are rectangular as in *macleayi*, and the front tibiae bidentate as in *occidentalis*.

PHYLLOTOCUS MARGINATUS, Macl.

Specimens of this species taken on Stradbroke Island (Queensland) by Mr. Hacker are smaller (5 mm.), than usual, with part of the apex of the elytra black, and the pale marking on the sides of the prothorax of the female smaller than usual.

PHYLLOTOCUS AUSTRALIS, Boi.

Specimens of this species taken on Stradbroke Island by Mr. H. Hacker, and at Cairns by Mr. F. P. Dodd, are smaller (5·75 mm.) than usual, and with the pronotum, scutellum, and elytra (except for a slight infuscation of the latero-apical margins of the latter) entirely pale.

PHYLLOTOCUS USTULATUS, Blanch.

The prothorax of this common Western Australian species varies from entirely black (as on the type) to entirely reddish; several specimens before me have the prothorax reddish, with three infuscated spots: a moderately long median one and a small one towards each side.

PHYLLOTOCUS NAVICULARIS, Blanch.

In his table of the species of this genus Blackburn placed *navicularis* in the first section "A. Elytra glabrous (or nearly so) except along their lateral margin." But on many specimens before me the hairs are quite as numerous about the suture and base as on specimens of species he referred to "AA. Elytra clothed with hairs (at any rate along the suture and base)."

The typical form has the head, prothorax, and a large spot on each elytron black, the spots frequently have a greenish or bluish iridescence, on the sides they occupy about half the length; along the suture they are conjoined for about half their own length, being divided in front by a sutural extension of the reddish basal portion. The species is common in parts of Queensland and of northern New South Wales; in addition to the varieties noted below there are others in the Museum.

var. RUFIBASIS, n. var.

Four specimens from Cape York (H. Elgner), differ from the typical form in having only about one-fourth of the elytra reddish, the black being widely subtriangularly advanced in front, so that it almost extends to the scutellum.

var. ERYTHRODERES, n. var.

Three specimens from the Coen River (W. D. Dodd), differ in having the prothorax entirely reddish; on two of them the apical half of the elytra is dark, but the suture is pale for portion of the distance; on the third specimen the spots are as on the typical form.

var. APICALIS, Macl.

Three specimens from the Coen and Stewart Rivers (W. D. Dodd), and Cairns (E. Allen), differ in having the prothorax and four basal segments of abdomen reddish, but elytra with the apical markings typical; this form appears to be the one described from Port Denison by Macleay as *apicalis*. Three other specimens from Cape York (H. Elgner) agree with these, except that the black portion is advanced to cover slightly more than half of the elytra.

PHYLLOTOCUS LATEROFUSCUS, n. sp.

Flavous; an infuscate vitta occupying about one-third the length of each elytron near the side, abdomen slightly darker than metasternum. Glabrous except for a few stiff setae on sides of prothorax and of elytra, and on the legs.

Head flattened, and with scarcely visible punctures. Clypeus not distinctly separated from labrum in middle, their combined length about two-thirds of the basal width. Antennae nine-, club three-jointed, the lamellae rather short. *Prothorax* about once and one-half as wide as long, sides rather strongly rounded, front angles produced and acute, hind ones rounded off; punctures fairly dense, but small and inconspicuous. *Elytra* with rows of fairly large punctures in conspicuous striae, interstices gently convex, and of almost even widths, except that they become narrower towards the sides. Hind *coxae* at sides much longer than metasternum; front tibiae bidentate; front claws uneven, the larger one moderately thick, but not appendiculate. Length, 5·5 mm.

Hab.—Queensland: Endeavour River (Dr. A. R. Pulleine, and National Museum from C. French). Type, I. 10775.

In Blackburn's table of the genus this species would be placed beside *occidentalis*, from which it differs in the elytra being more strongly striated, with larger punctures in the striae, and by the dark lateral markings; it is not very close to any other species before me. The elytral vittae are rather narrow, and are quite distinct, but their outlines are not sharply defined. The clypeus in front is slightly upturned on each side, but not in the middle, the uplifted parts being almost concealed by the rather strongly elevated labrum, which appears to be pressed close to them. The upper-surface is only slightly polished, but it could hardly be called opaque. The abdomen is small and curved to the tip, so the specimens are probably males, despite the non-appendiculate front tarsi.

PHYLLOTOCUS BASICOLLIS, n. sp.

♀. Head and metasternum reddish-brown, prothorax and scutellum reddish-flavous, elytra black and brightly iridescent, but margins (except at base) pale, abdomen and club of antennae black, legs flavous, the hind tibiae infuscated at apex. Front and sides of prothorax, sides and apex of elytra and pygidium with flavous or reddish setae.

Head with small and crowded but distinct punctures. Clypeus not quite the length of an eye, and more than thrice as wide as long; labrum slightly more than half the length of clypeus, its margins lightly upcurved and the front one gently incurved to middle. Antennae nine-, club three-jointed. *Prothorax* not much wider than the greatest length, basal half parallel-sided, front and hind angles produced and acute, the latter embracing shoulders; without punctures except for those containing the margining setae. *Elytra* with well-defined striae containing shallow punctures; interstices gently convex, moderately wide near suture, narrower towards the sides. *Abdomen* strongly convex, each of four segments with a conspicuous row of setiferous punctures. Hind *coxae* at sides almost twice the length of metasternum, and with sharply-defined but not very dense punctures; front tibiae tridentate; front claws equal and simple. Length, 5-5·5 mm.

Hab.—Queensland: Brisbane, November, 1912, and November, 1916 (H. Hacker). Type, in Queensland Museum; cotype, I. 10777, in South Australian Museum.

The hind angles of the prothorax embracing the shoulders are without parallel in the genus; the claws are all thin, simple, and long, but not of the great length that is usual in *Phyllotocus*, and in other respects it is not close to any other before me. The comparatively large, evenly-convex abdomen, with simple front claws, are indicative that the specimens taken by Mr. Hacker are females; one of them has beautiful golden depressed pubescence margining the base of the prothorax, of the elytra and scutellum, and forming a patch on each side of the pygidium; it is absent from the other, probably due to abrasion. The elytral striae are almost absent posteriorly and about the shoulders.

PHYLLOTOCUS DECIPIENS, n. sp.

♂. Black; elytra with two conspicuous flavous vittae. Sides of prothorax and of elytra fringed with dark setae.

Head gently convex and with small punctures between eyes. Clypeus about thrice as wide as the median length; punctures denser and coarser than between eyes, sides moderately elevated, front not elevated in middle; labrum short, distinctly separated from clypeus, moderately upturned in front. Antennae eight-, club three-jointed. *Prothorax* scarcely one-fourth wider than long, sides gently rounded, front angles produced and acute, the hind ones almost rectangular; punctures as between eyes. *Elytra* with well-defined but not even striae, mostly containing distinct but not very large punctures; interstices gently convex, narrower towards sides than towards suture, with small but fairly distinct punctures. Hind *coxae* at sides scarcely one-fourth longer than metasternum; front tibiae tridentate; front claws unequal. Length (♂, ♀), 5-6·5 mm.

♀. Differs in having the club of the antennae somewhat smaller, abdomen larger, legs shorter, and front claws even.

Hab.—Victoria: Melbourne, eating grass, in October, 1911 (C. French, sen.), Oakleigh (C. French, jun.); South Australia: (F. Secker); Tasmania (Simson's collection). Type, I. 10839.

In general appearance strikingly like *meyricki*, from Western Australia, with which I had it confused, but the front part of the head is very different; on that species the clypeus and labrum are soldered together without a conspicuous suture, the front strongly upcurved, and a wide and feebly-punctate elevation occupying most of the base; on the present species the suture between the clypeus and labrum is well defined, the labrum is shorter, wider, and less elevated in front, and the subtubercular elevation of the clypeus is lower (although quite as wide) and with more conspicuous punctures. In Blackburn's table of the genus it would also be distinguished from *meyricki* by the tridentate, instead of bidentate, front tibiae; in that table it would be associated with *macleayi*, which is a larger and very differently-coloured species with head and legs different. The dark part of the elytral suture is wide and almost parallel-sided, but from each side the dark part is absent, or almost so, at the shoulder, and gradually dilates till near the apex it curves round to join in with the sutural part; the claws and parts of the tibiae, sometimes also other parts of the legs, are more or less reddish. Parts of the upper-surface and of the sterna have a pruinose bloom. From above the basal angles of the prothorax appear to be quite right angles, but from the sides they are seen to be slightly obtuse; most of the specimens have a vague median line. The front claws of the male are of even length, but the larger one increases much in thickness to the base, although it is not appendiculate.

PHYLLOTOCUS CRIBRICEPS, n. sp.

♂. Black, elytra usually with some parts paler, and with a bright bluish iridescence; front legs mostly flavous, parts of the other legs obscurely diluted with red. Prothorax and elytra fringed with long and mostly pale setae, a few on head and many on under-surface and legs.

Head with dense, sharply defined, and rather small punctures. Clypeus obliquely flattened, sides slightly elevated; punctures as between eyes; hind suture distinct only at sides, the front one throughout; labrum short, sharply defined, rounded and gently elevated in front. Antennae eight-, club three-jointed. *Prothorax* about once and one-half as wide as long, sides evenly rounded, apex evenly incurved with the front angles acute but scarcely separately produced, hind ones rounded off; punctures sharply defined, about as large as on head but not so dense. *Elytra* with strong striae containing rather large punctures, except posteriorly; interstices rather strongly convex, narrower towards sides than suture. Hind *coxae* at sides scarcely longer than metasternum, and both with distinct punctures; all femora stout, the hind ones especially so; hind tibiae shorter and stouter than usual, the front ones tridentate; front claws unequal, the larger one scarcely longer than the other, but more strongly curved, and with a large basal appendix. Length, 4·5-5 mm.

Hab.—Queensland: Mapleton, in October. Type, in Queensland Museum; cotype, I. 10837, in South Australian Museum.

As the antennal lamellae are long, the abdomen curved to its tip, and the front claws unequal, on each of the eight specimens from Mapleton, they are evidently all males. In general appearance the species is close to *luridus*, but is smaller, narrower, hind femora unarmed, and a smaller amount of elytra pale. The basal half of the elytra (except the suture and margins) is more or less obscurely flavous or reddish, but the markings, although usually distinct to the naked eye, are not sharply defined; one specimen has the elytra, except for their brilliant iridescence, entirely black. The front of the head seems slightly concave, owing to the obliquely flattened clypeus, with its edges and the front of the labrum elevated: the cephalic punctures, although small, are decidedly larger than usual in the genus. Each of the antennal lamellae is almost as long as the five basal joints combined, the fifth joint is very short, and can scarcely be seen except under a compound power.

Phyllotocus antennalis, n. sp.

♂. Flavo-testaceous, some parts more or less deeply infuscated. Prothorax and elytra fringed with white or brownish hairs; similar hairs on under-surface and legs.

Head with dense and sharply-defined, but not large punctures. Clypeus about four times as wide as long, sutures well defined, punctures as between eyes; labrum about half the length of clypeus, apex gently curved and moderately uplifted. Antennae nine-, club five-jointed, each lamella as long as the four basal joints combined. *Prothorax* about once and two-thirds as wide as long, sides moderately rounded, front rather strongly incurved to middle, front angles acute, the hind ones rounded off; punctures not very dense, and small but sharply defined. *Elytra* comparatively short; striae strong and containing well-defined punctures, interstices gently convex and with minute punctures. Sides of hind *coxae* slightly longer than metasternum; hind femora stout and edentate; front tibiae acutely tridentate; front claws unequal, the larger one with a large isosceles-triangle-like basal appendix. Length, 5-5·25 mm.

Hab.—New South Wales: Dorrigo (W. Heron). Type, I. 4279.

The three specimens taken by Mr. Heron are males, and as the middle claws are without long quill-like appendages, the species cannot be referred to *Phyllotocidium*, to which at first it appears to belong. The front of the head is much as in a female cotype of *Phyllotocidium macleayi* and so much more abrupt than in *Phyllotocus;* the antennal club composed of five joints is also greatly aberrant, but Blackburn has frequently commented on the fact that the number of joints composing the antennae or the club in Australian Melolonthides, cannot be relied upon generically; the third joint of the antennae is of considerable length, but the fourth is so small and closely applied to the club that it cannot be distinguished from most directions. Seen from behind the greater portion of the head appears gently concave, owing to the flattening of the middle parts and the slight elevation of the sides of clypeus and front of labrum. The elytral striae and punctures are confused about the tips, but regular elsewhere. The three are (except for slight variations) similarly coloured, so presumably are not immature; the head is more deeply infuscated than other parts, some of its margins being blackish, the antennal club is also blackish; the scutellum, suture, and sides of elytra, parts of sterna (sometimes the whole under-surface), and parts of legs are more or less deeply infuscated, and there are two large but vague discal blotches on the prothorax.

Cheirrhamphica.

Blackburn proposed this genus for species possessing the enormous front claws of the males of *Cheiragra*, but with the others long and simple; in his table it was distinguished by "basal four joints of front tarsi together shorter than apical process of tibia," but this holds good only for the male; in the female the joints of the front tarsi are longer and much thinner, the fourth conspicuously passes the tibiae, and the fifth is smaller with uniform claws.

Cheirrhamphica pubescens, Blackb.

The common form of the male was the one described by Blackburn, but the female is usually larger, and varies from a form having the upper-surface entirely dark to one in which it is entirely pale. The front tibial teeth are two in number, acute and fairly long, characters sufficient to distinguish the species from all the known Queensland members of the genus. It may be taken in abundance, from flowering wattles, from Geraldton to Beverley in Western Australia.

Cheirrhamphica insularis, n. sp.

Black; front femora and tibiae, and antennae, except club, flavous. Upper-surface with numerous more or less upright pale hairs or setae, parts of under-surface and of legs with somewhat longer ones.

Head smooth and with minute punctures about base, and crowded, with some larger ones between eyes. Clypeus semicircular, with crowded punctures, its sides gently upturned; labrum appearing as an upturned front margin to the clypeus. Antennae eight-, club three-jointed, lamellae scarcely longer than apical joint of palpi. *Prothorax* scarcely one-fourth wider than its greatest length, sides evenly rounded, front angles produced and acute, the hind ones gently rounded off; punctures fairly dense and sharply defined. *Scutellum* with a few basal punctures. *Elytra* rather narrow, basal half about the width of prothorax, thence strongly narrowed to apex, where each is almost pointed; with rows of rather large, asperate punctures, in shallow striae; odd interstices very feebly, in places not at all, elevated above the even ones. *Abdomen* small, curved to tip. Sides of hind *coxae* much longer than metasternum; hind femora and tibiae stout; front tibiae unidentate; front claws unequal, the others very long and thin. Length, 5-5·5 mm.

Hab.—Queensland: Stradbroke Island (H. Hacker and Dr. A. J. Turner). Type, I. 10776.

The specimens from the island are evidently of one sex, and are probably males, as the front tarsi are moderately thick (thinner than in males of *pubescens*, *coxalis*, and *tuberculata)* and passing the tips of the tibiae, but decidedly thicker than in the females of *pubescens* and *tuberculata*, and the front claws are decidedly uneven, one being quite small, and the other much larger, although much smaller than in known males of the genus, its abdomen also curves to the point as in undoubted males. If they are males the specimens before me are certainly distinct from *interstitialis*, described as from Northern Queensland; I examined the type of that species prior to its being sent to the British Museum, and noted that it was a peculiar-looking insect with somewhat similar colour and clothing to the present one, but opaque, the prothoracic punctures less conspicuous, and the head longer, with much smaller punctures; the specimens differ from the description also in having the elytra rugose, and without four obsolete costae, so that even if females they are unlikely to belong to that sex of *interstitialis*. The upper-surface is shining, but that is not always a feminine character in the allied genera. On two specimens the middle tibiae and parts of the hind legs are partly pale, but obscurely so. The tooth of each front tibia, including the curve at its commencing point, is fully half the length of the tibia itself; the claws of the middle tarsi are slightly uneven and one is slightly less curved than the other. The larger punctures between the eyes are about as large as the ones on the prothorax. On some of the specimens the clothing on the upper-surface is almost upright, on others it slopes at about 45°, the difference being probably due to treatment after capture.

Cheirrhamphica coxalis, n. sp.

♂. Flavous, some parts deeply infuscated or black. Upper-surface more or less opaque and with a pruinose gloss, more pronounced on the elytra than elsewhere. Clothing much as on preceding species, except that on the disk of the elytra it is somewhat shorter.

Head with very small punctures at base, dense and of moderate size between eyes. Clypeus semicircular, front margin gently upturned throughout, punctures as between eyes; labrum closely applied to clypeus. *Prothorax* moderately transverse, sides evenly rounded, front angles produced and acute, the hind ones moderately rounded off; punctures fairly numerous. *Elytra* with outlines and punctures much as on preceding species, except that the punctures are somewhat smaller. *Abdomen* small, curved to its tip. Hind *coxae* very large, their sides fully twice the length of the metasternum; hind femora and tibiae stout; front tibiae unidentate; front tarsi stout, fourth joint not passing tibiae, claw joint stout, claws very unequal, other claws very long and thin. Length, 5-5·25 mm.

Hab.—Queensland: Cairns (E. Allen). Type, I. 4290.

Distinguished from the preceding species by the less rugose elytra and absence of larger inter-ocular punctures, in addition to the very different colour and claws; the five specimens taken by Mr. Allen are all males, they differ from the description of *interstitialis* in colour and by the sculpture of the prothorax and elytra. The hind coxae seem to project almost as the drums of many species of cicadas; the longer claw of the front tarsus is almost as long as those of the others, but is irregularly widened towards its base, the smaller claw is scarcely half its length, and is much thinner, the middle claws although both long and thin are unequal, one being distinctly shorter, thinner, and less curved than the other. The elytra are black, or almost so, except for a transverse space on each side of the base, each space sometimes continued for a short distance near the suture, the hind tibiae are deeply and the hind tarsi and the head slightly infuscated; the abdomen is usually darker than the metasternum; the antennae are entirely pale. On one specimen the scutellum is rather dark, and there are two large smoky blotches on the prothorax. Four of the specimens have the prothorax and elytra entirely opaque, but the fifth is shining, evidently owing to abrasion, as many of its hairs are missing, its punctures in consequence are much more distinct, especially on the prothorax.

CHEIRRHAMPHICA TUBERCULATA, n. sp.

♂. Flavous, parts of legs tinged with red, sides of elytra partly infuscated. Clothed with numerous conspicuous pale upright setae, longer on sides of prothorax and elytra than on their disks, legs and parts of under-surface with moderately long hairs.

Head with fairly dense and small punctures, but interspersed with some fairly large ones between the eyes.

Clypeus semicircular, sides moderately uplifted; punctures, except that there are no large ones, as between the eyes; labrum, except at sides, not distinctly separated from clypeus, and apparently forming its uplifted front edge. Antennae eight-, club three-jointed. *Prothorax* moderately transverse, sides evenly rounded, front angles produced and acute, the hind ones rounded off; punctures fairly numerous. *Elytra* scarcely wider than head, parallel-sided to beyond the middle and then strongly narrowed to apex, with fairly distinct punctures in shallow striae. *Abdomen* small, curved to its tip. Hind *coxae* at sides much longer than metasternum; hind femora and tibiae stout; front tibiae short, stout, and unidentate, front tarsi thick, the fourth joint not passing the tibia, claw joint stout with very uneven claws; middle and hind claws long and thin. Length (♂, ♀), 5-5·25 mm.

♀. Differs in having the prothorax more narrowed in front, and with more distinct punctures, elytra less parallel-sided, with more distinct striae and punctures, and a conspicuous elongated tubercle on the middle of each side, abdomen larger and evenly convex along middle, legs somewhat shorter, front tarsi much thinner, fourth joint passing the tibia, and the claw joint thin with small equal claws.

Hab.—Queensland: Endeavour River (C. French). Type, in National Museum; cotype, I. 10838, in South Australian Museum.

A narrow pale species with peculiar tubercles on the elytra of the female; each tubercle is elongated, about one-fifth the length of the elytron, and whilst scarcely elevated above the general convexity of the surface, is rendered very distinct by the cutting away, as it were, of the adjacent parts. On the female the prothorax is shining and its punctures are rather large and very distinct, with numerous minute ones interspersed; on the male the surface is opaque, and the larger punctures are partly obscured, the minute ones disappearing. The infuscation of the sides of the elytra is rather narrow and varies in intensity, being more pronounced on the males than on the females. On the front tarsi of the male the three median joints are all much wider than long, the larger claw is quite as large as its supporting joint, and is considerably dilated to the base, the smaller claw is less than half its length and very thin; the claws on the middle legs are both long and thin, but one is distinctly longer and thicker than the other, on the hind legs the claws are almost even.

Cheiragra.

This genus was proposed by Macleay to receive a number of small species allied to *Phyllotocus*, but with a membranous appendage to each claw, the front claws of uneven size, and the larger one enormously developed. To it he referred *Phyllotocus pusillus*, Blanch., and six species which he supposed to be new—*ruficollis*, *pallida*, *aphodioides*, *atra*, *pygmaea*, and *lurida*, but the last-named species it is necessary to transfer to *Phyllotocus*. Subsequently he described another species, *vittatus*, referring it, however, to *Phyllotocus*. Blackburn also referred a new species, *macleayi*, to the genus, but subsequently made it the type of a new one, *Phyllotocidium*.

With long series of most species before me it seems probable that *all* the species of the genus are very variable in colour, and that perfect males have the prothorax and elytra sericeous, but that those parts are shining in the females. The females of several species may be readily distinguished *inter se* by the latero-posterior margins of the elytra being notched or flanged. By the courtesy of Mr. Shewan I have been able to examine all the specimens of the genus in the Macleay Museum.

CHEIRAGRA PUSILLA, Blanch. (not Macl.).

C. pygmaea, Macl., ♂.

C. aphodioides, Macl., ♀.

From examination of the named specimens in the Macleay Museum I am satisfied that Macleay wrongly identified *pusilla* (which presumably he regarded as the type of the genus), and that the species he named *pygmaea* is the real *pusilla*. The type was certainly a male, as its prothorax was described as "*nigro, opaco, haud punctato*" (punctures are present but could be easily overlooked).

Two specimens were labelled with a query as *pusilla*, these are 4 mm. in length, and have the prothorax entirely pale, they belong to forms 2 and 3 of *ruficollis;* three others were labelled without a query as *pusilla*, and are still larger, two are males and have the prothorax darker than the smaller ones, they belong to forms 2 and 4 of *ruficollis;* the other is a badly-damaged female close to form 7 of *ruficollis*.

Four specimens standing under the name of *aphodioides* in the Macleay Museum are all females of the real *pusilla*, not one of them has the elytra black, or even much darker than any of the others, the colour being of the same shade as the base of the prothorax; they all have conspicuous punctures on the prothorax, and the front claws not enormously developed.

The species is the smallest of the genus; in the common form of the male the head and prothorax are black and the elytra pale, but with the sides widely infuscated or black (the infuscation occasionally extends over most of the surface); in the common form of the female (including the types of *aphodioides)* the head and prothorax are infuscated, but the base of the latter is pale, the elytra are also entirely pale. The sides of the elytra of the female are not notched or flanged, and by this feature alone it may be readily distinguished from small females of *ruficollis* and *sericeipennis.*

Cheiragra ruficollis, Macl.

C. pusilla, Macl., in error.

C. pallida, Macl., ♀.

Pl. xxv., fig. 23.

The original description of this species (which appears to be confined to New South Wales and Victoria) is unsatisfactory, and of the specimens standing as *ruficollis* in the Macleay Museum, not one agrees exactly with it; of the five specimens so standing two are males and three are females. One of each sex has the elytra entirely dark (whereas the description implies that the whole upper-surface is testaceous) and the head and prothorax of a rather bright reddish-flavous; to the male I have attached a label that it is probably the type; the second male has the head and prothorax of an obscure reddish-brown, the elytra testaceous with the suture darker (much the colour of the prothorax), and the sides widely margined with black; of the other females one has the prothorax as dark as in the second male, but with all its margins and a narrow line down the middle paler, it has also an obscure pale vitta extending from the base to about the middle of each elytron; the third female has a wider and longer vitta passing the middle of each elytron, and agreeing with "The female . . . sometimes a light patch on the disc of each elytron." These specimens vary from $1\frac{1}{2}$ to 2 lines in the males, and from $2\frac{1}{4}$ to $2\frac{1}{2}$ in the females, but were described as 2 lines.

The species is the most variable of the genus, but the females may be at once distinguished by the sides of the elytra, as near the apex of each there is a conspicuous notch (pl. xxv., fig. 23); the female, as in others of the genus, also differs from the male in having the prothorax shining and with conspicuous punctures.

The specimens described by Macleay as *pusilla* belong to this species, whilst the types of *pallida* (Macleay) also belong to it. The following colour forms may be noted:—

Males.

Form 1. Head and prothorax of a clear reddish-flavous, entire elytra and parts of under-surface and of legs blackish, or at least blackish-brown. The typical and fairly common form.

Form 2. As 1, except that the elytra are coloured as the prothorax, but with the sides more or less widely infuscated or black (a specimen of this species is standing, with others, as *pusilla* in the Macleay Museum, and another is the type male of *pallida*). This is the most common form of the male; on some specimens the head is darker than the prothorax; the latter may have some slight infuscations, or be even darker than the elytra, and the elytral suture is also sometimes slightly infuscated (thus approaching Form 3).

Form 3. As 1, but with a pale oblique fascia on each elytron. A fairly common form, but the vittae vary in extent, and the head and prothorax are sometimes as dark as in Form 4.

Form 4. Coloured as described for the second male of the original specimens, one of which was identified by Macleay as *pusilla*. A rare form.

Form 5. As 1, but with two infuscated blotches on the prothorax; the head is also sometimes infuscated. A rather rare form.

Females.

Form 6. As 1, except that the abdomen is paler than the metasternum. A rather rare form, one of which is a cotype of the species.

Form 7. As 6, except that the elytra are bivittate. A cotype female belongs to this form, which is variable and not very common; the other cotype female might also be regarded as belonging to it; one of the females identified by Macleay as *pusilla* could also be referred to it, although its head and prothorax are dark, but not black.

Form 8. Entirely pale, except that the tips of some of the tarsal joints and the club of the antennae are more or less infuscated. This is the most common form of the female, and includes the type female of *pallida*. A rather dark specimen of it was in error labelled as *aphodioides* in the Blackburn collection.

There is also a female from the Blackburn collection that has the elytra pale, but with the margins infuscated: narrowly at the base, rather widely at the apex; much as on Form 2; but as there is but one specimen before me it has not been given a number.

CHEIRAGRA ATRA, Macl.

In describing this species Macleay said he had only seen a male of it; but two specimens were pinned through the name label in the Macleay Museum; the type male, and a female, the latter in error, as it is an unusually dark specimen of *pusilla*. Two other males before me agree with the type; one is from Sydney, the other, from the Blackburn collection, is without locality, but labelled "*atra*." They all have the prothorax with a somewhat sericeous appearance, but also with sharply-defined punctures; the elytra also have sharply-defined punctures, and by the punctures alone the species may be distinguished from black males of other species. The female is at present unknown.

Cheiragra vittata, Macl. (formerly Phyllotocus).

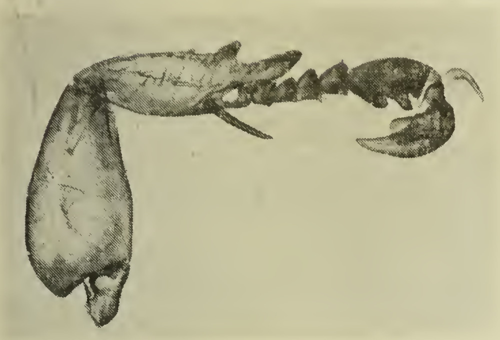
This species, as yet known only from the Cairns district, was referred by Macleay to *Phyllotocus*, but the generic table by Blackburn indicates that it belongs to *Cheiragra*, as although the front claws of the male are less enormously developed than is usual in the genus, the four hind ones are much shorter than is usual in *Phyllotocus*, and each has a conspicuous membranous appendage. The sharply-defined pale vitta on each elytron of the male usually passes the middle, and occasionally includes the preapical callus, but it is sometimes much shorter; one specimen has the elytra entirely black. The female differs from the male in being rather more robust, the whole of the upper-surface shining, and the front claws no larger than the others, but the elytral margins are of the same shape. Of the six females before me one has the upper-surface entirely dark, the second is almost as dark but has the prothorax obscurely diluted with red near the base, and the bases of the elytral vittae obscurely indicated; the third has more of the base of the prothorax pale, and the elytral vittae larger and almost conjoined to form a triangle (the scutellum at the middle of its base being dark); the fourth and fifth each have the prothorax of a rather bright red, except for an apical and two small lateral infuscations; the elytra have the apical third (more at the sides) infuscated, the basal parts and the scutellum being of the same shade of red as the prothorax; the sixth specimen is in the National Museum and has the upper-surface entirely red. Lengths: ♂, 4-6·5 mm.; ♀, 5·5-7 mm.

Cheiragra variabilis, n. sp.

Pl. xxv., figs. 24 and 25.

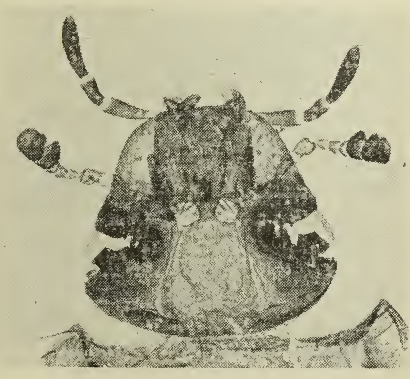
♂. Colours variable. Prothorax, elytra, sterna, and abdomen opaque, owing to a conspicuous sericeous or pruinose bloom. Prothorax and elytra with a thin fringe of pale hairs or long setae, similar hairs on under-surface and legs.

Head shining; with fairly dense and sharply-defined punctures. Clypeus with slightly coarser punctures than between the eyes, hind suture moderately distinct, not distinctly separated from labrum, sides and apex slightly elevated. Antennae eight-, club three-jointed, lamellae small. *Prothorax* not much wider than the greatest length, sides evenly rounded, front angles produced and acute, hind ones somewhat rounded off; punctures vaguely defined. *Elytra* rather strongly separately rounded at apex, sides gently rounded; striae and their contained punctures obscured by bloom; odd interstices slightly raised above and wider than the even ones. *Abdomen* small and curved to apex. Sides of hind *coxae* about one-third shorter than metasternum; tibiae stout, the front ones each with two large acute teeth and a very small one; front tarsi with four basal joints rather wide, the claw joint strongly notched near apex, and with very unequal claws, the larger one very large, strongly curved, and with a large basal appendix, the smaller one slightly larger than those on the other tarsi, and with its basal appendage similar but without a quill. Length (♂, ♀), 3·75-4·5 mm.



Cheiragra variabilis, Lea.

♀. Differs in having the upper-surface and part of the metasternum polished, prothorax slightly shorter, its punctures sharply defined, elytra with striae and their contained punctures sharply defined, and the interstices with distinct punctures; abdomen larger and more evenly convex,



Cheiragra variabilis, Lea.

legs shorter, the front claws even and no larger than the others, the basal appendix and quill as on the others.

Hab.—Queensland: Wide Bay (Macleay Museum), Brisbane (Queensland Museum from H. Hacker). Type, I. 10836.

A very variable species, of which there are at least two specimens of each colour form described below before me, and of which five forms have been taken in company by Mr. Hacker in October; they all have the basal joints of the antennae pale and the club dark.

Form 1, ♂. Black, head and scutellum somewhat paler, claws and front tibial teeth reddish. A specimen of this form has been made the type of the species.

Form 2, ♂. Of a dingy flavous or testaceous, head with base infuscated, prothorax with infuscated blotches, elytra with suture narrowly and sides and apex more or less widely infuscated or black, most of under-surface and of legs black or blackish. The blotches on the prothorax of this form vary from two small and obscure spots to four large longitudinal ones, covering most of the surface; occasionally the two median ones are conjoined so that there are but three blotches.

Form 3, ♂. Head, prothorax, scutellum, and parts of legs more or less brightly flavous (but not shining), elytra and most of under-surface and of legs black. On this form the head is infuscated from the base to the clypeal suture, and there are some vague infuscations on the prothorax.

Form 4, ♀. Head, prothorax, scutellum, front legs, and parts of the others of a bright flavous, elsewhere black. On this form the elytra are usually of a deep polished black, but on one small specimen parts near the suture are obscurely paler.

Form 5, ♀. Bright flavous, head and prothorax with vague infuscations, metasternum and parts of middle and of hind legs dark, abdomen partly or entirely pale. One Brisbane specimen has the vague infuscations of the head and prothorax as on this form, but with the elytra obscurely infuscated at the sides, approaching the following one; another in the Macleay Museum, from Wide Bay, has the upper-surface uniformly pale.

Form 6, ♀. Bright flavous, head more reddish, elytra with the sides and apex widely infuscated, metasternum, most of abdomen, and parts of legs blackish. The only two specimens of this form I have seen are in the Macleay Museum, from Wide Bay, and one of them has the infuscation of the elytra much more extended than on the other.

It is very difficult to distinguish some males of this species from some males of *ruficollis*, but the females may be readily distinguished by the tips of the elytra (pl. xxv., figs. 23 and 25), these not being notched on the present one. Black males may be distinguished from males of *atra*, by the inconspicuous punctures of the upper-surface. From the real *pusilla*, of Blanchard, it is distinguished by its larger size; the outlines of the female elytra are somewhat similar, but the longer front portion of the front tarsi of the male is considerably longer and otherwise different. So far as the specimens before me indicate, however, the present species is confined to Queensland, and the others mentioned to New South Wales and Victoria. On fig. 24 the apical portion of the larger front claw of the male is shown as long and thin, as it appears from one direction, but from another it is seen to be strongly dilated to its base; and in fact the claw varies in appearance from every point of view.

Cheiragra sericeipennis, n. sp.

Pl. xxv., figs. 26 to 31.

♂. Colours variable. Prothorax, elytra, and parts of under-surface opaque owing to a sericeous or pruinose bloom. Prothorax and elytra with a few fringing setae.

Sculpture as described in preceding species except that the hind suture of the clypeus is better defined, that its suture with the labrum is marked by a series of conspicuous punctures, that the elytra are less distinctly separately rounded at apex, and that the front claw-joint with its claws are somewhat different. Length (♂, ♀), 3·25-3·9 mm.

♀. Differs in having the prothorax and elytra polished, with more distinct punctures, the elytra wider and each side near apex with a flange-like elevation, the abdomen larger, more convex, and the front claw-joint with its claws, much as the others.

Hab.—Queensland: Cairns district (Macleay Museum and F. P. Dodd), South Johnstone River (H. W. Brown), Stradbroke Island (J. H. Boreham). Type, I. 4288.

A small species with the sericeous appearance of the elytra of the males very pronounced. The female may be distinguished from females of other species by the sides of the elytra, each of these near the apex has a somewhat convex flange, causing the apex to appear rather abrupt; from some directions and in certain lights each side appears to be notched (somewhat as on the females of *ruficollis*), but this is due to the part at the apparent notch being very thin, allowing light to show through. The average size of specimens is slightly more than that of *pusilla*, and distinctly less than that of *ruficollis*. On the male the fringe on each side consists of a few widely-separated hairs or setae, on the female they are more numerous, but by no means dense. The front claw-joint of the male is deeply notched twice on the inner-side, leaving a thin truncated projection between the notches; the larger claw is strongly curved, from some directions appearing thin and acutely pointed, from others triangular and from others four-sided; its basal appendix is large, and also varies with the point of view; the smaller claw is very much smaller than the other, but its basal appendix is much as those on the other tarsi. The antennae usually have the club distinctly darker than the basal joints. There are at least five specimens of each of the following colour forms before me.

Form 1, ♂. Flavo-testaceous; elytra black, with a conspicuous bloom, abdomen blackish, metasternum more or less deeply infuscated, four hind tibiae, except at base, and tarsi blackish, or at least deeply infuscated. Includes the type.

Form 2, ♂. Flavo-testaceous; elytra black, with sericeous bloom very conspicuous and almost golden, an obscure reddish spot, sometimes extended into a short vitta, on each side of the scutellum; metasternum, abdomen, hind legs, and middle tibiae (except at base) and tarsi black or infuscated. On this form there are usually two large infuscated blotches on the prothorax.

Form 3, ♂. Flavo-testaceous; elytra of a lurid reddish-brown, abdomen and parts of four hind legs black or deeply infuscated. The bloom of the elytra is rather less conspicuous than on the other forms, and their lurid-red colour is sometimes partly extended on to the prothorax. Three males have the elytra of the same shade as in this form, except that the sides are infuscated; but of these two have the prothorax deeply infuscated, and of these again one (the only specimen examined from Stradbroke Island) has the base of the head infuscated. There are only three females before me, all without bloom; they all have the under-surface entirely pale, and the dark parts of the legs confined to the four hind tibiae and tarsi; two have the upper-surface entirely pale, but on the third the elytra are black.

Telura.

In Blackburn's table of the subtribe Sericoides [13] *Telura* is distinguished by "femora glabrous and very slender and elongate." But the femora of the only then known species, *vitticollis*, although elongate, are certainly not glabrous, as some bristles are present on each of them.

(13) Trans. Roy. Soc. S. Austr., 1897, p. 32.

Telura vitticollis, Er.

This species is fairly common at night on eucalyptus foliage in Tasmania, and it occurs also in New South Wales (Mount Kosciusko), Victoria (Mounts Buffalo and Hotham), and South Australia (Mount Lofty). Specimens vary from having the upper-surface entirely flavous, to the prothorax bivittate, and the elytra quadrivittate. Erichson described the club of the antennae as three-jointed, but this is true only of the female, and Waterhouse has already pointed out that in the male it is five-jointed.

Telura clypealis, n. sp.

Flavous, basal two-thirds of head deeply infuscated (almost black), prothorax narrowly infuscated in middle of apex, and obscurely along middle to base, elytra with a sharply-defined and almost black vitta from base to near apex. Prothorax with four long hairs on each side, rest of upper-surface glabrous; under-surface and legs sparsely clothed, four segments of abdomen each with a transverse row of setiferous granules.

Head moderately convex, and with rather small punctures. Clypeus with apex conspicuously produced in middle, margins rather strongly upturned; punctures larger than between eyes but still small. Antennae nine-, club three-jointed. *Prothorax* moderately transverse, sides strongly and evenly rounded, front angles rather strongly produced and acute, hind ones rounded off; punctures small, varying slightly in size and density, but nowhere crowded. *Elytra* narrow, sides slightly dilated in middle; with regular striae, the sutural one with distinct but shallow punctures; interstices with fairly numerous, small, but sharply-defined punctures, becoming larger about base. *Pygidium* with minute and rather dense subasperate punctures. *Legs* long and thin; front tibiae strongly tridentate; basal joint of hind tarsi slightly shorter than second. Length, 11 mm.

Hab.—Western Australia: Beverley (E. F. du Boulay). Type (unique), I. 4835.

The narrow body, long and thin legs, tridentate front tibiae, eyes large and scarcely visibly faceted, and elytral striae not geminately arranged, indicate that this species, if not a *Telura* is extremely close to it, and provisionally, at least, may be referred to it; the clypeus is certainly very different to that of *vitticollis*, but in many allied genera it varies considerably. The vitta of the elytra is sharply defined, at the base it extends across four interstices on each, but it rapidly narrows till it only covers two, thence being parallel-sided almost to its apex; on the prothorax the markings are obscurely defined; but it is probable that they are not constant. The three-jointed club may be indicative that the type is a female; each ramus is about the length of the apical spur of the front tibiae.

ODONTOTONYX RUFICEPS, n. sp.

Black; head, legs, antennae and palpi red, parts of under-surface obscurely diluted with red. Upper-surface glabrous, except for marginal fringes; under-surface, pygidium, and legs with long pale hair, denser on metasternum than elsewhere. *Head* with moderately dense, sharply-defined punctures, rather small at base, larger in front. Clypeus semicircular, slightly concave, margins lightly upturned at sides, more strongly in front, hind suture curved backwards to middle; punctures near suture much as behind it, but sparser in front. Antennae nine-, club three-jointed and small. *Prothorax* about once and one-half as wide as long, sides strongly rounded and narrower at apex than at base, front angles produced and subacute, hind ones gently rounded off and slightly more than right angles; punctures much as on head but less crowded. *Scutellum* impunctate posteriorly. *Elytra* feebly dilated posteriorly, apex widely rounded; strongly striate, with shallow punctures in the striae, the interstices with scattered punctures, about as large as those on prothorax. *Pygidium* with dense and minute punctures. Front *tibiae* with two strong teeth and a very small one; basal joint of hind tarsi shorter than second, of the others longer than second; each claw with a fairly large basal appendix, and a whitish membrane. Length, $10\frac{1}{2}$ mm.

Hab.—New South Wales: Hunter River. Type (unique), in Macleay Museum.

Distinguished from *brunneipennis* by being more robust, the prothorax and elytra black, apical tooth of front tibiae more curved, the second larger, and the third smaller (almost vanishing), the appendix to each claw (the sole character distinguishing *Odontotonyx* from *Nosphisthis*) is rather large but less sharply defined than in *brunneipennis*, and the membrane is somewhat smaller. There is a vague remnant of a median line on the pronotum.

PLATYDESMUS CASTANEUS, n. sp.

♂. Bright castaneous with a slight iridescence, head slightly darker than prothorax. Upper-surface glabrous, except for conspicuous prothoracic and elytral fringes; under-surface with rather sparse, irregularly distributed, golden hairs.

Head with numerous but not dense, and rather small sharply-defined punctures. Clypeus with sides rather lightly upturned, the front more strongly, hind suture gently curved backwards to middle; punctures somewhat larger and more crowded than between eyes. Antennae ten-, club four-jointed, rami of the latter curved, and about the length of the front tibiae. *Prothorax* not twice as wide as long, sides moderately rounded, front angles produced and acute, hind ones obtuse but sharply defined; punctures about as large but sparser than on head between eyes. *Scutellum* impunctate except at base. *Elytra* feebly dilated to beyond the middle, apex widely rounded; strongly striate, with distinct punctures in the striae, second, fourth, sixth, and eighth interstices slightly wider than the others, and with more numerous punctures. *Pygidium* with rather dense punctures, except along middle. Front *tibiae* strongly tridentate; basal joint of hind tarsi shorter than second. Length, 10·5-11·5 mm.

Hab.—New South Wales: Richmond River, in November (W. W. Froggatt). Type, I. 10785.

May be readily distinguished from *inusitatus*, the only other species having the club of the antennae four-jointed, by its larger size, less convex form, prothorax no darker than elytra, and with much smaller punctures, etc. I have seen specimens of this species in the Macleay Museum, from Port Denison.

ANODONTONYX INSULARIS, n. sp.

Of a pale dingy red, some parts darker. Upper-surface with some long hairs scattered about, and forming a fringe on each side of prothorax and elytra, a row of setiferous granules across most abdominal segments.

Head with dense punctures of moderate size, and a few larger ones scattered about. Clypeus with front margin rounded and rather strongly upturned. Antennae eight-, club three-jointed, second joint globular and distinctly wider than second, club small. *Prothorax* not twice as wide as long, sides subparallel on basal half, front angles lightly produced and subacute, hind ones rectangular and flat; punctures sparser and shallower than on head, but scarcely smaller; median line absent or very vague. *Scutellum* impunctate except at base. *Elytra* with fairly numerous, but not dense punctures, slightly larger than on prothorax; with feeble longitudinal elevations. *Pygidium* with fairly dense and rather small punctures. Basal joint of hind *tarsi* slightly longer than second. Length, 7-8 mm.

Hab.—Queensland: Stradbroke Island, October, 1911 (H. Hacker). Type, I. 4687.

The flattening out of the hind angles of the prothorax, and the clothing of the head associate this species with *nigrolineata*, from which it may be distinguished by its much smaller size, and by the granules of the prothorax and elytra; before the type of *antennalis* was sent to the Britsh Museum I noted that in appearance it was close to some specimens of the present species, but the second joint of its antennae was described as "not at all thicker than the third joint," a character at once distinguishing it from the present and the two following species. They are referred to *Anodontonyx* on account of the small club, Blackburn somewhat unwillingly having recognized that as a valid distinction from *Scitala*. The smaller specimens (mostly males) usually have the prothorax and basal half of head darker than the elytra, sometimes almost black, the elytra usually have the suture and sides lightly infuscated, and sometimes each elytron has in addition three very vaguely infuscated discal lines (these being the feebly-elevated parts); the sterna are usually darker than the rest of the under-surface. From some directions the prothorax and elytra appear to be slightly iridescent, but from a few to have a conspicuous pruinose bloom; the head, however, is noniridescent from all points of view. The long hairs of the upper-surface each arise from a minute granule, they are fairly numerous, but not dense, between the eyes and on the front third of prothorax, on the elytra they appear to be sparsely scattered at random, but from directly in front or behind they are seen to be in rows on the feebly-elevated parts; on the abdomen the hairs are shorter, but the lineate arrangement is more distinct. The front tibiae have a large apical tooth and a much smaller subapical one; sometimes a feeble third tooth is indicated towards the base, but it is usually absent. Mr. Hacker obtained many specimens.

Anodontonyx opalescens, n. sp.

Dark piceous-brown obscurely mottled with red, but brilliantly opalescent. A few long hairs between eyes and across apex of prothorax, sides of prothorax and elytra fringed, rest of upper-surface glabrous; under-surface and legs very sparsely clothed.

Head with fairly dense punctures of moderate size, but sparse in middle. Clypeus almost truncate in front, margins rather strongly upturned. Antennae nine-, club three-jointed, second joint distinctly thicker than third and subglobular, club small. *Prothorax* about twice as wide as long, sides dilated in middle but narrowed to both base and apex, front angles produced and acute, hind ones rectangular, median line very feeble; punctures somewhat larger than on head but sparser. *Elytra* rather long and thin, vaguely striated; with fairly large punctures. *Pygidium* with fairly dense punctures. Front *tibiae* tridentate, the two front teeth large, the other small; basal joint of hind tarsi slightly shorter and thicker than second. Length, 6·5-8 mm.

Hab.—New South Wales: Barrington Tops, January, 1916 (H. J. Carter). Type, I. 10779.

The hind angles of the prothorax are not so flattened as in *nigrolineata*, but as the head has some long hairs it possibly would have been associated with that species by Blackburn; it is certainly allied to it, differing in being much smaller and narrower, hind angles of prothorax sharper, etc. From some directions most of the upper-surface appears to be black, but from others much of the elytra of a dingy red, it is difficult, however, to see their true colours on account of the brilliant opalescence (this obscures the margins of the punctures, so that it is not easy to be sure of their exact size); from some directions even this changes to a pruinose gloss. One specimen, with much the same opalescence, has the elytra of a rather dingy red, with obscure darker lines.

Three specimens from Kurrajong (C. T. Musson) and Mittagong (H. J. Carter and A. M. Lea) possibly belong to this species, and are probably females; they differ in being much paler (almost uniformly castaneous), without opalescent gloss, with denser and larger punctures, especially on the elytra, where they are rather crowded and moderately large, and shorter legs.

Anodontonyx niger, n. sp.

Black, shining; antennae, palpi, and legs dull red, prosternum and front of clypeus sometimes obscurely diluted with red. Prothorax and elytra with a thin fringe of reddish hairs, and a few hairs across apex of prothorax, rest of upper-surface glabrous; under-surface and legs sparsely clothed.

Head with fairly dense punctures at sides, but somewhat sparser in middle. Clypeus with margin rather strongly upturned in front but less strongly on sides, each side of base lightly produced, hind suture rather strongly drawn backwards to middle; punctures near base more crowded than between eyes, but becoming sparser in front. Antennae eight-, club three-jointed, second joint subglobular, distinctly wider than third; club small. *Prothorax* about twice as wide as long, front angles produced and subacute, hind ones gently rounded off; punctures rather small but sharply defined, nowhere crowded. *Elytra* rather short; with geminate rows or rather shallow punctures, the interstices with rather numerous punctures. *Pygidium* with fairly dense punctures, a depression in each basal angle. Front *tibiae* wide and strongly tridentate; basal joint of hind tarsi longer and stouter than second. Length, 8-9 mm.

Hab.—Tasmania: Kempton, Parattah, Hobart (A. M. Lea), Brighton (Aug. Simson's No. 2850). Type, I. 819.

The male has longer and thicker legs than the female, and the sexes differ to a slight extent in the prothorax, its greatest width in the male being postmedian, in the female antemedian, in the male also it is less transverse than in the female, hence the characters used in Blackburn's table (14) are unsatisfactory; but of the species known to Blackburn it seems closest to *tetricus*, from which it differs in its smaller size, much smaller elytral punctures, less convex elytral interstices and red legs; it is without the metallic gloss of *micans*, and differs in other respects from that species. The median line of the prothorax is either absent or vaguely impressed for a short distance near the base. Countless thousands of specimens of this species are sometimes washed up on the beaches near Hobart, after sultry nights.

Pseudoheteronyx seticollis, n. sp.

Pl. xxvi., fig. 61.

Black; antennae, palpi, and parts of tarsi obscurely reddish. Head and prothorax with dense and extremely short suberect setae; abdomen and pygidium with longer and sparser setae, parts of legs, front wall of clypeus, angles of prosternum, and margins of elytra with still longer setae, or stiff hairs.

Head smooth and impunctate at base, elsewhere with crowded (but not confluent) and rather shallow punctures of moderate size. Clypeus with punctures as on rest of head, front margin feebly incurved to middle, hind suture appearing as a narrow sinuous elevation. Antennae eight-, club three-jointed. *Prothorax* widely transverse, sides gently rounded, base very feebly bisinuate, front angles produced and acute, hind ones lightly rounded off, median line feeble; punctures somewhat smaller than on head, but quite as dense. *Elytra* with sides gently and apex widely rounded; with rather feeble relics of striation; punctures slightly larger, sparser, and more sharply defined than on prothorax. *Pygidium* with irregularly distributed, asperate punctures. Front *tibiae* strongly tridentate; basal joint of hind tarsi slightly longer than second, each claw with a strong basal appendix. Length, 11·5-15 mm.

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(14) Trans. Roy. Soc. S. Austr., 1907, p. 258.

Hab.—New South Wales: Mount Kosciusko (B. Ingleby, — Lucas, and — Guerand, 7,000 ft., in Howitt's collection). Type, I. 589.

A strongly-convex dull species, but with shining elytra. Specimens vary somewhat in the punctures of the elytra and one has a few fairly well-defined striae, but all agree in having the prothorax with very dense punctures, with a minute seta arising from each; on many of them the setae have caused mud to adhere uniformly to the surface, giving it a curious appearance; the setae on the upper-surface of the head are just as dense, but from several specimens have been completely abraded; the elytra have a few extremely minute setae towards the sides, but from most directions they are invisible. The apex of the scutellum is without punctures, the apparent base has a few large ones, and the real base (normally concealed by the overlapping base of the prothorax) has dense ones. I have been unable to find external indications of sex in the eleven specimens under examination. The eight-jointed antennae and general appearance associate the species with *baldiensis* and *creber*, from which it may be readily distinguished by the prothoracic clothing.

Pseudoheteronyx basicollis, n. sp.

(Pl. xxv., figs. 32 and 33; pl. xxvi., fig. 62.

Black; parts of antennae, of palpi, and of tarsi obscurely reddish. Upper-surface sparsely clothed with short, depressed setae, more numerous (but still not very dense) on head than elsewhere; prothorax and elytra fringed with stiff blackish setae, similar setae on parts of under-surface and of legs.

Head with numerous, but not very dense or large, and rather shallow punctures, becoming crowded on clypeus; front margin of the latter gently incurved to middle, hind suture lightly impressed and sinuous. Antennae nine-, club three-jointed. *Prothorax* scarcely twice as wide as long, sides strongly and evenly rounded, base evenly incurved to middle, front angles produced and subacute, hind ones rounded off, median line absent; punctures similar to those on head but sparser, a few very small ones scattered about. *Scutellum* with numerous punctures. *Elytra* with sides gently rounded and apex almost truncate; punctures slightly larger than on prothorax. *Pygidium* and *metasternum* with rather coarse punctures. Front *tibiae* strongly tridentate; two basal joints of hind tarsi subequal; claws strongly appendiculate.

Hab.—Australia: (Blackburn's collection); Queensland: Toowoomba (Hamlyn Harris in Queensland Museum); New South Wales (National Museum). Type, I. 4847.

The majority of the punctures on the upper-surface are so impressed that there appears to be a minute granule (often semicircular) at the back of each, but the granules are invisible from in front, they are decidedly coarser on some specimens than on others; in some specimens faint indications of elytral striae may be seen, but from others these are entirely absent; the lateral bristles each arise from a small granule. The front claws (fig. 32) are of very different shape to the others (fig. 33), and the difference is apparently not sexual (at least I have been unable to find external indications of sex in the nine specimens under examination); its upper-surface is subopaque owing to very fine shagreening. The nine-jointed antennae associate the species with *laticollis* and *helaeoides* in Blackburn's table; from which, as from all other described species of the genus, it may be distinguished by the base of the prothorax, this being gently and evenly incurved from each side to the middle; on all other species the base is gently bisinuate, with the part adjacent to the scutellum in the form of a wide feeble lobe. It is rather more convex than the preceding or following species.

PSEUDOHETERONYX PUNCTICOLLIS, n. sp.

Pl. xxvi., fig. 63.

Black; antennae, palpi, and parts of tarsi more or less reddish. Upper-surface almost glabrous; under-surface and legs sparsely setose.

Head with large and rather deep, but not crowded, punctures, suddenly becoming crowded on clypeus; the latter with apex gently incurved to middle. Antennae nine-, club three-jointed. *Prothorax* about thrice as wide as the median length, sides strongly rounded, base very feebly bisinuate, front angles rather strongly produced and acute, hind ones slightly rounded off; median line absent; with large deep punctures, becoming smaller towards sides, somewhat irregularly distributed but nowhere crowded. *Elytra* with sides gently rounded, apices very feebly rounded (almost truncate); with irregular rows of rather large punctures, in wide, shallow striae. *Pygidium* with very shallow punctures. Front *tibiae* strongly tridentate; basal joint of hind tarsi slightly longer than second; all claws acutely appendiculate. Length, 11 mm.

Hab.—Queensland: Camooweal. Type (unique), in Queensland Museum.

The head and prothorax are opaque, the elytra moderately shining; the whole of the body and even parts of the legs are very finely shagreened. There is a short seta in most of the punctures of the upper-surface, but they are very inconspicuous, as they seldom rise to the general level. The hind suture of the clypeus is not very distinct by itself, but is rendered very distinct by the difference in the density of the punctures before and behind it; there are about ten distinct striae on each elytron, the punctures in each do not form a regular row at the deepest part, but many are on the sloping parts, although they could scarcely be regarded as geminately arranged; each of them, when viewed from behind, appears to have a small basal granule. The nine-jointed antennae associate this species with *laticollis* and *helaeoides*, in Blackburn's table, from which it may be distinguished by the longer basal joint of the hind tarsi; the punctures of the head and prothorax approach those of *laticollis*, but the elytral sculpture is very different; the hind tarsi were not mentioned in the description of *laticollis*, but two specimens (received from Mr. Carter and taken by Judge Docker at Walgett, as was the type) of that species before me have the basal joint decidedly shorter and thicker than the second.

Byrrhomorpha rudis, n. sp.

Black; antennae, palpi, and parts of tarsi reddish. Metasternum with fairly numerous blackish hairs, rest of under-surface and legs sparsely clothed.

Head with crowded but sharply-defined punctures of moderate size. Clypeus widely excavated in front, sides rather strongly elevated, hind suture in the form of a narrow carina; punctures as between eyes, but becoming smaller on sides. Labrum conspicuously elevated in front, deeply impressed along middle, the impression continued on to mentum, but much shallower there. Antennae nine-, club three-jointed. *Prothorax* scarcely twice as wide as long, sides decreasing in width from near base to apex, front angles rather strongly produced and acute, hind ones somewhat obtuse; median line rather feeble at base, but rather wide and deep in front; punctures much as on head, but becoming smaller (although not sparser) towards all margins. *Scutellum* with dense punctures, but tip polished and impunctate. *Elytra* feebly dilated to beyond the middle, each obliquely truncate at apex; striae deep and wide, with coarse, irregular punctures, the interstices irregular, and with sharply-defined punctures. *Pygidium* with crowded asperate punctures, and a distinct median line. Front *tibiae* strongly tridentate. Length, 8-11·5 mm.

Hab. — Western Australia: King George Sound (Macleay Museum), Warren River (W. D. Dodd). Type, I 4836.

A rough-looking species close to *verres*, but club with only three joints, prothorax with more crowded punctures, and with a conspicuous enlargement of the median line; the largest is less than the length noted for *ponderosa*. The coarse punctures are often confluent on the sides near the shoulders. The elytra of this and of the following species (except for marginal fringes) at first glance appear to be glabrous, but they have sparse and exceedingly short pubescence, that even under a strong lens appears hardly more than dust.

Variety. One specimen has the front tibiae bidentate; but agrees in other respects with the type and seven other specimens.

Byrrhomorpha basicollis, n. sp.

Black; most of under-surface, and of legs, labrum, and sides of clypeus, obscurely reddish-brown, antennae paler. Parts of under-surface and of legs with rather long, yellowish hairs or bristles.

Head with crowded and small but sharply-defined punctures. *Prothorax* with crowded, small, and rather shallow, but sharply-defined punctures, frequently transversely or obliquely confluent. *Elytra* with punctures of moderate size, but (except at the apex where they are smaller and denser) not crowded or confluent. *Pygidium* with very dense and small asperate punctures, with a very feeble median line. Front *tibiae* tridentate, the two front teeth large and acute, the other very small. Length, 9-10 mm.

Hab.—South Australia: Lucindale (B. A. Feuerheerdt and F. Secker), Sandy Creek (J. G. O. Tepper). Type, I 4837.

The under-surface is sometimes uniformly dull reddish-brown; on two specimens the abdomen is almost black, and darker than the sterna, on another it is considerably paler than the sterna. On the head of one specimen there is a very conspicuous, narrow, impunctate line near the base; but this appears to be due to less of its back part being concealed by the apex of the prothorax than in the others. The subsutural and sublateral striae of the elytra are in parts fairly well defined, but there are no distinct discal striae, their places being taken by obscure and subgeminate rows of punctures, scarcely differing in size from those in their vicinity. There is an enlargement of the median line of the pronotum, as in the preceding species, but the punctures of the prothorax and elytra are very much finer than on that species; the clypeus (except that its punctures are smaller), labrum, mentum, outlines of prothorax and of elytra, and the scutellum are as described in that species. From *verres* it is readily distinguished by the much denser and finer punctures of the prothorax, which are also frequently confluent; the sculpture of the elytra is also much finer, and the subgeminate arrangement of punctures, although feeble, is more regular.

FRENCHELLA GAGATINA, n. sp.

Pl. xxvi., fig. 64.

Black, highly polished; parts of antennae and of palpi reddish. Upper-surface glabrous, except for fringes of dark hairs on the prothorax and elytra; under-surface and legs with blackish hairs, denser on metasternum than elsewhere.

Head with dense (but not crowded) and sharply-defined punctures of moderate size between eyes. Clypeus with suture gently sinuous; punctures (except in front) crowded and slightly larger than those between eyes. Antennae nine-, club three-jointed and rather small. *Prothorax* about twice as wide as long, sides strongly rounded in middle, front angles produced and acute, hind ones obtuse but not rounded off; punctures about as large as those between eyes, but sparser and becoming smaller on sides. *Scutellum* impunctate on apical half. *Elytra* slightly dilated to beyond the middle, apex gently rounded; each with ten well-defined striae containing numerous punctures, these of varying sizes but mostly fairly large; interstices with a few distinct punctures. *Pygidium* in parts with sharply-defined punctures. Front *tibiae* tridentate, the two front teeth large, the other very small. Length, 12·5 mm.

Hab.—Western Australia: Cue (H. W. Brown). Type (unique), I. 4780.

As the club is rather small the type is probably a female; the median line of its pronotum is vaguely impressed on the apical third, and represented by an impunctate line from there to the base. The hind angles of the prothorax are sharply defined, although they are rather more than right angles, but this is the case with other species that Blackburn referred to B of his table, "Hind angles of prothorax sharply defined," from some directions, however, they appear to be quite sharply acute; by that table the species would be associated with *sparsiceps*, which is a narrower and paler species, with much sparser punctures between eyes, etc. It is darker and more strongly convex than any previously-described species, in appearance closer to some dark specimens of *lubrica* than to any other, but differing by the absence of punctures from the greater portion of the elytral interstices, clypeus much less upturned in front, and front tibiae apparently bidentate at first glance, the third tooth being very feeble and nearer the base than in other species.

Frenchella fimbriata, n. sp.

Pl. xxvi., fig. 65.

Dark reddish-castaneous and highly polished; under-surface, legs, antennae, and palpi paler. Upper-surface glabrous, except for fringes of reddish bristles on the prothorax and elytra, a similar fringe on pygidium; under-surface moderately clothed in places.

Head with sharply defined but not very large punctures, sparser between eyes than elsewhere. Clypeus convex in middle, its hind suture almost straight; punctures crowded and slightly larger than those behind suture. Antennae nine-, club three-jointed. *Prothorax* not twice as wide as long, sides moderately rounded in middle, oblique to apex, with front angles produced and acute; feebly decreasing to base, with hind angles rectangular; base feebly bisinuate; punctures sharply defined and nowhere dense. *Scutellum* impunctate at apex. *Elytra* gently and evenly dilated to beyond the middle, apex widely rounded; strongly striate, with rather small punctures in striae near suture, becoming rather large towards sides, the interstices with few but sharply-defined punctures. *Pygidium* with slightly larger punctures than on prothorax. Front *tibiae* tridentate. Length, 11 mm.

Hab.—Queensland: Bowen (Simson's collection, No. 2007). Type (unique), I. 10782.

A less convex species than usual; the type appears to be a male, as the rami of the club are longer than the other joints of the antennae combined; the apical tooth of the front tibiae is long and acute, the second one is acute but small, and the third is very small; the basal joint of the hind tarsi is thick, and its full length is greater than that of the second, but from some directions it appears to be slightly shorter. Regarding the species as belonging to AA, B, of Blackburn's table, it would be associated with *sparsiceps*, from which it differs in its much darker colour, prothorax with sparser and more sharply-defined punctures, rather denser punctures between eyes, elytra more dilated posteriorly, pygidium with much larger punctures, etc.; if it was regarded as belonging to AA, BB, it would be associated with *lubrica*, which has much denser punctures, including many on the elytral interstices, and differs in other particulars.

Frenchella cribriceps, n. sp.

Pl. xxvi., fig. 66.

Black and highly polished; palpi and parts of antennae and of front legs more or less reddish. Upper-surface sparsely clothed, but with distinct reddish fringes, pygidium with rather long pubescence and a distinct fringe, sterna densely pilose.

Head rather convex, and with rather large, crowded punctures. Clypeus with margins rather strongly upturned, hind suture curved backwards to middle; punctures much as between eyes, but becoming smaller in front. Antennae eight-, club three-jointed. *Prothorax* distinctly less than twice as wide as long, sides subangularly produced in middle, rather strongly narrowed to apex, with front angles produced and acute, less strongly narrowed to base, with hind angles sharply defined and almost rectangular; punctures almost evenly distributed, sparser, and smaller than on head. *Scutellum* with rather sparse punctures. *Elytra* almost parallel-sided to near apex, which is almost truncate; striae well defined, but with irregular punctures; interstices with rather large, irregularly-distributed punctures. *Pygidium* with dense, subasperate punctures about base, becoming sparser elsewhere. Front *tibiae* strongly tridentate; basal joint of hind tarsi shorter than second. Length, 11·5 mm.

Hab.—South Australia: Lucindale (F. Secker). Type (unique), I. 4700.

As the club is small the type is probably a female. There are fairly numerous erect hairs between the eyes, and sparse ones on the elytra; but the type has probably been partly abraded. There is a feeble remnant of a median line on the pronotum. By Blackburn's table the species would be associated with *hispida*, from which it differs in being black, clothing of upper-surface much sparser, clypeus longer, etc. In general appearance it is fairly close to dark specimens of *lubrica*, but that species has denser prothoracic and elytral punctures, antennae nine-jointed, etc.

Engyops flavus, n. sp.

Flavous, front of head and parts of legs castaneous. A few long hairs between eyes, and a fringe of similar hairs on each side of the prothorax and elytra, rest of upper-surface glabrous; pygidium moderately densely clothed at apex; under-surface and legs very sparsely clothed.

Head with fairly numerous and small but sharply-defined punctures. Clypeus with semicircular and rather strongly upturned margins, middle rather strongly convex and with denser and coarser punctures than between eyes; hind suture sharply defined. Antennae nine-, club three-jointed. *Prothorax* about twice as wide as long, side sub-parallel on basal two-thirds, and then strongly rounded to apex, front angles produced and acute, hind ones almost rectangular; punctures somewhat larger and denser than between eyes. *Scutellum* with punctures as on prothorax. *Elytra* slightly dilated to beyond the middle, and then narrowed to apex, where each is obliquely truncated but with a fine membrane; with regular impunctate striae, interstices with slightly larger punctures than on prothorax, but not quite so dense. *Pygidium* with crowded punctures. *Undersurface* with rather dense and strong punctures, sparser and smaller on parts of abdomen than elsewhere. Front *tibiae* tridentate, the two apical teeth large, the other feeble; basal joint of hind tarsi as long as the second and third combined. Length, 8·5-9 mm.

Hab.—Queensland: South Johnstone River (H. W. Brown), Innisfail (Mrs. McArthur), Mackay (National Museum, from R. E. Turner). Type, I. 10781.

An elongate species, at first glance resembling some species of *Phyllotocus* (*e.g.*, *occidentalis*, and the variety *pallidus* of *macleayi*), but with very different front parts of head, etc. The very large eyes with the space between them not much wider than long, simple claws (they are, however, thickened at the base), and general appearance are as in *E. spectans*, from which it differs in being much larger, clypeus shorter, punctures (especially on elytra) denser, etc., the elytra are also truncated at apex; the mentum is granulate but much less densely clothed than in *spectans*. From above the hind angles of the prothorax appear to be acute, and to slightly embrace the elytra, but from the side each is seen to be almost rectangular. The sparse hairs on the head are partly in front of and partly behind the clypeal suture. Each ramus of the club is about as long as the inner spur of the front tibiae. The four specimens under examination appear to be all males.

HAPLOPSIS SERRICOLLIS, n. sp.

Black with a slight bronzy gloss, antennae (except club) and palpi red, tips and part of sides of elytra and parts of legs obscurely diluted with red. Rather densely clothed with long white hair.

Head with coarse and dense punctures. Clypeus with margins moderately upturned, front truncate but with corners rounded off, the sides oblique. Antennae nine-, club three-jointed, rami about the length of the claw-joint without the claws. *Prothorax* not twice as wide as long, sides strongly rounded and finely serrated, front angles produced and acute, hind ones obtuse but not rounded off; punctures large and asperate; the interspaces with dense small punctures. *Elytra* with subgeminate rows of close-set, asperate punctures, the wider interstices with numerous gaps on each side due to punctures. *Pygidium* with crowded punctures. Front *tibiae* tridentate, the two first teeth large and acute, the third small, acute, and subbasal; basal joint of hind tarsi much shorter than second. Length, 6-6·25 mm.

Hab.—Western Australia: Cunderdin, July-August, 1913 (Western Australian Museum, No. 7813). Type, I. 10797.

In size and structure close to *olliffi*, with which it would be associated in Blackburn's table, but the elytra have much longer clothing, and with scarcely a trace of metallic gloss; *debilis* has the clypeus somewhat different, the metallic gloss of elytra more conspicuous, and the clothing shorter; the tips of the elytra are obscurely reddish as in *grisea*, but the clothing of that species is much shorter and the clypeus is very different. On the upper-surface there are fairly dense subdepressed hairs, each about the length of a claw, and mixed with these (and very distinct from the sides) are longer erect ones, fairly dense on the head to base of elytra, but disappearing before the apex of the latter. From some directions the prothorax appears to be covered with small granules, much as in many small weevils (*e.g.*, *Essolithna*, *Polyphrades*, etc.). The semidouble rows of elytral punctures are very irregular, and are in shallow longitudinal impressions, but these could scarcely be regarded as striae; on each elytron there are three interstices that are conspicuously wider than the others, but all have jagged edges due to punctures. The clothing somewhat obscures it, but the whole of the derm appears to be very finely shagreened.

Maechidius hackeri, n. sp.

Castaneous, some marginal parts darker, club paler. Moderately densely clothed with long, erect, golden or light-brown hairs; parts of under-surface with rather sparse, subdepressed pubescence.

Head with coarse and rather crowded punctures. Clypeus deeply notched in front, each side conspicuously trilobed. Antennae with the club three-jointed. *Prothorax* about twice as wide as long, sides moderately rounded and finely serrated, front angles produced and moderately acute, hind ones obtuse and entire; punctures as large as on head, but less crowded. *Elytra* feebly dilated to beyond the middle, with double rows of large punctures. *Pygidium* convex, with asperate, setiferous granules. Front *tibiae* tridentate; each claw with a conspicuous basal quill. Length, 8 mm.

Hab.—Queensland: Buderim Mountain, in April (H. Hacker). Type (unique), in Queensland Museum.

The hairs are more conspicuously golden and denser on the pygidium than elsewhere. In Blackburn's table the species would be associated with *macleayanus*, from which, as from all other species except *variolosus* and *pilosus*, it may be readily distinguished by the long erect clothing of the upper-surface; from the two latter species it may be distinguished by the quilled claws; in general appearance it is strikingly close to *variolosus*.

Maechidius stradbrokensis, n. sp.

Blackish, some parts obscurely paler, antennae and palpi reddish. Head and prothorax with rather long, stiff, erect, rusty-red bristles, somewhat similar but shorter and paler ones on pygidium, elytra with subdepressed whitish setae, and a few suberect bristles; under-surface and legs with moderately dense, short, curved setae.

Head with large dense punctures between eyes. Clypeus strongly convex and with crowded punctures in middle, widely emarginate in front, each side with two triangular teeth, and a longer and more obtuse one extending to base. Antennae with club three-jointed. *Prothorax* about twice as wide as long, sides obtusely serrated, front angles produced, base strongly notched on each side; punctures large, round, and shallow. *Elytra* almost parallel-sided to near apex; with rows of large, elliptic, ring punctures. *Pygidium* with a large median fovea. Front *tibiae* strongly tridentate; each claw with a conspicuous basal quill. Length, 9-11·5 mm.

Hab.—Queensland: Stradbroke Island, in December (H. Hacker). Type, in Queensland Museum; cotype, I. 10795, in South Australian Museum.

In general appearance somewhat close to a species doubtfully identified by Blackburn as *emarginatus*, with which it would be associated in his table, but readily distinguished by the stiff bristles of the head and prothorax; on *excisicollis* the prothorax has much thinner setae, and the basal excavations and elytral sculpture are different; *insularis* is much smaller and otherwise very different.

Maechidius hopeanus, Westw.

M. obscurus, Macl.

The types of *obscurus* agree with specimens identified (correctly I think) by Blackburn as *hopeanus*. Macleay described the prothorax as "shallowly bifoveate near the sides with the median line lightly marked." One of the specimens certainly appears to be bifoveate, but the other has vague depressions only (much as on typical specimens of *hopeanus);* the lightly-marked specimen is also without a median line.

Maechidinus, n. g.

Head rather small. Eyes small and lateral. Clypeus entire in front, its basal angles slightly exterior to eyes. Maxillary palpi small, the labial ones very small. Antennae nine-, club three-jointed and rather small. *Prothorax* not much wider than greatest length; hind angles semicircularly excised. *Scutellum* semicircular. *Elytra* not covering the propygidium and pygidium. *Prosternum* with a W-shaped excavation in front for reception of antennae, one of which rests on each side of a triangular intercoxal process. *Legs* rather stout; front tibiae tridentate, the third tooth small and close to the base; claws long, thin, and simple.

This genus appears to be allied to *Caulobius*, and its front tibiae are much as in that genus and *Automolus*, but the prosternal sutures are widely open, allowing the antennae to be concealed when at rest, as in *Maechidius;* a notch on each side of the base of the prothorax is often present in *Maechidius*, near which the genus should be placed in catalogues; but it is readily distinguished therefrom by the entire clypeus, exposed propygidium, and great distance between the second and third teeth of the front tibiae.

Maechidinus latericollis, n. sp.

Black; palpi, claws, and parts of antennae reddish. Upper-surface with stout depressed setae, or lanceolate scales, dense and mostly black on head, dense and white on sides of prothorax, and black in middle, irregularly distributed and sparser on elytra; under-surface, pygidium, propygidium, and parts of legs closely plated with snowy-white scales, legs in addition with numerous long whitish hairs, tips of abdomen and of pygidium with golden setae.

Head with dense, partially concealed punctures. Clypeus widely transverse, front truncate, sides gently rounded, hind suture normally concealed. *Prothorax* strongly convex, sides strongly rounded, at about the basal third with a small tooth marking the outer end of a strong basal notch, front angles produced and acutely triangular; median line shallow; punctures crowded and moderately large. *Elytra* with irregular rows of punctures, many of which are separated by small transverse shining granules, interstices of uneven width and obtusely serrated. Basal joint of hind *tarsi* conspicuously shorter and thicker than second. Length, 7-9·5 mm.

Hab.—Western Australia: Beverley (E. F. du Boulay). Type, I. 4583.

To see the W-shaped excavation of the prosternum clearly it is necessary to remove the head; from most directions it is difficult to see the line dividing the front face of the clypeus from the labrum. The clothing is remarkable, especially on the elytra, where the setae or scales on perfect specimens seem to be in geminate rows, with the white ones stouter than the black ones, and either lanceolate in shape, or elongate-elliptic; on the upper-surface even where dense the derm may usually be seen from an oblique direction, but on the hind-parts and the under-surface the scales are so dense and flat that most of the derm is hidden.

Maechidinus marginalis, n. sp., or var.

Ten specimens differ from *latericollis* in having the prothorax wider, its clothing longer and more upright, the pale setae continued across both base and apex (on all the specimens of *latericollis* the pale clothing is confined to the sides), clothing of head longer and almost entirely pale, under-surface with clothing more setose in character, even on the abdomen (where the scales are all distinctly longer than wide, and many are longitudinally ribbed) and the hairs on the legs longer and denser. Length, 8-9 mm.

Hab. — Western Australia: King George Sound (Macleay Museum). Type, I. 10796.

There are ten specimens of the present form before me, all from King George Sound; and six of *latericollis*, all from Beverley, so that the differences noted are unlikely to be sexual; the curious front tibiae and lateral notches of prothorax are exactly alike on the two forms, but the distinctly wider prothorax of the present form is unlikely to be of varietal importance only. A specimen of this form was standing in the Blackburn collection at the end of *Automolus*, but it was damaged and the head was so mouldy that the antennae were concealed, hence he probably regarded them as broken off, and so refrained from describing it.

Cryptodus.

It is difficult and in many instances impossible, unless they are dissected out, to count the joints of the antennae of species of this genus, owing to the greatly dilated basal joint concealing some of the following ones, and to the brevity of the joint preceding the club, the latter I have presumed in every instance to be three-jointed. Probably Fairmaire dissected them out to make certain of them, as I have had to do in many instances, thus making certain that his counts of the antennae of *variolosus* and *piceus* as being nine-jointed were correct. Of the species described by him the following comments are offered: —

grossipes. A very distinct species, with the base of the mentum much as in *caviceps*, but the two species otherwise very different.

creberrimus. I cannot find that Blackburn has anywhere published a note as to *creberrimus* being a synonym of *paradoxus*, but at the side of his copy of the description of *creberrimus* he wrote "=*paradoxus* Macl." and the description agrees so well with ordinary specimens of that species that I also regard it as *paradoxus*. It is probable that some of Fairmaire's other names are bestowed upon forms of the same variable species.

fraternus. Although placed in A, species noted as having "antennae novem-articulatae. Mentum emarginatum," this species was said to have ten-jointed antennae, and the mentum was not even mentioned. Probably it was accidentally referred to A, and as the species of B were divided into three groups, dependent on the form of the mentum, it would be unsafe to identify any specimens as *fraternus*, without additional particulars to those given in the description (which is simply a brief comparison with *cycnorum*).

CRYPTODUS PARADOXUS, W. S. Macl.

C. subcostatus, Macl.

C. obscurus, Macl.

The types of *subcostatus* are quite ordinary specimens of *paradoxus;* the types of *obscurus* differ from those of *subcostatus* in the particulars mentioned by Macleay, but the differences are individual rather than specific. The life the insects lead naturally causes older specimens to lose much of their gloss; the antennae of the four specimens are almost or quite buried within their cavities, but appear to be quite as in *paradoxus*.

CRYPTODUS INCORNUTUS, Macl.

The type of *incornutus* is certainly very close to *paradoxus*, the general outlines of the head, prothorax, and elytra (and the subapical tuberosities of the elytra) are very much the same; the deeply-notched mentum, the antennae, and legs are also very similar, but the complete absence of cephalic tubercles (they are, however, often very feeble on *paradoxus*), the decidedly coarser prothoracic, and the generally coarser punctures, may be distinctive.

A smaller and even rougher specimen also with nontuberculate head was sent to me some years ago by Mrs. Hobler of Dalby; and has been considered a possible variety of *paradoxus*.

Cryptodus variolosus, White.

Mr. Clark and I have taken specimens of this species in abundance from nests of *Iridomyrmex conifera*, in many parts of Western Australia.

Cryptodus passaloides, Germ.

Mr. Clark and I have taken specimens of this species from nests of several species of ants in Western Australia, including *Ponera lutea*, and a small black *Iridomyrmex*.

Cryptodus foveatus, n. sp.

Pl. xxvii., fig. 85.

Dark brown, sometimes almost black, moderately shining. Upper-surface with very short, and rather sparse, golden setae.

Head with crowded reticulate punctures, a feeble median depression and two feeble tubercles. Clypeus with margins rather strongly upcurved, middle feebly incurved. Mentum with base deeply semicircularly notched, and with two rather acute processes; with dense, reticulate sculpture, becoming sub-obliterated in front. Antennae ten-jointed; basal joint strongly dilated to apex. *Prothorax* with fairly large, and rather dense, shallow punctures, each with a central pit, but becoming crowded and irregular on the sides in front, median line rather lightly defined, but with slightly larger punctures than on the adjacent surface. *Elytra* with rather large elliptic or round punctures, each with an elevated median line, the interstices with numerous sharply-defined punctures; costae distinct. *Pygidium* with a large median depression, with dense, reticulate sculpture, reduced to simple punctures at apex. Front *tibiae* quadridentate, the subbasal tooth small, the others large. Length, 20-23 mm.

Hab.—Northern Territory (Blackburn's collection), Daly River (H. Wesselman), Darwin (N. Davies); Queensland, Charters Towers (Blackburn's collection). Type, I. 2259.

Very distinct from all other known species by the large depression or fovea on the pygidium, which is distinct to the naked eye and gives that organ a bituberculate appearance (thinking this was possibly a masculine character one specimen was dissected, without an aedeagus being found); the quadridentate front tibiae is also a useful, but not unique, distinguishing feature. The five specimens before me have all simple front tarsi.

Cryptodus antennalis, n. sp.

Pl. xxv., figs. 34 and 35; pl. xxvii., fig. 86.

Dark brown and moderately shining. Upper-surface with sparse and very minute setae.

Head with dense, reticulate sculpture, becoming laminate in front; with a scarcely traceable median depression. Clypeus rather strongly elevated in front, less so on sides, the hind suture marked by a finely-elevated line, but not traceable across middle. Mentum with base deeply notched and bidentate; densely reticulate, but the sculpture subobsolete in front. Antennae ten-jointed, basal joint strongly dilated and lop-sided in front, the following joint inserted slightly nearer its base than apex. *Prothorax* with rather large and dense ring punctures, each with a central pit; median line feebly defined or absent. *Elytra* with rather large, elliptic, ring punctures, becoming smaller, denser, and rounder on sides; costae well defined. *Pygidium* with numerous ring punctures, each with a central pit, becoming crowded in corners, and almost simple at apex. Front *tibiae* strongly tridentate. Length, 16-21 mm.

Hab.—New South Wales: Mulwala, Coonabarabran (Blackburn's collection from T. G. Sloane); Queensland: Bowen (Aug. Simson's No. 4294). Type, I. 2266.

The general sculpture is somewhat as in *paradoxus*, but the surface is more polished, and the antennae are ten-jointed; the basal joint is so wide, with its tip overhanging the base of the club, that it is impossible to count the joints before dissection. The head has two very feeble elevations, and these are sometimes so ill-defined that they might fairly be regarded as absent. The punctures on the front sides of the prothorax are larger than elsewhere, and do not degenerate into crowded scratches. There are seven specimens before me, all with simple front claws.

Cryptodus angustus, n. sp.

Pl. xxvii., fig. 87.

Dark brown and shining. Upper-surface with sparse and extremely short setae.

Head with coarsely reticulate sculpture, becoming finer in front; with a shallow median depression, on each side of which is a feeble elevation. Clypeus moderately elevated in front, rather feebly on sides. Mentum with base deeply notched and strongly bidentate; with coarse reticulate sculpture, becoming finer in front. Antennae ten-jointed, basal joint strongly dilated to apex. *Prothorax* with fairly dense shallow punctures, each with a central pit, becoming crowded on the sides in front; median line feeble. *Elytra* with large, shallow, elliptic, ring punctures, becoming smaller and rounder towards sides, intérstices with rather sparse and small but sharply-defined punctures; costae rather feeble. *Pygidium* with more or less crowded ring punctures. Front *tibiae* quadridentate, the subbasal tooth small, the others strong. Length, 16-22 mm.

Hab.—Northern Territory: Darwin (Sir E. C. Stirling, N. Davies, W. K. Hunt, and Blackburn's collection); Queensland: Stewart River (W. D. Dodd). Type, I. 136.

An oblong, flat species, decidedly narrower than usual. Three of the specimens before me were doubtfully identified by Blackburn as *oblongoporus*, but that species was the first to be referred to Fairmaire's first section of the genus distinguished by having nine-jointed antennae, the front tibiae were also described as tridentate. The description of *fairmairei* was simply a comparison with *variolosus*, without the size, mentum, or antennae being mentioned; such as it is the present species differs from it in having the variolose elytral punctures deeper and sparser than on *variolosus*, the small ones on the interstices much sparser and not smaller. One specimen has some of the elliptic ring punctures, adjacent to the suture and the first discal costa, conjoined, so that they are prolonged from three to five times the normal length, without increase in width. Of the eight specimens before me seven have simple front tarsi, and from the other they are missing.

Novapus obscurus, Macl. (formerly Oryctes).

The type of this species was probably picked up dead; it is opaque and entirely covered with very minute reticulation that may often be seen on beetles that have partially rotted in damp situations; all its tarsi and one antennae are broken. It is a *Novapus*, and structurally is extremely close to the Western Australian *simplex*, but differs in the apex of clypeus, scutellum, and prothoracic excavation.

There are in the Australian Museum two specimens (sexes) from Queensland that probably belong to the species, and are in much better condition; they are both shining, with the punctures more distinct and the minute reticulation absent; the male (from Duaringa) is slightly larger than the type, with the tubercles at the apex of the clypeus rather more prominent, the cephalic horn slightly longer and thicker, and the median carina of the scutellum absent. There is an obtuse swelling at the posterior end of the prothoracic excavation on both the type and the Duaringa males, and I have seen no similar swelling on any other male of the genus.(15) The female (from Eidsvold, and there is an almost identical specimen in the South Australian Museum from Brisbane) in

(15) Since this was written I have seen a male in the National Museum from Cairns.

general appearance is much like the females of *laticollis* and *adelaidae*, but differs from them by the tip of the clypeus being bituberculate as in the male.

By the removal of this species from *Oryctes* that genus must now be expunged from Australian lists, as *barbarossa* has been transferred to *Haploscapanes*, and *mullerianus* to *Pseudoryctes*.

NOVAPUS RUGOSICOLLIS, Blackb.

Pl. xxvii., figs. 88 and 89.

There are numerous specimens of this species in the National Museum from the King River, Northern Territory, all marked as taken from termite mounds. The male, hitherto undescribed (the type was noted as a male, but this was subsequently corrected) in general appearance is very close to the male of *N. bifidus* (the types of which were also taken from termite mounds) but differs in having the cephalic horn much less conspicuously bifid, the extent of the prothoracic excavation is much the same, but its walls are more acutely carinated and in front (but not at the apex) and posteriorly (but not at the base) each carina from some directions appears to terminate as a subconical tubercle; by the males alone, however, it would probably have been considered that *bifidus* was only a varietal form; but the females are very distinct, on *bifidus* the cephalic horn is distinctly bifid; on *rugosicollis* it is briefly conical.

ANEURYSTYPUS CARINATICEPS, n. sp.

Pl. xxvii., fig. 82.

♂. Bright castaneous, some marginal parts narrowly infuscated. Under-surface, legs, base of antennae, and ocular canthi, with long rusty-red hair; elytra with a dense fringe of short pale hair, projecting downwards, and a longer fringe of stiffer redder bristles, projecting outwards, pygidium with a loose fringe of long hairs at the apex, but base glabrous.

Head with fairly dense punctures on a semicircular space behind the clypeus, base with sparse and small ones. Clypeus with semicircular, strongly-elevated margins; punctures larger than on rest of head, its hind suture marked by a strong transverse carina, subangularly elevated in its middle, and curved on each side so as not to touch the margin. Antennae ten-, club three-jointed; club very long and almost parallel-sided. *Prothorax* not twice as wide as long, a narrowly impressed line across front margin; with small scattered punctures, becoming more numerous, but not crowded towards sides in front. *Scutellum* almost impunctate. *Elytra* with a rather deep subsutural stria, elsewhere striation very ill-defined, but the punctures in subgeminate rows.

Pygidium with fairly dense punctures about base, but sparse elsewhere. Front *tibiae* strongly tridentate; claws long, thin, and equal. Length, 14-15 mm.

Hab.—Queensland: Capella (Relton collection). Type in Queensland Museum, cotype, I. 10768, in South Australian Museum.

In general appearance like *inermicollis*, but the clypeus is more semicircular, and the transverse carina is subangularly elevated in the middle; *pachypus* has the clypeus transverse, carina and legs very different; *pilosicollis* is much smaller, head very different, and prothorax conspicuously clothed; *laevis* is much smaller, with the carina not elevated in middle, etc.; the males of all the other described species have the prothorax armed in front. The club of the antennae is distinctly longer than the front tibiae; the elytral punctures are rather small and are rather distantly placed in rows, the gemination of these being very feeble. Under a fairly high power the whole upper-surface and the pygidium appear to be very finely shagreened, and as a result less shining than on other species of the genus. Both specimens appear to have feeble remnants of a wide median line on the prothorax, but these are possibly due to irregular contraction.

CORYNOPHYLLUS CURVICORNIS, n. sp.

Pl. xxvii., fig. 81.

♂. Bright castaneous, parts of head and tibiae, and margins of prothorax of scutellum and of elytra more or less infuscated. Under-surface, legs, basal joint of antennae, and ocular canthi with long, rusty-red hair, elytra with a rather dense fringe of short pale hair projecting downwards, and a somewhat longer fringe of sparser and darker hairs projecting outwards; pygidium fringed with hairs, at the base rather short and irregular, at the apex longer and regular.

Head with a strong and acute recurved horn between eyes, with sharply-defined but not very large punctures. Clypeus semicircular, margins rather strongly and equally upcurved. Ocular canthi wide, rather flat; with shallow and dense, subasperate punctures. Antennae ten-, club three-jointed; club widely subelliptic-ovate, about as long as width of head at base. *Prothorax* with a wide and deep excavation, front angles acutely produced, the hind ones widely obtuse; with rather small and sparse but sharply-defined punctures, becoming somewhat larger and denser on parts of sides. *Scutellum* impunctate. *Elytra* not much longer than wide; with subgeminate, but more or less irregular rows of fairly large ring punctures, usually in very feeble striae. *Pygidium* with sparse but distinct punctures, becoming crowded and shallow in corners. Front *tibiae* strongly tridentate; claws long, thin, and equal. Length, 16 mm.

Hab.—Queensland: Maryborough (H. J. Carter from A. Steven). Type (unique), I. 10766.

The raised margin of the clypeus forms an almost true semicircle, as on several species of *Aneurystypus*, more distinctly so than on *C. modestus*, or on a species which is probably *C. metallicola*, with which it would be associated by the simple cephalic horn, but the horn is much longer than on either of those species, and the prothoracic excavation is much larger; the club of the antennae is as long as in *modestus* or *fortnumi*, but not so wide, although less parallel-sided than on the species of *Aneurystypus*. The horn from its base in front is about as long as the head is wide across the eyes, it curves back well over the front margin of the prothorax. The excavation occupies about half the width and about two-thirds the length of the prothorax, at the middle of its hind border it has a short semicircular extension, the front corners of which, from some directions, appear subtuberculate; the front margin is without a median tubercle.

METANASTES BICORNIS, n. sp.

Pl. xxvii., figs. 83 and 84.

♂. Black, highly polished; parts of appendages obscurely diluted with red.

Head widely excavated and with a few punctures between eyes; with two stout curved horns in front; clypeus quadrisinuate in front. Antennae ten-, club three-jointed. *Prothorax* strongly and evenly convex, sides gently rounded and not much wider at base than at apex; marginal stria narrow, with a small median node near the apex; impunctate. *Elytra* as wide as prothorax, and about twice as long; with rather shallow ring punctures in feeble striae, but about apex rather crowded, an almost impunctate space near each side. *Prosternum* with a strongly elevated, subcylindrical process, crowned with reddish bristles, behind coxae. Front *tibiae* with three strong, and two or three small teeth; front claws unequal. Length, 21-22 mm.

♀. Differs in having the excavation on the head much smaller, the horns reduced to feeble elevations, the small prothoracic node absent, and the front claws equal.

Hab.—New South Wales (J. S. Clark); Queensland: Yandella (F. A. Gore); Brisbane (C. Wild). Type, I.10765.

The fringe at the apex of the hind tibiae is composed of but few short and stout processes (they are too stout to be regarded as setae) but as they are detachable no doubt the hind margin may be regarded as ciliate; this being the case the species (in an unpublished table by the late Rev. T. Blackburn) could only be referred to *Metanastes*. Excluding the head the general appearance of the species is like a very large *Metanastes australis*, Blackb., and the curious process behind the front coxae is much the same as on that species, but the head is very different, and there are many other slight differences. Of the four specimens before me one has a median line very faintly indicated on the pronotum, two have it just traceable about the base, and from the other it is absent. The front claws of the female are simple; on the male one claw is much thicker than the other and much more curved; on the front tibiae there are two strong teeth, then a small one, then a large one, and then one or two small ones; the pygidium has dense punctures on both sexes, but on the female they are larger and more crowded than on the male, and the female has on it a conspicuous transverse ridge that is barely indicated on the male. The horns on the head of the male are rather more than half the length of the front tibiae on two specimens, but are rather less on the type.

Chlorobapta frontalis, Don.

Pl. xxvii., fig. 90.

There are in the National Museum two males from Kookynie and Norseman, and one in the South Australian Museum from Ankertell, that I cannot satisfy myself are really distinct from *frontalis;* but they differ from the more ordinary forms of that species in having the submedian tooth of the front tibiae much more acute, and the strigae of the pygidium more conspicuous. The markings are of a clear sulphur-yellow, not the dingy shade of yellow that the green markings often turn to with age or improper treatment, and Mr. Horace W. Brown assures me this is the natural colour of living specimens; *frontalis*, however, is such an extremely variable species, that it does not appear desirable to describe these specimens as representing a new species, or even to give them a varietal name.

Diaphonia euclensis, Blackb.

Mr. W. du Boulay has a specimen of this species in which the prothoracic blotch is reduced to a slight infuscation at the apical third.

Anoplognathus prasinus, Cast., formerly Paranonca.(16)

Pl. xxvii., fig. 68.

The history of this species is somewhat complicated; at one time it was regarded as a New Zealand species, and a

(16) Hist. Nat., ii., 1835-40, p. 143.

synonym of *Stethaspis* (now *Chlorochiton) suturalis* of the Melolonthides, but Lansberge, followed by Arrow and Ohaus, referred it to the Rutelides. There are specimens of it in the Museum from the Richmond River (New South Wales) and Caloundra (Queensland); in general appearance it is like a short thick-bodied female of *Stethaspis eucalypti (Xylonychus)*, but it differs in many details of sculpture, and particularly in the metasternum and claws.

ANOPLOGNATHUS SMARAGDINUS, Ohaus.

Calloodes prasinus, Macl.

Pl. xxvii., figs. 69 and 70.

As the front tibiae of *Calloodes prasinus*, Macl., are not unidentate, Ohaus referred the species to *Anoplognathus*, and there being already a *prasinus* in that genus he altered the name to *smaragdinus*.[17]

ANOPLOGNATHUS MULTISERIATUS, n. sp.

Pl. xxv., fig. 36; pl. xxvii., fig. 67.

Of a rather dark olive-green and highly polished; legs reddish with a coppery gloss, tarsi darker, antennae, palpi, and tip of mesosternal projection reddish. Upper-surface glabrous, pygidium uniformly clothed with depressed white hairs or setae, becoming longer and denser on sterna, and sparser along middle of abdomen.

Head rather wide and lightly convex; with small and sparse but sharply-defined punctures near base, becoming larger in front. Clypeus about thrice as wide as long, front margin moderately, the sides lightly upturned; with rather crowded punctures. *Prothorax* about twice as wide as long, front angles subacute, hind ones obtuse, base trisinuate, the median sinus narrower than scutellum; punctures rather small and not very dense, becoming coarse and crowded on sides, with a narrow and scarcely depressed but impunctate median line. *Elytra* slightly wider than prothorax, apex truncate; with crowded rows of large punctures, becoming more regular towards sides. *Pygidium* with crowded punctures transversely arranged. Intercoxal process of *metasternum* long and acute. Front *tibiae* tridentate, apical tooth long and acute, second triangular and rather large, the other obtuse, claws uneven, the larger front one conspicuously bifid at apex. Length, 21 mm.

Hab.—Queensland: Bribie Island (H. Hacker). Type (unique), in Queensland Museum.

A rather small, strongly punctured species, not very close to any other known to me; of the other green species it may be

(17) Stett. Ent. Zeit., 1904, p. 90.

distinguished from *aeneus* (Waterhouse) by its much smaller size, very different clypeus and partly red legs, from *punctulatus* (Olliff) and *prasinus* (Macleay) by the more robust build, much coarser punctures, and very different clypeus, from the species identified by Ohaus as *prasinus* (Castelnau) by the much darker green without pale margins, elytra without regular striae, and by the different punctures and clypeus. From some directions the prothoracic margins and median line, scutellum, and the suture and margins of elytra appear to be of a brighter green than the adjacent parts. There are no distinct discal striae on the elytra, but to the naked eye the punctures appear to be packed together in close rows, about eighteen rows on each elytron, they are frequently transversely conjoined, and there are often strong punctures on the interstices between the rows; they are coarser than on any other species, except *velutinus*, but are not interspersed with foveae as on *porosus* and *olivieri*.

Calloodes nitidissimus, n. sp.

Pl. xxvii., figs. 71 and 72.

♂. Bright metallic-green and highly polished; antennae dull red, club darker. Upper-surface glabrous; pygidium evenly clothed with depressed white hairs or setae, these becoming dense on parts of sterna and sides of abdomen, legs sparsely clothed, a row of reddish bristles on front femora.

Head wide, obliquely flattened in front; with sparse and rather small but sharply-defined punctures. Clypeus about twice and one-half as wide as long, front margin rather strongly upturned; punctures distinct only on sides, hind suture feebly sinuous. *Prothorax* about twice as wide as long, gently convex, front angles acute, hind ones almost rectangular, base trisinuate, all margins thickened except close to scutellum and in middle of apex; punctures very small and sparse in middle, becoming larger (but still small) and denser on sides. *Scutellum* with sparse and minute punctures. *Elytra* with outlines continuous with those of prothorax, each elytron subtriangularly produced and finely serrated at inner apex, without discal striae, but with a narrow one on each side and a feeble one near apical half of suture; punctures very small and sparse, towards sides becoming lineate in arrangement. *Pygidium* with dense and fine sublaminate punctures. Front *tibiae* with a strong apical tooth only; claws unequal but simple. Length (♂, ♀), 20-23 mm.

♀. Differs in having a conspicuous brassy gloss, the clypeus considerably wider, less upturned in front, and with larger and denser punctures, the punctures behind its hind suture are also larger and denser, the club of the antennae is smaller, and there is a very slight projection on the smaller front claw.

Hab.—Queensland: Coen River (Blackburn collection and W. D. Dodd), Claudie River (J. A. Kershaw). Type, I. 1911.

The unidentate front tibiae renders it certain that this species should be referred to *Calloodes*, instead of to *Anoplognathus;* the size and shape are much as those of *atkinsoni*, but the margins of the prothorax and elytra are not purplish, and the clypeus has less strongly upturned margins (these in some lights appear to be diluted with red); *rayneri* has reddish legs, considerably larger, although small punctures, and differs in many other respects. On the male the coppery tinge is scarcely in evidence, but on the females it is very conspicuous, and their elytra in some lights appear to glow fiery-red; the abdomen and front coxae of the only male under examination are partly reddish, but this may be due to immaturity; the sides of the elytra are feebly wrinkled, the production of their apices is not a sexual character; all the specimens have a curious appearance as of being covered with wet varnish.

Repsimus manicatus, Sw.

The form with red prothorax, and hind tibiae in the male greatly dilated to the apex, and more than twice the width of the base, was considered by Ohaus as not the real *manicatus*, but *aeneus* [18]; in this he differed from several previous workers, and here I regard that form as *manicatus*.

var. montanus, n. var.

On several of the higher mountains in Victoria, and on Mount Kosciusko in New South Wales, a form occurs whose upper-surface in entirely brassy-green, or with only the sides of the prothorax obscurely diluted with red, but with the red legs and greatly dilated hind tibiae of the preceding form. Seen from behind the whole upper-surface of some specimens appears blackish-purple. The general colour is very similar to that of many small specimens of *purpureipes*, but on that species the hind tibiae of the male are scarcely thicker at the apex than in the middle. Mr. Davey took numerous specimens at Bright, in Victoria.

Schizognathus viridiaeneus, Ohaus.

Pl. xxvii., figs. 74 and 75.

The female of this species was unknown to Ohaus. Two specimens (sexes) were received from Bryon Bay (New South

(18) Stett. Ent. Zeit., 1904, p. 70, pl. i., fig. 8.

Wales); of these the male agrees perfectly with a male bearing Mr. Arrow's identification label as *viridiaeneus*, and with the position assigned to it in the table by Ohaus; the basal joint of its front tarsi is but slightly longer than the second joint (from above it appears to be no longer). The female differs in being more robust, its clypeus red, with its sides almost evenly decreasing in width to apex, which is upturned with the corners rounded off; the front tarsi are thinner, with the basal joint more than twice the length of the second, and the larger claw-joint cleft. By Ohaus's table it would be referred to *lucidus*, of which the female is unknown to me, but the male is very distinct from the male of *viridiaeneus*.

Schizognathus burmeisteri, Ohaus.

Pl. xxvii., fig. 73.

This species occurs in Victoria (Gippsland) as well as in New South Wales (Galston) and Queensland.

Mimadoretus niveosquamosus, n. sp.

Pl. xxvii., fig. 76.

♀. Dark piceous-brown, with a metallic-green gloss; elytra, antennae, palpi, and most of legs more or less castaneous. Moderately clothed with thin, white, depressed scales or setae, becoming dense on pygidium and under-surface.

Head with large, sharply-defined punctures, rather dense near clypeal suture, smaller and sparser near base. Clypeus transversely oblong, about thrice as wide as long, margins moderately upcurved; with crowded, asperate punctures. Antennae ten-, club three-jointed. *Prothorax* scarcely twice as wide as long, sides rather strongly rounded, front angles produced and subacute, hind ones subrectangular; middle with rather sparse and small but sharply-defined punctures, becoming larger and denser on sides. *Scutellum* with a few submarginal punctures. *Elytra* gently dilated to beyond the middle, each widely separately rounded at apex; each with thirteen well-defined striae, containing distinct punctures, interstices smooth and almost impunctate. *Pygidium* with dense but normally concealed punctures. *Prosternum* with a conspicuous elevation at base, produced to between middle of front coxae. Mesosternum with a triangular process, not passing middle of coxae. Front *tibiae* strongly bidentate; basal joint of front tarsi as long as the three following combined, larger claw-joint cleft at apex. Length, 12-14 mm.

Hab.—Queensland: South Johnstone River (H. W. Brown). Type, I. 10769.

The greenish gloss is very conspicuous on the scutellum and margins of prothorax. The scales on the elytra are almost confined to the sides of the striae, on the prothorax of one specimen they are fairly evenly distributed, but they are almost absent (no doubt from abrasion) from the median third of another. I have not been able to see the front of the lower lip clearly, but it appears to be obtusely pointed in the middle, in this respect differing from the typical species, *flavomaculatus;* but the ten-jointed antennae, shape of clypeus, processes between front and middle coxae, bidentate front tibiae, and larger front claw cleft in the female, with the scaly body, indicate that it is either a *Mimadoretus* or extremely close to that genus.

MIMADORETUS LEUCOTHYREUS, n. sp.

Pl. xxvii., fig. 77.

♂. Of a rather dark castaneous; antennae, palpi, and parts of legs paler. Somewhat irregularly clothed with white hairs.

Head rather convex; with dense and moderately large punctures, becoming smaller and sharply defined about base. Clypeus transversely suboblong, about twice as wide as long, front margin gently incurved to middle and moderately upturned, sides very feebly upturned; punctures much the same in front of, as behind the suture. Antennae ten-, club three-jointed; club as long as clypeus is wide. *Prothorax* rather strongly convex, about once and one-half as wide as long, sides subangularly dilated in middle, front angles subacute, hind ones obtuse; with moderately large and fairly numerous punctures in middle, becoming denser and larger on sides. *Scutellum* with dense, concealed punctures. *Elytra* slightly wider than prothorax, apex almost truncate; each with thirteen rather deep and regular striae containing punctures, these rather large at base, sides, and apex, but mostly smaller elsewhere; interstices almost impunctate. *Pygidium* with crowded, partially concealed punctures. *Prosternum* with a narrow wedge-shaped process extending to between coxae. Mesosternum with a triangular process between coxae. Front *tibiae* tridentate, apical tooth long, curved, and acute, second triangular and rather large, third feeble; basal joint of front tarsi slightly longer than second, claws long, thin, and unequal, but simple. Length, 11 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type, I. 4853.

Two specimens were obtained, on one of which there is a vague greenish gloss on part of the prothorax. The upper portion of the head is almost glabrous; on the prothorax there are numerous subdepressed hairs on the sides, but the median third is almost glabrous, the scutellum is densely clothed, on the elytra the hairs are fairly numerous, but mostly arise from the sides of the striae, on the margins they are denser, on the pygidium the depressed hairs are rather less dense than on the scutellum, and there is a marginal fringe of long ones; on the under-surface and legs the hairs are long, rather dense and erect. The humeral callosities are almost impunctate. The feebly incurved apex of lower lip, ten-jointed antennae, processes between front and middle coxae and clothed (although not scaly) body, indicate that this species also belongs to *Mimadoretus* or is extremely close to it, despite the tridentate front tibiae, of which, however, the tooth nearest the base is due more to the emargination between it and the second one, than to a projecting part of the tibia itself; they certainly do not belong to *Mimela*. On the present species the two joints before the club are so close together that from some directions the antennae appear to be composed of but nine joints.

Adoretus, Cast., Hist. Nat. Col., ii., p. 142; Lacord., iii., p. 380.

This genus apparently has not been previously recorded from Australia, it may be readily distinguished from all other Australian genera of Rutelides by the labrum being produced in a curved process, usually with crenulated sides, over the labrum. The general appearance of the species described below is like some *Melolonthides* allied to *Heteronyx* with unusually large eyes.

Adoretus melvillensis, n. sp.

Pl. xxvii., fig. 78.

♂. Smoky-brown, head darker between eyes, parts of elytra, and most of legs and antennae somewhat flavous. Evenly but not very densely clothed with depressed whitish pubescence, becoming longer on pygidium, parts of under-surface and legs; a dense and somewhat golden fringe on clypeus.

Head wide and moderately convex; with rather dense, shallow, and frequently transversely-confluent punctures. Clypeus semicircular, margins strongly elevated; punctures subgranulate, and more sharply defined than on rest of head. Eyes very large. Labrum with numerous, small acute granules, sides of its produced part black and crenulate. *Prothorax* more than thrice as wide as long, sides gently rounded and finely serrated; punctures much as on head between eyes. *Elytra* very little wider than prothorax, each with four discal costae, the first and second extending from base to near apex, the third shorter, the fourth (near the margin) still shorter, punctures of moderate size but shallow, almost regular close to the costae, irregular elsewhere. *Pygidium* with dense asperate punctures. Front *tibiae* strongly tridentate, the teeth black-tipped and close together, basal joint of front tarsi about as long as two following combined, claws long, simple, and unequal. Length, 11 mm.

Hab.—Northern Territory: Melville Island (W. D. Dodd). Type (unique), I. 4854.

The hairs composing the fringe on the clypeus are all depressed and directed backwards. All the elevated parts of the elytra are distinctly paler than the depressed parts.

Since the above was written I have examined some specimens from the King and Roper Rivers in the National Museum; these vary in length from 10 to 12 mm., and in colour from that of the type to having the upper-surface (the shoulders and subapical callosities excepted) black; two are females and have the larger of the front claws slightly cleft, their colour varies as in the males and the clypeal fringe is much the same.

Saulostomus mimicus, n. sp.

Pl. xxvii., figs. 79 and 80.

♂. Bright castaneous, tibial teeth and some marginal parts darker. Under-surface, legs, base of antennae, and ocular canthi, with long, rusty-red hair, pygidium with depressed but long pubescence, and with long straggling hairs, elytra fringed with reddish setae, directed outwards, and with a thin membrane directed downwards.

Head with sharply-defined and rather sparse punctures about base, becoming rather dense in front, and crowded but less sharply defined on clypeus. Clypeus semicircular, margin moderately upturned in front, less so on sides, hind suture slightly arched, the convex side directed to the front. Antennae ten-, club three-jointed; club long, almost parallel-sided, distinctly longer than front tibiae. *Prothorax* about thrice as wide as long, sides rather strongly and evenly rounded, not much wider at base than at apex, front angles subacute, hind ones rounded off, all margins narrowly impressed except in middle of base; punctures of moderate size, sharply impressed and nowhere dense, even on sides, interspersed with numerous minute ones. *Scutellum* with two kinds of punctures as on prothorax. *Elytra* with conspicuous, but irregular geminate rows of fairly large punctures, in moderate or feeble striae, the interstices also with rather large punctures, numerous small punctures scattered about. *Pygidium* with dense and rather shallow transverse punctures. Front *tibiae* strongly and acutely tridentate; claws unequal but simple. Length (♂, ♀), 13-16 mm.

♀. Differs in being more robust, head with crowded punctures except at extreme base, where only are they individually distinct, clypeus more transverse, club of antennae less parallel-sided and only about two-thirds of the length of front tibiae, prothorax with larger and more numerous punctures, and the larger claw of the front tarsi conspicuously cleft at apex.

Hab.—Queensland: Cunnamulla (H. Hardcastle).

Close to *S. collaris*, and like that species in general appearance strikingly resembling several species of *Aneurystypus*, (to which genus *collaris* was originally referred by Blackburn), but the male differs in being consistently larger and with different punctures on the head; on the present species the punctures from the clypeal suture to the base are all sharply defined, and non-confluent; on *collaris* they are crowded and confluent behind the suture, but become isolated towards the base, the differences being pronounced between five males of each species; there are other slight differences of the antennae and legs. In general appearance and structurally it is close to *S. weiskei*, but without the least metallic gloss, the prothorax smaller and with larger punctures, those on the head larger and clypeus less strongly narrowed in front. From *S. villosus* it is distinguished by its glabrous upper-surface and from the description of *S. felschei* by its very different colour. Mr. Hardcastle obtained numerous males at lights, but only one female.

DASCILLIDAE.

Macrohelodes.

The species of this genus are usually very variable in colour, and to a certain extent in size; Tasmanian specimens are also usually larger, and frequently darker than mainland ones of the same species.

Macrohelodes lucidus, Blackb.

The type of this species was described as having the upper-surface black, except for the narrowly reddish suture of elytra. Of two cotypes in the Museum one is of a very dark brown, with a slight bluish gloss, and the suture somewhat paler, but the second specimen is paler. Other specimens vary from a rather bright-castaneous to almost black, with the suture uniform in colour with the rest of the upper-surface. The species may be readily distinguished from all others by its polished and almost impunctate elytra, and by a small marginal fovea at the basal third of each elytron (not mentioned in the original descriptions). It occurs from Nelson, in Victoria, to Stradbroke Island, in Queensland.

MACROHELODES PRINCEPS, Blackb.

I have seen no specimen agreeing with the description of this species, the type of which is now in the British Museum; should it prove to belong to the same species as *crassus*, it has precedence over that name.

MACROHELODES CRASSUS, Blackb.
var. *intricatus*, Blackb.
var. *gravis*, Blackb.
var. *tasmanicus*, Blackb.
var. *niger*, Lea.

This appears to be the most variable Australian species of the family, as it ranges from specimens having the upper-surface entirely pale, to those having it entirely black, and

where markings are present these are often asymmetrical; in size it ranges from 6·5 to 10 mm., the average of New South Wales specimens being about 7, those of Tasmania about 9. Two specimens from the Blue Mountains (figs. A and B) were standing in the Blackburn collection as *crassus;* two from Blackheath (figs. C and D) differ in having the median spot or fascia broken up into two, and one (fig. C) has the subapical spot broken up into two. A small specimen from Ebor (fig. E) has the humeral spot greatly reduced in size, and one (fig. F) from New South Wales, and another from the Endeavour River, have the markings (except the humeral one) absent. Tasmanian specimens frequently have the dark elytral markings, except the humeral ones, all conjoined (as in fig. G), or even extended (as in fig. H), with all conjoined, only rarely are they as in fig. I; in fig. J is shown a form in which the markings are irregularly broken up but black, on many specimens, however, the markings are broken up into indeterminate brown specks and blotches, which gradually become fainter till the elytra are entirely pale. In fig K the markings are reduced to three clusters, and there are many specimens with other markings before me. Although I have only given patterns of the elytra it is to be noted that the prothoracic markings are also very variable; in the patterns the elytra are drawn somewhat obliquely from the sides, this causing the scutellar notch to appear smaller than it really is, and the suture to appear somewhat curved.

intricatus, Blackb. Blackburn thought this form was possibly a variety of *crassus*, and this I think is the case; of three specimens standing in his collection one has markings approaching those of fig. J, but less sharply defined, usually on the variety only the humeral spot (as in fig. F), is left, and not always that.

gravis, Blackb. This is an entirely pale form, which Blackburn considered distinct by its colour, by the obsoletely costate elytra and by the punctures. Although many specimens appear to have each elytron obsoletely tricostate, this appearance is really due to three vague longitudinal pale stripes on each; the punctures are subject to a certain amount of variation, but their apparent size is considerably altered by waterlogging (as on many specimens of *Cordus hospes*); their real size may be noticed by looking at them obliquely.

tasmanicus, Blackb. This is a fairly common form in Tasmania. I cannot follow Blackburn in regarding its antennae as essentially different from those of *crassus*; comparing New South Wales and Tasmanian specimens side by side with antennae *in the same position*, no such differences as he denotes are distinct, but comparing a specimen with antennae gummed to the card, and one with them free apparent differences may be seen, this being partly due to matting of pubescence.

niger, Lea. This is the extreme form on the dark side, as *gravis* is on the pale side. The type was from King Island, but there are specimens in the Museum from Flinders Island and Tasmania (George Town and Sheffield).

Macrohelodes montanus, n. sp.

Head black; prothorax reddish, lateral and apical margins paler, base narrowly infuscated; elytra of a dingy flavo-testaceous, sides paler, shoulders and suture black or infuscated; mesosternum, metasternum, and part of abdomen black or blackish, rest of abdomen of a dingy red; legs reddish, parts of tarsi infuscated. Under-surface and legs densely and finely pubescent, upper-surface glabrous.

Head with crowded and sharply-defined punctures, a shallow depression near each eye. Antennae extending to hind coxae, second joint shorter than third, their combined length about equal to fourth. *Prothorax* more than thrice as wide as the median length; with crowded punctures, slightly larger than on head, and much as on scutellum. *Elytra* not much wider than prothorax, but about six times its length; with crowded punctures not quite as dense, but larger than on prothorax. *Under-surface* with dense and minute punctures. *Tibiae* finely spurred at apex. Length, 4·5-6 mm.

Hab.—Tasmania: Mount Wellington, including the summit (Aug. Simson and A. M. Lea), Cradle Mountain (H. J. Carter and Lea), Devonport (Simson), Magnet (O. L. Adams). Type, I. 10686.

An elliptic species, readily distinguished from all others of the genus by its consistently smaller size, more depressed form, and much denser punctures, notably of the pronotum. The colour of the majority of the specimens under examination is as above noted, but the prothorax sometimes has two, four, or more infuscated spots, the scutellum is usually black, the dark spot on each shoulder may be sharply defined and small, or less defined and continued as a vague stripe to well beyond the middle, on such specimens the pale sides are very conspicuous, the sutural infuscation is usually very narrow. One specimen, from Magnet, has the prothorax black, except for the narrowly pale sides and apex, the dark humeral marking is continued almost to the apex, but beyond the middle breaks up into a series of infuscate spots, and there are numerous other feeble spots on the disk. Another specimen, from Mount Wellington, has the prothorax red, with pale margins and a few indeterminate dark spots about the base; its elytra are black, except for a narrow flavous stripe on each side, and a small transverse flavous spot, between the scutellum and each shoulder.

Sclerocyphon maculatus, Blackb.

The markings of this species (which occurs from the Alpine district of Victoria to Cairns in North Queensland, although apparently nowhere common) vary considerably, but on the prothorax the sides are usually flavous, with the median third blackish.

Sclerocyphon basicollis, Lea.

Two specimens from North Queensland (Blackburn collection), and Toowoomba (Queensland Museum), differ from the type in having the pale pubescence on the pronotum extended so as to cover the base with the exception of three spots, which by contrast with the rest of the surface appear black. The Toowoomba specimen has the elytra of a dingy red, irregularly mottled with brown.

Sclerocyphon aquaticus, n. sp.

Black; extreme margins of prothorax and of elytra, and parts of legs obscurely reddish. Upper-surface irregularly clothed with ashen pubescence, under-surface densely and uniformly clothed.

Head gently convex in middle; with small, dense, almost concealed punctures. Antennae not extending to middle coxae, third joint scarcely longer than fourth, but conspicuously longer than second. *Prothorax* about thrice as wide as the median length, sides curved, thin, and much wider at base than at apex, front rather deeply emarginate for reception of head, median line feebly defined in front, distinct on basal half, with a small, shallow, transverse impression on each side of middle, and several elsewhere; punctures dense and minute. *Elytra* at base the width of prothorax, sides gently dilated to beyond the middle, and narrowly margined, at about the basal third with a fairly large but very shallow marginal depression; punctures as on prothorax. Length, 6-7 mm.

Hab.—Tasmania: Waratah (H. J. Carter and A. M. Lea). Type, I. 10687.

In searching for Parnidae at Waratah Mr. Carter pulled out a log from the water and obtained a specimen of this species from an immersed part of it; a few minutes afterwards I obtained two more in the same way. The clothing of their upper-surface has a somewhat spotted appearance, as if the derm had been irregularly abraded, although I am satisfied they are in perfect condition; the type has an appearance as of having a feeble median fascia, on a second specimen (returned to Mr. Carter) this appearance is less defined; on the third most of the clothing is blackish, but there are several distinct pale spots, and beneath these the derm itself is reddish, there being quite a conspicuous angular spot about the middle of each elytron. The general outlines are briefly elliptic; the junction of the prothorax with the scutellum and elytra is very finely serrated; the elytra in parts about the suture are very finely transversely wrinkled.

Two specimens from Hobart (A. M. Lea) agree in structure with the type, but have the elytra reddish, with many infuscated spots or blotches, and these, with the pale patches of clothing, give them a curiously speckled appearance; the prothorax has the sides rather widely diluted with red; the under-surface is reddish, except for the metasternum and for three black spots on each of the second to fourth segments of abdomen. A specimen from Brighton (Simson's collection) may also belong to the species, but is of an almost uniform rusty-brown colour, with the pubescence on the upper-surface scarcely variegated; the median line of its prothorax is less distinct than on the type, and the two small submedian transverse impressions are just traceable. A specimen from the Tasmanian Lakes (Blackburn's collection) in colour is very similar to one of the Hobart specimens, but the prothoracic impressions are even less distinct than on the one from Brighton. Looking at these specimens from a distance the elytra of each of the seven appear to have two thin and more or less vague pale fasciae: one about the middle, the other half-way between the first and the apex.

MALACODERMIDAE.

Carphurus myrmecophilus, n. sp.

♂. Red; elytra (suture excepted), mesosternum, metasternum, and parts of abdomen and of legs more or less deeply infuscated. With numerous long, straggling, dark hairs, more numerous on elytra and abdomen than elsewhere.

Head with two feeble longitudinal depressions between eyes, bounded by obscure ridges, the latter transversely conjoined behind eyes; with fairly dense but somewhat irregular punctures. Eyes rather small, but lateral and prominent. Antennae extending to about middle of elytra, first joint moderately stout, about as long as second and third combined, second subglolular but slightly wider than long, third slightly wider and larger, third-tenth subequal in length, fourth-tenth conspicuously wider than long, each joined to the middle of the preceding one by a thin stalk, eleventh distinctly longer than tenth, its tip bilobed. *Prothorax* slightly wider than long, sides evenly rounded, base depressed; almost impunctate. *Elytra* not much longer than their greatest width, which is just beyond the middle; with numerous shallow punctures and feeble granules. *Legs* moderately long, basal joint of front tarsi with a narrow black rim at outer apex. Length, 4·50-5 mm.

Hab.—South Australia: Lucindale, several specimens from a nest of *Iridomyrmex detectus* (B. A. Feuerheerdt). Type, I. 10680.

The elytra on one of the specimens are almost black, with a slight bluish gloss; the apical segment of the abdomen is entirely pale, the others have the sides and tips pale; the four hind femora are more or less deeply infuscated, and the infuscation sometimes extends to other parts of the legs. The elytra from some directions appear to be feebly wrinkled, the punctures and granules are not very sharply defined, although sufficiently distinct. The female (not taken by Mr. Feuerheerdt) will probably be found to have the head smooth and the basal joint of the front tarsi simple.

The generic distinctions between *Carphurus*, *Helcogaster*, and *Neocarphurus* are comparatively trifling, but still with long series of each seem quite satisfactory, and they may be readily separated at a glance; but the present species, except for the antennae, seems intermediate between *Carphurus* and *Helcogaster;* the fourth-tenth joints of its antennae, however, are conspicuously wider than long (not due to serrations or rami), this being at variance with all other brachelytrous Malacodermidae with exsertile vesicles. The species should perhaps have been regarded as the type of a new genus.

PTINIDAE.

Enasiba tristis, Oll.

Pl. xxv., figs. 37 and 38.

Mr. Clark has taken, near the Swan River, several specimens of this species from nests of the twig-mound ant *(Iridomyrmex conifera).* They vary in length from 3·5 to 4 mm., and in colour from piceous to deep shining black, with the legs more or less reddish. They all have four small short yellow fasciae on the subbasal impression of the prothorax: two marking the end of the median line, and one on each side. The antennae are peculiar, and from the side (pl. xxv., fig. 38) agree with Olliff's description, but from above they look very different (fig. 37).

Enasiba tristis, Oll.

Polyplocotes carinaticeps, n. sp.

Pl. xxv., fig. 39.

Castaneous, elytra, abdomen, and tip of antennae somewhat paler than other parts. Glabrous.

Head opaque, and with dense punctures; with a narrow median line from antennae to base, from antennae to lip with a strongly elevated narrow ridge. Antennae rather short, first joint stout, second rather short, its base partly concealed by apex of first, third to seventh submoniliform, eighth and ninth indistinctly separated, at the base slightly wider than seventh, the tip truncated. *Prothorax* about as long as wide, with a large deep excavation on basal two-thirds, an impression connecting the fovea with each side, a strong acute tooth on each side near apex, with dense (sometimes punctate) striae, mostly converging to the excavation. *Elytra* subovate, base truncate and very little wider than prothorax; with regular rows of distinct and rather small punctures. *Mesosternum* with a narrow intercoxal process extending on to metasternum. *Legs* rather long and thin. Length, 1·5 mm.

Hab.—Western Australia: Swan River, eight specimens from nests of ants, *Cremastogaster conifera* (J. S. Clark).

The strong frontal crest has a rounded outline; the lower cheeks are each greatly expanded as a thin flange. The antennae at first appear to be composed of but eight joints, as the two apical ones are so close together that it is difficult to see the dividing line; on examining the under-surface of the basal joints under a compound power there appears to be a minute joint at the base of the apparent second, but it may not be a true joint. The lateral tooth on each side of the prothorax is nearer the apex than is usual in the allied genera, and in addition there is a very small process on each side at the exact middle. The abdomen of both specimens is widely depressed (probably a masculine feature), its first segment is very short and indistinctly separated from the metasternum, the second is large, its sutures with the first and third indistinct across the middle, but distinct at the sides (as a result, along the middle, the abdomen at first glance appears to be composed of but three segments), the third and fifth are much shorter, and the fourth still shorter. There is some special golden pubescence on the prosternum, but it does not extend to the metasternum or abdomen.

This species might have been regarded as belonging to a new genus, but if true inquilines were to be treated as ordinary Coleoptera, it would be necessary to propose almost as many genera as there are species.

Polyplocotes scabricollis, Lea.

By the favour of Mr. G. F. Hill the type and only known specimen of this species is now in the South Australian Museum.

Diphobia longicornis, n. sp.

Pl. xxv., fig. 40.

Castaneous, head and prothorax somewhat darker than other parts. Upper-surface with sparse and short, semierect setae.

Head with small dense punctures; with a shallow median line. Antennae long and thin, first joint rather stout, second with its base curved under apex of first, third distinctly longer than fourth, fifth-tenth moniliform, eleventh cylindrical, about as long as three preceding combined. *Prothorax* distinctly longer than wide, with a deep post-median transverse impression, marked at its middle by a deep fovea and towards each side by a smaller one; densely strigose. *Elytra* ovate, strongly convex, base truncate, not much wider than prothorax, and with six small deep foveae; with rows of small punctures, the interstices also punctate. *Metasternum* shining, and with fairly large, asperate punctures. *Abdomen* with small punctures in middle of two basal segments, becoming larger and asperate at sides, and on the whole of the third segment. *Legs* long and thin. Length, 1·75-2·25 mm.

Hab.—Western Australia: Swan River, five specimens from nests of the twig-mound ant, *Iridomyrmex* sp. (J. S. Clark). Type, I. 10653.

Readily distinguished from all other species of the genus by the long terminal joint of the antennae. The sterna and abdomen are glabrous. The femora are grooved throughout their length, on the under-surface, for the reception of the tibiae.

Ectrephes formicarum, Pasc.

Pl. xxv., figs. 41 and 42.

Mr. Clark has taken this species, about the Swan River, in abundance from nests of *Iridomyrmex conifera*, and one specimen from a nest of the green-head ant *(Ectatomma metallicum)*. These vary in length from 1·25 to 2·25 mm. Of the clothing Pascoe says "elytris . . . pilis minutis erectis valde dispersis." King (of its synonym *Anapestus kreusleri)* says "sub lente setosus." The clothing seems to be particularly liable to abrasion as most of the specimens before me are almost or quite glabrous on the upper-surface; on one specimen there were numerous fairly long hairs on the prothorax and elytra, but on floating it off for examination most of the hairs were lost; on three specimens there are still a few hairs left on the upper-surface. The antennae look very different from different points of view.

Diplocotes foveicollis, Oll.

Mr. Clark has taken four specimens of this species, about the Swan River, associated with the preceding species. Two of them have the elytra considerably darker than in Victorian specimens.

TENEBRIONIDAE.

Alphitophagus bifasciatus, Say.

A. pictus, Menetr.

A. populi, Redt.

A. quadripustulatus, Steph.

This species has been seen in countless thousands in wheat stacks at North Geelong, although it has apparently not been previously recorded from Australia. For references, etc., see Junk, Col., Cat., Pars. 28, p. 382; where it is recorded as from Europe and North America; but it is probably almost world-wide in distribution.

Latheticus oryzae, Waterh.

This species has been taken at wheat stacks in New South Wales (Barellan and Enfield); it does not appear to have been previously recorded as Australia. For references see Junk, *l.c.*, p. 393.

Thorictosoma, n.g.

Head wide, bilobed in front, the lobes partially overhanging antennae. Eyes apparently absent. Mandibles short, stout, notched at tips. Mentum large, convex, concealing labial palpi. Two joints of maxillary palpi exposed, short and subequal. Antennae short, with a closely-compacted three-jointed club. *Prothorax* transverse, front angles produced, hind ones obtuse. *Scutellum* absent. *Elytra* rather short, conjointly rounded at apex, and slightly arcuate at base; epipleurae rather narrow and terminated before apex. *Prosternum* with an obtuse intercoxal ridge, each front angle foveate. Metasternum about as long as two basal segments of abdomen; episterna rather wide, but with indistinct sutures. *Abdomen* with first segment once and one-half the length of second, and the length of fifth, third slightly shorter than second and longer than fourth. *Legs* short; front coxae lightly separated, the middle ones more widely, the hind ones still more widely; femora unarmed, tibiae spinose near base, the front pair dilated, with a strong tooth near base separated from one near apex by a deep notch; tarsi thin, hind ones four-jointed, the others five-jointed; claws small and simple. Apterous.

In general appearance the two species described below are strikingly like several species of *Thorictus* of the Clavicornes; but the tarsi are heteromerous, tibiae very different, and prosternum without pads of clothing. I carefully examined the type of each species both from above and below without seeing eyes, and then decapitated them and examined the heads under the microscope from many angles still without seeing any, so presume both species to be blind. Most of the surface under a fairly high power of the microscope appears to be very finely granulate or shagreened, and in certain lights this causes some parts to have a deceptive resemblance to eyes, but when viewed at a right angle this resemblance vanishes. The clypeus and labrum appear to be absent, as there are no sutures defining their margins. The mentum is large and convex, concealing the labial palpi; of the maxillary palpi only the two apical joints (these fairly stout and subequal) are visible. The antennae are eleven-jointed, but the joints are so close together and even in width at their junctions that it is only under a fairly high power that they can be counted; the three basal joints are concealed from above, the three apical ones form a closely compacted club. The fovea on each of the front angles of the prosternum is closed externally, but open internally, it is evidently for the reception of the club of the antennae, the basal portion of which is received, when at rest, within a groove (bounded internally by a strong ridge) on the lower part of the head. Both species are gently convex with oblong-elliptic outlines. The parts of the mouth of inquilines are usually so greatly modified from species living normal lives, that I do not regard the great modifications of these as excluding the genus from the *Tenebrionidae*. In catalogues it may be placed near *Typhluloma*, the only other known blind genus of the family, but it differs from it in many particulars of the head, antennae, and legs, in some respects it appears to approach *Brachycilibe* and *Platycilibe*, and with the fossorial front legs of *Caedius*, *Caediomorpha*, etc. Type of genus, *ectatommae*.

Thorictosoma ectatommae, n. sp.

Dark castaneous-brown, legs and antennae somewhat paler. Glabrous.

Head gently convex, with two vague oblique depressions in front; punctures dense and sharply defined but rather small. *Prothorax* about once and one-third as wide as long, front angles lightly produced but not clasping sides of head, hind ones not quite rectangular; punctures much as on head, but becoming more crowded on sides. *Elytra* about the width of prothorax, with a deep marginal stria from base almost to apex; punctures almost even throughout, and slightly denser than on middle of prothorax. *Under-surface* with fairly dense, small, sharply-defined punctures, becoming larger and more crowded on parts of prosternum. Front *tibiae* with a subtriangular tooth near base, separated by a semicircular notch from a larger and more obtuse one at apex; apex with three processes: an acute and rather short spine at inner apex, an obtuse somewhat curved one close to and almost the length of tarsi, and a subacute and somewhat shorter one between it and the short one. Length, 1·9 mm.

Hab.—Western Australia: Swan River, from a nest of a large dark species of *Ectatomma* (J. S. Clark). Type, I. 10681.

One of the most interesting of the many interesting inquilines recently taken by Mr. Clark.

THORICTOSOMA TIBIALE, n. sp.

Pl. xxv., fig. 43.

Castaneous-brown. Glabrous.

Head much as in preceding species. *Prothorax* about once and one-half as wide as long, almost semicircularly emarginate in front for reception of head, with a distinct stria from base to apex on each side; punctures small, sharply defined, and almost uniform throughout. *Elytra* about twice the median length of prothorax, and almost its exact width at base; with a narrow deep stria on each side from base to apex, and with extremely vague indications of other striae; punctures much as on prothorax. *Under-surface* with somewhat larger punctures than on upper-surface. Front *tibiae* much as in preceding species, except that there is an additional small process at apex. Length, 2-2·25 mm.

Hab.—Western Australia: Geraldton (A. M. Lea).

In general appearance fairly close to the preceding species, but more uniformly coloured, prothorax rather more deeply emarginate in front, with a stria close to each side (there are none on that species), the marginal stria on each elytron deeper, and two conjoined at apex, with vague indications of other striae, and the front tibiae with an additional process at apex. Of the processes on the front tibiae one is short and acute, one is about the length of the three basal joints of tarsi, one is slightly longer, and the other is longer than the four basal joints combined, somewhat curved and rather blunt. Two specimens, one of which is now headless, were taken in 1896, probably from a nest of ants.

CERAMBYCIDAE.

Parandra frenchi, Blackb.

Pl. xxvii., figs. 91 and 92.

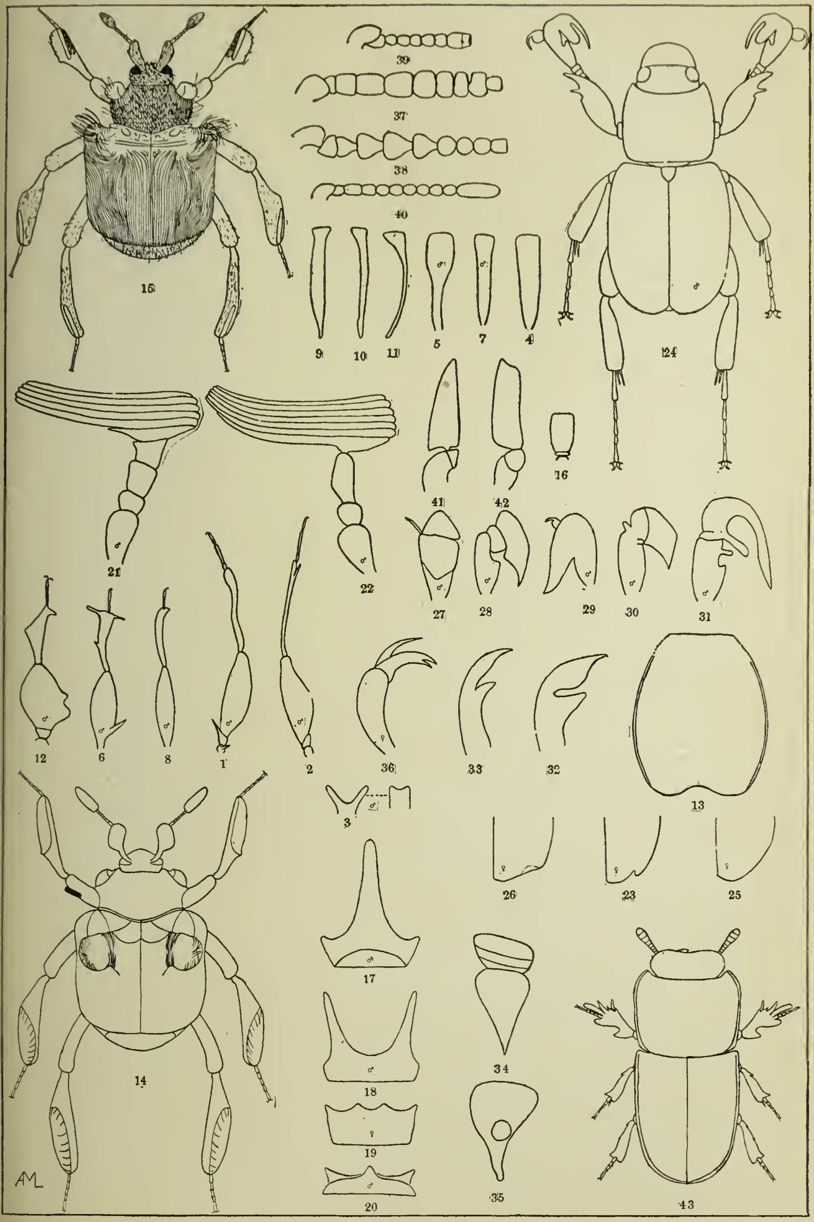
Several specimens of this species have been taken in the Dorrigo district by Mr. W. Heron, and on the Tweed River by Mr. Horace W. Brown. The male differs from the female in having the head considerably wider (its width across the eyes is equal to or slightly exceeds the greatest width of the prothorax, in the female it is distinctly narrower than the apex of the prothorax, and this, in the female, is less than the median width) with larger jaws, antennae longer, with the apical joint decidedly longer, prothorax more narrowed to the base, with the hind angles more acute and the elytra much shorter (only about two-thirds the length) and less parallel-sided. The reference given by Blackburn was misprinted 1885, instead of 1855.

Photographs of Plates XXVI. and XXVII. by H. M. Hale. Photomicrographs in text by H. Hacker.

EXPLANATION OF PLATES.

Plate XXV.

Fig. 1. ... ... *Leanymus mirus*, Lea, front leg.
,, 2. ... ... ,, ,, ,, hind leg.
,, 3. ... ... ,, ,, ,, armature of metasternum.
,, 4. ... ... *Articerus subcylindricornis*, Lea, antenna.
,, 5. ... ... ,, *wilsoni*, Lea, antenna.
,, 6. ... ... ,, ,, ,, middle leg.
,, 7. ... ... ,, *mesosternalis*, Lea, antenna.
,, 8. ... ... ,, ,, ,, middle leg.
,, 9 to 11. ,, *duboulayi*, Waterh., views of antenna.
,, 12. ... ... ,, ,, ,, middle leg.
,, 13. ... ... *Rodwayia intercoxalis*, Lea, intercoxal process of prosternum.
,, 14. ... ... *Chlamydopsis latipes*, Lea.
,, 15. ... ... ,, *striatipennis*, Lea.
,, 16. ... ... *Euclarkia costata*, Lea, antenna.
,, 17. ... ... *Bolboceras quadrifoveatum*, Lea, front view of clypeus.
,, 18. ... ... ,, *bispinicolle*, Lea, front view of clypeus of male.
,, 19. ... ... ,, ,, ,, front view of clypeus of female.
,, 20. ... ... ,, *triunum*, Lea, front view of clypeus.
,, 21. ... ... *Rhopaea decipiens*, Lea, antenna.
,, 22. ... ... ,, *nigricollis*, Lea, antenna.
,, 23. ... ... *Cheiragra ruficollis*, Macl., apex of elytra.
,, 24. ... ... ,, *variabilis*, Lea.
,, 25. ... ... ,, ,, ,, apex of elytron.
,, 26. ... ... ,, *sericeipennis*, Lea, apex of elytron.
,, 27 to 31. ,, ,, ,, views of front claw-joint and claws.



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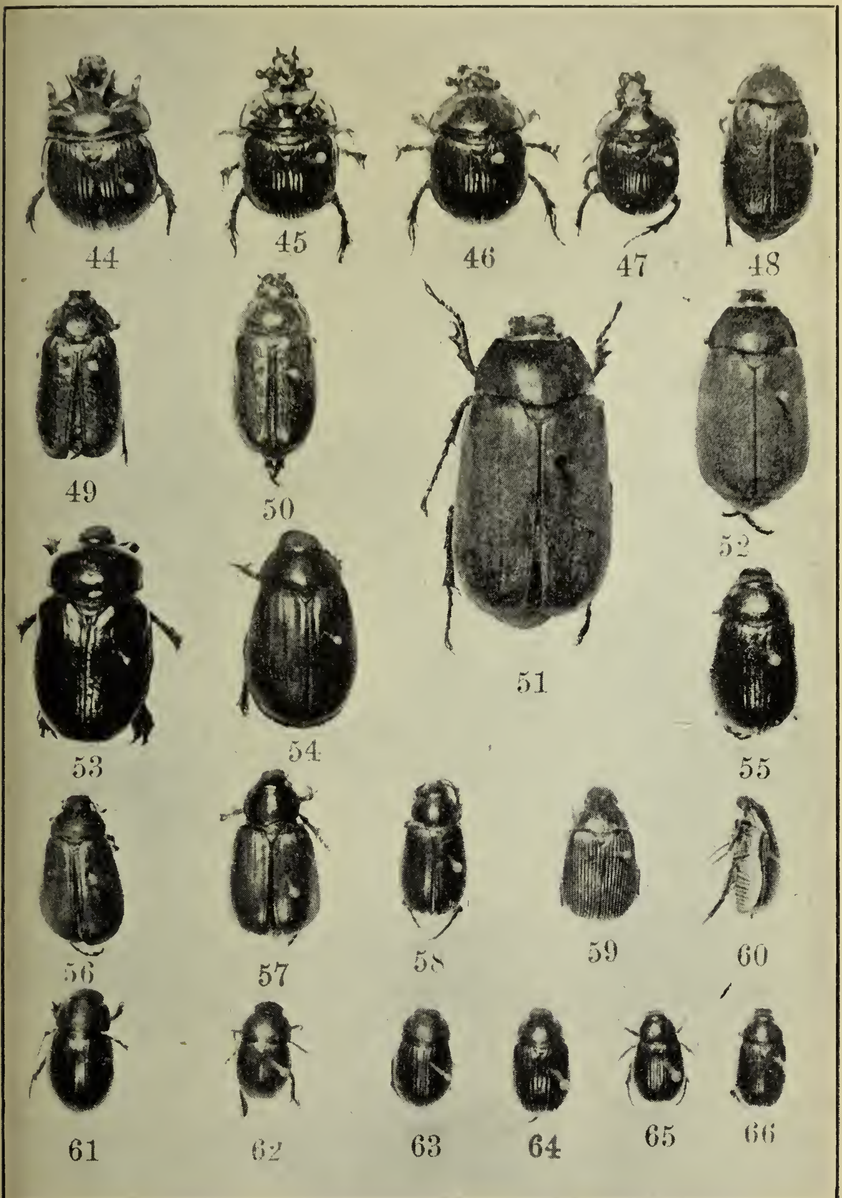

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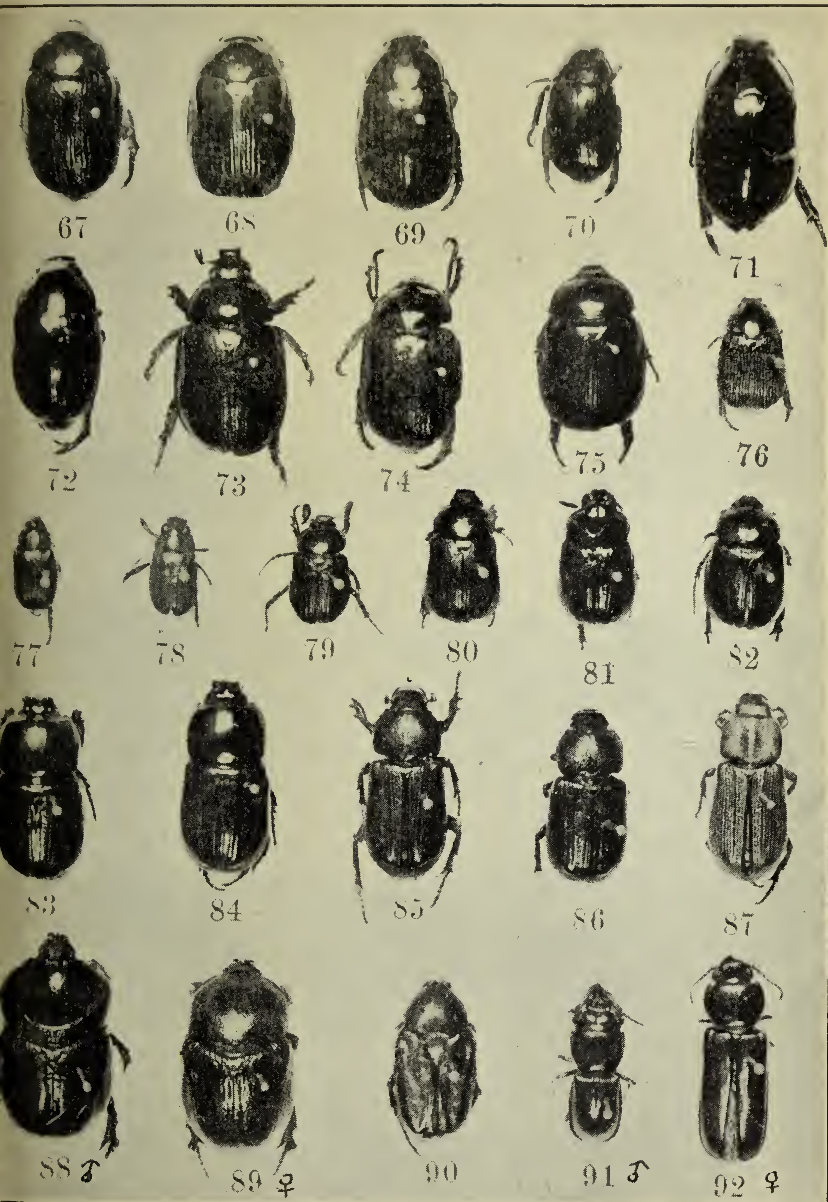

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Fig. 32.... ...	*Pseudoheteronyx basicollis*, Lea, front claw.
,, 33.... ...	,, ,, ,, hind claw.
,, 34.... ...	*Cryptodus antennalis*, Lea, antenna as seen when at rest.
,, 35.... ...	,, ,, ,, under-surface of basal joint of antenna.
,, 36.... ...	*Anoplognathus multiseriatus*, Lea, front claw-joint and claws.
,, 37.... ...	*Enasiba tristis*, Oll., antenna from above.
,, 38.... ...	,, ,, ,, antenna from the side.
,, 39.... ...	*Polyplocotes carinaticeps*, Lea, antenna.
,, 40.... ...	*Diphobia longicornis*, Lea, antenna.
,, 41 and 42.	*Ectrephes formicarum*, Pasc., views of antenna.
,, 43.... ...	*Thorictosoma tibiale*, Lea.

Plate XXVI.

Fig. 44.... ...	*Bolboceras quadrifoveatum*, Lea.
,, 45 and 46.	,, *bispinicolle*, Lea.
,, 47	,, *triunum*, Lea.
,, 48.... ...	*Rhopaea decipiens*, Lea.
,, 49.... ...	,, *nigricollis*, Lea.
,, 50.... ...	*Paralepidiota cavifrons*, Lea.
,, 51.... ...	*Lepidiota froggatti*, Macl.
,, 52.... ...	,, ,, ,, var. *stradbrokensis*, Lea.
,, 53.... ...	*Systellopus ater*, Lea.
,, 54.... ...	*Haplonycha marginipennis*, Lea.
,, 55.... ...	,, *nigra*, Lea.
,, 56.... ...	,, *suavis*, Lea.
,, 57 and 58.	*Glossocheilifer bidentatus*, Lea.
,, 59 and 60.	*Stethaspis squamosus*, Lea.
,, 61.... ...	*Pseudoheteronyx seticollis*, Lea.
,, 62.... ...	,, *basicollis*, Lea.
,, 63.... ...	,, *puncticollis*, Lea.
,, 64.... ...	*Frenchella gagatina*, Lea.
,, 65.... ...	,, *fimbriata*, Lea.
,, 66.... ...	,, *cribriceps*, Lea.

Plate XXVII.

Fig. 67.... ...	*Anoplognathus multiseriatus*, Lea.
,, 68.... ...	,, *prasinus*, Cast.
,, 69 and 70.	,, *smaragdinus*, Ohaus.
,, 71 and 72.	*Calloodes nitidissimus*, Lea.
,, 73.... ...	*Schizognathus burmeisteri*, Ohaus.
,, 74 and 75.	,, *viridiaeneus*, Ohaus.
,, 76.... ...	*Mimadoretus niveosquamosus*, Lea.
,, 77.... ...	,, *leucothyreus*, Lea.
,, 78.... ...	*Adoretus melvillensis*, Lea.
,, 79 and 80.	*Saulostomus mimicus*, Lea.
,, 81.... ...	*Corynophyllus curvicornis*, Lea.
,, 82.... ...	*Aneurystypus carinaticeps*, Lea.
,, 83 and 84.	*Metanastes bicornis*, Lea.
,, 85.... ...	*Cryptodus foveatus*, Lea.
,, 86.... ...	,, *antennalis*, Lea.
,, 87.... ...	,, *angustus*, Lea.
,, 88 and 89.	*Novapus rugosicollis*, Blackb.
,, 90.... ...	*Chlorobapta frontalis*, Don., var.
,, 91 and 92.	*Parandra frenchi*, Blackb.

Australian Fungi: Notes and Descriptions. No. 3.

By J. Burton Cleland, M.D., and Edwin Cheel, Botanical Assistant, Botanic Gardens, Sydney.

[Read September 11, 1919.]

Plates XXVIII. and XXIX.

The following paper is a continuation of our two previous ones in this series, and contains a number of notes on, and records of, the larger Australian fungi. The serial numbers are for future reference to the species concerned. The references under "colour tints noted" are to the plates in Henri Dauthenay's "Répertoire de Couleurs . . . ," unless Ridgway's "Colour Standards and Colour Nomenclature" is specifically mentioned.

We would once more emphasize the difficulty attendant on the identification of the fleshy agarics. When referring these to known species, we have in most cases given our description of the Australian plants so determined, so that if we are in error, the mistake can later be rectified.

We would again express our gratitude for being enabled to reproduce coloured plates of most of the new species described, and would offer our congratulations to our artist, Miss Phyllis Clarke, of Chatswood, Sydney, for her admirable delineations of these. We also owe much to the kindness of Mr. C. G. Lloyd, of Cincinatti, for identifying for us so many polypores and other more permanent species. Without his help, our task in these groups would have been very heavy, and errors doubtless numerous. Miss E. Wakefield, of Kew Gardens, has also kindly helped us on several occasions, whilst we are indebted to various Australian friends, whose assistance is acknowledged in the text, for a number of specimens.

SUMMARY OF CONTENTS.

WHITE-SPORED AGARICACEAE.

Amanita: 90—*A. grossa*, Berk.

Amanitopsis: 91—*A. punctata*, n. sp.

Armillaria: 92—*A. mellea*, Vahl. 93—*A. mucida*, Schrad., var. *exannulata*, var. nov.

Tricholoma: 94—*T. muculenta*, Berk. 95—*T. colossa*, Fr.

Clitocybe: 96—*C. media*, Peck. 97—*C. pinophila*, Peck. 98—*C. dealbata*, var. *minor*, Cooke. 99—*C. cyathiformis*, var. *cinerascens*, Fr. 100—*C. paraditopa*, n. sp.

CANTHARELLUS: 101—*C. lilacinus*, n. sp. 102—*C. imperatae*, n. sp. 103—*C. nigripedes*, n. sp. 104—*C. corrugatus*, n. sp. 105—*C. foliolum*, Kalch.

LACTARIUS: 106—*L. stenophyllus*, Berk. 107—*L. subtomentosus*, B. and Rav. 108—*L. serifluus*, Fr.

RUSSULA: 109—*R. adusta*, Fr. 110—*R. Flocktonae*, n. sp. 111—*R. Mariae*, Peck. 112—*R. xerampelina*, Fr. 113—*R. azurea*, Bres. 114—*R. granulosa*, Cooke. 115—*R. pectinatoides*, Peck. 116—*R. emetica*, Fr. 117—*R. fragilis*, Fr. 118—*R. erumpens*, n. sp.

COLLYBIA: 119—*C. radicata*, Relh. 120—*C. velutipes*, Fr. 121—*C. confluens*, Pers. 122—*C. ingrata*, Schum. 123—*C. stipitaria*, Fr.

HYGROPHORUS: 124—*H. miniatus*, Fr. 125—*H. conicus*, Fr. 126—*H. psittacinus*, Schaeff.

MARASMIUS: 127—*M. porreus*, Fr. 128—*M. alliatus* (Schaeff.). 129—*M. calopus*, Fr. 130—*M. equi-crinis*, F. v. M.

MYCENA: 131—*M. banksiae*, n. sp. 132—*M. coccineus*, n. sp. 133—*M. sanguinolenta*, Alb. and Schw.

PLEUROTUS: 134—*P. lampas*, Berk. 135—*P. ostreatus*, Jacq. 136—*P. subostreatus*, n. sp. 137—*P. Cheelii*, Mass. 138—*P. striatulus*, Fr.

LENTINUS: 139—*L. tuber-regium*, Rumph. 140—*L. strigosus*, Fr. 141—*L. dealbatus*, Fr. 142—*L. fasciatus*, Fr. 143—*L. radicatus*, Cooke and Mass. 144—*L. ursinus*, Fr.

PANUS: 145—*P. stypticus*, Fr. 146—*P. viscidulus*, B. and Br.

XEROTUS: 147—*X. fuliginosus*.

LENZITES: 148—*L. abietina*, Fr. 149—*L. ungulaformis*, Berk. 150—*L. striata*, Swartz. 151—*L. saepiaria*, Fr. 152—*L. Beckleri*, Berk. 153—*L. repanda*, Mont. 154—*L. Muelleri*, Berk. 155—*L. bicolor*.

POLYPORACEAE.

BOLETUS: 156—*B. romanus*, Ottav. 157—*B. scarlatinus*, n. sp.

STROBILOMYCES: 158—*S. pallescens*, Cooke and Mass. 159—*S. floccopus*, Rost.

POLYSTICTUS: 160—*P. elongatus*, Berk. 161—*P. meleagris*, Berk. 162—*P. badius*, Berk. 163—*P. ochraceo-stuppeus*, Lloyd. 164—*P. occidentalis*, Klotzsch. 165—*P. (Trametes) Persoonii*, Mont. 166—*P. subfulvus*, Berk. 167—*P. flavus*, Klotz. 168—*P. versicolor*, L. 169—*P. sanguineus*, L. 170—*P. cinnabarinus*, Jacq. 171—*P. cervino-gilvus*, Jungh.

POLYPORUS: 172—*P. Clemensiae*, Murr. 173—*P. anthracophilus*, Cooke. 174—*P. sulphureus*, Fr. 175—*P. rosettus*, Lloyd. 176—*P. rufescens*, Pers. 177—*P. Albertini*, Mueller. 178—*P. eucalyptorum*, Fr. 179—*P. gilvus*, Schw. 180—*P. gilvus*, var. *scruposus*, Fr. 181—*P. (Trametes) pertusus*, Fr. 182—*P. Patouillardii*, Rick. 183—*P. fruticum*, Berk. 184—*P. sessilis*, Murr.

FOMES: 185—*F. robustus*, Karsten. 186—*F. conchatus*, Pers. 187—*F. densus*, Oleson. 188—*F. roburneus*, Fr. 189—*F. rimosus*, Berk. 190—*F. badius*, Berk. 191—*F. pseudosenex*, Murr. (?) 192—*F. yucatensis*, Murr.

PORIA: 193—*P. callosa*, Fr. 194—*P. vaporaria*, Fr.

TRAMETES: 195—*T. lactinea*, Berk. 196—*T. protea*, Berk. 197—*T. semitosta*, Berk.

HYDNACEAE.

Hydnum: 198—*H. rufescens*, Pers. 199—*H. coralloides*, Scop. 200—*H. ochraceum*, Pers. 201—*H. Muelleri*, Berk. 202—*H. zonatum*, Batsch. 203—*H. alutaceum*, Fr.
Tremellodon: 204—*T. gelatinosum*, Scop.
Radulum: 205—*R. Neilgherrense*, Berk.
Irpex: 206—*I. consors*, Berk. 207—*I. cingulatum*, Lloyd. 208—*I. saepiaria*, Lloyd.

THELEPHORACEAE.

Thelephora: 209—*T. terrestris*, Ehrenb. 210—*T. myriomera*, Fr.
Stereum: 211—*S. caperatum*, Berk. and M. 212—*S. elegans*, Fr. 213—*S. semilugens*, Kalchb. 214—*S. hirsutum*, Willd. 215—*S. zonarium*, Lloyd. 216—*S. vellereum*, Berk. 217—*S. lobatum*, Fr. 218—*S. illudens*, Berk. 219—*S. membranaceum*, Fr. 220—*S. (Lloydella) cinerascens*, Schw. 221—*S. (Hymenochaete) adustum*, Lev.
Corticium: 222—*C. coeruleum*, Pers.

GASTEROMYCETES.

Chlamydopus: 223—*C. Meyenianus*, Berk.
Battarea: 224—*B. phalloides*, var. *Stevenii*.
Geaster: 225—*G. Clelandii*, Lloyd. 226—*G. floriformis*, Vitt. 227—*G. simulans*, Lloyd. 228—*G. Berkeleyi*. 229—*G. minimus*, Schw. 230—*G. saccatus*, Fr.
Mycenastrum: 231—*M. corium* (Guers.).
Lycoperdon: 232—*L. gemmatum*, Batsch.
Calvatia: 233—*C. lilacina* (Berk.).

ASCOMYCETALES.

Endogone: 234—*E. tuberculosa*, Lloyd.
Morchella: 235—*M. esculenta*, L. 236—*M. conica*, Pers.
Leotia: 237—*L. marcida*, Pers.
Geoglossum: 238—*G. Muelleri*, Cooke. 239—*G. glabrum*, Pers.
Phillipsia: 240—*P. polyporoides*, Berk.
Urnula: 241—*U. campylospora*, Berk.
Hypomyces: 242—*H. aurantius*, Tul.
Xylaria: 243—*X. anisopleura*, Mont. 244—*X. phosphorea*, Berk. (?) 245—*X. myosurus*, Mont. (?) 246—*X. faveolis*. 247—*X. hypoxylon*, Grev.
Sarcoxylon: 248—*S. Le Rati (Hennings)*.
Poronia: 249—*P. punctata*, L. 250—*P. oedipus*, Mont.
Nummularia: 251—*N. Baileyi*, B. and Br.
Daldinia: 252— *D. concentrica*, Bolt.

WHITE-SPORED AGARICACEAE.

Amanita.

90. *Amanita grossa*, Berk. *Agaricus (Amanitopsis) grossus*, Berk.: Fl. Tasm., ii., 242; Sacc.: Syll., 23; Cooke: Handb. Austr. Fungi, No. 10 (Tasm.). *Agaricus (Amanita) ananaeceps*, Berk. (?): Hook, Lond. Journ., viii., 572; Sacc.: Syll., 36; and Cooke: Handb. Austr. Fungi, No. 8 (Tasm.).—We sent specimens of our plants to Miss E. M. Wakefield at Kew, asking if they were *A. solitaria*. She

has replied that they do not seem to be so, as *A. solitaria* has floccose and easily removed warts; their smell seems to exclude *A. strobiliformis*. She suggested that they might be *A. grossa* or *A. ananaeceps*. On referring to the brief descriptions of these two, it seems probable that they may refer to different stages of the one species. As the specimens of one of our collections agree very well with the description of *A. grossa*, we place our plants under this name, though if only one species is concerned *A. ananaeceps* has priority. A composite description of our specimens is as follows:—Pileus $4\frac{1}{2}$ to 7 inches in diameter, globose then convex, white sometimes with a silvery tinge, shining, covered with scattered warts which have a broad base of puckered membrane and a projecting ragged apex as if a piece of tissue paper had been twisted round with the fingers, with large soft ragged fragments of the veil attached to the edge. Gills just reaching the stem, moderately close, of a dirty creamy-white colour, drying to a darker tint. Stem up to 6 inches high, up to $1\frac{3}{4}$ inch thick at the bulbous base and 1 inch in the upper part, solid (in one a little hollowed out above, probably from insects), mealy-white, above sometimes with narrow ragged irregular rings from the veil, sometimes with no ring, the upper part of the bulb smooth, the lower with concentric rings of small warts. Spores 8·5 to $10{\cdot}4 \times 6{\cdot}8$ to 7·2 μ, not thick walled. A strong sour smell as of rancid butter. In one specimen the gills showed frequent anastomoses by cross-veins forming elongated cells. Narrabeen, March, 1916; Kendall, December, 1917.

Amanitopsis.

91. *Amanitopsis punctata*, n. sp.—Pileus up to $3\frac{1}{2}$ inches in diameter, at first globose, then convex, sometimes gibbous, then plane or slightly depressed, smooth, slightly sticky when moist, edge markedly striate or even sulcate, with occasional patches of the volva especially near the edge when young, very dark grey, greyish-brown or smoky-grey, darker in the centre. Gills just free, showing lines on the adjacent part of the stem, close, greyish-white to very pale smoky-grey, edges darker and finely serrate. Stem 4 to $5\frac{1}{2}$ inches high, stout, $\frac{1}{2}$ inch thick below, slightly attenuated upwards, finely striate, hollow below with pith, finely spotted with greyish fibrous scales forming striae below, or with fine dark cobweb-like fibrils. Volva sheathing, ample, greyish-lead colour. Spores spherical, thick-walled, 10·4 to 14, occasionally 17 or 18 μ. After heavy rain, Bradley Head, Sydney, March to May; Mosman, April (D. I. C., Watercolour 62; Herb., J. B. C., Formalin Sp. 165)

Colour tints noted:—Pileus smoke-grey (pl. 313, Ton 4). Stem flecked with smoke-grey (pl. 313, Ton 4). Gills very pale smoke-grey or greyish-white.

Pileus ad 8·7 cm. latus, primo globosus, deinde convexus, interdum gibbosus, deinde planus aut depressus, glaber, margine striata, fumoso-cinereus. Lamellae subdisjunctae, confertae, cinereo-albidae, marginibus percinereo-albidis et subserratis. Stipes 10 ad 13 cm. altus, crassus, sursum subattenuatus, substriatus, deorsum cavus, fumoso-cinereus et punctatus. Volva vaginata, ampla, fumoso-cinerea. Sporae sphericae, 10·4-18 μ.

This species is clearly closely related to, but quite distinct from, *A. vaginata*, Roze, which we have also collected. We have come upon our species on several occasions, and it has always presented the same characters. The colour of the gills, punctate grey stem, and size and shape of the spores are distinctive features. We have designated it "punctata" from the appearance of the stem. (Pl. xxviii.)

Armillaria.

92. *Armillaria mellea*, Vahl; Cooke: Illustrs., pl. 32; Cooke: Handb. Austr. Fungi, No. 47; Clel. and Cheel: Agr. Gaz., N.S. Wales, xxvii., 1916, p. 104, pl. 4.—Ararat, Vict., May, 1917 (E. J. Semmens, No. 24); National Park, S. Austr., April and June, 1917; Kendall, N.S. Wales, May, 1917; near banana (*Musa*, sp.), Botanic Gardens, Sydney, July, 1916.

In May, 1917, an interesting form was found at Mosman, Sydney, growing in a dense caespitose mass at the base of a stump. The cap was almost black with dense short fibres. There were definite remains of a pale-brownish ring $\frac{7}{8}$ inch below the cap, whilst just below the cap itself was a flimsy veil rupturing to form a very definite second ring.

93. *Armillaria mucida*, Schrad., var. *exannulata*, var. nov.—Cap up to 4 inches in diameter, slightly convex, then plane, glutinous, edge a little striate, whitish to pale stone-brown, cuticle peels. Gills very slightly sinuate, slightly ventricose, moderately distant to distant, white. Stem $3\frac{1}{2}$ inches high, slender to quite stout, bulbous below, attenuated upwards, slightly fibrously streaked, fibrous, tough, white to whitish, solid. Spores spherical, granular, thick-walled with a "nucleus," white, 15·5 to 24 μ, basidia and hyphae large in proportion. On rotting fallen trunk, Mummulgum Brush, near Casino, December, 1916.

Even in young specimens we can find no sign of a ring. The plants are obviously like a large ringless *Armillaria* *mucida*, and on comparison with dried English specimens received from Miss Wakefield, the spores of the latter are found to be similar to those of our plants but smaller (15·5 to 17·3 μ). Obviously the Australian plants are very close relatives to *A. mucida*, probably being the Australian representatives, and, in spite of the complete absence of a ring, we place them under *A. mucida* as a variety rather than transfer them as a new species to another genus, and so lose their obvious affinity.

Pileus ad 10 cm. latus, subconvexus, deinde planus, glutinosus, substriatus, albidus ad subfusco-albidus, cuticulo decorticante. Lamellae subsinuatae, subventricosae, subdistantes ad distantes, albae. Stipes ad 8 cm. altus, tenuis ad robustus, ad basem bulbosus, albus ad albidus, solidus. Sporae sphericae, granulatae, 15·5-24 μ.

Tricholoma.

94. *Tricholoma muculenta*, Berk.: Hook. J., 1845, p. 43; Cooke: Handb. Austr. Fungi, No. 50 (W.A.).—The following agaric we are provisionally placing under this specific name, but are not quite sure of its identity with the species:—Pileus 2 inches in diameter, glutinous, white with a tinge of brown at the apex, umbonate (conical), convex then expanded. Gills white (drying to a light brown), moderately distant, just adnexed. Stem white, glutinous, solid, faintly striate (?). Caespitose on bare ground. Taste (dry specimen) mild. Spores white, spherical, 4 to 4·5 μ, warty with an apiculus at one end. Milson Island, Hawkesbury River, May 5, 1913.

This agrees with the original description, save that the spores are a little smaller (5 to 6 μ in Berkeley's species). No mention is made of the spores being warty. No British species of *Tricholoma* agrees with our specimen. There is some resemblance between our fungus and the description of *Russula virginica*, Cooke and Massee. The spores correspond exactly, but our specimen is caespitose, and has not decurrent, crowded gills, and is clearly not a *Russula*.

95. *Tricholoma colossa*, Fr.: Epicr., p. 38; Cooke: Illustrs., p. 87; Massee: Brit. Fung. Flora, iii., p. 182.—A large agaric, usually half buried in the sandy soil, frequently occurring after autumn rain in the coastal district near Sydney, seems referable to this species. The description of *Tricholoma coarctata* given by Cooke and Massee (Cooke: Handb. Austr. Fungi, No. 51) also seems like that of our species, but fig. 5, given by Cooke, is quite different. If this figure is one reconstructed from a rough sketch, and not

a true representation of the original, then it may still happen that our species is that given by Cooke, but until this is settled we leave it under *T. colossa*. The following is the description of our specimens:—Caespitose. Pileus 3 inches in diameter, convex, brownish-tan, somewhat squamulose and cracking, edge turned in when young. Gills crowded, straw-coloured, becoming discoloured rufous, adnate. Stem stout, $2\frac{1}{2}$ inches × $1\frac{1}{4}$ inch thick, somewhat bulbous, discoloured reddish-brown, white above. Flesh showing pink at the base of the stem and under the cap. Spores pear-shaped, white, $7 \times 5{\cdot}2\ \mu$. Newcastle (Miss Clarke), April, 1915. Other specimens show a cap convex to plane, and finally often upturned, up to $4\frac{1}{2}$ inches in diameter, shining, fawn to reddish-brown, when old often very dark reddish-brown and slimy, broken up more or less into scales; flesh thick; gills adnate or sinuately adnexed, spores $5{\cdot}5$ to $6{\cdot}8 \times 3{\cdot}8$ to $4{\cdot}2\ \mu$, in some specimens apparently of this species 7 to $8{\cdot}5 \times 5{\cdot}2$ to $7\ \mu$. Narrabeen, April; Sydney, April and May; Hawkesbury River, April.

Clitocybe.

sect. i.—disciformes.

96. *Clitocybe media*, Peck.—Peck's description (N. York State Mus., Mus. Bull. 157, p. 61) is as follows:—"Pileus fleshy, convex, becoming plane or slightly depressed in the centre, often wavy or irregular on the margin, not polished, greyish-brown or blackish-brown, flesh white, taste mild; lamellae broad, subdistant, adnate or decurrent, whitish, the interspaces often venose; stem equal or nearly so, solid, elastic, coloured like or a little paler than the pileus; spores ellipsoid, $8 \times 5\ \mu$. Pileus 5 to 19 cm. broad; stem $2{\cdot}5$ to 5 cm. long, 8 to 16 mm. thick. Gregarious or scattered. Mossy ground in woods."

We have not had access to his plates of the species. The following South Australian plants approximate to the description of *C. media*, though differing in some details, *e.g.*, the pallid-whitish stem. They differ from *C. nebularis*, Batsch, in their larger spores, and from *C. clavipes*, Pers., in the non-clavate stem and non-decurrent gills. There seems justification for the present in placing them under *C. media*.

Pileus up to 6 inches across, convex, then plane or a little upturned, somewhat irregular and wavy, subgibbous, matt, centre smoky-brown, the rest moist-looking yellowish-stony-brown. Flesh whitish, moist-looking in places. Gills adnate, close, whitish, then rather pallid or creamy. Stem up to $1\frac{3}{4}$ inch high, slender to stout (up to $\frac{3}{4}$ inch thick), rather attenuated in the middle, slightly fibrillose or fibrously streaked, solid, pallid whitish. Hardly any smell. Spores 8·5 to 10·4 × 5 μ. In a garden amongst grass, Beaumont, Adelaide, and on the Mount Lofty Range above Beaumont amongst grass under a tree, June, 1917. (Miss Rennie, Watercolour No. 3.)

97. *Clitocybe pinophila*, Peck.—Peck's description (N. York State Mus., Mus. Bull. 157, p. 63) is as follows:—"Pileus fleshy, thin, convex becoming umbilicate or centrally depressed, glabrous, pale-tan colour when moist, paler when dry, odour and taste farinaceous; lamellae moderately close, subarcuate, adnate or slightly decurrent, whitish; stem equal, glabrous or slightly pruinose, coloured like the pileus; spores broadly ellipsoid or subglobose, 5 to 6 × 4 to 5 μ. Pileus about 2·5 cm. broad; stem 2·5 to 5 cm. long, 2 to 4 mm. thick. Gregarious. Under or near pine trees. Sometimes the pileus becomes striate on the margin in drying."

Though the spores of the following Australian plants growing under pines are slightly narrower and the gills seem to have a greyish tint, it seems probable from Peck's description that they may be his species. Possibly they are better referred to the Sect. Orbiformes. Pileus up to 2 inches across, convex or plane, sometimes slightly depressed, thin, surface matt, when moist greyish-brown and translucent, when dry pallid brownish and opaque, edge turned in when young. Gills adnate to slightly decurrent, close, pallid whitish then pallid greyish. Stem up to 2 inches high, moderately slender, slightly attenuated downwards, slightly striate, often flattened, pallid brownish or pallid greyish-brown, hollow. Very slight fragrant mealy odour. Spores 5·2 to 7 × 2·5 to 3 μ. Amongst grass, apparently usually (always [?]) under *Pinus*. Beaumont, near Adelaide, and National Park, S. Austr., June, 1917; amongst pine needles under *Pinus*, Craigie, Ararat (E. J. Semmens, No. 146).

98. *Clitocybe dealbata*, var. *minor*, Cooke: Handb., p. 50; Cooke: Illustrs., pl. 173.—Small plants, growing on the ground or attached to grass or fern roots at Milson Island, Hawkesbury River, in April and November, seem to be var. *minor* of this species. They were pure white, sometimes with a yellowish tinge when old, convex and somewhat irregular, with moderately distant gills. Occasional specimens were truncate above, descending conically with deeply decurrent gills. Spores elliptical, 5·5 to 6·6 × 3·4 μ.

SECT. IV.—CYATHIFORMES.

99. *Clitocybe cyathiformis*, var. *cinerascens*, Fr.—We have collected specimens of this variety at Mosman, Sydney,

in March, May, and June, and at Lisarow in May. Reticulations have not been noted on the stems. The description of our plants is as follows:—Pileus up to 1½ inch in diameter, very thin, translucent, pale greyish-brown, striate, sometimes somewhat rugose, umbilicate to infundibuliform. Gills moderately crowded, deeply decurrent, branching and anastomosing. Stem up to 2¼ inches high, tubular, and the hollow centre sometimes apparently communicating with the funnel-shaped cap, base slightly bulbous, of the same colour as the cap but browner below. Spores pear-shaped with a large vesicle, 7 to $8 \cdot 5 \times 4 \cdot 2$ to 5 μ. Under trees, sometimes on rotten wood. (D. I. C., Watercolour 38.)

SECT. V.—ORBIFORMES.

100. *Clitocybe paraditopa*, n. sp.—We have met with the following species of *Clitocybe* on several occasions in New South Wales and South Australia. It has usually been found on or in the neighbourhood of cow-dung, and, if this habit is a necessity, is evidently an introduced species. From the descriptions and from Cooke's illustrations of *C. ditopa*, Fr., it seems close to this species but, from comparison with dried plants kindly forwarded to us from England by Miss E. M. Wakefield, is clearly not identical with it. It also seems, from the description, to be close to *C. subditopoda*, Peck. Its outstanding feature is a strong scent of wattle blossom, noticeable even at a distance as when walking near. Pileus 1½ to 2½ inches in diameter, slightly convex and irregular, the centre sometimes slightly depressed or almost infundibuliform, sometimes obscurely gibbous, smooth, when moist shining moist-looking pallid stony-grey to brownish, drying from the centre, which become pallid fawn, and finally pallid white and shining, sometimes when dry dingy greyish-white, edge incurved when young. Gills moderately crowded to moderately distant, adnate, sometimes somewhat decurrent, rather thick, narrow, French grey, dark grey or violet-grey, becoming dark greyish-brown. Stem 1½ to 2 inches high, moderately stout or slender, often compressed and deformed, slightly fibrously streaked, rigid, usually markedly hollow, occasionally when young nearly stuffed, whitish. Often densely caespitose and deformed, on bare rich soil or under *Casuarina* twigs, etc., in or near cow-dung or in pastures. Strong scent of wattle blossom *(Acacia pycnantha* or *suaveolens)*. Spores with one end a little pointed, $5 \cdot 2$ to $6 \cdot 8 \times 2 \cdot 6$ to $3 \cdot 6$ μ. Milson Island, Hawkesbury River, April to July; The Oaks, N.S. Wales, June, 1914; Adelaide, July, 1914 (spores $7 \times 3 \cdot 8$ μ). (Miss Clarke, Watercolour 79; D. I. C., Watercolours 50 and 51.)

Pileus 3·7 ad 6·2 cm. latus, subconvexus et irregularis, modo depressus, modo subgibbosus, glaber, hygrophanus, pallido-cinereo-fuscus, siccatus pallidus et nitidus. Lamellae adnatae, interdum subdecurrentes, angustae, pallido-cinereae aut violaceo-cinereae, deinde cinereo-fuscae. Stipes 3·7 ad 5 cm. latus, saepe distortus, cavus, albidus. Habitus saepe caespitosus. Odor fragrans. Spores 5·2-6·8 × 2·6-3·6 μ.

Coloured figures of this new species were prepared by the Government Printer of New South Wales several years ago for publication in the Agricultural Gazette of N.S. Wales. Owing to the war such publication has had to be postponed, but it is hoped that the plate may appear in that journal during 1920.

Cantharellus.

101. *Cantharellus lilacinus*, n. sp.—Pileus up to 1 inch in diameter, convex and edge turned in when young, then slightly convex or even depressed, often deformed, surface matt or almost floccose, of a brilliant artificial-looking pinky-lilac. Gills markedly decurrent from the first, very distant, often branching, many short, edge rather thick, white or with a lilac tint. Stem up to 1½ inch long, 3/16ths inch thick, moderately stout, equal, lilac above, a pale dull-yellow below. Flesh thick, lilac above, that of the stem white. Spores pear-shaped, 7 to 8·5 × 4·5 to 5·5 μ. Under *Kunzea* bushes, Gladesville, Sydney, June, 1916. (Miss Clarke, Watercolour 115.)

Pileus ad 2·5 cm. latus, convexus, deinde subconvexus aut depressus, saepe distortus, subfloccosus, rosaceo-lilacinus. Lamellae decurrentes, distantes, saepe furcatae, marginibus crassis, albae vel sublilacino-albae. Stipes ad 3·7 cm. altus, ·5 cm. crassus, equalis, sursum lilacinus, deorsum pallido-croceus. Caro crassa, sursum lilacina, in stipite alba. Sporae pyriformes, 7-8·5 × 4·5-5·5 μ. (Pl. xxix., fig. 1.)

102. *Cantharellus imperatae*, n. sp.—The following species, which we refer to the genus *Cantharellus*, though it approaches *Clitocybe*, has occurred during successive years on a patch of the grass *Imperata arundinacea* growing at Neutral Bay, Sydney. It especially occurs after heavy rains when the grass has been burnt and is attached in small gregarious masses to the bases of the stems near the ground. Pileus up to ⅝ inch or more in diameter, convex, subgibbous, then plane or a little depressed, somewhat irregular, edge turned in especially when young, surface matt, pale fawny-white in centre with the periphery paler or nearly pure white, later

with a brownish tint. Gills adnate, then decurrent, edges rather thick and entire, moderately distant, sometimes branching and connected by irregular cross-veins, white with an orange tint when dry. Stem up to $1\frac{3}{4}$ inches high, markedly attenuated downwards, slightly hollow, white and somewhat mealy above, mouldy greenish-grey and mealy below. Spores obliquely pear-shaped or flask-shaped, one end acute, with a central globule, 9 to $13{\cdot}8 \times 5{\cdot}2$ to 7 μ. Neutral Bay, Sydney, February, March, and almost at any time after heavy rain.

Pileus ad 1·5 cm. aut plus latus, convexus, subgibbosus, deinde planus vel subdepressus, paulo irregularis, margine inverto, subcervino-albidus vel albus, deinde subfusco-albidus. Lamellae adnatae, deinde decurrentes, marginibus crassis, subdistantes, interdum furcatae et venis connectantibus, albae. Stipes ad 2 cm. altus, deorsum attenuatus, subcavum, sursum albus et subfarinaceus, deorsum sub-viride-glaucus et farinaceus. Sporae obliquae, pyriformes, $9\text{-}13{\cdot}8 \times 5{\cdot}2\text{-}7$ μ.

As indicated under *Clitocybe paraditopa* (No. 100), it is hoped that a coloured figure of this species, the plate of which has been prepared for some years, may be published in the Agricultural Gazette of N.S. Wales in 1920.

103. *Cantharellus nigripedes*, n. sp.—Pileus $\frac{3}{4}$ inch in diameter, slightly convex to nearly plane, centre sometimes depressed, very thin, distantly ribbed, rather fragile, white with a pale-brownish tint, darker in the centre, edge turned in when young. Gills adnate, pure white, moderately distant, many short, sometimes with irregular branching veins, edges a little thick. Stem up to $1\frac{1}{2}$ inch high, very slender, slightly attenuated downwards, tough, black except near the apex which is white, nearly wholly white when very young, slightly greyish-mealy. Spores (?) $4 \times 2{\cdot}5$ μ. Attached by a very small disk to fallen trees, etc., near brush. Murwillumbah, N.S. Wales, April, 1916. (Herb., J. B. C., Form. Sp. 204.)

Pileus ad 2 cm. latus, subconvexus ad subplanus, tenuis, costatus, subfragilis, albidus sed pallido-fusco tinctus. Lamellae adnatae, albae, subdistantes, interdum venis irregularibus et ramosis, marginibus crassis. Stipes ad 3·75 cm. altus, pertenuis, deorsum attenuatus, lentus, niger sed apice albo. Sporae (?) $4 \times 2{\cdot}5$ μ.

104. *Cantharellus corrugatus*, n. sp.—Pileus 1 inch in diameter, irregularly convex, then expanded with the edge a little flattened, the edge turned in when young, when moist semitranslucent greyish-white and striate, drying from the centre to become pure white and scarcely striate. Gills

distant, many short, sometimes forked and connected by numerous transverse wrinkles, white. Stem $2\frac{1}{4}$ inches high, a little wavy, becoming attenuated at the base, hollow, rather cartilaginous, white with a slight brown tint below. Spores 7 to $8·5 \times 3·8$ μ. Subcaespitose amongst dead wood at the base of a log. Kendall, May, 1917. (Miss Clarke, Watercolour 159; Herb., J. B. C., Form. Sp. 282.)

Pileus 2·5 cm. latus, irregulariter convexus, deinde expansus, primum margine incurvato, substriatus, semitranslucidus et subcinereo-albidus, siccatus albus. Lamellae distantes, interdum furcatae, venis frequentibus connectantibus, albae. Stipes 6·2 cm. altus, deorsum attenuatus, cavus, albus, deorsum subfusco-albidus. Sporae 7-$8·5 \times 3·8$ μ. Plantae subcaespitosae.

We have given the specific name "*corrugatus*" to the species on account of the wrinkled appearance presented by the intercommunicating veins. (Pl. xxix., fig. 2.)

105. *Cantharellus foliolum*, Kalch.: Grev., ix., 134; Sacc: Syll., v., 1956; Cooke: Handb. Austr. Fungi., No. 414 (Q.).—We have specimens, apparently of this species, taken on fallen sticks and twigs at Mosman, Sydney, in April and November. The plants are small and pure white, showing a greyish tinge in drying. The gills are very irregular. Spores pear-shaped, 12 to $13·8 \times 7·2$ μ. (Herb., J. B. C., Form Sp. 88.)

Lactarius.

SUBGENUS I.—PIPERITES.

106. *Lactarius (Piperites) stenophyllus*, Berk.: Fl. Tasm., ii., p. 248, t. 181, fig. 8; Cooke: Handb. Austr. Fungi, No. 388.—A comparison of the following specimens with Berkeley's rather crude figure of this species leaves no doubt in our minds that they are one and the same. Before referring to Berkeley's description, we had noted the resemblance to *L. insulsus*. Our plants we describe as follows:—Pileus up to 3 inches across, convex, often irregular, usually markedly infundibuliform, pale yellowish-brown, often somewhat zoned, slightly viscid when moist, edge markedly incurved when young. Gills very crowded, adnate to slightly decurrent, creamy-yellow becoming dirty yellowish-brown, apparently not pruinose from the spores. Stem up to $1\frac{1}{2}$ inches high, moderately slender to stout, slightly expanded above, white, rather mealy. Exuding copious white milk from the gills on the slightest injury and juice from the stem. Instantly peppery. Spores warty, spherical, 5 μ. Under trees, Ryde, Sydney, May, 1916. (Miss Clarke, Watercolour 105.)

SUBGENUS III.—RUSSULARIA.

107. *Lactarius (Russularia) subtomentosus*, B. and Rav.: Ann. Nat. Hist., Oct., 1869; Cooke: Handb. Austr. Fungi, No. 391 (Vict., N.S. Wales).—Specimens which we refer to this species have been obtained at the Hawkesbury River and at Lisarow, both in May. Their description is as follows:—Pileus 4½ inches in diameter, convex to irregularly infundibuliform (funnel-shaped), brownish-umber, villous looking, rigid. Gills pale cream, distant, many short, deep, decurrent. Milk abundant, white, mild. Stem up to 2 inches long, usually rather eccentric, double in one specimen, matt, pale brownish to brown, becoming hollow. Spores spherical, warted, 7 to 9 μ. Under trees.

108. *Lactarius (Russularia) serifluus*, Fr.: Epicr., p. 345; Cooke: Illustrs., 1012; Massee: Brit. Fung. Flora, iii., p. 32.—Our specimens may be described as follows:—Pileus when small convex and slightly umbonate, later expanded with centre depressed and sometimes infundibuliform, rich reddish-tan to dark velvety reddish-brown. Gills adnate, some forked near the stem or near the edge, some very short ones interposed near the edge between long ones, very pale brown to salmon or tawny-white. Stem central or eccentric from distortion, reddish-brown like the cap, whitish at the base, finally hollow. Slightly caespitose under trees. Spores very rough, spherical to oval, 6·5 to 7, $8 \times 6{\cdot}5$ μ. Neutral Bay, Sydney, May, June, November; Lane Cove River, June; Bulli Pass, November.

RUSSULA.

109. *Russula adusta*, Fr.: Epicr., p. 350; Cooke: Illustrs., pl. 1051; Massee: Brit. Fung. Flora, iii., p. 52.—We have collected this species on three occasions. The following is the description of specimens from the Blue Mountains obtained in May, 1914:—Pileus convex, deeply depressed, pallid becoming tinged darker brown, not viscid, rigid, edge turned in. Flesh becoming dark grey. Gills crowded, fading off towards the stem, pure white becoming dark greyish-black. Stem 1 inch high, ⅝ inch thick, white becoming sooty, finely pruinose. Taste mild. Spores warty, slightly oval, $8{\cdot}5 \times 8$ μ (in the other collections, the spores are spherical to irregular, 7 to 9 μ). In specimens collected at Lane Cove River, Sydney, in May, fine woolly scales were noted on the cap.

110. *Russula Flocktonae*, n. sp.—Pileus up to 4 inches in diameter, irregularly convex, then depressed, pale pinkish-fawn, pale yellowish-brown, dull reddish-orange or brilliant velvety buff-orange. Gills adnate, moderately to widely separate, occasionally bifurcating, interspersed with short

ones, pure white, becoming darker and pruinose from the spores. Stem 1 to 1½ inch high, stout, sometimes attenuated downwards, solid, reddish-brown to pinkish-buff. Substance white. Taste mild, occasionally slightly peppery. Spores elliptical, warty, 8·5 to 10·8 × 7 to 8·5 μ, occasionally more spherical. Elongated cystidia, 26 μ long, seen in two collections. On the ground under trees, Ryde, Sydney, May; The Spit and Bradley Head, Sydney, June; Lane Cove River, Sydney, May; Hawkesbury River, April, June; Terrigal, June. (Miss Margaret L. Flockton, Watercolour A.)

We have been unable to find any figure or description agreeing with this species, and so describe it as new. We have named it in honour of Miss Flockton, who has admirably delineated it, and who for many years has taken a special interest in fungi.

Pileus ad 10 cm. latus, irregulariter convexus, deinde depressus, pallido-rosaceo-cervinus ad luteo-aurantiacus. Lamellae adnatae, subdistantes ad distantes, interdum bifurcatae, albae deinde pallidae et pruinosae. Stipes 2·5 ad 4 cm. altus, robustus, interdum deorsum attenuatus, solidus, rubro-subfuscus ad rosaceo-cervinus. Caro alba. Insipidus, interdum subpiperatus. Sporae ellipticae, verrucosae, 8·5-10·8 × 7-8·5 μ. Interdum cystidiis.

As indicated under *Clitocybe paraditopa* (No. 100), it is hoped that coloured plates of this species, with others, may be published in the Agricultural Gazette of N.S. Wales in 1920.

111. *Russula Mariae*, Peck.—Peck's description (N. York State Mus., Bull. 75, 1903 (1904), p. 29, pl. 85, figs. 1-8) of this species is as follows:—"Pileus at first nearly hemispheric, soon broadly convex, nearly plane or centrally depressed, pruinose and minutely pulverulent, dark crimson or purplish, sometimes darker in the centre than on the margin, rarely striate on the margin when old, flesh white, pinkish under the cuticle, taste mild; lamellae moderately close, adnate, white when young, pale yellow when old; stem equal, solid or slightly spongy in the centre, coloured like or a little paler than the pileus, usually white at the top and bottom, rarely entirely white; spores pale yellow, globose, ·003 of an inch broad." From this description and from the coloured figures given by Peck, we think there is little doubt that the common mild-tasted purple-capped *Russula* with a rosy-pink stem found in the Sydney district is *R. Mariae*. Perhaps the specimens of *R. purpurea*, Gill. (*R. Queletii*, var. *purpurea*, *vide* Massee), recorded by Cooke (No. 395) for Victoria are also this species, but *R. purpurea* is an acrid species.

We describe our specimens as follows:—Pileus up to $2\frac{1}{4}$ inches in diameter, convex, centre depressed, edge sometimes turned up, of various tints of dark purple, purplish-red, rosy-purple, or pallid yellow, the general tone being purplish, edge slightly striate, cuticle occasionally apparently slightly sticky when moist. Flesh white, perhaps faintly purple under the thick cuticle. Gills moderately close, white, becoming pale yellowish, fading away at the stem to adnate. Stem moderately stout, a little swollen below or sometimes attenuated downwards, tinged with rosy-pink, rarely whitish only, hollow, pithy, base rooting. Spores warty, spherical to slightly oval, 7·2 to 9 μ. Taste mild. Sydney, May; Milson Island, Hawkesbury River, March, April, May, November; Mount Lofty, S. Austr., July (gills yellow). Portions fed to a pig and to a rabbit produced no ill-effects. (Miss Clarke, Watercolour 65.)

The following are in the National Collection at the Botanic Gardens, Sydney:—Helensburgh (W. Craigie); Leura (A. A. Hamilton), April, 1908; Mosman (E. Cheel), May, 1912; Gladesville (Miss M. Flockton), April, 1910; Hawkesbury River (J. B. Cleland), April, 1910; Brownsville (E. Cheel), April, 1910.

112. *Russula xerampelina*, Fr.: Epicr., p. 356; Cooke: Illustrs., pls. 1053 and 1074; Massee: Brit. Fung. Flora, iii., p. 60.—We refer the following to this species. It agrees well with the illustrations given by Cooke:—Pileus up to $3\frac{1}{2}$ inches across, irregular, rather depressed in the centre, splitting and cracking, pallid whitish blotched with bright-brownish vermilion. Gills adnate, moderately close, sometimes forking, occasionally in deformed specimens forming irregular pores near the stem, pale buffy-white. Stem $2\frac{1}{2}$ inches high, $1\frac{1}{2}$ inch thick above, stout, attenuated downwards, root rather conical, fibrously striate, white with tinges of pinkish. Flesh solid, white. Slight smell. Rather rigid. Taste mild. Spores pale-tinted microscopically, warty, 8·5 to 10·5 μ. Partly buried in the ground. Mount Lofty, S. Austr., April, 1917.

113. *Russula azurea*, Bres.: Fungi Trident., t. 24; Cooke: Illustrs., pl. 1088; Massee: Brit. Fung. Flora, iii., p. 57.—The following resembles Cooke's illustrations of *R. cyanoxantha*, Schaeff., but cystidia have not been found. For the present at least we refer it to *R. azurea*, which resembles *R. cyanoxantha*, and has no cystidia:—Pileus 1 inch across, convex and dimpled atop, finally 3 inches across and depressed, definitely sticky when moist, not striate, when small the colour usually blotchy purplish with stone tints between, sometimes with distinct greenish tinges; tending to crack into small

purplish-brown scales or to become blotchy bluish-green and brownish-yellow in the centre, when old pale brownish with shades of dull bluish-green, cuticle separable. Gills adnate, close, all equal, sometimes forked, sometimes slightly anastomosing at the stem, diminishing towards the stem and rounded externally, white or creamy. Stem up to 1¾ inch high and up to ⅝ inch thick, slightly attenuated downwards, mealy, very slightly striate, solid, white. Taste mild. Shed spores white, spherical, warty, 7 to 8·5 μ. Neutral Bay, Sydney, March and May, 1917; Narrabeen, March, 1916; North Bridge, Sydney, July, 1916. (Miss Clarke, Watercolour 147.) A similar plant obtained at Sydney in March, 1916, had a very slightly peppery taste. Probably the same species, with the cap pallid brownish-white with dull greyish-green blotches, was collected at Mount Lofty, S. Austr., in April, 1917 (spores 6 to 7 μ).

114. *Russula granulosa*, Cooke: Handb., p. 332; Cooke: Illustrs., pl. 1038; Massee: Brit. Fung. Flora, iii., p. 69.—The punctate brown spots on the stem, the cystidia, and the acrid taste seem to indicate with reasonable certainty that the following is this species:—Pileus when young somewhat dome-shaped and irregular with the edge sharply turned in, then irregularly convex, finally expanding up to 4 inches in diameter, smooth but sometimes with a few wrinkles, or slightly fibrously streaked, edge plicate, somewhat viscid when moist, cuticle not separable, yellowish-brown. Flesh thick, becoming attenuated towards the edge, white. Gills adnate to adnexed, moderately close, edges darker and very slightly serrate, creamy, when bruised becoming brownish. Stem 1½ to 2½ inches high, attenuated downwards, mealy white with a tinge of ochre or with fine scattered punctate brown spots. Taste intensely peppery and somewhat bitter. Spores warty, 7 to 9 μ; a few projecting acuminate cystidia, 42×12 μ. Narrabeen, March, 1916, and February, 1917; Kew, January, 1917; Neutral Bay, Sydney, March, 1917. (Miss Clarke, Watercolour 90.)

115. *Russula pectinatoides*, Peck.—Peck's description (N. York State Mus., Bull. 116, p. 90) of this species is as follows:—"Pileus thin, broadly convex, becoming nearly plane or centrally depressed, viscid when moist, widely tuberculose striate on the margin, dingy straw colour, brownish, yellowish-brown or cinerous brown, sometimes darker in the centre, flesh white, greyish-white under the separable pellicle, taste mild or slightly and tardily acrid; lamellae thin, equal or with an occasional short one, some forked at the base, adnate, white becoming pallid; stem equal or nearly so, even, glabrous, spongy within, white; spores whitish, subglobose; ·00025-·0003

of an inch long, nearly or quite as broad. Pileus 1-3 inches broad; stem 1-2 inches long, 3-4 lines thick."

From this description and from Peck's figures, we believe the following to be this species. The stem is, however, usually attenuated downwards and grey under the cap has not been noted:—Pileus up to 3 inches in diameter, slightly convex to infundibuliform, periphery more or less striate, the striae sometimes showing small rounded warts on the ridges, smooth, viscid when moist, edge thin and not turned in, yellowish-brown and paler in the centre, or a brownish centre with a pale-fawn periphery or olive-brown or pale olive. Gills sinuately adnexed or adnato-decurrent, usually fading away near the stem, moderately close, thick, cream becoming spotted with brown or becoming pallid brownish-white. Stem $1\frac{1}{2}$ inch high, about $\frac{5}{8}$ inch across above, usually attenuated downwards to $\frac{3}{8}$ inch below, sometimes equal, slightly streaky, solid, white or white with a faint greyish tinge. Flesh white, thick in the centre, very thin towards the edge. Taste mild. Spores with a pale-yellow tint, spherical to subspherical, warty, 7 to 10 μ. Under trees, Neutral Bay, Sydney, March, April, May, June; Bulli Pass, April; Hawkesbury River, June; Manly, April.

116. *Russula emetica*, Fr.: Epicr., p. 357; Cooke: Illustrs., pl. 1030; Massee: Brit. Fung. Flora, iii., p. 73; Cooke: Handb. Austr. Fungi, No. 399 (N.S. Wales, Victoria, Tasm.).—An acrid species with a red cap and a tinge of pink on the stem, though in stature more resembling *R. fragilis*, we believe to be *R. emetica*, as the former is not stated to possess a pink tinge to the stem. Other acrid specimens, very similar but with pure white stems, may be the same species as the ones with pink tinges to the stems, but as the stature and general appearance resemble so closely *R. fragilis*, we at present leave them under that species. Our pink-stemmed specimens have a bitter pungent taste and a purplish to purplish-pink cap. Spores warty, 8·5 to $10·4 \times 5·2$ to 8·5 μ. Sydney, June.

117. *Russula fragilis*, Fr.: Epicr., p. 359; Cooke: Illustrs., pl. 1091; Massee: Brit. Fung. Flora, iii., p. 75; Cooke: Handb. Austr. Fungi, No. 400 (Q'land, Vict., S. Austr.).—Specimens, with the stature and general appearance of this species, have been found at Neutral Bay, Sydney, in June, and at The Spit, Sydney, in July. These may be described as follows:—Pileus 1 inch in diameter, depressed in the centre, deep crimson, edge slightly striate. Flesh reddish under the cuticle. Gills close, adnate, white. Stem $1\frac{1}{2}$ inch thick, slightly fibrously striate, solid. Taste acrid. Spores warty, spherical to oval, 8·5 to 10·5 μ.

118. *Russula erumpens*, n. sp.—Pileus up to 3 inches in diameter, depressed to infundibuliform, pure white or with a dirty-brown tint, surface dull, not polished. Flesh white. Gills adnate, from depression of the pileus with rather a decurrent tooth, crowded, creamy-white, when old rufescent. Stem 1¼ to 2 inches high, ½ to ¾ inch thick, sometimes a little excentric, white or slightly brown-tinted below, stout, equal, solid, dull, not polished. Spores pale rusty, spherical to slightly oval, verrucose, 7 μ, 8·5 × 7 μ. Taste mild. Emerging covered with soil. Neutral Bay, Sydney, January to May (after heavy rain), October and November; Milson Island, Hawkesbury River, April; Eagle on the Hill, Mount Lofty Ranges, S. Austr., April, 1917 (pileus up to 4½ inches across; spores 8·5 to 10·4 × 7 to 7·8 μ, microscopically apparently white). (Miss Clarke, Watercolour 63.)

Pileus ad 7·5 cm. latus, depressus ad infundibuliformis, albus vel subfusco-albidus, non nitidus. Caro alba. Lamellae adnatae, confertae, subluteo-albidae, deinde subochraceae. Stipes 3 to 5 cm. altus, 1·25 ad 1·8 cm. crassus, interdum subexcentricus, crassus, solidus, non nitidus, albus. Sapor non piperatus. Sporae subochraceae, sphericae ad subellipticae, verrucosae, 7 μ, 8·5 × 7 μ.

At one time we thought our species might be *Russula periglypta*, B. and Br., of Ceylon. Through the kindness of Mr. T. Petch, of Peradeniya Gardens, Ceylon, we have received coloured drawings and dried specimens of the Ceylon species which show that the two are clearly distinct.

As indicated under *Clitocybe paraditopa* (No. 100), it is hoped that a coloured figure of this species, the plate of which has been prepared for several years, will be published in the Agricultural Gazette of N.S. Wales in 1920.

Collybia.

Sect. I.—Striaepedes.

119. *Collybia radicata*, Relh. (Syn. *C. eradicata*, Kalch.; *C. olivaceo-alba*, Cke. and Mass.).—The typical form is recorded by Cooke (No. 78) for Victoria, Queensland, Tasmania, and Western Australia. *C. eradicata* (Cooke, No. 79) is recorded for New South Wales and Victoria; as it differs from *C. radicata* only in the stem not being rooting and not being thickened at the base, we adopt Cooke's suggestion that it may be possibly only an accidental variety of the latter, and so sink *C. eradicata* as a synonym. *C. olivaceo-alba* is recorded in Cooke (No. 82), and for Kogarah, New South Wales, by R. T. Baker (Proc. Linn. Soc. N.S. Wales, xxiv. (1899), p. 446) for Victoria and South Australia. From

the description and from Cooke's plate, it is apparent that *C. olivaceo-alba* closely resembles *C. radicata*, the chief point of difference being the black base of the stem of the former. In May, 1915, we found specimens of *C. radicata* in the Sydney district with whitish bases to the stems and growing near these, plants with the abrupt black bases of *C. olivaceo-alba*. Obviously both were the same species, and both showed the large spores—in this case 12 to 13·8 × 10·4 μ—characteristic of *C. radicata* and of *C. olivaceo-alba*. Apparently, therefore, the black-based plants are only a form of *C. radicata* not yet breeding true, and so not entitled to be established as a variety or species. We consider that a variety is a departure from the type due to some innate change and breeding true, whilst a form is a departure from type not necessarily breeding true, sometimes being merely a recognizable or an extreme variation in a variable species, sometimes being the result merely of environment, as in depauperate examples. On these grounds we sink *C. olivaceo-alba* to the level of a synonym of *C. radicata*.

SECT. II.—VESTIPEDES.

120. *Collybia velutipes*, Fr. Cooke: *loc. cit.*, No. 85 (Vict.). —On a fallen log near Wauchope, N.S. Wales, in February, 1917, a number of dried specimens of a *Collybia* were found almost identical with dried specimens of *C. velutipes* kindly forwarded by Miss E. M. Wakefield from England. They revived perfectly on being placed in water, but were not then viscid; the edge of the cap was also tuberculo-striate, which is not mentioned in the description of *C. velutipes*. Spores 7 to, usually, 8·5 × 5·2 μ; of the English specimens 8 to 8·5 × 3·4 μ.

121. *Collybia confluens*, Pers. Massee: Brit. Fung. Flora, iii., p. 130.—Plants collected by E. J. Semmens (No. 40) amongst pine needles at Craigie, near Ararat, Victoria, in June, 1917, seem indistinguishable from dried English specimens of this species received from Miss E. M. Wakefield. Spores 5 to 7 × 3 μ.

122. *Collybia ingrata*, Schum. Massee: Brit. Fung. Flora, iii., p. 131.—Pileus up to 2¼ inches across, convex, gibbous, the thin edge rather upturned, edge frayed, somewhat striate, pale to dark brown, sometimes chestnut. Gills adnate, moderately to very crowded, rather thick, edges finely serrate, livid or pallid brown. Stem up to 3 inches long, wavy, slender, clad with a dense velvetty-greyish bloom, stem brown when this is rubbed off, when moist brownish with a white bloom, cartilaginous, rather stringy. Spores with one

end more pointed, 7 to $9 \times 3{\cdot}4$ to 4 μ. Under bushes, Mosman, Sydney, April, May.

123. *Collybia stipitaria*, Fr. Massee: Brit. Fung. Flora, iii., p. 129.—We have collected this species on one occasion on Milson Island, Hawkesbury River, in March. As mentioned by C. G. Lloyd (Mycolog. Notes, No. 100), it revives on moistening like a *Marasmius*. The description of our specimens is as follows:—Pileus $\frac{3}{8}$ inch in diameter, convex, thin, tough, reddish-tan. Gills moderately crowded, pale brown, slightly decurrent. Stem up to $\frac{3}{4}$ inch high, base slightly swollen, hollow, villous, dark brown. Spores elliptical, $4{\cdot}4$ to $5{\cdot}2 \times 2{\cdot}5$ to $3{\cdot}4$ μ. Attached to the bases of living grass stems. (D. I. C., Watercolour 33.)

Hygrophorus.

Subgenus Hygrocybe.

124. *Hygrophorus miniatus*, Fr. Cooke: Handb. Austr. Fungi, No. 383 (Q'land, Vict.).—Our specimens approach *H. coccineus* in having a tendency to decurrence in the gills and occasionally a trace of yellow at the base of the stem. The spores are also a little smaller than those given for *H. miniatus* or *H. coccineus*. Our specimens may be dsecribed as follows:—Pileus $\frac{1}{2}$ to 1 inch in diameter, convex, sometimes a little dimple in the centre or umbilicate, sometimes irregular, sometimes upturned, sometimes slightly rugose and sometimes slightly squamulose, crimson, sometimes orangey-crimson or reddish-orange or pinky-scarlet. Flesh reddish. Gills distant, yellowish or rosy-pink or pallid, edge rather thick, adnate, becoming decurrent from depression of the pileus or with a decurrent tooth. Stem $1\frac{1}{4}$ to $2\frac{1}{4}$ inches high, dilated upwards, solid, sometimes hollow, crimson, with base sometimes slightly yellowish or the buried part whitish and fluffy. Spores elliptical 7 to $8{\cdot}5$ μ, occasionally $10{\cdot}4 \times 3{\cdot}6$ to $6{\cdot}8$ μ. Amongst moss or under trees. Neutral Bay, Sydney, May; Lisarow, May; Mount Wilson, Blue Mountains, June; Leura, June; Blue Mountains, July; National Park, July; Oxford Falls, Narrabeen (Darnell-Smith), October; Tuggerah, October; Hawkesbury River, November.

125. *Hygrophorus conicus*, Fr. Cooke: *loc. cit.*, No. 384 (Vict.).—Our collections of this species may be described as follows:—Pileus $\frac{3}{4}$ inch in diameter, elongated globular, then convex with an acute umbo, fibrillosely streaked, yellowish-green or dark greyish-brown, turning black with black fibrils. Gills just free or just sinuately adnexed, triangular, yellowish becoming grey or dark grey. Stem $2\frac{1}{2}$ to $3\frac{1}{2}$ inches high, rather fibrillose and twisted, the fibrils later becoming

blackish, pallid brownish, with scattered black cobweb-like lines, or yellowish-green, becoming hollow. Spores elliptical, almost colourless, often with apparently a watery blackish tint, 9 to 10·4 × 6 to 7 μ. Under shrubs. Lisarow, May; Neutral Bay, Sydney, May; Mosman, Sydney, June; Mount Lofty Ranges, S. Austr., June, 1917.

126. *Hygrophorus psittacinus*, Schaeff. Massee: Brit. Fung. Flora, ii., p. 341.—The following specimen seems to be best referred to this species:—Pileus up to 1 inch in diameter, somewhat conical, then convex, then expanded, dark green, browner on top, later pale olive-green, not apparently viscid, silky shining, rigid. Gills sinuate, thick, moderately distant, greyish flesh in colour. Stem 1½ inch high, attenuated upwards, reddish-brown, becoming paler, hollow. Spores pear-shaped, 7·2 to 8·5 × 5·2 μ. On the ground, Blue Mountains, May, 1914.

Marasmius.

Sect. I.—Collybiarii.

127. *Marasmius porreus*, Fr. Massee: Brit. Fung. Flora, iii., p. 155.—Pileus ¾ inch in diameter, plane or slightly depressed, striate, brown. Gills adnate, then seceding, close, dirty white. Stem slightly striate, base downy, brown. Slight foetid smell. Complete revival in water. Spores 5·2 × 2·5, 4·4 × 2 μ, one end more pointed. Amongst leaves, Manly, April, 1915. (Herb., J. B. C., Form. Sp. 50.) Though our plants resemble more Cooke's illustrations of *M. erythropus* than those of *M. porreus*, on account of the smell we place them provisionally under the latter.

128. *Marasmius alliatus*, (Schaeff.) Schröt. (*M. scorodonius*, Fr. Cooke: Handb. Austr. Fungi, No. 424; Massee: Brit. Fung. Flora, iii., p. 162.—Pileus ½ inch or larger, slightly umbilicate, coarsely but flatly grooved, dirty brownish-white to reddish-brown, paler periphery. Gills adnate, moderately crowded, many short, slightly toothed, pale cream. Stem ¾ inch high, slender, hollow, smooth, dark reddish-brown. Slight smell of garlic. Attached to fallen leaves, sometimes apparently on the ground, by a slightly bulbous base. Shed spores elongated, pear-shaped or pip-shaped, one end narrower, 8·7 to 10·3 × 3·6 to 4 μ. (D. I. C., Watercolour 32.) Neutral Bay, Sydney, February, March (spores 10·4 to 12·4 × 5·3), May; Murwillumbah, April, 1916 ([?] this species, stem finely mealy, pallid brown, spores 8 × 2·5 μ); Wiseman's Ferry, June, 1915.

The plate of *M. scorodonius* given by Cooke (Illustrs., 1125A) shows plants stouter and with caps and stems brighter rufous than our specimens.

129. *Marasmius calopus*, Fr. Massee: Brit. Fung. Flora, iii., p. 163; Cooke: Illustrs., 1125B, and Handb. Austr. Fungi, No. 425 (Q'land).—Specimens collected at Mosman, Sydney, in November, 1914, and at Manly in April, 1915, and found growing on fallen twigs, agree with Cooke's illustrations. They differ slightly from the description given by Massee in the stem being dark below and paler above. We describe our plants as follows:—Pileus up to $\frac{1}{3}$ inch in diameter, convex, then plane or umbilicate, creamy-white sometimes with a smoky centre, somewhat sulcate-rugose, edge turned in when young. Gills adnate or adnexed, moderately distant, finely toothed, white. Stem $\frac{1}{2}$ inch or more long, very slender, blackish below, then dark brown suddenly becoming whitish, sometimes almost throughout pale or dark brown, mealy tuberculose below, mealy above, attached by a minute disc. No smell (slight garlicky smell noticed in one collection). Spores rather elongated, one end more pointed, 5·2 to 7 × 2·5 to 3·4 μ. (Miss Clarke, Watercolour 56; Herb., J. B. C., Form. Sps. 49 and unnumbered.)

130. *Marasmius equi-crinis*, F. v. M.: Grev., viii., 153; Cooke: Handb. Austr. Fungi, No. 441 (Vict., N.S. Wales, Q'land). (Syn. *Thamnomyces hippotrichoides*, C. E. Broome; *Alectoria australiensis*, Knight. Records in Ann. Rep. Bot. Gdns., Sydney, 1909 (1910), 10).—The sterile horse-hair-like mycelium is common in the Big Scrub on the Richmond River and in the Dorrigo Scrub, and also in Queensland, specimens having been collected at Enoggera, Coomera, Mount Mistake, Allumbah, Taylor Range, Kerang Creek, and Dalrymple Creek. We have also specimens collected at Futuma, in the New Hebrides. The mycelium has a superficial resemblance to certain lichens, and has been recorded under the name *Alectoria australiensis*, Knight, in Bailey's and Shirley's works, as pointed out by one of us (Cheel: Proc. Linn. Soc. N.S. Wales, xxxii., 1907, p. 475).

The following we believe to be a pileate specimen:—Pileus $\frac{1}{12}$ to $\frac{1}{8}$ inch in diameter, convex, with about 8 coarse rugae, brown, apex smooth and a little depressed, paler with a dark central knob. Gills adnate and attached to a collar but free from the stem, distant, about 9 or 10 in number, pallid. Stem up to 4 or 5 inches long, smooth, hair-like, dark brown or black, abruptly piercing the matrix. Under shrubs on fallen wood or leaves. Mount Wilson, Blue Mountains, June, 1915 (Herb., J. B. C., Formalin Sp. 145). Extensive hair-like light-brownish mycelial threads, found covering fallen leaves, etc., in the neighbourhood of these specimens, may have been the sterile mycelium of this species, though the colour was not the dark brown or black of the stems of the cap-bearing portions.

Mycena.

SECT. II.—BASIPEDES.

131. *Mycena banksiae*, n. sp.—Pileus up to ½ inch in diameter, convex, then nearly plane, viscid, sulcate-striate to near the centre, which may be depressed, covered with a pruinose downiness except in the centre, greyish-white becoming brownish, centre darker. Gills not or scarcely reaching the stem to adnate, moderately close, edges not serrate, greyish-white. Stem short, less than ½ to ¾ inch high, shining, smooth, not definitely viscid, whitish with a slight greyish tint, attached by a small disk to the base of *Banksia* trunks, dead or living; we have also found it on dead wood other than *Banksia*. No smell. Spores subspherical, often with a large "nucleus," 6·8 to 9, 8·5 × 7, 8 × 5, 6 × 5 μ, etc. No cystidia. Mosman, April, 1915; Neutral Bay, April, 1915 (pileus conico-convex, pileus and stem with a glaucous bloom, lavender-grey, pileus widely sulcate; gills few, adnate, widely separate, greyish-white; stem swollen below); Neutral Bay, April, May; National Park, N.S. Wales, July, 1916; Bradley Head, Sydney, May, 1917. (Miss Clarke, Water-colour 52; Herb., J. B. C., Form. Sps 55 and 63.)

Pileus ad 1·25 cm. latus, convexus, deinde subplanus, viscidus, sulcato-striatus, pruinosus, subcinereo-albidus, deinde subfusco tinctus. Lamellae subadnatae ad adnatae, subconfertae, marginibus non serratis, cubcinereo-albidae. Stipes brevis, 1·25 (minus) cm. altus, nitidus, glaber, subcinereo-albidus, disco parvo. Sporae subsphericae, 6·8-8, 8·5 × 7, 6 × 5 μ.

We have named the species *banksiae* from having frequently found it growing on the trunks of various Banksias. (Pl. xxix., fig. 3.)

SECT. III.—GLUTINIPEDES.

132. *Mycena coccineus*, n. sp.—The following beautiful little species seems referable to the genus *Mycena*. Specimens exhibit a tendency to revive when moistened, though this feature is not so definite as in the typical *Marasmius*. The gills, adnate when young, also tend to be definitely though slightly decurrent when old, suggesting *Clitocybe*, whilst their edges are rather thick, thus approaching *Cantharellus*. In Cooke's illustrations we can find no species at all resembling it. By its darker denticulate edge to the gills it is probably related to *Mycena strobilina* and *M. rosella*, though on account of the glutinous stem when moist we place it in *Mycena* under *Glutinipedes*:—Pileus ⅜ inch in diameter, hemispherical to convex, occasionally dimpled or with a slight

obtuse umbo, faintly striate, when moist definitely viscid, of a dark blood-red or rich reddish-crimson colour. Gills adnate, then slightly decurrent, rather thick, moderately close, rose colour or slightly paler than the pileus, edge very slightly darker and finely denticulate. Stem 1 inch high, slender, coloured like the cap, glutinous when moist, hollow, usually attached by a small fluffy disc. On bruising the gills or stem, a little dark-red moisture appears. The colour rapidly disappears in formalin solution. Spores elongated, one end more pointed, very hard to see, 7 to 8·5 × 2·5 to 3·5 μ. Attached to small sticks and leaves in damp shady places. Mosman, Sydney, April, May, and June; Tuggerah, October; Hawkesbury River; Mount Kembla, November.

Colour tints noted:—Pileus dull carmine-lake (pl. 106, Ton 4); old blood-red (pl. 103, Ton 2).

Pileus ad 1 cm. latus, hemisphericus ad convexus, interdum umbilicatus vel subgibbosus, substriatus, viscidus, sanguineo-coccineus. Lamellae adnate, deinde subdecurrentes, subcrassae, subconfertae, rosaceo-coccineae, marginibus sanguineo-coccineis et subdenticulatis. Stipes 2·5 cm. altus, tenuis, cavus, glutinosus, sanguineo-coccineus, ad basem disco. Sporae elongatae, 7-8·5 × 2·5-3·5 μ. (Pl. xxix., fig. 4.)

SECT. IV.—LACTIPEDES.

133. *Mycena sanguinolenta*, Alb. and Schw. Massee: Brit. Fung. Flora, iii., p. 89; Cooke: Handb. Austr. Fungi, No. 116 (Vict.).—Cooke has recorded this species for Victoria and Baker (Proc. Linn. Soc. N.S. Wales, xxxi., p. 720 [1906]) for New South Wales. On several occasions in New South Wales and South Australia we have met with a *Mycena* which combines some of the characters of *M. sanguinolenta* with some of those of *M. haematopa*, Pers. It agrees with the latter in the margin of the pileus being minutely toothed and the juice being prune coloured. It grows amongst leaves or grass on the ground, however, and not on trees or stumps. In size it resembles the former, and also has a dark-red edge to the gills, which in addition are finely toothed. The colour of the juice is darker than that of *M. sanguinolenta* given in Cooke's illustration. At present we place it under *M. sanguinolenta*, as being probably the Australian species hitherto recorded as such, but it is possible that it may not be either of the two species above mentioned.

The description of our specimens is as follows:—Pileus up to $\frac{5}{8}$ inch broad and $\frac{1}{2}$ inch high, submembranaceous conico-campanulate, sometimes finally irregularly upturned, sometimes umbonate, striate, edge of cap very finely toothed, pale brown to reddish-brown, drying paler. Gills adnate, moderately close, often irregular with connecting veins, whitish with a faint pink tinge or pallid, edges dark red or dark purple, and finely toothed. Stem up to 3 inches high, slender, shining, slightly attenuated upwards, hollow, pale to reddish-brown. A prune-coloured watery juice exudes on section or from the broken gills. Spores elongated, white, coarsely granular internally, 7 to 9 or even 12×5 to 7 μ. The colour may dissolve in formalin specimens. Amongst leaves under trees, grass, etc. Neutral Bay, Sydney, June, 1913; Mosman, May, 1914; Manly, May, 1915; Mount Lofty, S. Austr., July, 1914; National Park, S. Austr., June, 1917 (unusually large, the maximum sizes given above); amongst fallen bark and twigs, Craigie, Victoria, June, 1917 (E. J. Semmens, No. 39; probably this species).

Pleurotus.

134. *Pleurotus lampas*, Berk.—*Agaricus (Pleurotus) lampas*, Berk.: Hook. J., iv., 1845, p. 44; Cooke: Handb. Austr. Fungi, No. 155. Synonyms:—*Agaricus noctilucus*, Berk. *(vide* Cooke, No. 155). *Agaricus (Pleurotus) phosphoreus*, Berk.: Hook. J., vii., 1848, p. 572; Cooke: No. 157. *Agaricus (Pleurotus) illuminans*, Muell.: Linn. J., xiii., 1873, p. 157; Cooke: No. 150. *Agaricus (Pleurotus) candescens*, Muell.: Linn. J., xiii., 1873, p. 157; Cooke: No. 158; McAlpine: Linn. Soc. N.S. Wales, 1900, p. 553, pls. xxxi. and xxxii. *Panus incandescens*, B. and Br.: Linn. Trans., ii., p. 5; Cooke: No. 498; Bailey: Comp. Cat. Q'land Plants, p. 725 (*=A. Gardneri). Agaricus (Pleurotus)* Gardneri, as identified by Berk. and Br.: Linn. Trans., 1878, p. 399; Cooke: No. 149. (?)*Agaricus (Pleurotus) nidiformis*, Berk.: Hook. J., iii., 1844, p. 185; Cooke: No. 154.

In our opinion all of the above supposed species recorded for Australia represent examples of but one variable and very common form, of which by priority the name should be *P. lampas* (or *P. nidiformis*, if this also is the same species). Our common luminous species is undoubtedly the species described so accurately by McAlpine *(loc. cit.)*.

Our reasons for considering that there are so many synonyms are as follows:—First of all, the specimens we have ourselves examined are very variable as to texture, size, and colour. Some examples are very firm, approaching *Panus*, whilst others, usually growing in shady places, are very soft and watery. The colour of the cap varies from a creamy-white in shaded examples to purplish-black and occasionally bright fulvous-brown. Various collections might thus quite well be classified as separate species. Then, with the exception of Baron von Mueller—who only incidentally collected fungi—none of the authors quoted had, apparently, access to fresh material, and so were dependent on the notes (if any) of the collectors. In the paper in which *P. Gardneri* is recorded by Berkeley and Broome for Queensland, it is in fact definitely stated that all the species recorded by them were "unaccompanied by notes or sketches of any kind." In this paper there is no reference, as suggested by Cooke, to the fungus growing on "petioles and half-putrid fronds of palms," which obviously is taken by Cooke from the original description of the species from Brazil. There is no reference even to the species being phosphorescent. Bailey (Compr. Cat. of Q'land Plants, p. 775), evidently on higher authority, states that *Panus incandescens*=*Agaricus Gardneri*, "the large luminous fungus." As regards *P. nidiformis*, though the original description does not mention any phosphorescence, Berkeley in speaking of *P. lampas* later says it is allied to *P. nidiformis*, which is also phosphorescent. The gills in the latter are described as "ochraceous," which term might perhaps be applied to old specimens of our common species. In the original description of *P. illuminans* there seems no reason for it to have been classed by Cooke in the section with an annulate veil.

Taking everything together, therefore, we feel quite justified in this apparent "lumping," and a reference to the original descriptions will show how imperfect these are for purposes of separation. We have written to Kew to ask whether specimens of *Pleurotus lampas*, *phosphoreus*, *illuminans*, and *candescens* and *Panus incandescens* exist there, and whether the dried plants could be distinguished from each other. Through the Director of the Royal Botanic Gardens, Miss E. M. Wakefield has replied as follows:—"Specimens exist only of *Pleurotus lampas*, *P. candescens*, and *Panus incandescens*. To a person familiar with the fresh plants it might be possible to make a comparison, but the dried specimens alone are practically useless. The habit of all is very similar, but the spores found vary slightly in size, as follows:—*P. lampas* (type), 6 to 7×3 to 4 μ; *P. candescens* (type), 7 to $7{\cdot}5 \times 4$ μ; (Melbourne specimen) 7 to 10×5 to 6 μ; *Panus incandescens* (type), 7×5 μ. These are in all cases the spores obtained by scraping the gills, so that young ones would probably be included amongst them." This reply strongly supports our attitude. As regards *P. nidiformis*, Miss Wakefield, in answer to a later enquiry, said that no specimens of this species were in Kew Herbarium.

New South Wales.—We have a number of collections from the Sydney district, April to November; also specimens from Mount Wilson and Kendall, May. Spore mass sometimes pale ochraceous. Edge of pileus sometimes incurved. Spores oval, with a large "nucleus," 7 to 9×5 to 6 μ, usually $7·5 \times 5·5$ μ. In one collection made at Milson Island, Hawkesbury River, in April, the pileus was of a brilliant rufous-brown, the gills being also rufous coloured.

We have collected this "bronzed" form also at Mosman in December, 1916, spores $6·2 \times 4·2$ (Miss Clarke, Watercolour 142; Herb., J. B. C., Form. Sp. 280), and in May, 1917, at Mosman, Sydney, April, 1918, we found this species and *Armillaria mellea* growing together at the base of a stump.

Victoria.—Ararat (E. J. Semmens, No. 25), May, 1917.

Colour tints noted:—Pileus, in the centre tints of purplish-black (pl. 345, Ton 1), grading into, but greyer than, Parma violet (pl. 200, Ton 4); grades of colour between dark chocolate-brown (pl. 342, Ton 3), buff (pl. 309, Ton 4), mostly browner than Mars yellow (pl. 316, Ton 4), with some yellowish-tan colour (pl. 315, Tons 1 to 4) but browner; mineral-brown (pl. 339, Ton 2), the centre darker than Ton 4; Kaiser brown (Ridgway, pl. xiv.), light ochre-buff (pl. xv.), light buff (pl. xv.), and tints of light Payne's grey (pl. xlix.); shades of Payne's grey (pl. 356, Ton 4); grey (pl. 359) with a violet tint. Stem, tints of Mars yellow (pl. 316, Ton 1) at the base; tints of light Payne's grey (Ridgway, pl. xlix.).

135. *Pleurotus ostreatus*, Jacq. Cooke: Illustrs., pls. 195 and 953; Massee: Brit. Fung. Flora, ii., p. 371.—We refer the following to this species:—Pileus up to 6 inches broad and 4½ inches from before backwards, convex but nearly plane, pale smoky-brown, surface dull, edge slightly turned in. Gills close, creamy-white, anastomosing below on the short stout lateral almost obsolete stem. Spores elongated, in the mass with a slight pinkish tinge, 8·5 to $10·5 \times 3·5$ μ. Attached one above the other at the base of a stem of sassafras (*Doryphora sassafras*, Endl.). Hawkesbury River, November, 1916. The following is probably also this species, having been found two years previously near the same spot. These latter plants grew singly on a fallen trunk:—Pileus up to 2½ inches in diameter, convex and indented on the side nearest the stem, of a pallid stone-colour or greyish-brown, smooth but finely-punctate looking, slightly sticky, edge turned in. Stem nearly lateral, short (½ inch or under), stout, whitish to somewhat smoky. Gills moderately close, creamy-coloured, tendency to fork, some short, deeply decurrent on to the stem, where they reticulate. Flesh thick, white, rather

tough, not phosphorescent. Spore elongated, 8·5 to 8·8 × 3·4 μ, no cystidia. On upper surface of fallen trunk. Hawkesbury River, December, 1914. (Herb., J. B. C., Form. Sp. 18.)

136. *Pleurotus subostreatus*, n. sp.—Pileus up to 7 inches broad and 4 inches from before backwards, convex, becoming depressed towards its attachment, pallid whitish, matt. Gills thick, creamy-white, anastomosing near the base to form a network. Laterally attached by a short broad pallid to brown matt stem, $\frac{3}{4}$ inch long and $\frac{5}{8}$ inch thick. Spores pear-shaped, 4 × 2·5 μ. On a fallen log, Wauchope, N.S. Wales, February, 1917. This species seems to approach *Panus* in texture. It differs from *P. ostreatus* in the definite brownish stem and in the small spores.

Pileus ad 17·5 × 10 cm., convexus, albidus, subtomentosus. Lamellae crassae, subflavo-albidae, ad basem anastomosae. Stipes ad 2 cm. longus, lateralis, brevis, crassus, pallidus ad fuscus, subtomentosus. Sporae pyriformes, 4 × 2·5 μ.

137. *Pleurotus Cheelii*, Mass.: Kew Bull., 1907, p. 122; Proc. Linn. Soc. N.S. Wales, xxxii. (1907), p. 202.—Small, white. Pileus thickly hairy, attached by the vertex. Gills radiating from the centre, moderately close, rather thick. Spores thick-walled, subspherical, 6 to 8, 7·5 × 5·8, 8·5 × 7 μ. On branches, Eden, Twofold Bay (portion of the type); National Park, N.S. Wales, July, 1916.

138. *Pleurotus striatulus*, Fr.: Icon., t. 89, f. 5; Sacc.: Syll., 1518; Cooke: Illustrs., 212B; Cooke: Handb. Austr. Fungi, No. 184 (Q'land).—Our specimens, which have been identified by Lloyd, may be described as follows:—At first minute and cup-shaped, finally more open, sometimes fan-shaped, sessile by the edge or excentrically, light grey to dark grey, slightly striate, powdery looking. Gills moderately distant, darker grey than the pileus, sometimes with a brownish tint, radiating from the downy base. At once reviving on moistening (hence really a *Panus*). On decaying branches of a living cultivated mulberry (*Morus alba*, L.), Milson Island, Hawkesbury River, June, 1913 (spores 5·5 × 3·6 μ); on a twig (spores 6·8 × 4·2 μ); on dead wood (spores 3·5 to 7 × 2 μ); Manly, April; Sydney, May; Lisarow, June; Mount Wilson, June—all the latter with subspherical spores, 4·8 to 5·5 μ (hence some doubt exists as to there being two species, with oval and subspherical spores respectively).

Lentinus.

139. *Lentinus tuber-regium*, Rumph. Lloyd: Mycol. Notes, No. 47, 1917, p. 666, fig. 959 (this collection).—Pileus up to 6 inches across, deeply infundibuliform, slightly

obscurely striate, with a lens minutely scaly, light brown to light smoky-brown. Gills close, deeply decurrent, white then with a brownish tint. Total height up to 9 inches; stem alone, above ground, 4 inches. Stem more or less equal, $\frac{5}{8}$ inch thick, brownish, with darker fibrillose scales. Sclerotium on section pure white, 2 inches in diameter. Spores pear-shaped, 5 to $6 \times 2{\cdot}5$ to 3 μ. On the ground amongst fallen branches of *Araucaria Cunninghamii*, Ait., Mummulgum Brush, near Casino, December, 1916. Identified by C. G. Lloyd. We have recently received from Mr. C. T. White, Government Botanist, Queensland, some undeveloped sporophores obtained by Mr. Munro Hull at Eumundi in November, 1918, on an old hickory *(Tarrietia)* stump in a banana plantation.

140. *Lentinus strigosus*, Fr. Cooke: Handb. Austr. Fungi, No. 454.—We have made several collections in New South Wales, two of which have been identified by Lloyd. The pileus is up to $2\frac{1}{2}$ inches in diameter, moderately depressed, of a brownish-fawn colour, densely strigosely hairy. The decurrent gills are moderately close, entire, pallid ochraceous. The stem is short, up to $\frac{1}{2}$ inch long, swollen, contracted above where the gills join, and densely strigosely hairy. Spores 4·5 to $5 \times 2{\cdot}2$ to 2·5 μ; cystidia thick-walled, blunt to club-shaped or irregular, 26 to $52 \times 8{\cdot}5$ to 13·8 μ. New South Wales, locality not noted; Mummulgum, near Casino, December, 1916; Wingham, November, 1916; Comboyne, September, 1918. See Proc. Linn. Soc. N.S. Wales, xxxii., p. 202 (1907), for previous records.

141. *Lentinus dealbatus*, Fr. Cooke: *loc. cit.*, No. 459 (W. Austr.).—We have specimens, obtained at Manildra, N.S. Wales, on a fallen *Callitris* log in October, 1916, which have been identified by C. G. Lloyd. The gills when young were purple-violet, bnt when old pallid yellowish without voilet. A few spores, 5 to $7 \times 3{\cdot}4$ μ, seen.

142. *Lentinus fasciatus*, Berk.: Hook. J., 1840, p. 146; Sacc.: Syll., 2317; Cooke: Handb. Austr. Fungi, No. 458 (Q'land, N.S. Wales, W. Austr., Tasm.); Lloyd: Mycol. Notes, No. 55, August, 1918, p. 796.—Our specimens, which have been identified by Lloyd (No. 412, described in his Mycol. Notes) were found growing at Malanganee, near Casino, in August, 1917, in rotten wood, the mycelium being effused over the wood for several inches as a thick brown velvety layer; a few spores seen, 5 to $7{\cdot}5 \times 3{\cdot}4$ to 4·5 μ. We have also the following:—New South Wales, locality not noted; Milson Island, Hawkesbury River, April, 1915, identified by Lloyd (spores $7 \times 3{\cdot}4$ μ, when moist the pileus straw-brown, the gills buffy-brown, adnato-decurrent, and the stem

dark brown); Stockton, October, 1915, bleached specimens (identified by Lloyd).

143. *Lentinus radicatus*, Cooke and Mass.: Grev., xiv., 118; Sacc.: Syll., 2395; Cooke: Handb. Austr. Fungi, No. 474 (Q'land).—A specimen collected on burnt soil at Milson Island, Hawkesbury River, in March, 1914, appears to be this species. This opinion has been confirmed by C. G. Lloyd. Its description is as follows:—Pileus 3 inches in diameter, upturned, reddish-tan, villous. Gills pale cream, crowded, decurrent, edge a little toothed in places. Stem 4 inches long, 1 inch thick, pale brownish-white above ground but mostly buried, the lower $2\frac{1}{2}$ inches rooting and attenuated with a slightly bulbous hollow base, the rest solid, soil aggregated round the root. Spores elongated, oblique, 10·4 to $12 \times 5{\cdot}2\ \mu$.

144. *Lentinus ursinus*, Fr.—Our specimens, kindly identified by C. G. Lloyd, are 1 inch or more laterally and about $\frac{3}{4}$ inch from behind forwards, the pileus fan-shaped, convex, densely pilose, dark brown. The gills are close, with the edges denticulate, pallid whitish. Laterally attached by a contracted base, sometimes developing into a short stem which is coloured and pilose like the pileus. On fallen trunks, often overlapping. Spores subspherical, $4{\cdot}2 \times 3{\cdot}4$, 3·8 μ, etc., no cystidia. Mount Wilson, June; Lisarow, December.

Panus.

145. *Panus stypticus*, Fr. Cooke: Handb. Austr. Fungi, No. 502 (Vict.).—Specimens have been kindly identified for us by C. G. Lloyd. All the Australian specimens we have tasted lack entirely any hot or pungent taste. Spores 4·2 to $5{\cdot}5 \times 1{\cdot}8$ to 2·5 μ. Mount Wilson, June; Leura, June; Lisarow, June; between Bowral and Robertson, August; Macquarie Pass, August.

146. *Panus viscidulus*, B. and Br.: Linn. Trans., ii., 55; Sacc.: Syll., 2568; Cooke: Handb. Austr. Fungi, No. 504 (Q'land, N.S. Wales, Vict.).—Though our specimens revive perfectly on moistening, from their general appearance we feel inclined to consider them rather as a *Pleurotus* than as a *Panus*. Pileus rather small, fan-shaped, glutinous, bright tanny-brown to chestnut, edge paler and slightly striate. Gills white or pale brownish-white, decurrent, connected by veins, moderately close, edge rather thick. Stem lateral or nearly so, very short (up to $\frac{1}{4}$ inch long), villous to hairy at the base, pallid or pale brownish. Spores colourless, 6 to $7{\cdot}2 \times 3{\cdot}4$ to 4 μ. On fallen trunks amongst moisture, Mount Wilson, June, 1915. The weak formalin in which a

specimen was preserved has become dark grey and clouded, as does a solution of silver nitrate when exposed to light.

XEROTUS.

147. *Xerotus fuliginosus*, Lloyd: Letter 60, Note 338.—This species has been identified for us by C. G. Lloyd, who in his letter states that it is probably also *X. tener*, of B. and Br.; *X. Berterii*, of Mont.; *X. lateritius*, of B. and C.; *X. papyraceus*, of Berk.; and *X. Drummondii*, of Berk., mentioned in Cooke's Handb. of Austr. Fungi. The pileus is thin, fan-shaped, up to ½ inch from side to side and ¼ to ½ inch from before backwards, rugosely folded, reddish-tan when moist. The gills are distant, dark purplish-brown when moist. The stem is lateral, very short, dark brown, and finely villous. Young plants are bright rufous with hymenium a deep reddish-brown. Shed spores 10·4 to 12×7 μ. On fallen twigs and sticks in brush forests, etc. Helensburgh (A. A. Hamilton), October, 1913; Bulli Pass, May, 1914, and November, 1917; Blue Mountains, November, 1914 (spores $8{\cdot}5 \times 4{\cdot}2$ μ); National Park, July, 1916; Mosman, December, 1916.

LENZITES.

148. *Lenzites abietina*, Fr.: Epicr., p. 407; Cooke: Illustrs., pl. 1146A; Massee: Brit. Fung. Flora, ii., p. 306; Cooke: Handb. Austr. Fungi, No. 529 (Q'land, S. Austr.).—The gills of one of our specimens, identified by Lloyd, when moist were pale brown and pruinose with spores, slightly toothed and folded; the spores were colourless, elongated, 8·5 to $10{\cdot}5 \times 5$ μ (slightly larger than the measurements, 7 to 8×4 μ, given by Massee for European specimens), no cystidia; extending longitudinally many inches; on a fallen log near Hill Top, N.S. Wales, October, 1913. We also have the following:—Narromine, May, 1914; on fallen log, Milson Island, Hawkesbury River (sometimes effused, sometimes reflexed; pileus dark brown, growing edge yellow-brown to pallid; gills chocolate-brown; spores 8·5 to $10{\cdot}4 \times 4$ μ), February, 1915, identified by Lloyd (No. 325). This species(?), on fallen *Callitris* log, Pilliga Scrub, November, 1916, identified by Lloyd (No. 328), who says, "Compared to the European plant, it is much thinner, more rigid, and has distinct pubescent zones, not seen on the European plant; it should have a name."

149. *Lenzites ungulaformis*, Berk. Lloyd: Mycol. Notes, No. 56, October, 1918, page 811.—Lloyd has published the above note on our specimens, which were obtained at Malanganee, near Casino, in August, 1917. He thinks that this

"species," described by Berkeley from the Southern United States, is not a true species, but an aberrant form of *L. betulina*. He says, "The context is white, the gills typically those of the common *Lenzites betulina*, but the upper surface is different. It is white, not pubescent, nor zoned, but glabrous and rugulose." We have also collected a specimen at Lorne, near Kendall, September, 1918.

150. *Lenzites striata*, Swartz. Fr.: Epicr., i., p. 406; Sacc.: Syll., 2653; Cooke: Handb. Austr. Fungi, No. 531 (Q'land, Vict.).—On fallen *Callitris* log, Narrabri, November, 1916 (identified by Lloyd, No. 266). Lloyd says of these specimens that they are not exactly the common plant of the American tropics, but close to it. "The colour, gills, and general shape are the same, but the surface is harder and more zonate."

151. *Lenzites saepiaria*, Fr.: Hym. Eur., 494; Cooke: Illustrs., pl. 1146A; Sacc.: Syll., 2636; Cooke: Handb. Austr. Fungi, No. 528 (Vict.).—Specimens identified by Lloyd (No. 219) from Manildra, October, 1916, on old *Callitris* stump.

152. *Lenzites Beckleri*, Berk.: Linn. Journ., xiii., 161; Sacc.: Syll., 2664; Cooke: Handb. Austr. Fungi, No. 536 (N.S. Wales, Q'land).—Wingham, Nov., 1916, identified by Lloyd (No. 331) as doubtfully this species. He adds that this specimen has the surface and context of *L. Beckleri* with the pores of *L. repanda*. "The gills of *L. Beckleri* are more lamellate, like those of *L. betulina*, but I put more stress on the context nature and surface of this group of plants than on the hymenial configuration. In nature of context and surface it approaches *Trametes lactinea*."

153. *Lenzites repanda*, Mont. Fr.: Epicr., 404; Sacc.: Syll., 2688; Cooke: Handb. Austr. Fungi, No. 542 (Q'land, N.S. Wales).—Eumundi, Q'land, January, 1911 (J. Stair; identified by Lloyd, No. 329); Murwillumbah, April, 1916 (spores $7 \times 2{\cdot}5$ to $3\ \mu$; Lloyd, No. 330); Malanganee, August, 1917; Kendall, May, 1917; Comboyne, September, 1918. We have also specimens from Mango Island, Suva, Fiji, 1918 and 1919 (Mrs. Lucas).

154. *Lenzites Muelleri*, Berk. *Daedalea Muelleri*, Berk.: Grev., xix., 93; Cooke: *loc. cit.*, No. 868, Vict. (aberrant *L. repanda*, Lloyd in letter).—Comboyne, September, 1918; identified by Lloyd (No. 512). Lloyd in a note says that *L. repanda*, unlike *L. flavida*, is remarkably uniform in hymenial form, but that our specimen is so different from the usual appearance that Berkeley might be excused for naming it a new species as *Daedalea Muelleri*. He adds that it must not

be confused with *Trametes Muelleri*, which may also be a variant, but has small round pores and is more frequent and constant.

155. *Lenzites bicolor*.—On a dead stump of *Callitris robusta*, R. Br., Pilliga Scrub, October, 1918; identified by C. G. Lloyd (No. 509). In a note on these specimens Lloyd says that they are the same as regards context-colour and gills as *Lenzites abietina*, but the surface is pale (almost white) and of a different colour to the context, and there are dark zones on the surface, where this pale surface layer is undeveloped. The upper surface view is the same as that of *Polystictus Friesii*. Lloyd mentions that this is the only *Lenzites* he has seen where the context-colour and surface layer are not uniform.

POLYPORACEAE.

Boletus.

156. *Boletus romanus*, Ottav.—The following species, of which we have had prepared a coloured drawing, resembles so closely the figure of "*Boletus Romanus*, Ottav.," given on pl. xv. of Badham's work "On the Esculent Funguses of England," that we consider, for the present at least, that we are justified in calling it by this name. Unfortunately all that Badham says of the species is as follows:—"The *B. Romanus* was first described by Ottaviani, who obligingly sent a coloured drawing of it (from which the present figure has been taken), and a minute description, which I have unfortunately mislaid. The site of this *Boletus* is on ground where wood has been burnt, and it is brought by the 'Carbonari' in autumn when they come with their charcoal to Rome." We do not find the name in Fries. Our plants were described when gathered as follows:—Pileus convex, splashed with madder-brown in fibrils, yellowish between. Pores rounded near the stem, very fine, rich sulphur-yellow. Stem stout, $2\frac{1}{2}$ inches high, 1 inch broad below, sulphur-yellow with slightly darker raised flecks. Flesh showing a tinge of blue in places. Spores "mummy-shape," greenish, $10{\cdot}4 \times 3{\cdot}4\ \mu$. Under *Casuarina*, North Bridge, Sydney, April, 1916.

157. *Boletus scarlatinus*, n. sp.—Pileus usually $1\frac{1}{4}$ to 2 inches in diameter, but after heavy rains occasionally reaching $3\frac{3}{4}$ inches across, convex to nearly plane, irregular, smooth, somewhat viscid when moist (leaves may adhere to the separable cuticle), brilliantly but often irregularly coloured with tints of madder red, deep-orange cadmium, scarlet, crimson or yellowish buff. Pores adnate, rarely with a slight sulcus round the stem or slightly decurrent, in large specimens

the tubes 3/16ths to 5/16ths inch deep, rather large and irregular, rarely somewhat sinuous or gill-like near the stem, pale yellowish flesh or dingy yellow, becoming browner when old. Stem usually about $1\frac{1}{4}$ to $1\frac{1}{2}$ inch high, in large specimens 3 inches high, slender or stout ($\frac{1}{2}$ to $\frac{3}{4}$ inch thick), conical or even a little bulbous below, often excentric, sometimes slightly striate, whitish, yellowish or with tints of the pileus in places. Flesh white. Sometimes subcaespitose. Spores elliptical (not "mummy-shaped"), pale yellowish, slightly curved, one end a little broader, 5·5 to 8·5 (occasionally to 11) $\times$ 3·4 to 4·2 μ. Neutral Bay and Mosman, February to May (Miss Clarke, Watercolour 202); North Bridge, April (Miss Clarke, Watercolour 95); National Park, N.S. Wales, May.

Colour tints noted:—Pileus fiery red (pl. 80, Ton 4) when wet, dull and more crimson when dry, to reddish chrome (pl. 51, Ton 4) at edge; orange cadmium (pl. 85, Ton 4); deep-orange cadmium (pl. 50, Ton 1); scarlet (pl. 49, Ton 4); dull madder-red (pl. 97, Ton 4); carrot red (Capuchin lake) (pl. 55, Ton 2); blood-red brown (faint) (pl. 337, Ton 1); cherry red (cerise) (pl. 91, Ton 4); nearly yellowish-buff (pl. 310, Ton 1); yellowish-white (pl. 13, Ton 4); yolk yellow (pl. 24, Ton 1). Pores, in one specimen, a little greyer than purplish-white (pl. 6, Ton 3). Stem, sunflower yellow (light cadmium yellow) (pl. 23, Tons 1 and 2) with tinges of red; primrose yellow (pl. 19, Ton 3) in upper part; deep cadmium yellow (saffron yellow) (pl. 48, Ton 1); orange cadmium (pl. 85, Ton 2); yellowish-white (pl. 13, Ton 4) at the top; a little brighter than honey yellow (pl. 35, Ton 1) tinged with faint brown lake (pl. 336, Ton 1).

Pileus 3 ad. 5 cm. latus, interdum ad 9·3 cm. latus, convexus ad subplanus, irregularis, subviscidus, scarlatinus, coccineus aut aurantiaco-scarlatinus. Tubi adnati, 5-7 mm., flavido-albidi. Stipes 3 ad 3·75 cm. altus, interdum ad 7·5 cm. altus, subtenuis aut crassus (1·2-1·9 cm. latus), colore flavo, flavo-pallido aut aurantiaco-scarlatino tinctus. Sporae ellipticae, 5·5-8·5 $\times$ 3·4-4·2 μ, interdum 8·5-11 $\times$ 3·8-4·2 μ.

This species resembles *Boletus Ballouii*, Peck (N. York State Mus., Mus. Bull. 157, 1911, p. 22, pl. viii., figs. 1-5), but the colour is much more brilliant than in his illustrations. The general description and spore shape and spore measurements show that the species are closely allied. The species may perhaps also be related to *B. sanguineus*, With. (Masse: Brit. Fung. Flora, i., p. 266), though there is no change in colour in the flesh when cut. (Pl. xxvii., figs. 5 and 6).

Strobilomyces.

158. *Strobilomyces pallescens*, Cooke and Mass.: Grev., xviii., 5; Cooke: Handb. Austr. Fungi, No. 575, fig. 51 (Q'land).—The base of the stem often bulbous; flesh turning bluish when cut, the blue later disappearing, flesh of stem reddish on section; upper part of stem sometimes tinted with rosy purple; spores 17 to 22·5 × 6 to 8·5 μ, longitudinally rugose; usually at the base of trunks, sometimes with pale fawn-tinted mycelium attached to leaves, etc. Frequent at Neutral Bay, Sydney, May; Chatswood (Miss Clarke, Water-colour No. 148); Narrabeen, March; Milson Island, Hawkesbury River, March; Kendall, December.

159. *Strobilomyces floccopus*, Rost. Vahl: Ic. Pl. Fl. Dan., t. 1252; Sacc.: Syll., 4835; Cooke: Handb. Austr. Fungi, No. 579 (Q'land).—The following, from the only description available to us, that in Cooke's Handbook, seems to be this species. We have not noticed, however, that the veil is appendiculate as a ring, and the stem in our specimens can hardly be called lacunose above. There is no reference in Cooke's description as to whether the epispore is smooth or rough (as in our specimens). *S. velutipes*, Cooke and Massee (Cooke, No. 580), resembles our plants to some extent from the description, but its spores are definitely stated to be "even." Pileus up to 3 inches in diameter, almost hemispherical, then convex, edge turned in and extending slightly beyond the pores and sometimes showing fragments of the veil, soft to the touch, covered with a cotton-wool-like villosity with fine warts, sometimes presenting the appearance of adpressed dark-brown imbricate cotton-wool-like scales, dark sooty-brown to reddish-black, sometimes paler at the periphery. Pores adnate or slightly rounded near the stem and gradually separating from it or tending to be slightly decurrent, somewhat irregular, medium-sized, up to $\frac{3}{8}$ inch deep, creamy to pallid white, turning dark brown or blackish. Flesh up to $\frac{5}{8}$ inch thick, a thick cotton-wool-like layer on the surface, the flesh and tubes at once turning red, then blackish, when cut. Stem up to 4 inches high and $\frac{3}{4}$ inch thick, equal or sometimes attenuated upwards or downwards, with a cotton-wool feeling from shaggy remains of the veil or finely strigosely scaly or villose, in one specimen splitting and the separated part revolute, in the upper part sometimes with a network derived from the pores or breaking into areolate dark portions showing the white flesh between, base sometimes slightly bulbous, pallid to brownish and dark sooty-brown, solid. Spores subspherical to broadly pear-shaped, rough (mulberry-like), 7 to 10·4, 8·5 × 7 μ. At the roots of trees or stumps. Neutral Bay, April, 1915; Bradley Head, Sydney,

April, 1919; Lisarow, May, 1918 (Miss Clarke, Watercolour 70; Herb., J. B. C., Form. Sp. 98); Krambach, near Gloucester, January, 1918.

Colour tints noted:—Pileus reddish-black (pl. 344, Tons 1 and 2).

POLYSTICTUS.

160. *Polystictus elongatus*, Berk.: Hook. J., 1842, p. 149; Sacc.: Syll., vi., 5640; Cooke: Handb. Austr. Fungi, No. 750 (Vict., Q'land).—Mount Wilson and Katoomba, June; Leura, November; Somersby Falls, near Gosford, May; Hawkesbury River, August and December (spores elongated, 5 × 2 μ)—all in New South Wales. Specimens have been identified by Lloyd.

161. *Polystictus meleagris*, Berk. Lloyd: Letter 65, Note 577.—Specimens collected in Mummulgum Brush, near Casino, in December, 1916, have been identified by C. G. Lloyd (No. 257).

162. *Polystictus badius*, Berk. Lloyd: Letter 67, Note 666.—Specimens, sent to us by Dr. Leighton Jones from Darwin, have been identified by C. G. Lloyd (No. 317).

163. *Polystictus ochraceo-stuppeus*, Lloyd: Letter 63, 1916, Note 464.—Petersham, Sydney, April, 1912 (T. Steel). Identified by C. G. Lloyd in the above reference, who thus describes it:—"Pileus erect, confluent, somewhat rosette form. Surface ochraceous, soft tomentose, not zoned. Context dry, soft, pinky, ochraceous. Pores minute, adustous. Cystidia none. Spores not known to me. In general colour much like *Polystictus ochraceus*, but context not of the same nature. The soft, pinky context is similar to species of *Trametes*, as *T. lactinea*, rather than to other *Polystictus*. We would put it in the section with *Polystictus occidentalis*, though its context relations are entirely different. The specimens, while well developed, grew on an ash floor, and the form, like the rosette form of *Polystictus versicolor*, when growing on top of a log, is probably not the normal form."

164. *Polystictus occidentalis*, Klotzsch. Cooke: Grev., xiv., 85 (1886), and Handb. Austr. Fungi, No. 794; Sacc.: Syll., vi., 5843 (Vict., Q'land, N.S. Wales, S. Austr.).—Darwin, 1917 (Dr. Leighton Jones); identified by C. G. Lloyd (No. 316).

165. *Polystictus (Trametes) Persoonii*, Mont. Cooke: Handb. Austr. Fungi, No. 791 (Vict., Q'land, New Guinea).—We have two collections, identified by Lloyd (Nos. 140 and 270), one from Mummulgum Brush, near Casino, N.S. Wales, December, and one from Murwillumbah(?) Of the former Lloyd says "pileus usually of a brighter colour. Pores somewhat irpicoid."

166. *Polystictus subfulvus*, Berk.—In identifying specimens for us, Lloyd says he thinks they are the same as the Brazilian plant. We have collected it at Kurrajong Heights in August, 1912 (spores(?) $3·5 \times 1·7$ μ), and at Leura, June, 1916.

167. *Polystictus flavus*, Klotz. Lloyd: Mycol. Notes, iii., p. 450 (1911-12), and Letter 67, Note 680.—Specimens collected on a fallen log near Nattai River, *via* Hill Top, in October, 1913 (spores 6·2 to 8·5, usually 7, $\times 3·8$ μ), were considered by Lloyd as a daedaloid form of *P. flavus*, having "the same context colour and microscopic structure (hyaline cystidia and spores)." We have also specimens from Narrabri, March, 1914 (spores 7 to $8·5 \times 3·5$ μ).

168. *Polystictus versicolor*, L.—Cooke: Handb. Austr. Fungi, No. 774 (Vict., N.S. Wales, Q'land, Tas.).—New South Wales: Mount Wilson, June, 1915; The Rock, July, 1917; Narrabeen, April, 1915; Hornsby, July, 1916; Neutral Bay, July, 1917 (confirmed by Lloyd, No. 386, who says "a little pale but very close to the usual colour"); Dorrigo, January, 1918; on decaying trunk of willow (*Salix caprea*, L.), Moss Vale, June, 1919; Myall Lakes (Mr. Gross), May; destroying a telegraph post, Mosman, May.

Tasmania: Wilmot (A. M. Lea), January, 1918.

Victoria: C. Brittlebank (No. 1), 1919.

169. *Polystictus sanguineus*. L. Cooke, *loc. cit.*, No. 746; Clel. and Cheel: Jour. Proc. Roy. Soc. N.S. Wales, li., 1917, p. 485, No. 30.—Comboyne, August, 1915; Mango Island, Suva, Fiji, 1919 (Mrs. Lucas).

170. *Polystictus cinnabarinus*, Jacq. Cooke: *loc. cit.*, No. 770; Clel. and Cheel: *loc. cit.*, p. 486, No. 31.—New South Wales: Barellan, August, 1918; The Rock, July, 1917; Dungog, November, 1916; Bellinger River (Mr. Smithers), June, 1919; Narrabri, November, 1916; Myall Lakes (Mr. Gross), May.

Victoria: Ararat (E. J. Semmens, No. 6).

Queensland (on *Acacia aulalocarpa*, A. Cunn. (?), May, 1918 (E. Swain); on scrub-box (*Eucalyptus*, sp.), Gympie, June, 1918 (E. Swain).

South Australia: Port Elliot, August, 1918 (D. I. C.).

Western Australia: Guildford, December, 1918 (E. C.).

171. *Polystictus cervino-gilvus*, Jungh.; recorded for Australia in Cooke, *loc. cit.*, No. 789, as *P. peradeniae*, Berk. and Br., which Lloyd states is a synonym.—Malanganee, 25 miles west of Casino, August, 1917, identified by Lloyd (Nos. 388 and 418).

POLYPORUS.

172. *Polyporus (Petaloides) Clemensiae*, Murr. Lloyd: Letter 65, Note 574, and Letter 68, Note 734; place after *Polyporus rubidus*, No. 12, Sect. 15, in Clel. and Cheel, Jour. Proc. Roy. Soc. N.S. Wales, li., p. 481.—Specimens obtained at Barron Falls, Kuranda, Queensland (Mrs. Fraser), in September, 1917, have been identified by Lloyd (No. 429), who refers to them in Note 734. He says the species is close to *P. rubidus*, and is perhaps the basis of the record of the latter species in Cooke's Handbcok (No. 640).

173. *Polyporus (Merismus) anthracophilus*, Cooke. Cooke: Handb. Austr. Fungi, No. 622; Clel. and Cheel: *loc. cit.*, p. 488, No. 39.—Pileus pallid to dark smoky-brown, spores ([?] conidial) $5 \times 3{\cdot}4$, 6 to $7 \times 3\ \mu$, at base of a trunk, National Park (S. Austr.), June, 1917. These specimens were identified by Lloyd, who says that this is the plant so named by Cooke, but he thinks that it is better referred to *Polyporus giganteus*, Pers., as there is no real difference, though the Australian plant is darker and harder.

174. *Polyporus (Merismus) sulphureus*, Fr. Cooke: *loc. cit.*, No. 624 (Q'land, Tas.); Cleland and Cheel: *loc. cit.*, p. 488, No. 42.—In large masses at or near the bases of trees, Macquarie Pass, August, 1917; identified by Lloyd (No. 410).

175. *Polyporus (Merismus) rosettus*, Lloyd: Mycol. Notes, No. 43, 1916, p. 601; Cleland and Cheel: *loc. cit.*, p. 490, No. 47.—At the base of an old stump, National Park (S. Austr.), June, 1917, spores $4{\cdot}2 \times 2{\cdot}5\ \mu$; identified by Lloyd (No. 350).

176. *Polyporus (Spongiosus) rufescens*, Pers. Cooke: *loc. cit.*, No. 600; Clel. and Cheel: *loc. cit.*, p. 490, No. 48.—At the base of a cultivated olive, numerous white spores, $5 \times 3{\cdot}4$, Beaumont, near Adelaide, April, 1917; identified by Lloyd (Nos. 300 and 443).

177. *Polyporus (Spongiosus) Albertini*, Mueller. Lloyd: Stipit. Polyporoids, p. 160, and Letter 67, Note 662; place after *P. tomentosus*, p. 491, No. 51, in Clel. and Cheel, *loc. cit.*—This species closely resembles *P. Schweinitzii* in appearance, but microscopically has brown spores. Lloyd has identified specimens for us. Taree district (H. Lyne), numerous brown, slightly irregular spores $8{\cdot}5 \times 5{\cdot}5\ \mu$, January, 1917 (Lloyd, No. 295); Kendall, at base of tree, numerous brown oval spores 8 to 9×6 to $6{\cdot}8\ \mu$, March, 1918 (Llyod, No. 442).

178. *Polyporus eucalyptorum*, Fr. Cooke: *loc. cit.*, No. 656; Clel. and Cheel: *loc. cit.*, p. 522, No. 120.—On fallen trunks, Kendall, March, 1918, spores broadly pear-shaped, $8{\cdot}5$ to $10{\cdot}4 \times 6{\cdot}8\ \mu$.—colour tints noted, pores

yellowish-white (Dauthenay, pl. 13, Ton 4), cap tinted with pale otter brown, paler than otter brown (pl. 354, Ton 1); pellicle on pileus, greyish-brown with minute punctate spots, pores bright yellow, 1/16th inch deep, Bradley Head, Sydney, May, 1918; on underside of dead fallen trunk, Berrima, July, 1919, spores $8{\cdot}5 \times 6\ \mu$—colour tint noted, pores near massicot yellow (Ridgway, pl. xvi.).

179. *Polyporus gilvus*, Schw. Cooke: Handb. Austr. Fungi, No. 641; Clel. and Cheel: Jour. Proc. Roy. Soc. N.S. Wales, li., 1917, p. 533, Sect. 91, No. 143.—Near Wauchope, February, 1917, identified by Lloyd; Bulli Pass, November, 1917; Myall Lakes (Mr. Gross), May.

180. *Polyporus gilvus*, var. *scruposus*, Fr. Cooke: *loc. cit.*, No. 643; Clel. and Cheel: *loc. cit.*, p. 534, Sect. 91, No. 143A.—Barron Falls, Kuranda, Queensland, September, 1917 (Mrs. Fraser).

181. *Polyporus pertusus*, Fr. (as *Trametes)*. Llloyd: Mycol. Notes, No. 58, 1917, p. 827.—Barron Falls, Kuranda, Queensland, September, 1917 (Mrs. Fraser), setae brown, sharp-pointed, 25 to $34 \times 7\ \mu$ at base; identified for us by C. G. Lloyd (No. 426). Speaking of this specimen in the note above cited, Lloyd states that this species belongs to the "gilvus" group, having the same colour, spores, and setae, but the upper flesh is soft and spongy, as in *P. fruticum*. He considered it a very rare plant.

182. *Polyporus Patouillardii*, Rick. Lloyd: Letter 68, Note 738; Clel. and Cheel: *loc. cit.*, p. 539, Sect. 95, No. 154.—Bribie Island, Moreton Bay, Queensland, spores yellow-brown, $5 \times 3{\cdot}4\ \mu$, no setae—Lloyd in determining this (No. 499) adds "this (determination) does not seem exactly right to me"; Warren, N.S. Wales, on decaying trunk of a large specimen of *Acacia salicina*, var. *varians*, Benth., spores $7{\cdot}2 \times 6\ \mu$—confirmed by Lloyd; Malanganee, near Casino, August, 1917, spores brown, $4{\cdot}8 \times 3{\cdot}4\ \mu$, no setae—identified by Lloyd (No. 415), Lloyd in the above note now thinks that the species grades into *P. dryadeus*, Fr., the Australian plants being midway between the two with dark spores but no setae-like hyphae.

183. *Polyporus fruticum*, Berk. Cooke: *loc. cit.*, No. 649; Clel. and Cheel: *loc. cit.*, Sect. 96, No. 155.—On shrubs, about 1 foot or so from the ground, Malanganee, near Casino, August, 1917—identified by Lloyd (No. 397); Barron Falls, Kuranda, Queensland (Mrs. Fraser), September, 1917 —identified by Lloyd (No. 434).

184. *Polyporus sessilis*, Murr.; in Clel. and Cheel: *loc. cit.*, under Sect. 98B.—Barron Falls, Kuranda, Queensland, September, 1917 (Mrs. Fraser); Lloyd in identfying these

(No. 469) adds that this is really a sessile *P. lucidus.* We have also specimens from Mango Island, Suva, Fiji (Mrs. Lucas), 1918, spores brown, very slightly rough, 12 × 6·5 μ.

Fomes.

185. *Fomes robustus*, Karsten. Lloyd: Synop. Genus Fomes, p. 242, fig. 589; Clel. and Cheel: Jour. Proc. Roy. Soc. N.S. Wales, li., 1918, p. 509 (No. 101); Clel. and Cheel: Forest Comm. N.S. Wales, Bull. 12, 1918, p. 9, pl. ix.—Syns. *Fomes Robinsoniae*, Murrill, and *F. squarrosus*, Wilson; Clel. and Cheel: Journ. Proc. Roy. Soc. N.S. Wales, li., 1918, p. 514 (No. 106); *F. setulosus*, Petch (form with abundant setae), Clel. and Cheel: *loc. cit.*, p. 511 (No. 102).—Lloyd has now come to the conclusion (Mycol. Notes, 50, p. 713) that *F. setulosus* is a setae-bearing form of *F. robustus. F. Robinsoniae* and *F. squarrosus* he considers also to be *F. robustus.* In Australian specimens we note slight differences in the depth of colour of the context in different collections and even in the same individual plant. In some specimens we have not found setae, in others we have met with a few, whilst occasionally they are abundant. It may be convenient to retain the name *F. setulosus* for the latter.

Queensland: Darling Downs, 20 miles from Toowoomba (Miss Butler), December, 1917.

New South Wales: On a smooth-barked eucalypt, probably *E. saligna*, Sm., near Robertson, August, 1917: at base of *Angophora lanceolata*, Cav., Cremorne, Sydney, spores colourless, subspherical, 7 μ, setae not seen, August and November; on *Eucalyptus botryoides*, Sm., Bradley Head, Sydney, spores subspherical, 6·8 μ, setae not seen, April, 1918; on *Casuarina suberosa*, Ott. et Dietr., Manly, November, 1916; on *Casuarina* sp., between Telegraph Point and Kempsey, January, 1918; on *Casuarina Luehmanni*, R. T. Baker, Pilliga Scrub, Narrabri (identified by C. G. Lloyd, No. 303), November, 1916; on dead *Banksia*, Berrima, July, 1919.

South Australia: On *Eucalyptus viminalis*, Lab., National Park (identified by Lloyd, No. 424), spores colourless, subspherical, 5 to 7 μ, a few scattered brown acuminate setae with broad bases.

186. *Fomes conchatus*, Pers. Lloyd: Syn. Gen, Fomes, p. 244; Clel. and Cheel: *loc. cit.*, p. 512 (No. 103). Kendall, August, 1918; near Wauchope, February, 1917 (identified by Lloyd, No. 305).

187. *Fomes densus*, Oleson. Lloyd: Syn. Gen. Fomes, p. 245; in Clel. and Cheel, *loc. cit.*, place after *F. conchatus*, No. 103, p. 512.—This Lloyd describes as a thick heavy form

of *F. conchatus.* He has identified specimens for us (No. 448) found destroying telegraph posts at Cremorne, Sydney, in February and June, 1918; small brown setae present, the context suggesting a Fomes form of *Polyporus gilvus.*

188. *Fomes roburneus*, Fr. Lloyd: Syn. Gen. Fomes, p. 246; in Clel. and Cheel, *loc. cit.*, place after *F. igniarius*, No. 105, p. 514.—Lloyd considers this species as a form of *F. igniarius* with abundant setae and a hard, black crust. He has identified a specimen for us (No. 428) found on a fallen log at Kendall, with very numerous brown setae projecting 17·4 μ, December, 1917.

189. *Fomes rimosus*, Berk. Lloyd: Syn. Gen. Fomes, p. 248; Clel. and Cheel: *loc. cit.*, p. 515 (No. 107).—Queensland: Well-camp, Toowoomba (Miss I. H. Cameron), identified by Lloyd (No. 489), spores brown, 7 × 5·5 μ, August, 1918; Bribie Island, Moreton Bay, spores 5·2 × 3·4 μ, September, 1918; on ironbark (*Eucalyptus paniculata*, Sm.), Redbank, Brisbane, spores yellow-brown, 6·8 × 5·5 μ, September, 1918.

190. *Fomes badius*, Berk. Lloyd: Syn. Gen. Fomes, p. 249; in Clel. and Cheel, *loc. cit.*, place after *F. rimosus*, var. *Niaoulii*, No. 107A, p. 115.—Lloyd defines this as a large-spored *F. rimosus.* He has identified two collections for us. No. 310 is from South Australia, spores subspherical, dark yellow-brown, 6·5 × 5 μ, no setae seen; No. 466 on wattle (*Acacia aulalocarpa*, A. Cunn. [?], Gympie, Queensland (E. Swain), May, 1918.

191. *Fomes pseudosenex*, Murr. (?). Lloyd: Syn. Gen. Fomes, p. 255; in Clel. and Cheel, *loc. cit.*, place after *F. pullus*, No. 110, p. 516; Lloyd: Letter 65, Note 546.—We have received from Mr. E. Swain two specimens of apparently the same species, one obtained in May, 1918, and one in September, found growing on hoop pine (*Araucaria Cunninghamii*, Ait.) on Bunya Mountains, Queensland. One of these has been identified by Lloyd (No. 493) as probably *F. pseudosenex;* the pores were minute and yellowish, and the bracket was 4 inches laterally and high and 2½ inches antero-posteriorly. The other specimen was larger, weighing 5 lb. 2 oz., and measuring 10 inches laterally, 7 inches high, and 8 inches antero-posteriorly; it showed the presence of *brown setae* and occasional brown spores, 5·5 to 6·5 × 3·8 μ, one apparently 8·5 × 5 μ.

192. *Fomes yucatensis*, Murr. Lloyd: Syn. Gen. Fomes, p. 257; Clel. and Cheel: *loc. cit.*, p. 516 (No. 112).—Dorrigo, identified by Lloyd (No. 446), spores brown, subspherical, 4 to 5 μ, numerous dark-brown setae, acuminate, with dilated bases, 34 to 50 × 8·5 μ; on *Acacia aulalocarpa*,

A. Cunn. (?), Gympie, Queensland (E. Swain), spores brown, 6 to 7 μ, a few acuminate setae.

Poria.

193. *Poria callosa*, Fr.: Syst. Myc., i., p. 382; Sacc.: Syll., 5964; Cooke: Handb. Austr. Fungi, No. 820 (Q'land).—Mr. C. White, Government Botanist, Queensland, has kindly given us a portion of the specimen identified as this species for F. M. Bailey, and referred to in Cooke under No. 820. It bears a note, "Bailey's No. 430, on rafters of a verandah, Brisbane." In April and June, 1917, we obtained at Burnside, Adelaide, on the rotting trunk of *Pinus*, sp., portion of a *Poria* which had dried a reddish-brown. This colour is a little deeper and redder than that of Bailey's specimen, but the plants seem otherwise identical.

Another species apparently, which has dried a dark brown, is like Bailey's specimen, save that the pores are twice as big. It formed an easily separable crust under the boards of a damp kitchen sink, Neutral Bay, Sydney, October, 1916.

194. *Poria vaporaria*, Fr.: Syst. Myc., i., p. 382; Sacc.: Syll., 6035; Cooke: Handb. Austr. Fungi, No. 829 (Q'land, Vict., W. Austr., Tas.).—The following agree with an American specimen kindly sent to us by C. G. Lloyd. On dying trunk, Neutral Bay, Sydney, August, 1912; Moss Vale, November, 1918; Ararat (A. J. Semmens, No. 10). We have a number of other specimens, probably of several species, resembling but not identical with Lloyd's specimen.

Trametes.

195. *Trametes lactinea*, Berk.: Ann. Nat. Hist., x., 371; Sacc.: Syll., 6204; Cooke: Handb. Austr. Fungi, No. 849 (Q'land, N.S. Wales, S. Austr.).—Specimens have been identified for us by C. G. Lloyd. Milson Island, Hawkesbury River, July; Tuggerah, October; Kew, March, pores turn reddish on bruising when fresh (Lloyd, No. 343); Malanganee, near Casino, August, pores turn reddish on bruising; on ironbark, Gympie, Queensland, June, red marks from bruising when fresh (E. Swain). See also Proc. Linn. Soc. N.S. Wales, xxxii., p. 203 (1907), for previous record.

196. *Trametes protea*, Berk.—Lloyd has identified specimens for us (No. 438), growing on a fence at Kendall, December, 1917; he considers the species as better placed under *Polystictus*. We have also collected specimens on dead wood on Bribie Island, Moreton Bay, September, 1918.

197. *Trametes semitosta*, Berk. *Fomes semitostus*, Berk., in Lloyd, Syn. Gen. Fomes, p. 220; Lloyd: Letter 68, Note

736.—In identifying specimens (No. 432) for us, found on a fallen trunk at Kendall in December, 1917, Lloyd (Letter 68, Note 736) says as follows:—"In my Fomes Synopsis as a *Fomes*, but really a *Trametes*. The type is a thin plant, hardly ½ cm. thick, but this specimen is 2 cm. thick. The surface is not of as dark a colour as the type, but no doubt will be when it gets to be as old as the type. 'Half-toasted' is a good name for it now, but not for the type now."

HYDNACEAE.

Hydnum.

198. *Hydnum rufescens*, Pers.: Sym., p. 555; Massee: Brit. Fung. Flora, i., p. 152. A colour form of *H. repandum*, L. (Lloyd).—Lloyd has identified specimens for us under this designation. The flesh of the Australian species turns reddish-brown when injured. Neutral Bay, Sydney, June, 1912 and 1916; Newington, Sydney, June, 1914; Milson Island, Hawkesbury River, July, 1912; National Park, New South Wales, July, 1916, Spores 3·5 to 5·5 μ, spherical to oval.

199. *Hydnum coralloides*, Scop.: Carn., 2, p. 472; Massee: Brit. Fung. Flora, i., p. 156; Cooke: Handb. Austr. Fungi, No. 925 (Q'land).—The identification has been confirmed for us by C. G. Lloyd. Mount Irvine, Blue Mountains, January, 1915 (G. P. Darnell Smith), spores subspherical, 3·5 μ; on side of a trunk, Mount Wilson, Blue Mountains, June, 1915, spores $3{\cdot}8 \times 2{\cdot}2\ \mu$.

200. *Hydnum ochraceum*, Pers. Sacc.: Syll., 6725; Cooke: Handb. Austr. Fungi, No. 928 (Vict., Q'land).—Specimens, identified by Lloyd (No. 391), were collected at Lismore in August, 1917.

201. *Hydnum Muelleri*, Berk.: Linn. J., xvi., 167; Sacc.: Syll., 6727; Cooke: Handb. Austr. Fungi, No. 929 (N.S. Wales, Q'land).—Specimens collected at Lisarow in June, 1916, were sent to C. G. Lloyd, who, in referrring to this species, adds:—"I judge from my photograph of the type. . . . The plant is very close to *H. rawakense*, Pets. I am not sure if it is distinct. It has similar cystidia on the teeth. It is more conchoid and the teeth are not so dark."

202. *Hydnum zonatum*, Batsch.: F. 224; Massee: Brit. Fung. Flora, i., p. 154.—Specimens collected on the underside of a fallen trunk at Mount Lofty, South Australia, in June, 1917, have been identified by Lloyd (No. 352). We have also collected specimens at North Bridge, Sydney, in June, 1916, on the ground—pileus 3 cm. broad, gibbous, rugose, slightly upturned, pallid to reddish-brown; flesh dark brown; teeth pallid; stem irregular, more or less central, brownish.

203. *Hydnum alutaceum*, Fr.: Syst. Myc., i., 417; Sacc.: Syll., 6761; Cooke: Handb. Austr. Fungi, No. 934 (Vict.).—Narrabeen, New South Wales (E. C.); Craigie, Victoria, June, 1917, on living bark of *Eucalyptus melliodora*, A. Cunn. (E. J. Semmens, No. 54).

TREMELLODON.

204. *Tremelloden gelatinosum*, Scop.: Fr. Hym. Eur., 618; Sacc.: Syll., 6862; Cooke: Handb. Austr. Fungi, No. 942, fig. 68 (Q'land).—Mount Wilson, June, 1915, spores subspherical, 7 to 10·4 μ; National Park, New South Wales, July, 1917, spores $8{\cdot}5 \times 7$ μ, 7 μ.

RADULUM.

205. *Radulum (Lopharia, Thwaitesiella) Neilgherrense*, Berk. (*R. mirabile* of Ceylon, *R. lirellosa* of Africa, *R. Emerici* of India, and *R. javanica* of Java are considered by Lloyd as probably this species; also *Sistotrema irpicinum*, Berk. and Br., Linn. Trans., ii., 63, t. 13, f. 23, and Cooke, Handb. Austr. Fungi, No. 943 (Q'land), and *Irpex hexagonoides*, Kalchb., Grev. ix., p. 1, and Cooke, Handb. Austr. Fungi, No. 944 (N.S. Wales).—Lloyd has identified specimens for us (Nos. 64, 65, and 113). Milson Island, Hawkesbury River, June and July, 1912; Narrabeen, December, spores pear-shaped, 5 to $6 \times 2{\cdot}5$ μ.

IRPEX.

206. *Irpex consors*, Berk. Lloyd: Mycol. Notes, 45, 1917, p. 625, fig. 887 (specimens from us). Syn.—Lloyd considers *I. brevis*, Berk.; *I. decurrens*, Berk.; and probably *Hynum meruloides*, Berk., Linn. Trans., ii., 63, t. xiii., f. 4, and Cooke, Handb. Austr. Fungi, No. 926 (Q'land), as all this species. Sydney district, January, April, June, October (spores $5 \times 3{\cdot}4$ μ); Narrabeen, April; Hawkesbury River, July (Lloyd, No. 353); Somersby Falls, near Gosford, May; Lisarow, June; National Park, New South Wales, July; Macquarie Pass, August (Lloyd, No. 393); Mount Wilson, June (spores $4 \times 2{\cdot}5$ μ; Lloyd, No. 354, who says "the original matches this exactly—largely resupineate with a few pilei"; Victoria, October (C. Brittlebank).

207. *Irpex cingulatum*, Lloyd: Mycol. Notes, 55, 1918, p. 795, fig. 1197.—Lloyd, in describing our specimens (No. 355), says that they differ from *Irpex consors*, which is a white plant, in being washed with a dark zone and appear so different that they should be named. He presumes that the Australian record of *I. zonatus* (Cooke, No. 945, Vict., N.S. Wales, Q'land) is based on this plant, and that the previous

identification by him of a specimen from Australia from J. T. Paul as *I. zonatus* was probably a mistake. New South Wales, spores oval, white, 5·2 × 3·2 μ.

208. *Irpex saepiaria*, Lloyd: Mycol. Notes, 48, 1917, p. 682, fig. 1019.—Lloyd considers that the record of *I. tabacinus* (Cooke, No. 948) for Australia probably refers to this species. Our New South Wales plants (locality not noted) are described by Lloyd as follows in the above Notes:—"Resupinate with reflexed pileus. Pileus coriaceous, dark brown (Brussels), smooth. Context concolorous. Teeth dense, 2 to 3 mm. long, concolorous, irregular. Hymenium white. Setae densely covering the teeth, projecting 20 to 30 μ. Spores globose, 5 μ, smooth." He points out that this species belongs to a section of *Irpex* corresponding to "*Hymenochaete*," and at one time described generically as "*Hydnochaete*."

THELEPHORACEAE.

Thelephora.

209. *Thelephora terrestris*, Ehrenb. Cooke: Handb. Austr. Fungi, No. 981 (Vict.); Clel. and Cheel: Proc. Linn. Soc. N.S. Wales, xli., p. 860 (N.S. Wales, S. Austr.); Syn. *T. laciniata*, Pers. (according to Lloyd); Cooke: No. 982.—Always under or near *Pinus*. Mount Lofty, April, and Adelaide, June, 1917; Ararat, Victoria, June, 1917 (E. J. Semmens); Blayney, December, 1917, when young whitish and encrusting, then frondose. Spores nodular, 7, 8·5, 8·5 × 6 μ.

210. *Thelephora myriomera*, Fr.: Pl. Preiss., 137; Sacc.: Syll., 7129; Cooke: Handb. Austr. Fungi, No. 978 (W. Austr.).—Neutral Bay, Sydney, April, 1915; identified by C. G. Lloyd from the description of this species, no type existing.

Stereum.

211. *Stereum caperatum*, Berk. and M. Cooke: *loc. cit.*, No. 992 (Vict., Q'land); Clel. and Cheel: *loc. cit.*, p. 860.—Lisarow, New South Wales, October, 1916.

212. *Stereum elegans*, Fr. Cooke: *loc. cit.*, No. 994; Clel. and Cheel: *loc. cit.*, p. 861.—Mount Irvine, June, 1915, the upper surface very light brown or damp-looking dark tan; spores 4·2 to 5 × 3·4 μ—identified by C. G. Lloyd; Ararat, Victoria, spores 5 × 3·4 μ (E. J. Semmens, No. 11).

213. *Stereum semilugens*, Kalchb.: Grev., ix., 1; Sacc.: Syll., 7278; Cooke: *loc. cit.*, No. 1010 (Q'land).—Mount Wilson, June, 1915, spores 12 to 14 × 4·2 μ. Lloyd in identifying these adds:—"The surface is relatively smooth and concolorous with the context, ferruginous brown. The hymenium

is cinereous, reminding one of *Polyporus adustus*. Cystidia none. . . . It is a good species, different from anything in Europe or America."

214. *Stereum hirsutum*, Willd. Cooke: Handb. Austr. Fungi, No. 1014; Clel. and Cheel: Proc. Linn. Soc., N.S. Wales, xli., 1916, p. 862.—On *Eucalyptus tereticornis*, Sm., Bumberry, September, 1916; on *E. Stuartiana*, F. v. M., Orange, October, 1916; Taree (H. Lyne), April, 1917; Kew (N.S. Wales), October, 1915; The Rock, July, 1917; Ararat (Vict.), (E. J. Semmens, No. 7).

Lloyd has identified specimens for us as being pale forms approaching *S. vellereum*, Berk. The following belong to this group:—Mount Lofty, on *Eucalyptus* trunks, and National Park, South Australia, June, 1917; Hawkesbury River, February, 1916 (Lloyd No. 373).

215. *Stereum zonarium*, Lloyd: Mycol. Notes, No. 47, 1917, p. 664, fig. 95.—Lloyd has kindly identified New South Wales specimens (locality not noted) for us. His description of these in the above Notes is as follows:—"Pileus sessile to a reduced base, thin, rigid. Surface smooth, reddish-brown (Brussels brown, Ridgway), with narrow, strong, darker zones. Context tissue brown. Hymenial layer white, distinct from the context layer, and often but partially developed over the surface. Basidia clavate, forming a palisade layer. Cystidia none. Spores 3×5 μ, hyaline, smooth." He adds:—"Stereum with smooth pilei are very rare. In fact, we know but one other well authenticated, *viz.*, *Stereum versicolor*, in its true sense."

216. *Stereum vellereum*, Berk.: Fl. N. Zea., 183; Cooke: Handb. Austr. Fungi, No. 1004 (Vict.).—At the base of a trunk, Lisarow, June, 1916, spores $4{\cdot}2$ to $5 \times 3{\cdot}4$ μ. Lloyd in identifying these specimens says that the surface hairs are not so strong as in those specimens he has heretofore referred to this species, but still he believes our specimens belong to it.

217. *Stereum lobatum*, Fr.: Epicr., 547; Cooke: *loc. cit.*, No. 1008 (all the States except S. Austr. and W. Austr.).—Lloyd has kindly identified specimens for us. When moist, zoned with grey and brown or dark browny-chestnut passing to chestnut, yellowish at the periphery; hymenial surface reddish-orange to yellowish-brown and yellow; spores 7 to $7{\cdot}2 \times 3{\cdot}2$ μ. Bulli Pass, April, 1912; National Park, New South Wales, July, 1916; Lisarow, April, June, and December; Mummulgum, near Casino, December; Malanganee, near Casino, August; Barron Falls, Kuranda, Queensland (Mrs. Fraser).

218. *Stereum illudens*, Berk.: Hook. J., iv., 59; Cooke: *loc. cit.*, No. 1015 (all the States); Clel. and Cheel: Proc.

Linn. Soc. N.S. Wales, xli., 1916, p. 863.—Lisarow, June, 1915; National Park, New South Wales, July, 1916.

219. *Stereum membranaceum*, Fr. Clel. and Cheel: *loc. cit.*, p. 863 (N.S. Wales, Q'land).—Kurrajong Heights, August, 1912; Sydney, September; Milson Island, August; Lisarow, June; near Wangan, Pilliga Scrub, October, 1918—dark-brown setae, 50 to $70 \times 8{\cdot}5$ μ at the base, acuminate, points acute or blunt.

220. *Stereum (Lloydella) cinerascens*, Schw.—Both of our collections have been identified by Lloyd. Bulli Pass, November, 1917, spores 9 to 10×6 to $6{\cdot}8$ μ, metuloids 87×25 μ, rough, club-shaped; on dead leaves of *Ficus macrophylla*, Desf., Domain, Sydney, May, 1917.

221. *Stereum (Hymenochaete) adustum*, Lev. (*S. villosum*, Lev.)—"The same, I think, as *Stereum villosum*, Lev., but weathered specimen, the dark colour due to exposure (*S. nigricans*, Lev.; *S. strigosum*, Berk.; *S. phaeum*, Berk.; *S. spadiceum*, Berk., are all synonyms for me)."—Lloyd, in identifying specimens for us found on a fallen log at Lisarow in June, 1916 (brown acuminate setae, 42×7 μ). *S. (H.) phaeum* is recorded in Cooke, No. 1034, for Victoria, New South Wales, and Queensland; and *S. (H.) spadiceum* under No. 1037. We have recorded *S. (H.) villosum* for New South Wales (*loc. cit.*, p. 864), and have a further specimen of this from Kurrajong Heights, August, 1912.

Corticium.

222. *Corticium coeruleum*, Pers. Massee: Brit. Fung. Flora, i., p. 127.—Dorrigo, January, 1918, identified by Lloyd (No. 475).

GASTEROMYCETES.

Chlamydopus.

223. *Chlamydopus Meyenianus*, Berk. Lloyd: Lycop. of Austr., 1905, p. 9, fig. 6; Clel. and Cheel: Jour. Proc. Roy. Soc. N.S. Wales, l., 1916, p. 109; as *Tylostoma maxima*, Cke. and Mass. in Cooke, Handb. Austr. Fungi, No. 1237, fig. 113 (W. Austr.).—We have received specimens of this rare species from Mrs. A. F. Cleland from Kurrawang, near Kalgoorlie, July, 1918. The peridium is $\frac{3}{4}$ inch broad and $\frac{3}{8}$ inch high, flattened spherical in shape, the apex irregularly torn with an aperture about $\frac{1}{2}$ inch $\times$ $\frac{1}{4}$ inch; stem 3 inches high, $\frac{1}{4}$ inch thick above, slightly attenuated downwards, striate, pallid; volva as a definite cup, $\frac{1}{2}$ inch high, widely separated from the stem above; gleba light rusty in colour; spores finely rough, $6{\cdot}8$ μ.

Battarea.

224. *Battarea phalloides*, var. *Stevenii*: Lloyd: *loc. cit.*, p. 11, pl. 28, figs. 2 and 3; Clel. and Cheel: *loc. cit.*, p. 111; Cooke: Handb. Austr. Fungi, No. 1243 (W. Austr.), and as *B. Muelleri*, No. 1244 (S. Austr.), and *B. Tepperiana*, No. 1245 (Vict.).—Baan Baa, New South Wales, stem up to 12 inches high, attenuated upwards, very shaggy; volva buried in the ground.

Geaster.

225. *Geaster Clelandii*, Lloyd: Mycol. Notes, No. 55, 1918, p. 794, fig. 1196.—The type and cotype were found by Mrs. A. F. Cleland at Kalgoorlie in June, 1917. Lloyd describes the species as follows:—"Exoperidium rigid, incurved when dry, cut into eight (in this specimen, also in the cotype) rather narrow lobes. Endoperidium scurfy, with a short, thick pedicel. Mouth protruding, strongly furrowed." He adds:—"The single specimen of this plant presents a character to separate it from others of the section (Rigida, Cfr. Myc. Notes, p. 317) to which it belongs. It has a pedicellate endoperidium. The colour is decidedly reddish, but it grew in red soil, which no doubt has something to do with the colour. Geasters are best defined in terms of others. This is *Geaster Schmidelii* as to size, pedicel, and mouth, but the exoperidium puts it in a different section. It is *Geaster striatulus* excepting the endoperidium, which is pedicellate. As a matter of fact, it is probably the original of *Geaster striatulus*, which was from Australia and not authentically known (Cfr. Myc. Notes, p. 312), and which was described as endoperidium 'subsessile.' But it is entirely different from *Geaster striatulus* in the sense of Hollós, which we have adopted and illustrated several times (Cfr. Myc. Notes, p. 71, and Lycop. Austr., p. 16)."

226. *Geaster floriformis*, Vitt. Lloyd: Lycop. of Austr., 1905, p. 16, fig. 10; Cooke: Handb. Austr. Fungi, No. 1264 (Vict., Q'land); Clel. and Cheel: Journ. Proc. Roy. Soc. N.S. Wales xlix., 1915, p. 221.—Manildra, New South Wales, October, 1916, identified by C. G. Lloyd—spores finely rough, 3·4 to 4 μ.

227. *Geaster simulans*, Lloyd: Lycop. of Austr., 1905, p. 17, fig. 11; Clel. and Cheel: *loc. cit.*, p. 220; as *G. hygrometricus*, Pers., in Cooke, Handb. Austr. Fungi, No. 1268 (W. Austr., Q'land).—Manildra, October, 1916, identified by Lloyd—spores nearly smooth, 5·2 μ; Dubbo, October, 1915—spores rough, 5·8 μ; Mount Lofty, South Australia, July, 1914—spores rough, 4 to 6 μ.

228. *Geaster Berkeleyi*, Lloyd: Lycop. of Austr., p. 19.—Mummulgum, near Casino, December, 1916, spores rough, 3·5 μ.

229. *Geaster minimus*, Schwein. Lloyd: Lycop. of Austr., p. 21—Narrabri, November, 1916, spores finely rough, 3·5 to 4·5 μ; Baan Baa, January, 1917, spores rough, 5 μ—both kindly identified for us by C. G. Lloyd.

230. *Geaster saccatus*, Fr. Lloyd: Lycop. of Austr., p. 22; Clel. and Cheel: Jour. Proc. Roy. Soc. N.S. Wales, xlix., 1915, p. 225.—Bumberry and Manildra, September and October, 1916, identified by Lloyd, who says "larger than our (*i.e.*, the American) plant and tending towards *rufescens*"—spores distinctly rough, 5·8 to 6·8 μ; Manildra, October, 1916, identified by Lloyd as a small form—spores finely rough, 3·5 μ; Forbes, August, 1915, spores smooth, 3 μ; Murwillumbah, April, 1916, spores rough, 3·8 to 5 μ.

MYCENASTRUM.

231. *Mycenastrum corium*, (Guersent) Desv. Clel. and Cheel: Jour. Proc. Roy. Soc., N.S. Wales, l., 1916, p. 116.—Dungog, New South Wales, November, 1916, spores 10·5 μ; Beaumont, near Adelaide, June, 1917, spores shaggy, 8·5 to 9 μ; Kalgoorlie, June, 1917, spores rough, 10·4 to 12 μ.

LYCOPERDON.

232. *Lycoperdon gemmatum*, Batsch. Clel. and Cheel: Jour. Proc. Roy. Soc. N.S. Wales, l., 1916, p. 122, No. 30.—National Park, New South Wales, on and near rotten wood, July, 1916, spores finely rough, 3·6 to 4 μ; New South Wales, spores spherical, very finely warted under oil-immersion lens, 3·5 to 4 μ.

CALVATIA.

233. *Calvatia lilacina*, (Berk.). Clel. and Cheel: *loc. cit.*, p. 123, No. 32.—Baan Baa, January, 1917, identification confirmed by Lloyd (Nos. 287 and 288), spores echinulate, 5 μ, capillitium branching, 3·5 μ in diameter—in one of these specimens the substance is bleached to a pale fawny-whitish colour; Sydney, May, 1918; Krambach, near Taree, January, 1918, spores echinulate, 5·5 μ; Craigie, Ararat, May, 1918 (E. J. Semmens, No. 90).

ASCOMYCETALES.

Fam. TUBERACEAE.

ENDOGONE.

234. *Endogone tuberculosa*, Lloyd: Mycol. Notes, No. 56, October, 1918, p. 799.—The type specimens were obtained

by one of us (J. B. C.) at The Rock, New South Wales, in July, 1917. Mr. Lloyd's description of the species is as follows:—"1-2 cm. thick, globose, pale orange. Surface tuberculate. Peridium indistinct. Gleba convolute, lacunose, yellow. Vesicle imbedded in the context tissue, globose, 50-60 mic., with thick, hyaline walls and granular, yellow contents." Lloyd adds that, possessing the characteristic vesicles of the genus *Endogone*, this is best so referred, but it differs from all other species in the lacunose gleba and tubercular surface. Our notes state that the plants were just above the ground, ½ inch in diameter when fresh, pallid orange in colour, and with a tuberculate surface. The vesicles were large, oval, thick-walled bodies, 85×60 μ in size in some cases, with granular contents.

DISCOMYCETIINEAE.

Fam. HELVELLIINEAE.

Morchella.

235. *Morchella esculenta*, L. Pers.: Syn., 618; Sacc.: Syll., viii., 8; Cooke: Handb. Austr. Fungi, No. 1353 (no locality).—Victoria, September, 1913 (asci cylindrical, occasionally slightly wavy, $243 \times 17{\cdot}4$ μ, spores oval, 19 to $20{\cdot}7 \times 11{\cdot}2$ μ).

236. *Morchella conica*, Pers. Cooke: Myco., t. 81, f. 315; Sacc.: Syll., viii., 10; Cooke: Handb. Austr. Fungi, No. 1354, f. 139 (Vict., S. Austr., Tas.); Cambage: Proc. Linn. Soc., N.S. Wales, 1901, p. 691 (N.S. Wales); Clel. and Cheel: Jour. Proc. Roy. Soc. N.S. Wales, xlviii., 1914, p. 443 (N.S. Wales).—Victoria, September, 1913 (asci 210×21 μ; spores 24 to 26×16 μ).

Leotia.

237. *Leotia marcida*, Pers. Lloyd: Geoglossaceae, p. 15.—Specimens have been identified for us by Llyod (No. 161), who says that many authors consider this species as merely a colour form of *L. lubrica*, Pers. Our collecting notes are as follows:—Pileus ¾ inch wide and ½ inch high, irregularly nodular or "bumpy," greenish-waxy looking, the undersurface slightly concave and paler and more watery in appearance, on section tremelloid and watery waxy-looking. Stem 1¼ inch high, ¼ inch thick, yellow-waxy looking, punctate with slightly darker, apparently warty, particles, on section showing an outer clear cortex and a thick solid yellow-waxy core, which expands in the pileus as a thin disc. The spore-bearing part of the ascus about $60 \times 10{\cdot}5$ μ, the whole ascus about 140 μ long. Spores overlapping in the ascus, 17·5 to

$21 \times 6\ \mu$, ends rather pointed, usually with four large globules. Under trees, Lane Cove River, Sydney, June, 1916; Dr. Darnell Smith also collected specimens in the same month and year at Somersby Falls, Gosford; Neutral Bay, May, 1917; Mosman, April and May, 1918 (asci 60 to 70 μ, spores $17{\cdot}5 \times 4{\cdot}2\ \mu$, one side of the spore a little flattened).

Geoglossum.

238. *Geoglossum Muelleri*, Cooke: Myco., t. 1, f. 2; Sacc.: Syll., 138; Cooke: Handb. Austr. Fungi, No. 1362 (Vict.).—$1\frac{3}{4}$ inch high. Club slightly viscid when moist, a little shorter than the stem, black. Stem shining. Asci fusiform. Sporidia 3-septate, 58 to $66 \times 5\ \mu$. Under bushes, Parramatta, July, 1912.

239. *Geoglossum glabrum*, Pers.: Syn., p. 608; Sacc.: Syll., 141; Cooke: Handb. Austr. Fungi, No. 1363 (Vict., Q'land).—Club $\frac{1}{2}$ inch high, $\frac{1}{4}$ inch wide, flattened, slightly sulcate, matt, almost black. Stem $1\frac{1}{4}$ inch high, attenuated downwards, dark chocolate, and lighter than the club. Asci 139 to $174 \times 18\ \mu$. Sporidia brown, 7-septate, $56 \times 6\ \mu$. On the ground, Neutral Bay, June, 1913 (identified by Lloyd, No. 230). We also have the following:—New South Wales, asci cylindrical club-shaped, 120 to $138 \times 13{\cdot}8\ \mu$, sporidia brown, 7-septate (one 6-septate), $72{\cdot}5 \times 4{\cdot}8\ \mu$. Sedgwick, Victoria (E. J. Semmens), amongst mosses, asci $155 \times 17\ \mu$, sporidia brown, 7-septate, 53 to $61 \times 7\ \mu$.

Fam. PEZIZACEAE.

Phillipsia.

240. *Phillipsia polyporoides*, Berk.: Linn. J., xviii., 386; Sacc.: Syll., 608; Cooke: Handb. Austr. Fungi, No. 1399 (Q'land); Lloyd: Letter 62, Note 432, 1916.—Specimens obtained at Kurrajong Heights on a fallen log in August, 1912, are considered by Lloyd, from Berkeley's description, to be probably this species, though he sees no justification for the specific name. He adds that the genus *Phillipsia* is close to *Urnula*, though put in a different section in Saccardo. He describes our specimens as being thick, dark, coriaceous, and cup-shaped, with large, hyaline, arcuate, smooth spores, $12 \times 36\ \mu$, and numerous dark, filiform paraphyses, slightly enlarged at the apices. Our measurements show slightly curved spores, 27 to $29{\cdot}5 \times 10{\cdot}14$ to $12\ \mu$. We have also specimens collected by Prof. S. J. Johnston at Kendall in June, 1917, on wood—asci cylindrical, 313 to 340×12 to $14\ \mu$, spores white, slightly curved, 25 to $28 \times 10{\cdot}5\ \mu$.

Urnula.

241. *Urnula campylospora*, (Berk.) Cooke; *Peziza campylospora*, Berk.: Fl. N. Zeal., 200; *Geopyxis cinereo-nigra*, B. and Br.; *Peziza cinereo-nigra*, B. and Br.: Linn. Trans., i., 404, t. 46, f. 16-18; Lloyd also mentions as synonyms *Rhizina reticulata* and *Peziza rhytidia*, and quotes Massee for a figure (Jour. Linn. Soc., xxxi., pl. 16, f. 17); as *Urnula campylospora* in Cooke, Handb. Austr. Fungi, No. 1453, f. 165 (Q'land), and in Lloyd, Mycol. Notes, No. 49, 1917, p. 695, f. 1037.—Lloyd has identified two collections for us. On wood, Lisarow, August, 1916 (asci $350 \times 17\ \mu$, sporidia curved $26 \times 8{\cdot}5\ \mu$). On fallen wood, National Park, New South Wales, July, 1916 (under-surface and stalk black, finely rough; cup dark brown, then blackish; sporidia curved, sausage-shaped, $27{\cdot}5$ to $31 \times 10{\cdot}4$ to $12\ \mu$).

PYRENOMYCETIINEAE.

Fam. HYPOCREACEAE.

Hypomyces.

242. *Hypomyces aurantius*, Tul.: Carp., iii., 43; Plow.: Grev., iii., 44, t. 150; Cooke: Handb. Austr. Fungi, No. 1508 (Q'land).—Lloyd has identified a specimen for us, found on old *Polyporus Berkeleyi* at Lisarow in June, 1916. He thinks this is probably also *H. rosellus* (Cooke, No. 1506, W. Austr.). Asci about $100 \times 5\ \mu$; sporidia constricted in the centre, pointed at the ends, $17{\cdot}5 \times 3{\cdot}4\ \mu$ (Lloyd found them to be 20 to 24×5 to $6\ \mu$, hyaline, smooth, septate).

Fam. XYLARIACEAE.

Xylaria.

243. *Xylaria anisopleura*, Mont.: Syll., 688; Cooke: Handb. Austr. Fungi, No. 1535 (Q'land); as *X. tuberiformis*, Berk., in Lloyd, Mcyol. Notes, No. 48, 1917, p. 678, fig. 1011 only, later in Xylaria Notes, ii., 1918, p. 24, on the advice of Petch referred to *X. anisopleura*.—Our specimens, identified by Lloyd (No. 228), and referred to and figured in the above Notes, were gathered on a fallen trunk at Mount Irvine in June, 1915—asci about $100\ \mu$ long; spores black, often slightly curved, $12{\cdot}5 \times 7\ \mu$.

244. *Xylaria phosphorea*, Berk. (?): Linn. J., xiii., 177; Grev.: xi., t. 168, f. 75; Cooke: Handb. Austr. Fungi, No. 1537 (Vict.).—Specimens collected by Dr. Darnell Smith at Mount Irvine in January, 1915, were identified by Lloyd (No. 229), with much doubt, as this species—asci about $104 \times 8{\cdot}5\ \mu$; spores black, 12 to $13{\cdot}8 \times 6{\cdot}6\ \mu$, one side slightly flattened.

245. *Xylaria myosurus*, Mont. (?)—Lloyd has identified specimens (No. 269), collected on a rotten trunk at Katoomba in December, 1916, as probably immature examples of this species. Conidiospores 7 to $10{\cdot}4 \times 3{\cdot}5$ to 4 μ, dagger-shaped.

246. *Xylaria faveolis*.—Lloyd, Xylaria Notes, i., 1918, p. 9, figs. 1214-1216.—Lloyd has identified specimens for us (No. 440), referred to and figured in the above Notes. The plants were collected at Dorrigo in January, 1918—asci about 70×6 μ, spores $10{\cdot}4 \times 4$ μ, blackish, one side a little flattened.

247. *Xylaria hypoxylon*, Grev.: Fl. Edin., 355; Sacc.: Syll., 1260; Cooke: Handb. Austr. Fungi, No. 1547 (Q'land). —Lloyd has identified as probably the conidial form of this species specimens (No. 268) found at the base of a dead tree-fern at Katoomba in December, 1916—conidiospores $8{\cdot}5 \times 2$ μ, elongated, one end more pointed.

Sarcoxylon.

248. *Sarcoxylon Le Rati* (Hennings). Lloyd: Mycol. Notes, 1917, No. 47, p. 668, fig. 960; *Xylaria gigas* (?), Cooke: Handb. Austr. Fungi, No. 1539 (N.S. Wales), is thought by Lloyd to be possibly this species.—Lloyd places this genus close to *Xylaria*. He has identified for us as *Sarcoxylon Le Rati* the specimens mentioned in his Mycological Notes. The species was previously, he states, only known from New Caledonia. Our specimens were found on the ground under trees at Lisarow, New South Wales, in December, 1916. The plants when fresh were in shape somewhat like large examples of one of the forms of *Polysaccum pisocarpium*, *i.e.*, broadly club-shaped. They were attached to large irregular white mycelial masses in the ground. The surface was covered with a yellow efflorescence showing numerous conidial spores ($8{\cdot}5$ to $12{\cdot}5 \times 2$ to $3{\cdot}4$ μ). On section the centre was whitish and surrounded by a broad yellowish layer, whilst outside this was a black line covered with the yellow efflorescence. Smell unpleasant.

Poronia.

249. *Poronia punctata*, L. Cooke: Handb. Austr. Fungi, No. 1548 (Vict., Tas., W. Austr.).—Specimens collected on dung at Orange in October, 1916, were identified by Lloyd (No. 227)—asci 156 μ long, spores black, 26 to $27 \times 15{\cdot}5$ μ.

250. *Poronia oedipus*, Mont.: Ann. Sci. Nat., 1855; Cooke: Handb. Austr. Fungi, No. 1549 (Vict., N.S. Wales, Q'land).—We have two New South Wales collections, both identified by Lloyd (Nos. 225 and 226)—asci 121×17 μ, spores oval, surrounded by mucus, $19 \times 8{\cdot}5$ μ (immature).

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Nummularia.

251. *Nummularia Baileyi*, B. and Br. Cooke: Hand. Austr. Fungi, No. 1554 (Q'land).—New South Wales specimens have been identified for us as probably this species by Lloyd (No. 223)—spores blackish, $17 \times 8{\cdot}5$ to $12\ \mu$, ends sometimes pointed.

Daldinia.

252. *Daldinia concentrica*, Bolt. Cooke: Hand. Austr. Fungi, No. 1561, fig. 202 (all the States except S. Austr.).—Mosman, Sydney, New South Wales (spores slightly curved, $13{\cdot}8$ to $15{\cdot}5 \times 7\ \mu$, asci $8{\cdot}5\ \mu$ in diameter); Malanganee, New South Wales, August (spores oval, $10{\cdot}4$ to $13{\cdot}8 \times 6$ to $8{\cdot}5\ \mu$); Kendall, August; Flinders Island, Bass Straits, November (spores black, obliquely elongated, slightly pointed, $13{\cdot}8$ to $15{\cdot}5 \times 7$ to $7{\cdot}2\ \mu$). See also Proc. Linn. Soc. N.S. Wales, xxxvii., p. 236 (1912), for previous record.

DESCRIPTION OF PLATES.

Plate XXVIII.

Amanitopsis punctata, n. sp., with section, volva, and spores.

Plate XXIX.

Fig. 1. *Cantharellus lilacinus*, n. sp., with spore.
,, 2. ,, *corrugatus*, n. sp., with spore.
,, 3. *Mycena banksiae*, n. sp., with spore.
,, 4. ,, *coccineus*, n. sp., with spore.
,, 5. *Boletus scarlatinus*, n. sp.
,, 6. ,, ,, ,, small form with spore.

The Petrology of the Granitic Mass of Cape Willoughby, Kangaroo Island:—Part I.

By C. E. Tilley, B.Sc., A.I.C.,

Demonstrator in Geology and Mineralogy, University of Sydney. Deas-Thomson Scholar in Geology, 1919.

(Communicated by Professor Walter Howchin.)

[Read September 11, 1919.]

Plates XXX. and XXXI. and 2 Maps.

Contents.

I. Introduction.

The imposing granite headland of Cape Willoughby forms the easternmost extremity of Kangaroo Island. From the standpoint of petrology this locality has received little attention, and in the previous literature dealing with this area brief reference only is made to the intrusion. This literature is:—

(i.) Howchin, W.: Trans. Roy. Soc. S. Austr., vol. xxvii., 1903, pp. 80-83.

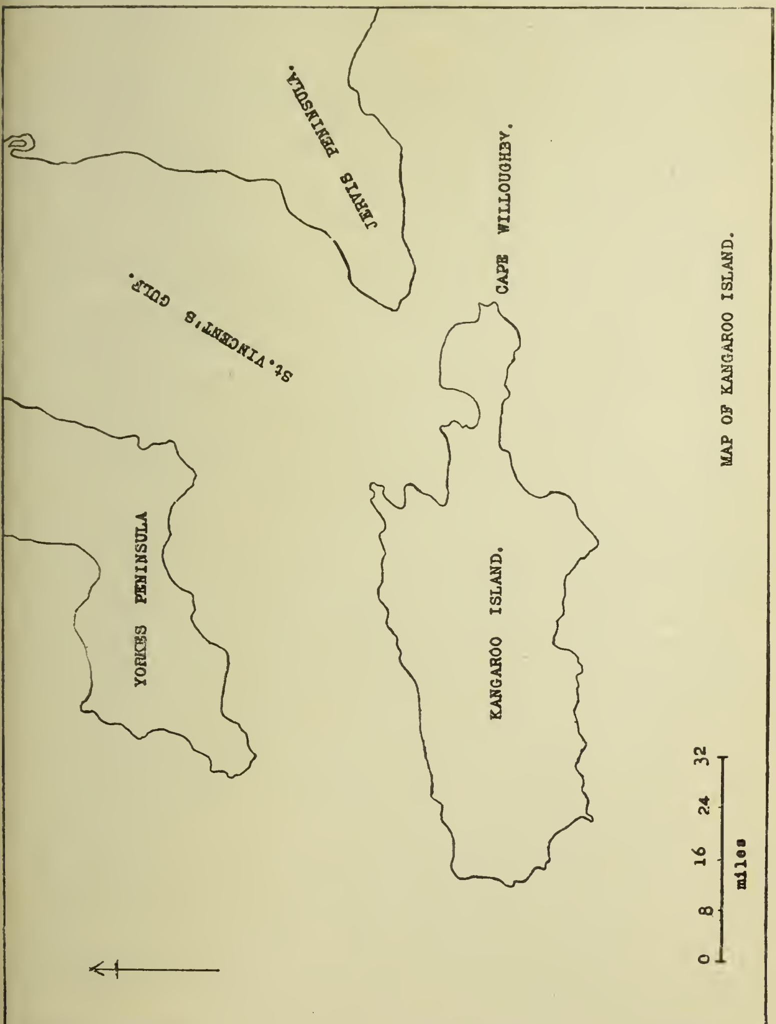
(ii.) Wade, A.: Bull. No. 4, Geol. Surv. S. Austr., pp. 20 and 21.

In addition the writer has described certain quartz tourmaline nodules from this area.(1)

Howchin, while investigating the geographical extent of the late Palaeozoic (Permo-carboniferous) glacial deposits on Kangaroo Island visited Cape Willoughby, and in his subsequent paper briefly refers to the granite and its minor intrusions. Wade mentions its intrusive character into the

(1) Tilley: Trans. Roy. Soc. S. Austr., 1919, p. 156.

associated quartzites, and both investigators note the remarkable blue opalescence of the quartz grains present in the granite.



As far as the writer is aware, no further data are available of this intrusion.

II. General Description.

The granite mass occupies an area of approximately 2 square miles, and forms a length of coastline of $5\frac{1}{4}$ miles. In plan the outcrop is roughly triangular, in shape approaching a right-angled triangle, with the coastline forming the two sides of the right angle.

Along the sea coast, the granite ends sharply up against dark-coloured quartzites, which macroscopically suffer little or no change; nor does there appear to be a border or contact zone to the granite, for this retains the mineralogical and textural characteristics of the main mass.

The intrusive nature of the mass is well shown by the manner in which the granite cuts across the strike of the quartzites and by the presence of rifted blocks of the quartzite (accidental xenoliths), which are developed near the contact and are obviously derived from the country rock.

At the northern sea coast contact with the country rock, small aplitic veins proceed into the micaceous quartzites, which are here striking north-east with a south-easterly dip at 64°. The rifted blocks maintain proximity to the contact surface. At the southern sea coast termination of the granite xenoliths are less numerous and are generally small. The quartzites here have the same north-east and south-west strike, but dip south-east at 74° to 80°.

In the granite, near the junction, occur quartz geodes lined and filled with tourmaline. Associated with the granite occur a series of aplitic and pegmatitic dykes, which are clearly younger than the main mass of granite, for they are seen to cut across and intersect it. These intrusions bear a close relationship to the granite, and form a highly interesting series.

The main occurrences are listed below:—

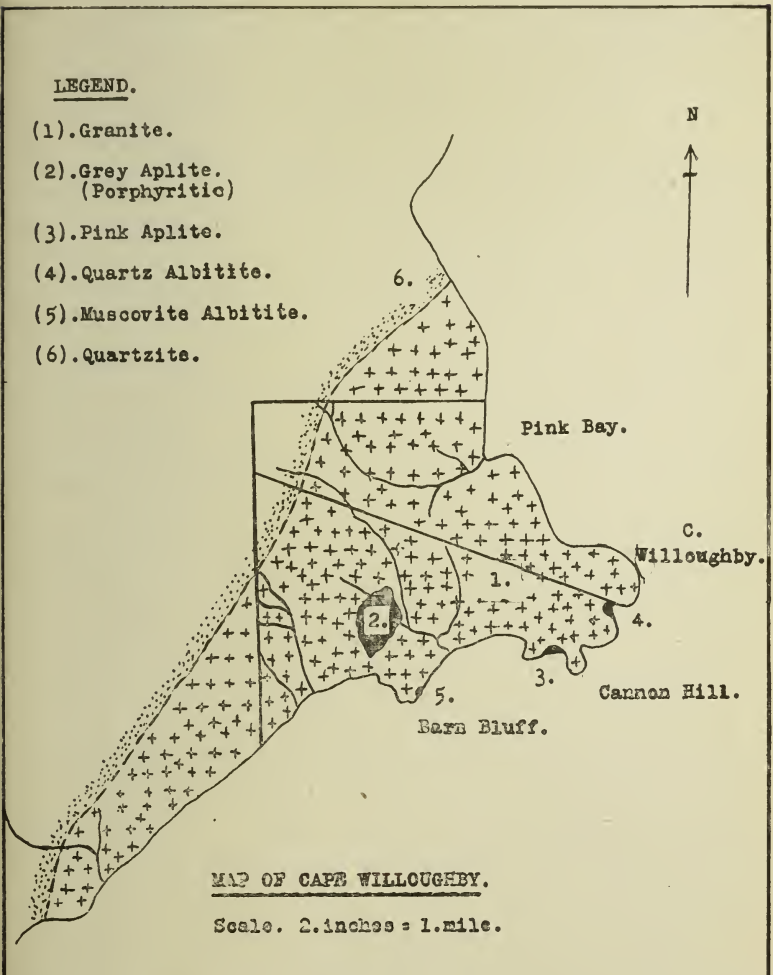
(i.) A large elliptical (in cross section) mass of grey aplite is developed behind Barn Bluff.

(ii.) A smaller mass occurs on the sea coast, south of Cannon Hill. This is a pink aplite.

(iii.) Minor dykes of a white pegmatite occur at the northern side of Barn Bluff at the head of the first gully south of the lighthouse, and veins both north and south of Pink Bay. These latter veins have the trend for the most part of the joint planes of the granite.

In the main mass of granite segregations are sporadically distributed. These are generally ovoid and finer-textured patches (cognate xenoliths). Some show a slightly darker colour than the general colour of the normal granite.

In the accompanying map, the extent of the granite mass is outlined, and its contact with the quartzite-schist country rock shown. The inland junction is only approximate. The



more important dykes or intrusive masses are shown in addition.

No detailed petrographic study has been made of the country rocks, which consist of quartzites, quartz-mica schists, and mica schists. The whole region has suffered considerable regional metamorphism, in common with the metamorphism shown by the eastern beds of the Mount Lofty Ranges on the mainland. The differentiation of contact and regional metamorphism for the area under consideration would demand much careful field and petrographic study.

III. Characters of the Rock Types.

(a) the main granite.

Throughout the mass, the granite maintains a very constant mineralogical and textural character. In hand specimens the rock is more or less even-grained, with the occasional development of phenocrysts of unstriated felspar. The most striking feature of the rock is the presence of subidiomorphic crystals of quartz, showing a remarkable blue opalescence. This quartz is also developed in the minor intrusions associated with the granite. The felspar shows well-developed cleavages, and often contains inclusions of biotite. Occasionally a felspar phenocryst may show, with the aid of a lens, an intergrowth with quartz—suggestive of a graphic intergrowth. According to the freshness of the rock the felspars are seen as greyish, pink, or tending to greenish in colour. The dark mineral is biotite. In addition small quantities of iron pyrites can be detected in some specimens. Under the microscope the minerals developed are seen to be quartz, microcline, plagioclase, biotite, and, as accessories, muscovite, apatite, ilmenite, pyrites, and zircon. As secondary minerals there are present epidote, leucoxene, sericite, kaolin, and chlorite.

Quartz occurs, firstly, as subidiomorphic grains with well-developed cracks, and showing undulose extinction. These represent the grains seen in hand specimens. Minute inclusions are very numerous, and in many cases appear to be laid out in strings. Many of these undoubtedly are fluid or gaseous inclusions, whilst others appear to be solid, and probably represent rutile needles. Whilst in reflected light this quartz is characterized by a bluish opalescence, in transmitted light it has a distinct yellowish to reddish yellow appearance, according to the thickness viewed.

Again, some of the quartzes when carefully examined show zones of alternate clear and opalescent layers in reflected light, and, in transmitted light, these show up as colourless and yellowish areas respectively. These zones appear to follow the outlines of the growing crystal. $D^{20^\circ}_{4^\circ} = 2{\cdot}650$. It is not proposed to consider this question in the present paper, as the subject is reserved for a subsequent communication.

In some sections it would appear that, as an accompaniment of cracking, there has been a rotation of sectors of the grain, for the grain is not optically continuous throughout. Along these cracks the quartz may show higher polarization colours.

Quartz is also present in the slides in allotrimorphic grains, or as a constituent of a graphic intergrowth with microcline. This intergrowth may develop around the large quartz or microcline crystals, and is obviously of later crystallization.

Microcline is present in subidiomorphic crystals, which may show inclusions of biotite, plagioclase, and quartz. The microcline twinning after the albite and pericline laws is very finely developed, and the lamellae are often seen to overlap. In sections parallel to (010) pericline twinning may be absent or submicroscopically developed; where clearly developed, however, it cuts the trace of the (001) cleavage at an angle of 74°-76°.

Extinction on (010) sections has a maximum value of 6°-7° from the basal cleavage. Some sections show a very fine perthitic intergrowth with plagioclase. The layers traverse the microcline, and are optically continuous; optically they have the properties of albite. This is the typical microcline microperthite structure.

Plagioclase occurs in more or less tabular crystals of well-developed form, and shows the characteristic albite lamellae. Zoning is characteristic. The refractive index is $>$ C. Balsam, and most sections show R.I. $<$ quartz.

In zoned sections showing no multiple twinning the extinction from the (001) cleavage read as maxima:—

Outer zone	$+9°$
Intermediate zone	$10°$
Central zone	$-9°$

This corresponds to a range from Oligoclase (Ab_4 An_1) to Andesine (Ab_3 An_2).

Such zoned sections (010) in convergent light show the emergence of a bisectrix to be practically normal to the section. This is the obtuse bisectrix, and the negative birefringence is clear.

The felspar is an Oligoclase-Andesine, the average composition being nearer the oligoclase end.

Some sections of the granite show the presence of a more acid plagioclase than the above. This has the properties of oligoclase albite. It represents a later stage of crystallization, but is of minor development.

Biotite.—This mineral is developed in clusters of flakes of elongated section showing the strong basal cleavage. The colour is dark brown to greenish-yellow. The pleochroism is intense, showing practically complete absorption. The biotite encloses such minerals of earlier formation as apatite, zircon, and ilmenite.

Chlorite and epidote are developed as secondary products. The small amount of muscovite occurs in association with the biotite, and is of later crystallization. It remains clear and unaltered.

Apatite occurs in slender needles and small hexagonal prisms. It is most abundant as inclusions in the biotite.

Ilmenite is associated with the biotite, and is generally surrounded by a white leucoxenic decomposition product.

Zircon, like apatite, is enclosed in biotite, and occurs in short prisms. It is usually surrounded by faint pleochroic haloes.

Epidote is present, associated with biotite and plagioclase; it probably results from the interaction of biotite and plagioclase, and is obviously of secondary origin. Calcite may be developed in addition.

Kaolin occurs as a dust accompanying both felspars.

The cores of some sections of the plagioclase show plentiful sericite, occurring in small flakes, sometimes to the complete exclusion of the felspar, from which it has developed. It is probably paragonitic in composition.

The order of crystallization of the constituent minerals may be subdivided as:—

I. Accessories—Apatite, ilmenite, zircon.
II. Biotite and accessory muscovite.
III. Plagioclase—Quartz and microcline.

Overlapping of the crystallization periods of II. and III. occurred, as is evidenced by inclusions. This particularly refers to microcline, which in its occasional porphyritic development is then referable to an early stage. The order of cessation of crystallization is more truly represented by the above arrangement.

Nearing the completion of crystallization, the sodic character of the plagioclase had become marked, in some sections oligoclase-albite being developed independently, and the last stages are represented by the graphic intergrowths of quartz and microcline which surround the larger crystals.

The relative proportions of plagioclase to microcline felspar show some variation in the different sections examined. As a whole they are present in approximately equal amounts. The granite may therefore be placed in the Adamellite group.

Cognate Xenoliths.—These occur as ellipsoidal or ovoid patches in the main granite. In hand specimens they appear as moderately dark-greyish, fine-grained aggregates, with the occasional development as phenocrysts of the characteristic blue opalescent quartz seen in the main granite. Microscopically the segregations are seen to consist of the minerals of the main granite. Biotite is present in ragged flakes and, in parts, is altered to chlorite; epidote is also present as a secondary product. In some cases the remains of biotite are now only represented by chlorite and epidote together.

Ilmenite is sparingly present with its leucoxenic decomposition product.

Phenocrysts of quartz and oligoclase-andesine or andesine are present, and the remaining mass consists of a fine-grained assemblage of allotrimorphic quartz and microcline, mostly untwinned.(2)

The microcline is heavily dusted with kaolin. With the plagioclase the secondary development of scaly mica appears more usual. There is a minor amount of graphic intergrowth of quartz and felspar (microcline).

The specific gravity of one of these ovoid segregations was determined as 2·655 (16° C). The specific gravity of the main granite is 2·668 (16° C). $D^{16^\circ}_{4^\circ} = 2{\cdot}668$.

The segregations show a variable amount of biotite, the one in question being, if anything, freer from this mineral than the average. In some cases their slightly darker colour, as an indication necessarily of a greater concentration of biotite than in the main granite, is probably illusory, in that they are finer grained, and the biotite is more evenly distributed than in the main granite.

(b) THE MINOR INTRUSIONS.

For the purpose of later discussion these minor intrusions can be separated into three distinct groups:—*(a)* The grey aplite; *(b)* the pink aplite; *(c)* the white pegmatite. These will be treated *seriatim*.

(a) The Grey Aplite.—This occurs as an intrusive mass, elliptical in plan, behind Barn Bluff (*vide* map). In hand specimens it is a fine-grained light-grey rock with development

(2) The absence of microcline twinning in some sections of the potassic felspar is not considered sufficient evidence to interpret the rock as possessing orthoclase in addition. The presence of microcline is definitely fixed by its characteristic "grating" structure, but it is quite possible for microcline to occur with albite twinning alone or no twinning at all. The very general presence of microcline in the older plutonic rocks is suggestive that this mineral is really the stable phase of potassic felspar. On this question *cf.* C. H. Warren, "A Quantitative Study of certain Perthitic Felspars" (Proc. Amer. Acad. Arts and Sciences, vol. 51, No. 3, 1915, pp. 127-154).

of occasional phenocrysts of the characteristic opalescent quartz, bunches of biotite, and very sparingly an occasional phenocryst of felspar. A few scattered grains of pyrites are also present.

The specific gravity of this rock is 2·625. $D^{18°}_{4°} = 2·625$.

Under the microscope the quartz phenocrysts have the same characteristics as possessed in the normal granite.

Biotite is spread sporadically through the rock with its accompanying chlorite and epidote. Pyrites is also present.

Quartz and microcline are developed, showing allotrimorphic boundaries. The microcline shows Carlsbad twinning, but the grating structure may be absent or represented only by submicroscopic lines of light and shade.

Some plagioclase is present, and has the properties of oligoclase albite.

Secondary mica and kaolin are developed as alterations of the felspar. In a phenocryst of microcline the micasation may be well developed.

A primary micrographic intergrowth of quartz and microcline is often present round the borders of a large quartz grain. A determination of alkalies in this rock gave $K_2O = 5·58\%$, $Na_2O = 2·63\%$.

The rock is a Biotite Microcline Aplite. In parts it has a distinct granite-porphyry facies, but its relationship to the associated intrusions is better indicated in the name given.

(b) The Pink Aplite.—This aplite occurs as a distinctly intrusive mass along the coast immediately south of Cannon Hill. Its junction with the granite is in most places markedly sharp. The mass shows a somewhat variable texture throughout its extent; the greater part is of very fine grain, but this grades into a coarser variety, in which are developed phenocrysts of blue quartz and a ferromagnesian mineral, biotite, also makes its appearance. It is an aplite with development in part of a distinct granite-porphyry facies.

It is in this rock that occur the quartz tourmaline nodules already described in detail in a previous paper.(3)

A number of quartz veins occupy fissures in the aplite, and associated with these veins occurs a zone of altered aplite which appears to be of the nature of a greisen.

A further alteration of the aplite is the production along fissures of a white kaolinized product. A number of quartz geodes are also developed. Microscopic description of this aplite is dealt with on page 325.

(c) The White Pegmatite (Aplite).—There are a number of occurrences of this type all of which are not noted on the

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(3) Tilley: *loc. cit.*

map. Some occur as veins in the main granite. The first occurrence noted is in the first gully south of the Cape Willoughby Lighthouse. The dyke outcrops at the head of the gully, and has a width of eight yards. Its boundaries are ill-defined and are covered with sand. In hand specimens it is a coarse aggregate of blue quartz and white felspar, apparently not graphically intergrown.

A second pegmatite with predominant felspar and showing strings of quartz is well developed on the northern side of Barn Bluff. Limonite is associated with the felspar in parts as a subsequent alteration; muscovite is also present. The rock has weathered out into honeycombed masses.

The remaining occurrences of this rock are in the form of veins, which outcrop on both sides of Pink Bay, along the coast. They vary in width from 2 ft. downwards, and vary in composition from an aggregate of blue quartz and white felspar to veins of pure felspar. For the most part these veins run parallel to the trend of the joint planes in the granite.

The three types of minor intrusion occur as separate and distinct masses. In no case have they been observed in association, to enable their order of intrusion to be determined. These, too, were the only types of intrusions seen exposed in the granite mass.

Minor intrusions into the neighbouring quartzites were not observed; about seven miles from Cape Willoughby a pegmatite dyke is developed in schist. Gem tourmaline has been derived from this area, and the dyke is most probably an offshoot from the Willoughby mass. The writer had not an opportunity of visiting this locality.

Microscopically, the minerals present in the pink aplite are quartz, microcline, plagioclase (albite), and, as accessories, biotite (much chloritized), and muscovite. Kaolin and secondary mica accompany the felspars as alteration products.

One slide shows a well-developed phenocryst of plagioclase as a trilling, and, in addition, albite lamellae are present. This is probably an oligoclase albite. It is surrounded by a beautiful micrographic intergrowth of quartz and microcline.

The micrographic intergrowths are displayed more especially in the coarser varieties of the intrusion. In these, also, apatite begins to appear and muscovite is more plentifully distributed, often in plumose fashion. Some of the albite shows twinning after both albite and pericline laws. In the finer-grained types the fabric approaches the type "granulitic" characteristic of some aplites.

In an aplite near Pink Bay, related to this series, subidiomorphic grains of magnetite appear, and in addition there are present a few scattered grains of blue strongly pleochroic tourmaline. The albite in this rock is more abundant than in the aplite described above.

The specific gravities of the rocks of this series are indicated below:—

(i.) Fine-grained red aplite, $D^{18°}_{4°} = 2{\cdot}590$.

(ii.) Medium-grained red aplite, $D^{20°}_{4°} = 2{\cdot}602$.

(iii.) Coarse-grained red aplite, $D^{15°}_{4°} = 2{\cdot}605$.

(iv.) Aplite from near Pink Bay, $D^{15°}_{4°} = 2{\cdot}625$.

The aplites of this series are characterized by the predominance of microcline felspar; plagioclase is subordinate. This plagioclase is an acid albite, and in the finer-grained aplite may appear as idiomorphic phenocrysts rarely, the main development being in association with the quartz and mircrocline. The listed specific gravities further point to the dominant felspar being potassic. A partial analysis of the fine-grained red aplite yielded $K_2O = 5{\cdot}48\%$, $Na_2O = 2{\cdot}79\%$.

The pink colour of this series is due to the presence of a fine film of haematite dusting the cleavages and cracks of the alkali felspars.

IV. Products of Pneumatolysis of the Pink Aplite.

These may be listed as follows:—*(a)* The quartz-tourmaline nodules (Pneumatoliths); *(b)* the greisen; *(c)* the kaolin.

The quartz-tourmaline nodules have already been described in the paper cited above. They were developed anteriorly to the greisen, which will now be discussed.

(b) The Greisen.—Subsequent to the consolidation of the aplite fissures in turn were developed and afforded an avenue of escape for the remaining volatile constituents, now much reduced in temperature.

The effects of the volatile constituents are denoted by the presence of quartz veins and the occurrence of small quantities of greisen developed as an alteration of the aplite.

The quartz of the vein material has crystallized in the characteristic prismatic crystals capped with pyramid faces. A section across a quartz vein to the original aplite shows in succession-quartz, an alteration product of the aplite which proves to be a greisen, and this grades into an unaltered aplite.

In hand specimens the greisen has a porous, fine-grained, light-greenish appearance, and with the aid of a lens quartz and a lightish-green mica are easily recognized. The porous character of the rock is well marked.

Under the microscope the minerals seen to be present are quartz and muscovite, the latter being slightly greenish in colour, and so is slightly pleochroic.

The muscovite is present in elongated flakes showing good cleavages, and is often present in bunches or tufts, but in all degrees of orientation. In the true greisen replacement of felspar has been complete. A gradational alteration of the aplite occurs, however, and some sections show the incipient greisenization of the felspar.

The quartz of the original aplite is unchanged, but some secondary quartz has been introduced.

(c) The Kaolin.—At a still later stage in pneumatolysis kaolinization of the aplite has occurred. The kaolin is developed in bands along minute fissures, which may contain thin quartz veins, and may be ascribed essentially to the action of superheated water at a lower temperature than that of greisenization.

The evidence of pneumatolysis of the aplite is clearly shown, and the progressive fall in temperature of the pneumatolytic agents is reflected in the change of pneumatolytic product. The order of development of pneumatolytic product in these aplites is in accord with that worked out for other fields.[4]

The formation of muscovite from microcline is doubtless represented by the well-known equation:—

(i.) $3\ K\ AlSi_3O_8 + H_2O \longrightarrow H_2\ K\ Al_3\ (SiO_4)_3 + K_2\ SiO_3 + 5\ SiO_2$, and the development of kaolin by

(ii.) $2\ K\ AlSi_3O_8 + 2\ H_2O \longrightarrow Al_2O_3\ 2\ SiO_2\ 2\ H_2O + K_2\ SiO_3 + 3\ SiO_2$, or if CO_2 is regarded as an active agent by

(iii.) $2\ K\ AlSi_3O_8 + 2\ H_2O + CO_2 \longrightarrow Al_2O_3\ 2\ SiO_2\ 2\ H_2O + K_2CO_3 + 4\ SiO_2$.

The volume changes represented by these equations are for (i.) the development of muscovite and quartz, a volume decrease of 22 per cent.; for (iii.) the production of kaolin and quartz, a volume decrease of 13 per cent.

During the greisenization kaolin can accompany the production of mica, although in general the former is distinctly formed at a lower temperature. If this is so, the porous nature of the greisen can be explained as due to the weathering out of kaolin from the rock. Even so, it is possible that the porosity may in part represent the volume decrease on greisenization, as shown by the preceding equations. It is difficult to understand, however, if this be correct, why the

(4) *Cf.* Flett, J. S.: Memoir of Geol. Surv. Eng. and Wales, 1909, Geology of Bodmin and St. Austell, p. 118.

quartz solutions in the associated vein did not completely infill the cavities.

V. The Nature and Composition of the White Pegmatite.

The mode of occurrence of these dykes and veins has already been described, including a brief macroscopic description of the various types.

When these rocks were examined microscopically the predominant felspar was found to be albite, and the rock types can now be classed as albitites. The varieties present are quartz-albitites, muscovite-albitites, and an almost pure albitite consisting practically of albite. This rock occurs in veins associated with a quartz-albitite.

(a) Albitite.—$D^{18^\circ}_{4^\circ} = 2{\cdot}622$:—Under the microscope this rock is seen to consist essentially of albite. Accessories are apatite, in hexagonal crystals; zircon, in idiomorphic prisms, showing high polarization colours; and rutile, usually in prismatic forms.

Muscovite is present in small tufts and is usually associated with apatite, zircon, and rutile. The albite is usually subidiomorphic to allotriomorphic. A curious mottled twinning shows up in some sections. This has been described as "chequer albite."(5) In other sections only well-defined albite lamellae are present.

A very small quantity of interstitial quartz is present in the slide.

The chequer structure is due to the presence of irregular interpenetrating twin lamellae. No traces of a mottled character, however, are present on sections parallel to (010). This structure was first described by Becke.(6) Flett and Hughes have noted its development in phenocrysts of volcanic rocks associated with albite of the usual kind.

In the albite rocks under consideration, there is no evidence to suggest albitization of original microcline felspar.

Some albite sections show a transition from normal albite lamellae to the chequer type. Its occurrence, associated with normal albite, both here and in the example given by Flett, appear to negative any secondary origin as a pressure effect.

Its origin is admittedly obscure, but it seems possible that it may be primary, indicating irregular deposition of albite substance during growth. The presence of excess mineralizers may have been effective to this end.

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(5) *Vide* Flett, J. S.: Mem. Geol. Surv. Eng. and Wales, Geology of Newton Abbot, 1913, p. 60. E. W. Hughes: Geol. Mag., Jan., 1917, p. 18.

(6) F. Becke: Denk. Kais. Akad. Wien., vol. lxxv., p. 28, 1906.

The descriptions by Jack [7] and Ransome [8] of the albite present in albitite rocks, described by them, strongly suggest the presence of chequer albite in these rocks.

(b) Quartz Albitite.—$D^{19°}_{4°} = 2·640$. This forms the most abundant type, and it is with this rock that the albite is associated. Here the quartz is present as blue opalescent grains as in the main granite. Microscopically, the minerals present are quartz, albite, and as accessories apatite, zircon, and rutile. The latter mineral is present in idiomorphic prismatic crystals and, also, as geniculate twins (twinning plane [101]), giving a sagenite network.

The albite has a refractive index less than Canada Balsam. In sections perpendicular to the albite lamellae, the symmetrical extinction is 16° and on sections showing as untwinned the maximum extinction is 19° from the (001) cleavage. Further confirmation is provided by the extinction given on (010) for the two parts of a Carlsbad twin. The sign of the birefringence is positive.

(c) Muscovite Albitite.—This is developed at Barn Bluff. The rock in hand specimens has an altered appearance. Through the felspar can be seen very small veinlets of quartz, and portions of the felspar show alteration with limonitic material. Muscovite is recognizable. Under the microscope, the minerals present are albite, muscovite, and accessorily, quartz, apatite, zircon, and rutile.

The albite possesses the same characteristics as in the other occurrences, and the peculiar chequer twinning is observed.

Some of the mica is associated with quartz in little tufts and rosettes. Both mica and quartz are probably secondary. Some muscovite, however, is undoubtedly primary. The rock has apparently suffered some change, due to the presence of mineralizers, but the results are not as clearly demarcated as in other examples.

A study of the literature of albite, aplites, or pegmatites indicates that this type of rock is comparatively rare.

Rocks of this type were first described under the name albitite by Turner [9] from Plumas Co., Sierra Nevada. These aplites occur as dykes, and consist essentially of albite in granular aggregates. Quartz is occasionally completely absent, but may occur plentifully in the same dyke. Muscovite may or may not be present. Iron ores and apatite are sparingly distributed, and garnet is an occasional accessory. Duparc

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(7) R. L. Jack: Geol. Surv. S. Austr., Bull. No. 3, 1914, p. 16.

(8) F. L. Ransome: Journ. Wash. Acad. Sci., vol. i., No. 4, 1911, pp. 114-118.

(9) H. W. Turner: 17th Ann, Rep. U.S.G.S., pp. 728, *et seq.*

and Pearce [10] describe albitites from the Northern Urals, where they are associated with gabbro. In these rocks the albite is developed intergrown with a little quartz.

It is to be noted that both these occurrences are associated with more or less basic rocks, *e.g.*, in the Sierra Nevada with serpentine, and in the Northern Urals with gabbroid masses.

In Australia rocks of this nature have been found in Western and South Australia. Maitland [11] described a pegmatite from the Pilbarra region. The constituents appear to be albite, quartz, garnet, and cassiterite. From Eyre Peninsula, South Australia, R. L. Jack [12] describes dyke rocks of aplitic habit consisting, essentially, of albite with small amounts of quartz, muscovite, apatite, and magnetite. From the descriptions given, the albite evidently possesses the peculiar chequer structure. In one instance there is a remarkable association of wernerite with the albitite, the scapolite being developed in long prismatic crystals.

The association of the Western Australian albitite is with granite, whilst the Eyre Peninsula rock is intrusive into metamorphosed sedimentary beds, but granites are developed at hand.

A partial analysis of an albitite from Cape Willoughby has been made. This is tabulated below, and for comparison the analyses of a number of other albitite rocks are listed with it :—

	I. Sierra Nevada.	II. N. Urals.	III. Pilbarra.	IV. Eyre Pen.	V. Cape Willoughby.
SiO_2	66·54	66·09	68·36	66·13	68·39
TiO_2	n.d.	0·23	0·07	0·31	n.d.
Al_2O_3	n.d.	18·85	18·74	19·92	n.d.
Fe_2O_3	n.d.	0·91	—	0·60	n.d.
FeO	n.d.	—	1·15	0·19	n.d.
MnO	n.d.	—	0·45	—	n.d.
MgO	0·77	1·53	0·54	0·12	n.d.
CaO	0·43	1·09	0·39	0·57	0·65
Na_2O	10·28	10·84	10·22	10·83	11·22
K_2O	0·89	0·48	0·07	1·02	0·21
H_2O	n.d.	1·17	0·03	0·44	0·45
P_2O_5	n.d.	—	—	0·09	n.d.

I. H. W. Turner: 17th Ann. Report U.S.G.S., 1895-6, p. 728.
II. Duparc et Pearce: Compt. Rendu., 140, 1905, 1614.
III. A. Gibb Maitland: Bull. 40, Geol. Surv. W. Austr., p. 100.
IV. R. L. Jack[13]: Bull. 3, Geol. Surv. S. Austr., p. 16.
V. C. Willoughby albitite.

(10) Duparc et Pearce: Compt. Rendu., 140, 1905, 1614.

(11) A. Gibb Maitland: Bull. No. 40, Geol. Surv. W. Austr., pp. 100-102.

(12) R. L. Jack: Bull. No. 3, Geol. Surv. S. Austr., pp. 15, 16.

(13) The abnormally high content of Na_2O (13·48%) reported for the Miltalie albitite casts suspicion on its reliability.

VI. The Relations of the Rock Types.

In the accompanying table the mineral constitution of the rock types is shown.

The sign + indicates the presence of the mineral as a constant feature, and often in relative abundance.

The sign − indicates that the mineral is sparingly present, and may be absent.

The two combined, ±, indicate that varieties of the one rock type may show the variation indicated:—

Rock Type.	Iron Ores.	Biotite.	Oligoclase - Andesine, or Basic Oligoclase.	Microcline.	Quartz.	Albite.	Muscovite.	Zircon.	Apatite.	Rutile.
Granite ...	+	+	+	+	+		−	−	−	
Microcline Aplites	−	−		+	+	± (Calcic)	−		−	
Albitites ..					±	+	±	+	+	+

The origin of the aplites, both potassic and sodic (albitite), with the granite remains to be discussed.

Aplites associated with granite rocks consist essentially of alkali felspars and quartz, and occur as dykes or irregular sheets. In distinction from pegmatites they are characteristically fine grained. This fine-grained texture may be inconstant, and with a transition into a coarser type they grade into pegmatites.

Pegmatites appear to differ from aplites only in this, that they are typically coarser grained, and often contain a wider range of accessory minerals, these characteristics being generally assignable to the greater concentration of mineralizers during their crystallization.

These rocks represent the residual magma obtained by fractional crystallization, whether by sinking of crystals, or by a selective filter pressing, or squeezing out of the residual liquid from the crystalline mass of granite composition.

Such residual magma, on the contraction resulting from the cooling of the crystalline mass, is injected into cracks or joints so formed. Where differentiation of the granitic magma followed different lines, we have aplites associated with lamprophyric rocks in complementary relationship.

A review of the literature on granite aplites indicates that these are dominantly potassic, or sodi-potassic.

Of aplites associated with basic rocks our knowledge has increased during the last few years. Such aplites may occur as salic interstitial masses or segregations within the associated rock, and are often characterized by a micrographic fabric, or they may occur as distinct dykes cutting the igneous mass.

The composition of such aplites is variable. The predominant felspar is very often albite or oligoclase, with quartz. Orthoclase may be absent. Such aplites are therefore often characteristically sodic.

Examples of this type have been described by Elsden,[14] Bowen,[15] Collins,[16] and others.

To be correlated here also are the albite—rich dyke-rocks described by Turner, Duparc and Pearce, and Ransome.[17] The former are associated, as has been noted, with serpentine and gabbro masses respectively. The albite rocks described by Ransome are associated with diorite.

In the micropegmatite of the Purcell Sills,[18] orthoclase is associated with the sodic-plagioclase, and the potassic felspar plays the dominant part in the pegmatites of the Duluth gabbro.[19]

In all these examples the dominant process of differentiation has probably been one of fractional crystallization.

Before discussing the mechanism of the differentiation of the Willoughby aplites and pegmatites, the characteristics of the types will be shortly reviewed. They may be divided into two groups:—

(i). Those characterized by dominant microcline.

(ii). Those characterized by dominant albite.

The microcline aplites consist essentially of fine-grained aggregates of quartz, microcline, and subordinate albite. They may pass locally into a porphyritic type in which phenocrysts of quartz, biotite, and more rarely acid plagioclase are present. Granophyric phenocrysts of microcline and quartz also occur.

The albite pegmatites (albitites) are composed essentially of albite with quartz (quartz albitite), of dominant albite with accessory muscovite (muscovite albitite), and are comparatively coarse grained, sufficiently so to texturally determine them as pegmatites. Microcline appears to be absent.

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(14) J. V. Elsden: Q.J.G.S., 1908, vol. 64, p. 273.

(15) N. L. Bowen: Journ. Geol., 1910, vol. 18, p. 658.

(16) W. H. Collins: Mem. 33, Geol. Surv. Can., 1913, p. 59.

(17) F. L. Ransome: Journ. Wash. Acad. Sci., vol. i., No. 4, 1911, pp. 114-118.

(18) S. J. Schofield: Mus. Bull. 2, Geol. Surv. Can., 1914, pp. 1, *et seq.*

(19) F. F. Grout: Econ. Geol., vol. 13, No. 3, 1918, p. 185.

The mode of differentiation of these rocks can be considered under the following heads:—

A. THE ORIGIN OF THE MICROCLINE—ALBITE APLITES.

The microcline-aplites and albite-pegmatites are the only intrusions within the confines of the granite as exposed. No basic dyke-rocks were seen by the writer. In the country rock, some miles from the granite contact, Prof. Howchin [20] has reported a basic dyke of diabasic composition. The writer, unfortunately, was unable to visit the locality during his visit.

Despite the abundance of aplite associated with the granite, there appears to be a scarcity of other satellitic types of intrusion, such as those of lamprophyric type, which, if present, might suggest complementary differentiation. The field evidence must be taken as it stands, for we have no warrant to assume that such lamprophyric types are present but still uncovered.

This evidence is therefore suggestive that the microcline aplites are direct derivatives of the granite magma by a process of fractional crystallization.

The aplites as now developed in the granite came into their position during the cooling and contraction of the crystalline granitic mass, *viz.*, by intrusion into contraction cracks and fissures. In this respect, therefore, the aplitic intrusions resemble those characteristic of so many granitic masses.

The origin of the albite rich pegmatites which are developed in minor amount within the granite remains to be treated.

B. THE ORIGIN OF THE ALBITITES.

It has been noted in the previous discussion that aplites associated with basic rocks were often highly sodic, but not invariably so. In the case of the Willoughby pegmatites, the sodic type is associated only with granite. Their sodic nature —in some cases they consist almost wholly of albite—is, however, no reason for genetically connecting them with basic rocks. Here again field evidence warrants no such assertion.

Their mode of occurrence is essentially as small dykes cutting the granite. Their possible modes of differentiation can be considered under three heads:—

(a) They represent an immiscible liquid phase separating from the residual magma.

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[20] W. Howchin: Trans. Roy. Soc. S. Austr., 1903, vol. xxvii., pt. i., p. 82.

(b) They are of secondary origin, and represent the albitization of original microcline dyke-rocks, this albitization being accomplished by magmatic soda-rich solutions.

(c) They represent the "end product" and final differentiate of the residual magma, and are therefore directly related to the potassic-aplites.

(a) An immiscible phase of the liquid residual magma.—Daly,[21] Grout,[22] and others have resorted to liquid immiscibility to explain certain types of differentiation.

It must be admitted that the evidence for the separation of liquid phases in igneous magmas has not yet been clearly demonstrated, nor has the extensive experimental work on silicate-melts given any indication of such a process.

For the Willoughby albitites it is thought that this mechanism is untenable, for homogenous rock masses abound in which all minerals herein concerned, *viz.*, quartz, microcline, and albite, are associated in a wide range of mixtures. It is to be noted here, however, that the objection raised by Bowen[23] that the formation of a monomineralic rock is generally impossible by liquid immiscibility, owing to the fact that this would necessitate its crystallization at its true melting point—*i.e.*, far above the temperature of the magma, say for albite, 1100° C.—ignores the possibility, theoretically, of albite and a volatile mineralizer *(e.g.*, water) separating as a liquid phase, in which case the *reductio ad absurdum* argument fails.

(b) Albitization of original potassic rocks.—This view immediately admits the albitites to be of secondary origin and the process of albitization to have been produced by magmatic soda-rich solutions.

As far as the writer is aware, there is no evidence of albitization of the surrounding granite with which the albitites are in contact. Nor does the texture of these rocks suggest such a replacement. Both occurrence and texture are strongly against their derivation from original potassic-aplites.

(c) The albitites represent the final differentiate or end product of the residual magma.—The writer is of the opinion that the albitites represent the final differentiate of the residual magma.

The intimate relationship of the potassic-aplites and the albite-pegmatites is indicated by the presence, in each, of the

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(21) R. A. Daly: Igneous Rocks and their Origin, p. 226.

(22) F. F. Grout: Econ. Geol., 1918, p. 185.

(23) N. L. Bowen: Journ. Geol., Dec., 1915 (Supplement), p. 80.

blue opalescent quartz so characteristic a feature of the normal granite. They are further related by the presence of albite, which, while the subordinate felspar in the potassic-aplite, is the dominant felspar in the albitites.

The albite-pegmatites are to be distinguished from the potassic-aplites:—

(i.) By their relatively minor development—being limited to a few dyke or pipe-like masses.

(ii.) By their coarse-grained texture—the potassic aplites being predominantly fine grained.

(iii). By the presence of accessory minerals as apatite, zircon, and rutile in relative abundance. Such accessory minerals are practically absent from the microcline aplites.

(iv.) By the absence of biotite.

(v). By the absence of microcline.

Varieties of Albitites.—The predominant type is a coarse-grained quartz-albitite, which may pass into veins of pure albite. The quartz occurs in blue opalescent grains and the albite in Carlsbad twins—also twinned on the albite law. The remaining type is a muscovite-albitite, in which muscovite is associated with albite. The accessory minerals are developed in all types.

The Mechanism of Differentiation.—The residual magma, dominantly potassic in composition, was derived by the fundamental process of differentiation—fractional crystallization. This liquid, by a process of straining off from the crystalline granite, is regarded as occupying subsidiary pools or chambers (24) within the granitic mass. Consequent on such fractional crystallization the residual liquid was enriched in mineralizers, chiefly water.

In the main granite the crystallization of plagioclase was early initiated, and occurred with marked zoning, the varying composition being from andesine to oligoclase. The residual magma was thus enriched in albite molecules relatively to

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(24) In granitic masses the evidences of the existence of such magma pools, as stipulated, are principally provided by the occurrence of aplitic or pegmatitic phases with distinctly blended contacts with regard to the granite mass. Crystallization, *in situ*, is therefore demanded. Where contacts between the aplitic or pegmatitic phase and the granite are sharp and well defined crystallization occurred after intrusion from such a magma pool. Many granitic masses show the evidences of two such types of satellitic phases.

anorthite, these latter being selectively locked up in the inner zones of plagioclase.

The non-volatile constituents of the residual magma thus consisted essentially of quartz and microcline and subordinately slightly calcic albite.

With the renewal of crystallization in the residual magma quartz and microcline were early precipitated, the magma being thus constantly depleted in these constituents. That some albite crystallized during this period is also evidenced by the presence of subordinate albite, associated with the microcline and quartz. This albite was still slightly calcic and with crystallization its composition approached pure albite. The amount crystallizing, however, was quite subordinate, and the impoverishment of the still liquid residue in microcline molecules especially occurred.

Nearing the completion of crystallization of such a magma pool, the residual liquid would have markedly changed in composition through such selective crystallization. This residual liquid depleted in potassic constituents would therefore have become highly *sodic*.

By the opening of fissures in the surrounding rock this residual liquid, derived by fractional crystallization from the dominant potassic magma, was strained off from the crystalline mass and solidified in the occupied fissures.

Derived by such a process of fractional crystallization this residual liquid would be:—(i.) Predominantly sodic; (ii.) characterized by an increased concentration of mineralizers.

This process of differentiation receives considerable support from a study of the albitites.

Their coarse-grained texture and the concentration in them of such minerals as zircon, apatite, and rutile are characteristically to be associated with a concentration of mineralizers during crystallization, or, in other words, they are typical end products of differentiation.

It has been noted that some muscovite and quartz in the muscovite-albitites appears to be secondary. This is principally evidenced by the shattering of albite plates by small quartz stringers. This pneumatolytic process is intimately related to the concentration of mineralizers during the crystallization of the rock. The shattering of albite plates by quartz strings and the production of muscovite can be relegated to a late stage of crystallization, *i.e.*, at or near the completion of crystallization. The muscovite, indeed, may represent the hydrolysis of potential microcline-felspar.

The scheme of differentiation can be summarized in the appended chart:—

Chonolitic Mass. Differentiation *in situ*.	Residual Magma → Albite Pegmatites. (dominantly sodic).
	↑
	Microcline Albite Aplites (differentiation may cease here).
	↑
	Residual Magma (dominantly potassic).
	↑
	Granite [Adamellite].
Salic differentiate from a batholitic Magma.	↑
	Granitic Magma.
	↑

The very minor amount of albitite in comparison to the development of potassic-aplite is here again emphasized. If this relation be preserved at depth, it follows that the composition of the residual magma lies very close to that of the potassic-aplites.

In this connection the writer would point out that the differentiation of the residual magma may be controlled by a mechanical factor. Where the residual magma has been forced into fissures and caused to rapidly cool, further differentiation may be inhibited and the magma solidify as a crystalline aggregate of quartz, microcline, and subordinate albite.

On the other hand, the filtering of the residual magma into a subsidiary pool without rapid change of temperature and its slow crystallization undisturbed, then fractional crystallization may take place with the production of a small amount of residual liquid, enriched in mineralizers and of composition markedly different from that of the original residual magma.

Movement at this stage would result in the straining off of the small amount of residual liquid, giving rise to intrusions of highly sodic-pegmatite.

In composition, the potassic-aplites so derived would differ but slightly from that representing the composition of the residual magma.

We have here in miniature the outlines of a process which, on a grander scale, Smyth [25] has suggested for the differentiation of alkaline from subalkaline magmas.

Review of differentiation.—The predominant potassic-aplites with the minor sodic-pegmatites, plus the volatile mineralizers, represent, approximately, the residual magma derived from the fractional crystallization of the granitic magma.

This residual magma under favourable conditions underwent further differentiation, yielding predominant potassic-aplites as the fractionally crystallized portion and the minor sodic-pegmatites as the residual liquid highly enriched in mineralizers, now represented by the presence of the accessory minerals.

In the main, the mechanism of differentiation appears to have been one of straining off of a residual liquid from a crystalline mass.

It may well be that the extent of differentiation in such cases is dependent on the magma chamber remaining undisturbed by external agencies for sufficiently long periods to allow of delicate adjustment of equilibrium in the presence of volatile mineralizers.

With the crystallization of the albite-pegmatites differentiation appears to have closed. At a late stage in the consolidation of the microcline-aplite, the pneumatolytic action of mineralizers is represented by the quartz-tourmaline pneumatoliths, and at a still later stage greisenization and kaolinization were developed.

Correlation with other Australian Albitites.—These albite-pegmatites, or albitites, are to be correlated with the previously-described albitites from Pilbarra region, Western Australia, and the albitites from Eyre Peninsula. In all three cases their association appears to be with granitic rocks. In the case of the Pilbarra rock, the pegmatite is tin bearing. The Eyre Peninsula albitites are remarkable for the association in one case of wernerite in long prismatic crystals.

VII. General Discussion.

Form of the Intrusion.—It has been noted in the Introduction that the granite is distinctly transgressive to the surrounding schists and quartzites. The seaward extension of the granite is not known. Some evidence of the underground extension of the granite, in an horizontal direction, is afforded

(25) C. H. Smyth, jr.: Amer. Jour. Sci., 1913, 36, p. 42.

by the occurrence of a pegmatite dyke 8 miles from the granite headland. This is genetically related to the Cape Willoughby massif, and carries gem tourmalines. With the crystallization of the granite and associated dyke rocks, the igneous cycle appears to have closed.

The foregoing data admittedly are insufficient to determine the form of the intrusion, yet the writer ventures to place it in the class of chonolite, as described by Daly and defined by him as an igneous body:—*(a)* Injected into dislocated rock of any kind stratified or not; and *(b)* of shape and relations irregular in the sense that they are not those of a true dyke, vein sheet, laccolite, bysmalite, or neck; and *(c)* composed of magma, either passively squeezed into a subterranean or orogenic chamber, or actively forcing apart the country rocks.

The chonolite type, therefore, covers a wide range of intrusions whose form cannot be considered well characterized. It is thought that, for the Willoughby massif, the evidences of underground extension, horizontally, and the apparent rapid closing of the igneous cycle are not favourable to a batholitic nature.

The relation of the Cape Willoughby Massif to other South Australian Intrusions.—Kangaroo Island is separated from the mainland of Jervis Peninsula by the narrow strait of Backstairs Passage. The island really forms a continuation of the Mount Lofty Range, cut across by the Backstairs Passage, which is probably a block-faulted area. The extension of the island in a westerly direction is related to the strike of the axis of Palaeozoic folding, and is perhaps emphasized by the fact that the late Tertiary fault scarps are developed parallel to the strike of the Palaeozoic folding.

The structure of the Mount Lofty Ranges has been shown to consist of a central geological axis of Pre-Cambrian schists and intrusive rocks with a north-east-south-west strike,[26] and developed, anticlinorially, a series of sediments dipping easterly and westerly from this axis. These sediments on the western side are only slightly altered, whilst their eastern representatives are markedly metamorphosed, being represented by quartzites, schists, and marbles.

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(26) W. Howchin: Trans. Roy. Soc. S. Austr., vol. xxviii., 1904, pp. 253-280. W. Howchin: *Ibid*, vol. xxx., 1906, pp. 227-262. W. Howchin: Aus. Ass. Adv. Sci., 1907, Sect. C, pp. 414-442.

The easternmost beds have been invaded by igneous intrusions which are comparatively absent from the western side of the axis.[27]

These sedimentary beds contain an interstratified glacial tillite. They have been designated as Lower Cambrian by Professor Howchin, but the possibility of their being Proterozoic must not be denied.

Age of the Intrusion.—The granitic mass of Cape Willoughby is intrusive into the eastern representatives of this series. Howchin has shown that the late Palaeozoic (Permo-Carboniferous) glacial deposits overlie the old metamorphic rocks of eastern Kangaroo Island, and are represented near Cape Willoughby itself. The presence of these glacial beds indicates that already the granite was exposed in Permo-Carboniferous times. If the intruded beds are to be relegated to the Proterozoic, as has been suggested for their western representatives, then the age of the granite can only be rigidly defined as Post Proterozoic and Pre Permo-Carboniferous.

On further analysis, however, it would appear that these limits can be somewhat narrowed. It is clear that in Permo-Carboniferous times the granite was exposed at the surface. The vast amount of erosion that would be required for its exposure indicates that it was intruded considerably prior to Permo-Carboniferous times. On the other hand, it is clear that the first great orogenic movements in this area subsequent to deposition of the intruded beds developed only after Cambrian time, for the Proterozoic age of these beds is dependent on a disconformity between their western representatives and the Cambrian Archaeocyathinae limestones.

The absence of Ordovician beds at the edges of the Cambrian geosyncline points to the folding of this geosyncline at the close of the Cambrian or in Ordovician time.

The development of the Mount Lofty Ranges as a huge anticlinorium with a pronounced westerly overthrust and the occurrence of an eastern zone of igneous intrusion is suggestive that these igneous intrusions are related to the folding.

Since Ordovician times no orogenic movements have disturbed this area to the present day. The evidence of inclusions of country rock in the granite indicates that partial

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(27) This view of the structure of the Mount Lofty Ranges has been denied by some observers, particularly W. G. Woolnough. Remarkably clear evidence of the anticlinorial character of the ranges can be obtained in the Inman Valley, where an easterly succession beginning with the great angular unconformity of the Grey Spur can be traced through to Victor Harbour. More complicated but none the less clear is the succession in the Williamstown-Mount Crawford area, Barossa. The possible Proterozoic age of the westernmost beds affects this question not at all.

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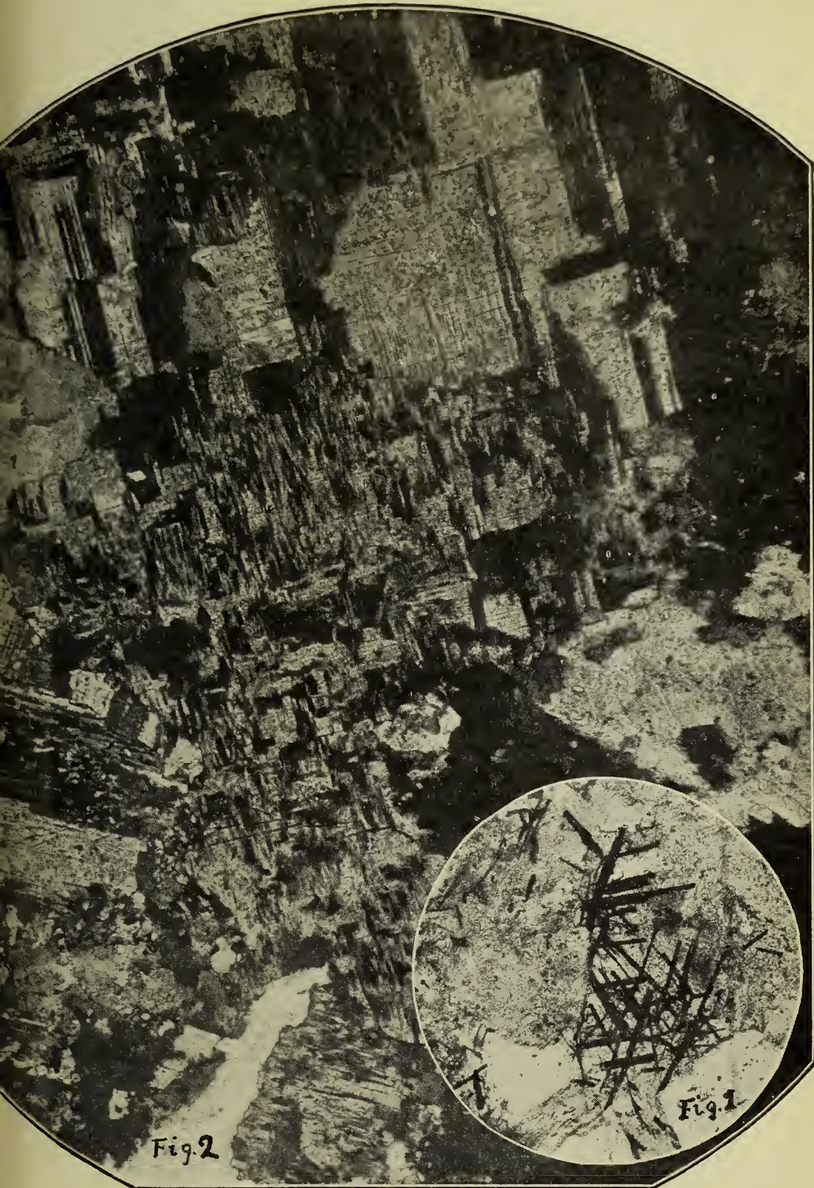

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metamorphism had already been effected prior to intrusion. This is in harmony with the view that regional metamorphism had been induced in the period of maximum intensity of folding, and that the igneous intrusions, while directly related to the orogenic movements, were developed at the close of the folding period, when movement was of a broad and relatively simple type.

The mass of Cape Willoughby is to be correlated—based on the observations of Mr. W. R. Browne, B.Sc., detailed in a forthcoming paper—with the granite masses of Victor Harbour and Port Elliot, both on field and petrological evidence.

Conclusion.

In conclusion the writer would suggest that:—

(i.) The masses of Cape Willoughby, Victor Harbour, and Port Elliot represent chonolitic masses of limited surface extent, which are connected at depth to a single batholitic chamber.

(ii.) These chonolites are arranged along a zone parallel to the strike direction of the older Palaeozoic folding.

(iii.) These chonolitic intrusions, whilst related to the orogenic movements, were developed only at the close of the folding epoch, when movements were of a comparatively broad and simple type.

The writer is indebted to Mr. W. R. Browne, B.Sc., for much help and advice during the preparation of this paper.

DESCRIPTION OF PLATES.

Plate XXX.

View of granite outcrop forming part of the Cape Willoughby headland.

Plate XXXI.

Fig. 1. Sagenite web of rutile in quartz albitite. Magn., 50 diams.

Fig. 2. A typical section of chequer structure in albite of the albitites. Magn., 53 diams. + nicols.

Australian Coleoptera—Part 1.

By Albert H. Elston, F.E.S.

[Read September 11, 1919.]

PAUSSIDAE.

Arthropterus articularis, n. sp. (fig. 1).

Dark castaneous, elytra slightly paler. With very short and sparse setae, except on sides and legs where they are more numerous and longer.

Head wide, slight interocular depression, with numerous clearly-defined but somewhat irregular punctures; sides tuberculate behind the eyes. Antennae with more numerous punctures being somwhat subrugose at sides, first joint stout, slightly longer than second and third combined, second about three times wide as long, fourth to ninth each about twice as wide as long and almost semicircular, the tenth about as long as eighth and ninth combined, almost circular, its apex slightly more rounded than base. *Prothorax* slightly narrower than head, apex somewhat wider than base; disk flattened, median line clearly defined, margins slightly reflexed, more so at basal angles than elsewhere, with numerous well-defined but somewhat irregular and small punctures. *Scutellum* subtriangular. *Elytra* about thrice as long as prothorax, with irregular subseriate punctures, smaller than those on prothorax and almost disappearing posteriorly; apical membrane about as long as scutellum. Front *tibiae* each with a large apical spur overhanging an apical notch, the middle and hind ones are similarly furnished but much less conspicuously, and all strongly curve inwards on underside near base. Length, 5-5½ mm.; width, 3-3½ mm. Type, in author's collection; cotype, I. 10842, in South Australian Museum.

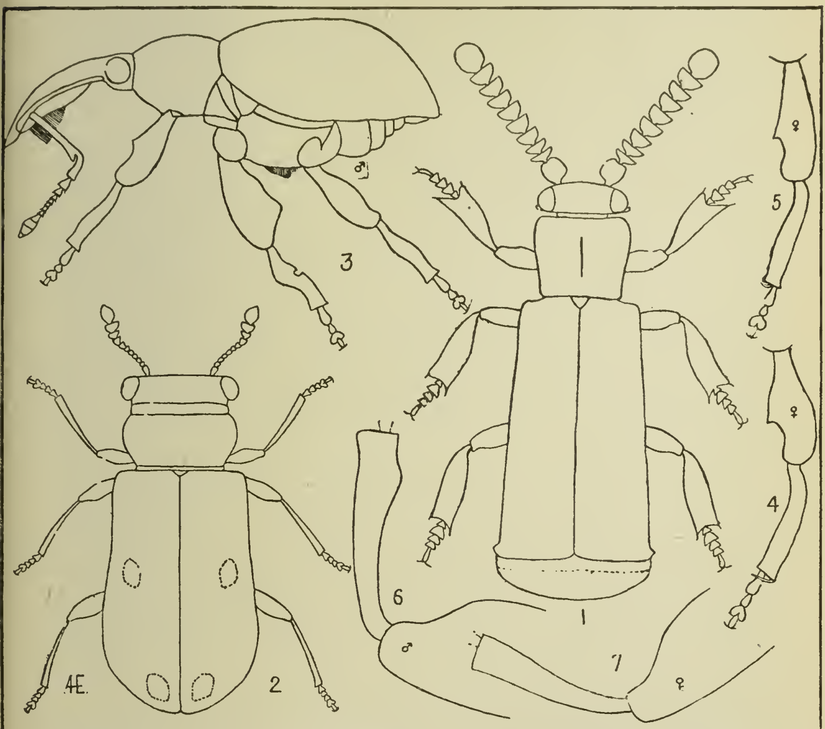
Hab.—South Australia: Quorn (A. H. Elston), Lake Callabonna (A. Zeitz).

This species is easily distinguished by the apical joint of the antennae, which is almost circular, and the fourth to ninth which are somewhat semicircular in shape. On some specimens the interocular depression is more pronounced than on others, and those taken at Lake Callabonna are much darker in colour (although this is probably due to age), the prothorax and head being a dark brown, and in being more hairy, especially on antennae. The elytral pubescence is semi-erect and very short, but is quite distinct when viewed from the sides. On each of the front tibiae the apical spur is much larger than the free spur, but on the others the free spur is the more conspicuous of the two, and the second and third joints of the tarsi are strongly dilated.

CLERIDAE.

Lemidia basiflava, n. sp.

Glossy black; front of head, antennae, base of elytra, and parts of front and middle legs flavous, hind legs black, the knees all more or less pale. Sparsely clothed with moderately



1, *Arthropterus articularis*, n. sp. 2, *Lemidia variabilis*, n. sp. 3, *Diethusa insignita*, n. sp. 4, Front leg, *D. insignita*, n. sp, ♀. 5, Front leg, *D. mollis*, Lea, ♀. 6, Hind leg, *Edusa pulchra*, n. sp., ♂. 7, Hind leg, *E. pulchra*, n. sp., ♀.

long straggling hairs, becoming shorter, more or less erect and seriate on elytra.

Head wide, almost impunctate with a few subrugose punctures at sides near ocular suture, inter-ocular impressions distinct. *Prothorax* about as long as wide, sides rather suddenly inflated at the middle, distinctly narrower than head, constricted slightly more towards apex than near base, with a transverse impression near apex and a moderately large depression near middle of base, with a few scattered punctures. *Elytra* about as wide as head, sides near base parallel, but becoming gradually dilated behind the middle then rounded at apex, with rows of rather large clearly-defined punctures becoming smaller posteriorly and disappearing at apex. Length, 4 mm.

Hab.—South Australia: Mount Lofty Ranges (R. J. Burton, S. H. Curnow, J. G. O. Tepper, A. H. Elston), Kangaroo Island (A. M. Lea). Type, I. 10833, in South Australian Museum.

At first this was thought to be a variety of *exilis*, but it differs from that species in having the prothorax black, the sub-basal depression less transverse, and the elytral punctures in rows and more clearly defined. In some of the specimens the apical joints of the antennae are more or less infuscate; the flavous markings at base extend from near the suture (on two specimens they touch it) to the margin, the pale basal portion is confined to the depth of elytra, and when viewed from behind is barely perceptible. In Lea's table (1) this species would be associated with *elongata* from which it differs in being smaller, glossy black, the flavous portion of head more conspicuous, and the post-median fascia absent.

L. basiflava, var. fasciata, n. var.

Differs from above form in having the legs flavous, except that the hind tarsi and apex of tibiae are infuscate, and a somewhat irregular flavous fascia situated at the middle of the elytra, beginning near the suture and extending a little more than half way across. On one specimen the legs are much the same as on the type form and its fascia is represented by two semi-detached spots, and on two the apical joints of the antennae are infuscate, one specimen has a tinge of red near the apex of the prothorax. Length, 4 mm.

Hab.—South Australia: Kangaroo Island (A. M. Lea), Mount Lofty Ranges (A. H. Elston).

L. auricoma, n. sp.

Piceous-brown, head and prothorax black with a slight metallic gloss; mandibles, antennae, palpi, and legs flavous, the hind tarsi more or less infuscate; elytra with a pale median fascia and pale markings basal and apical. Upper-surface with long, straggling, pale hairs becoming shorter and semi-erect on elytra.

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(1) A. S. E. Belg., 1907, p. 334.

Head wide with rather sparse punctures, interocular impressions feeble. *Prothorax* about as long as wide, narrower than head with sparse punctures more or less concealed, but in places subconfluent, sides dilated near the middle, with transverse impressions subapical and subbasal. *Elytra* wider than prothorax, sides parallel but becoming slightly dilated towards the apex, with numerous well-defined punctures becoming smaller posteriorly and disappearing at apex. Length, 3 mm.

Hab.—Queensland: Cairns district (F. P. Dodd). Type, I. 10832, in South Australian Museum.

The pale markings at base differ, on some of the specimens there is a subtriangular patch along the suture of each elytron connected with the shoulders, but on others the basal markings are absent or very ill defined. The median fascia is narrow near the sides and is rather suddenly dilated near the suture, but it does not quite touch the sides or suture. The apical markings appear to be always present but are not so sharply defined as the median fascia, they are sometimes obscure and continued along the suture and sides, but not touching the median fascia. In Lea's table the typical form would be referred to *Ill* and there associated with *flavifrons*, from which it differs in being smaller and having the front of head and prothorax black, the legs flavous, and elytral punctures not so clearly defined. The specimens with the basal markings absent would be referred to another section altogether, *IIll*. Elytra with pale markings median and apical, or subapical.

L. auricoma, var. flaviventris, n. var.

Differs from the previous species in having front of head and abdomen flavous.

L. variabilis, n. sp. (fig. 2).

Black with a bluish or purple gloss, the elytra conspicuously purple and furnished with two median and two subapical flavous spots; antennae flavous, the basal and several of the apical joints infuscated. Upper-surface sparsely clothed with straggling, semi-erect hairs, becoming shorter and more erect towards apex of elytra.

Head rather wide and covered with small clearly-defined punctures becoming subrugose in front, interocular depression distinct. *Prothorax* transverse, sides strongly dilated in middle, rather narrower than head with a few small punctures and a subapical and subbasal transverse impression. *Elytra* wider than prothorax, about twice as long as base, sides parallel near base and becoming dilated posteriorly, with moderately large and rather dense punctures becoming smaller posteriorly. Length, 4-5 mm.

Hab.—Queensland: Cairns district (F. P. Dodd). Type, I. 10831, in South Australian Museum.

This appears to be a rather variable species; there are four specimens in front of me and they all differ as regards the shape and size of the spots. In two the median spots are situated about midway between the suture and the margin, whilst in the others they are entirely absent. The subapical spots are fairly regular, and are placed quite close to the suture but do not touch it. On the head the interocular depression varies, the two shallow foveae being more conspicuous on some specimens than on others. In Lea's table of *Lemidia* this species would be inserted after *flavifrons* as *llll.* Elytra with pale markings submedian and apical or subapical.

L. flavicollis, n. sp.

Shining black; prothorax, antennae, palpi, and legs flavous, hind tarsi infuscate. Clothed with rather long, straggling, and mostly black hairs, becoming shorter and more or less erect on elytra.

Head wide, base and sides with a few small punctures, interocular foveae feeble. *Prothorax* slightly transverse, sides inflated at the middle, distinctly narrower than head, surface almost impunctate with a transverse subapical and subbasal impression. *Elytra* at base about as wide as head, sides near base parallel becoming dilated towards apex, with irregular rows of shallow punctures becoming smaller and disappearing posteriorly. Length, 3-4 mm.

Hab.—Queensland: Cairns district (F. P. Dodd). Type, I. 10830, in South Australian Museum.

In Lea's table this species would be associated with *L. pictipes*, Blackb., from which it differs in being somewhat shorter, antennae entirely pale, elytra with sparser and darker clothing, and with smaller and fewer punctures not extending so far towards apex, the size of the elytral punctures appear to vary on the six specimens before me. The hind tarsi appear to be always infuscated, the others sometimes have the apical joint infuscate, and on one specimen the middle tarsi are infuscate.

CURCULIONIDAE.

Diethusa insignita, n. sp. (fig. 3).

♂. Dark brown with apical part of rostrum, antennae, and parts of legs paler. Densely clothed with soft scales on the upper-surface, mostly sooty-brown interspersed with white, the under-surface with uniformly white ones.

Rostrum fully half as wide as head and about the length of the prothorax, tapering slightly towards apex, with dense punctures more or less concealed behind the antennae but distinct in front, a conspicuous flange on each side about the middle, each flange rendered more conspicuous by a fascicle of long pale clothing; scape thin, slightly thickened towards apex, about as long as funicle, inserted about one-third from apex of rostrum, first joint of funicle nearly as long as second and third combined. *Prothorax* moderately transverse with dense more or less concealed punctures. *Elytra* subcordate, distinctly wider than prothorax, base trisinuate, with regular series of large partially concealed punctures, interstices wide and even. *Metasternum* with a large deep excavation from its base, and continuing to near the apex of the first segment of the abdomen; between the middle and hind coxae, on each side an obtuse elevation crowned with a conspicuous fascicle. *Abdomen* with apex of last segment furnished with a small fascicle of pale clothing. *Femora* robust, dentate, the tooth on each of the middle pair considerably dilated; middle tibiae distorted. Length (♂, ♀), 4-5 mm.

♀. Differs in being lighter in colour; rostrum longer, thinner, paler, with punctures concealed only near base, and antennae inserted somewhat nearer middle; metasternum and abdomen without the excavation and fascicles, abdomen more convex, metasternum with a slight depression; the middle femora are less robust with the tooth smaller; middle tibiae are less distorted and at the top of the apex a spur is present that slightly diverges from the length of the apex.

Hab.—South Australia: Quorn (A. H. Elston). Type, in author's collection, cotype, I. 10835, in South Australian Museum.

This species is the most distinct in the genus and is easily distingushed by the fasciculate processes on the rostrum and metasternum of the male. The only other species in the allied genera that has fascicles on the metasternum is *Melanterius pectoralis*, Lea, whose male has only a slight depression, whereas in the present species the depression is deep and the fascicles are bent over at their apices, which are nearly touching, and so forming an arch. The strongly dilated femora and distorted tibiae of the middle legs are also characteristic. The female in general appearance closely resembles the female of *D. mollis*, Lea, but with the front and middle tibiae different at apices; in the former species the spur is inserted about the middle of the apex and not diverging from it to any great extent, (fig. 5), its clothing on the upper-surface is rather less variegated, and on the under-surface the scales are much the same as on the upper-surface; but on the present species the scales on the under-surface are decidedly smaller than those on the upper, and the spur on the front and middle tibiae is inserted at the top of the apex and continuing to its length, diverging from it at an angle of nearly thirty-five degrees (fig. 4).

CHRYSOMELIDAE.

Edusa pulchra, n. sp.

♂. Metallic-green or greenish-blue with a coppery gloss in parts; labrum, palpi, antennae, and legs castaneous; the apex of palpi, apical joints of antennae, and last two joints of tarsi infuscate; the labrum and sides near eyes furnished with pale depressed setae, and the front angles of prothorax pubescent. Under-surface metallic-green with coppery gloss and lightly clothed with pale pubescence, sparse in middle and somewhat dense at sides.

Head with numerous clearly-defined punctures, except at base of antennae, and a slight depression at the occiput. Antennae rather long with second joint about half as long as third. *Prothorax* with front angles acute, sides subsinuate, punctures as on head but becoming denser at margins. *Scutellum* transverse and almost impunctate. *Elytra* almost parallel-sided to beyond the middle, with dense punctures set in somewhat irregular rows, some of them confluent at the sides. *Abdomen* with a few scattered punctures, and the apical segment has a shallow transverse depression. The hind *tibiae* are suddenly dilated near apex (fig. 6). Length (♂, ♀), 5-6 mm.

♀. Differs in being more robust, the hind tibiae not suddenly dilated near apex (fig. 7), first joint of front tarsi smaller, the abdomen more convex and without the subapical depression, and more pubescent.

Hab.—South Australia: Quorn (A. H. Elston). Type, in author's collection, cotype, I. 10834, in South Australian Museum.

This apparently belongs to the glabrous group of *Edusa* and in Lea's table [2] would be referred to C *q*, but that the sides of its prothorax are almost straight in the middle, hence it could not be referred to either *angustula* or *heterodoxa;* in general appearance it is like a rather robust *heterodoxa*, but the abdomen is metallic and its fifth segment is different in the male.

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(2) Trans. Roy. Soc. S. Austr., 1915, p. 194.

ADDITIONS TO THE FLORA OF SOUTH AUSTRALIA. No. 16.

By J. M. Black.

[Read October 9, 1919.]

Plate XXXII.

Gramineae.

Dactyloctenium aegyptiacum, Willd. (*Eleusine aegyptiaca*, Pers.) Mount Deputy, near Mount Eba H.S. (Dist. W; G. Taylor).

**Lamarckia aurea*, Moench. Nuccaleena Mine, near Moolooloo (E. H. Ising). The most northerly record for this grass.

Cyperaceae.

Scirpus littoralis, Schrad. Billakalina Well, 20 miles west of Coward Springs (Dist. C; Dr. G. Taylor, May, 1919).

Cyperus distachyus, All. (Plate xxxii.) Coward Springs (Dr. G. Taylor, May, 1919); Nilpena (R. Helms, May 2, 1891, in the Tate Herb.). The latter is evidently the same plant as that collected at Coward Springs, but some of the spikelets are twin, whereas they are always solitary in Dr. Taylor's specimen. Helms' plant was listed by Mueller and Tate (these Trans., xvi., part 2, 379, ann. 1896) as "*C. laevigatus*, L., a slender form with some of the spikelets solitary." *C. distachyus*, All. (*C. junciformis*, Cav.), is sometimes treated as a variety of *C. laevigatus*, but it appears to be well distinguished by having fewer spikelets (2-5) in the cluster, the glumes dark-red instead of white and the nut only one-third (instead of one-half) shorter than the glume. Our plant agrees with the description in all particulars except that, so far as our present material goes, the spikelets are either solitary or only 2 in the cluster. The Tate Herbarium contains a specimen labelled *C. laevigatus*, from Middleton Creek (Miss Hussey, Feb., 1898), with white spikelets in clusters of 8-16. The same species is recorded in Max Koch's list of plants from Mount Lyndhurst run (these Trans., xxii., 116, ann. 1898). When Professor Tate's flora was published, neither species had been recorded for South Australia. *C. distachyus* is a Mediterranean plant, but it is doubtless native here.

Casuarinaceae.

Casuarina stricta, Ait., and *C. distyla*, *Vent.* (Plate xxxii). The difference between the male flowers of these 2 species is very marked. In the former the 2 bracteoles are deciduous, coherent at the summit by their cilia, and anterior rather than lateral; in *C. distyla* they are persistent, distinct, and lateral. The 2 perianth-segments of *C. stricta* are connate and have the appearance of a single, flattish bracteole, notched at the summit and pubescent on the 2 midnerves; they are enclosed within the summit of the 2 bracteoles and are posterior in position, *i.e.*, they are placed against the inner face of the stamen and next to the axis of the whorl. In *C. distyla* the perianth-segments are opposite and quite free; one is anterior and the other posterior. In *C. stricta* the bracteoles and perianth-segments cohere to each other on the summit of the ripening anther and usually fall off in one piece. The bracteoles are evidently the "valvulae calycis exteriores" of Labillardière (Nov. Holl. pl. spec. ii., 67, t. 218), and the perianth-segments are his "valvulae binae interiores," from which he named the species *C. quadrivalvis* (=*C. stricta*).

It is probable than an examination of the male flowers of *Casuarina*, which has only been attempted in one or two instances, would help materially in the satisfactory determination of species. It is essentially a task for those who can examine living specimens, because the delicacy of the organs renders the investigation of dried material very difficult, a fact which is noted by Bentham in his great work.

Proteaceae.

Hakea ulicina, R. Br., var. *flexilis*, F. v. M. Yurgo, near Karoonda (Dist. M; H. W. Andrew).

Santalaceae.

Choretrum glomeratum, R. Br. Yurgo, near Karoonda (Dist. M; H. W. Andrew).

Polygonaceae.

Muehlenbeckia Cunninghamii, F. v. M. Miller Creek (Dist. W; G. Taylor).

Chenopodiaceae.

Atriplex rhagodioides, F. v. M. Walebing, near Kingoonya (Dist. W; G. Taylor).

Bassia longicuspis, F. v. M. Nuccaleena Mine, near Moolooloo (E. H. Ising). This long-spined species is the "Bindy-eye" of the Far Northern settlers.

PORTULACACEAE.

Anacampseros australiana, J. M. Black. Moolooloo, "growing in a rocky gully" (E. H. Ising).

CARYOPHYLLACEAE.

Polycarpon tetraphyllum, L. Moolooloo (Dist. S; E. H. Ising).

PAPAVERACEAE.

Papaver aculeatum, Thumb. Robe (Dist. T or G; C. D. Black); Moolooloo (Dist. S; E. H. Ising). Apparently a very rare plant. The Robe specimen is 20 cm. high, that from Moolooloo only 4 cm.

CRASSULACEAE.

Crassula colorata, (Nees) Ostenf. (*Tillaea acuminata*, F. M. Reader). Moolooloo (E. H. Ising).

LEGUMINOSAE.

Glycyrrhiza acanthocarpa, (Lindl.), combin. nov. Renmark, River Murray. Flowers December-April; fruits April-May. A shrub 60-80 cm. high, much branched, with thick rootstock; the solitary seed is compressed-obovoid, shining, dull green mottled with brown. The anther-cells are confluent at the summit, and the anterior valve is smaller than the posterior one in all the anthers, of which 5 are smaller and on shorter filaments.—*Indigofera acanthocarpa*, Lindl., in Mitch. Three Exped., ii., 17 (1839); *Clidanthera psoraleoides*, R. Br., App. Sturt Exped. Centr. Aust., ii., 73 (1849); *Psoralea acanthocarpa*, F. v. M., Fragm., iii., 45 (1862); *Glycyrrhiza psoraleoides*, Benth., Fl. Aust., ii., 225 (1864).

Acacia stenophylla, A. Cunn. Kingoonya (Dist. W; G. Taylor); also Yankee Gunyah, 10 miles west of Coward Springs.

A. tarculensis, J. M. Black. Pera Rockhole (near Lake Labyrinth); Tomato Rocks (red felspar porphyries 15 miles south of Kingoonya; G. Taylor).

Aotus villosa, Sm. Karoonda (Dist. M; H. W. Andrew).

**Medicago minima*, Grufb., var. *brachyodon*, Reichb. (*M. brachyacantha*, A. Kern.). A specimen of this short-spined form which has established itself at Millicent, and which has already been referred to in these Trans., xlii., 174

(1918), was submitted to the botanists of the Muséum d'histoire naturelle, Paris, and determined as above.

RUTACEAE.

Microcybe multiflora, Turcz. Yurgo, near Karoon. (H. W. Andrew).

EUPHORBIACEAE.

Phyllanthus lacunarius, F. v. M. Walebing Swamp, near Kingoonya (Dist. W; G. Taylor).

Euphorbia Wheeleri, Baill. Moolooloo (Dist. S; E. H Ising).

DILLENIACEAE.

Hibbertia crispula, J. M. Black. Ooldea Soak (May, 1919; G. Taylor). This specimen contains 2 fruiting carpels; pericarp dehiscing down the inner angle; hairlike segments of the arillus extending beyond the seed.

FRANKENIACEAE.

Frankenia serpyllifolia, Lindl. Murrayville, Vict. (H. B. Williamson). The broad-leaved form. This is by far the most southerly locality recorded for this species, and points to the probability of its being found in our trans-Murray country.

F. fruticulosa, DC. Murrayville, Vict. (H. B. Williamson). This species has hitherto been collected only along our coastline.

MYRTACEAE.

Eucalyptus fasciculosa, F. v. M. Ashbourne (H. W. Andrew). Mr. Andrew says:—"Erect tree about 20 m. high; bark white on the upper part of the stem, mottled below; called locally Pink Gum or Mountain Gum." The leaves are dark green on both sides. The height is quite double that which *E. fasciculosa* usually assumes in the Mount Lofty Range (6-10 m.), where it grows mostly in poor soil and with a more or less crooked stem. The height and straight growth of the tree at Ashbourne bring it near *E. paniculata*, Sm. The outer stamens are barren and the anthers open in terminal pores. Also from Coonalpyn (Dist. T; W. J. Spafford).

E. dumosa, A. Cunn. In his Critical Revision of the Genus Eucalyptus, iv., 220 (1919), Mr. J. H. Maiden has restored *E. dumosa* to specific rank, in accordance with Bentham's treatment, instead of making it a variety of *E. incrassata*, Labill. Most Australian botanists will probably welcome this decision. The two species, at least in their South

Australian forms, are very distinct. *E. aumosa* includes var. *conglobata*, Benth., which is common at Port Lincoln and has clustered, sessile flowers.

Rubiaceae.

Galium Gaudichaudii, DC. Parachilna Gap (Dist S; E. H. Ising).

Goodeniaceae.

Goodenia vernicosa, J. M. Black. Parachilna Gap (E. H. Ising).

Compositae.

Helichrysum ambiguum, Turcz. If all the forms with solitary terminal flowerheads on woolly peduncles, ciliate or fringed involucral bracts, pappus-bristles plumose towards the summit, and female flowers usually devoid of pappus are to be placed in this species, then it becomes one of great variability. In the Tate Herb. is a specimen from Barrow Range, W. Austr. (R. Helms, 19/8/91), with soft, white-woolly appressed leaves only 4-8 mm. long, female flowers 4-toothed, the bisexual ones with 12-14 fragile pappus-bristles, the style swollen and hard at base. This form is probably near the type (which was collected by Drummond in Western Australia), and it bears a remarkable external resemblance to *Calocephalus Dittrichii*, F. v. M. Specimens from Idracowra, Finke River, N.T. (Horn Expedition), and Depôt Sandhills, Finke River (S. A. White), agree with the above in most respects, but the pappus-bristles are 6-9, and much dilated at base. Then there are specimens with stiff greenish leaves, glandular-scabrous above and more or less woolly below, from Ilapilla Gorge, N.T. (Horn Expedition); between Ferdinand River and Mount Watson (Dist. W; R. Helms); Nuccaleena Mine, near Moolooloo (E. H. Ising); Mount Lyndhurst (H. Koch); all these have pappus-bristles 12-18; female flowers 3-toothed, without pappus (in the heads examined). Probably these represent *H. semicalvum*, F. v. M. (var. *semicalvum*, Benth). The Mount Lyndhurst specimen (Tate Herb.) has leaves 10-35 mm. long and simulates *H. rutidolepis*, DC. More complete material may some day furnish characters for dividing these plants into 2 or more species. The achenes are slightly contracted at the summit, but not more so than in some other species of *Helichrysum*, and it does not seem necessary to transfer the species to *Leptorhynchus*.

Olearia decurrens, (DC.) Benth. Oratunga Creek, near Moolooloo (Dist. S; E. H. Ising). Almost all the leaves toothed in their upper part, those on the barren branchlets linear-cuneate and often 4-5 cm. long, the midrib prominent below; style-branches with lanceolate papillose tips as long as the stigmatic part; anthers obtuse at base.

Siegesbeckia orientalis, L. Owienagin Gap, near Moolooloo (E. H. Ising). A remarkable instance of dwarfing, the specimen being only 3 cm. high, with a single terminal flowerhead.

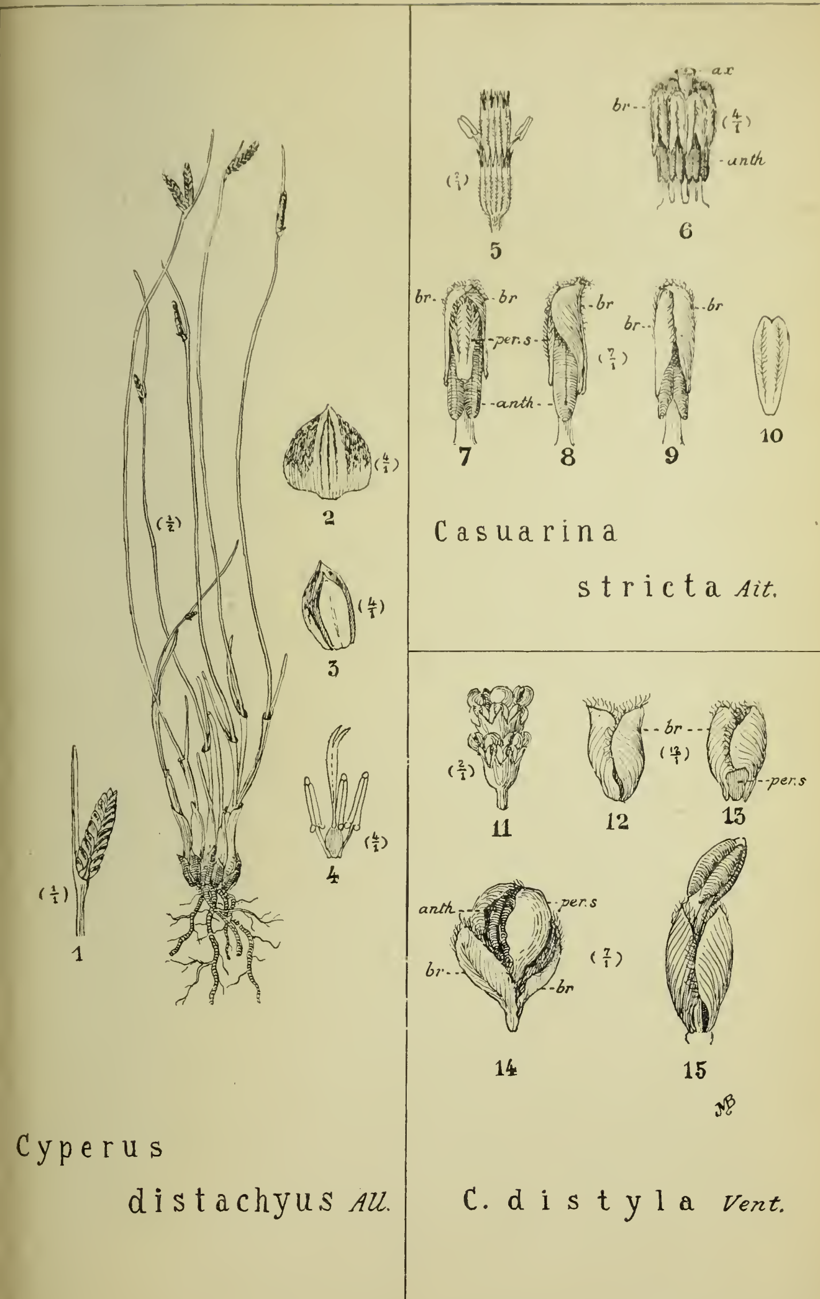
**Erigeron canadensis*, L. Port Pirie (H. W. Andrew). Growing in marshy ground.

DESCRIPTION OF PLATE XXXII.

Cyperus distachyus, All. 1, a spikelet. 2, glume spread open. 3, glume and nut. 4, pistil and stamens.

Casuarina stricta, Ait. 5, two whorls of the male spike. 6, whorl of 8 male flowers, the 2 ciliate bracteoles of each flower facing outwards. 7, inner face of the stamen (*i.e.*, that which is turned towards the axis of the whorl), the bracteoles and the 2 connate perianth-segments having been broken away from the base and lifted upwards by the anther, to which they still cling in the form of a hood. 8, side view of the same stamen. 9, outer face of stamen, showing the 2 bracteoles and the back of the anther. 10, the 2 connate perianth-segments. *ax*, axis; *anth*, anther; *br*, bracteole; *per. s*, perianth-segment.

Casuarina distyla, Vent. 11, two whorls of the male spike. 12, outer face of young male flower, still enclosed in the 2 bracteoles. 13, inner face of same, showing the 2 bracteoles and the base of one of the perianth-segments. 14, male flower at a later stage, showing the 2 bracteoles and the 2 perianth-segments partially enclosing the anther. 15, the same in the final stage; the perianth-segments have fallen and only the persistant bracteoles surround the filament.



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A Revision of the Australian Salicornieae.

By J. M. Black.

[Read October 9, 1919.]

Plates XXXIII. to XXXVII.

A tribe of *Chenopodiaceae*, popularly called "samphire" in Australia; low shrubs composed of imbricate articles more or less saucer-shaped at the summit and succulent during the first year. Later on the articles harden and finally lose all sign of the margins at the summit, becoming a continuous woody branch or stem. The flowers are normally arranged in 3's in hollows on each side of the lower part of the fertile articles, but in *Salicornia australis* 1 or 2 pairs of flowers are added at each side of the triad, so that we have a row of 5 or 7 flowers, instead of 3, or a whorl of 10 or 14 flowers, instead of one of 6. In *Tecticornia cinerea*, on the other hand, the triad is doubled and there are 6 flowers under each scale, or a whorl of 12 in all. The flowers are more or less protected by the margin of the article just below them. The article is usually regarded as consisting of 2 opposite rudimentary leaves, united by a sheath and combined with a succulent base which surrounds the whole internode.

In all the genera except *Tecticornia* the articles are practically of one form and there is so little difference between barren and fertile articles that in *Arthrocnemum halocnemoides* and *Pachycornia tenuis* one sometimes finds new shoots springing from the summit of the flowering spike, or the lower articles of the spike are barren. In *Tecticornia* the barren articles resemble those of other genera, but the fertile ones are split to the axis into 2 spreading opposite scales, and the stout spike consists of these scales decussately arranged along the axis.

The flowers are either bisexual or male only. In most species they are normally bisexual, but in *Arthrocnemum arbuscula* and in *Pachycornia* the central flower is bisexual and the 2 lateral are male. There is usually one stamen to each flower, and it is placed in front of the pistil. The only exceptions I have found are *Salicornia australis*, which has often 2 stamens, one before and one behind the pistil, and *Pachycornia robusta*, in one central flower of which were 2 stamens. The stamens ripen and protrude while the pistil is still very young, and this fact may easily lead to error in the examination of relaxed specimens, because the stamen is conspicuous, while the pistil is very difficult to find, and a flower which is really bisexual may be taken for a male. Another difficulty is that the anthers fall early and even the filament sometimes disappears from the open perianth, so that the somewhat similar mistake may be made, at a later stage, of considering a bisexual flower as female only. There is, however, considerable irregularity about the sex of flowers and in some cases there appears to be a tendency for the upper flowers of the spike to be male only. Much further work is required in the examination of living specimens.

The lobes or teeth of the perianth have been described by most authors with greater fullness than in some cases they deserve. The examination of living plants shows that in *Arthrocnemum halocnemoides* and *A. arbuscula* the young perianth completely encloses the male and female organs without any perforation at the summit. Probably the texture is thinner above the stamens and style, and as these develop they push through the perianth, leaving an irregularly lacerated opening. In *Arthrocnemum Lylei*, on the other hand, each perianth is divided at the truncate summit into 3 equal deltoid lobes, and in *Pachycornia robusta* there are 3 or 4 unequal lobes. As regards other species further researches should be made in the living plant.

The articles are, in the majority of species, so much alike that they afford an uncertain means of distinguishing between them. The exceptions are *Tecticornia cinerea*, *Pachycornia robusta*, and, to a lesser extent, *P. tenuis*. The fruiting perianth, pericarp, and seed are a much surer guide, as their characters are strongly differentiated and remain constant within the species or variety. The wrinkling and granulation of the testa in the rough-seeded species seems to be due to a shortening and contraction of the cells towards the back of the seed.

The fruiting perianth is various in texture, from thin and membranous to thick and spongy. The pericarp varies still more. It may be a delicate, hyaline membrane, often difficult to find, which breaks away from the base of the perianth and remains attached to the upper part of the latter, or it may become hardened and almost horny, or it may, along with the perianth, become more or less absorbed in the enlarged and hardened rhachis *(Pachycornia)*. In *Arthrocnemum* and *Salicornia* both perianth and pericarp usually open at the base before they fall from the spike, and the seed escapes in this manner. In *Tecticornia* the perianth splits into 2 segments or valves and the seed has already escaped from the base of the delicate pericarp. In *Pachycornia* the spike doubtless falls to the ground, and sun and moisture in time split open the bony axis and release the seed.

Much confusion has been caused in this difficult tribe by the description of specimens which had only reached the flowering stage. To prevent an increase of this confusion in the future it would seem desirable that botanists should refrain from naming new species unless they are in a position to describe the fruiting perianth, the pericarp, and the ripe seed.

The first serious work in this tribe was done by Moquin in his Chenopodearum monographica enumeratio, 108-116 (1840), and later on by the same author in DC. Prodromus, xiii., ii., 144-152 (1849). Bentham dealt with the Australian species in Fl. Aust. v., 201-205 (1870), and J. D. Hooker, in Benth. et Hook. Gen. pl. iii., 65 (1883), stablished two new Australian genera:—*Pachycornia* and *Tecticornia.* Dr. Ove Paulsen determined the *Chenopodiaceae* brought from Western Australia by Dr. Ostenfeld (C. H. Ostenfeld, Contributions to West Australian Botany, part 2, Dansk Botanisk Arkiv, ii., No. 8, 56-66, ann. 1918) with several illustrations. Two monographs by Ungern-Sternberg (Versuch einer Systematik der Tribus Salicornieae, ann. 1866; Salicorniearum Synopsis in Atti del Congresso internaz. botan. in Firenze, 259-343, ann. 1876) are not accessible here.

The specimens from the localities named below have all been examined by me.

I have to thank the Government Botanists of Victoria (Prof. A. J. Ewart), N. S. Wales (Mr. J. H. Maiden), Queensland (Mr. C. T. White), and South Australia (Prof. T. G. B. Osborn) for permitting me to examine many valuable specimens from the National Herbaria.

Fertile articles slightly lobed at summit or almost entire.
  Seeds with copious albumen.
    Fruit free and usually falling off with the perianth ... ... 1. ARTHROCNEMUM
    Fruit embedded in the enlarged, bony axis ... ... 2. PACHYCORNIA
  Seeds without albumen ... ... 3. SALICORNIA
Fertile articles divided to the base into 2 spreading segments or scales ... ... 4. TECTICORNIA

1. ARTHROCNEMUM, Moq.

Section 1. *Trachysperma.* Pericarp membranous; seed compressed; seed-coats 2, distinct, the outer crustaceous and bearing granules arranged in more or less concentric rows, the inner coat membranous.
  Perianth spongy, without distinct lobes; pericarp hyaline, inconspicuous ... 1. *A. halocnemoides*
  Perianth herbaceous, with 3 broad lobes; pericarp hardened at summit and conspicuous ... ... 2. *A. Lylei*

Section 2. *Leiosperma.* Pericarp horny; seed compressed, the 2 coats very thin and coherent, so as to present the appearance of 1 membranous, smooth seedcoat.

Spikes and branchlets stout; flowers all bisexual	3. *A. leiostachyum*
Spikes and branchlets slender, the spikes very short; central flower bisexual, the 2 lateral male	4. *A. arbuscula*

1. **A. halocnemoides,** Nees in Pl. Preiss., i., 632, ann. 1844-5. (Pl. xxxiii.) Shrub 20-120 cm. high, branches erect or intricate, barren articles 3-5 mm. long, slender (2 mm. thick), or stouter (4-5 mm. thick), constricted at each end, both forms of article often occurring on the same plant, lobes inconspicuous; spikes terminal and lateral 10-50 mm. long, usually turning red; fertile articles 6-40, short (2 mm. long, 3-4 mm. thick); flowers in 3's, all bisexual, fruiting perianth white, spongy, dilated at summit; pericarp hyaline, at length almost disappearing; seed compressed ovate-oblong, 1-1½ mm. long, placed obliquely in the pericarp; testa crustaceous, in the typical form light brown, granular on the back, smooth in front; endopleura membranous; albumen lateral; embryo slightly curved, the cotyledons one-third as long as the radicle. —*Salicornia arbuscula*, Benth. Fl. Aust., v., 203 (1870), ex parte; *S. tenuis*, Benth., *l.c.*, 204, ex parte *(i.e.*, quod ad ea specimina pertinet, quae auctor feminea censuit).

S. Australia. Salt lands along Port Adelaide River at Ethelton and Birkenhead (J. M. B., Feb.-April, 1919); Port Pirie (H. W. Andrew, July, 1919); Nilpena (R. Helms, May, 1891, "salt soil round spring," in Tate Herb, as *S. tenuis);* N.W. interior of S. Australia (J. McD. Stuart, in Botanical Museum of Melbourne as *S. tenuis);* Murat Bay (J. M. B., November, 1915); Port Wakefield (J. M. B., November, 1919).

Victoria. Geelong (H. B. Williamson).

N. Territory. Finke River (in Phytological Museum of Melbourne as *Salicornia leiostachya).*

W. Australia. Fremantle (Preiss., Jan., 1839, No. 1910, "in turfosis aquâ marinâ subinde inundatis prope oppidulum Fremantle"); Burswood Island, near Perth (F. W. Wakefield, Jan., 1914, per D. A. Herbert); "West Australia" (Drummond, no precise locality or date, in Botanical Museum of Melbourne as *Salicornia arbuscula).*

This species was united by Benthan with *Salicornia arbuscula*, R. Br., although he gives the number of fertile articles correctly in the latter as 2 to 6, whereas Nees gives them as 8 to 12 for his species. In reality they are much more numerous; the specimen from Burswood Island, W.A. has as many as 20, and in our South Australian coastal specimens the number of articles in the spike runs up to 30 and 40. The fruit, seed, and the number of bisexual flowers in each triad are quite different in the two species. In Nees' type specimen (Preiss, No. 1910) the seeds, although not quite ripe, show distinctly the characteristic markings of the testa.

For an explanation of what I believe is the confusion of two species in Bentham's *Salicornia tenuis* see below under *Pachycornia tenuis*.

Var. **pergranulatum**, n. var. (Tab. xxxiii.) A typo variat semine orbiculari-reniformi circiter 1 mm. diametro, testâ brunneo-rubrâ omnino subconcentrice granulatâ.

S. Australia. Salt lands near the Grange and at Birkenhead (Port Adelaide River, J. M. B., Jan.-May, 1919); Noarlunga (J. M. B., Jan., 1905); River Frome, near Marree (J. M. B., October, 1917); between Port Elliot and Victor Harbour (H. W. Andrew, Feb., 1919); Mann Crossing, River Murray (H. W. Andrew, Nov., 1915); Lake Hart (Dr. G. Taylor, May, 1919); Cootanoorinna (near Warrina, R. Helms, in Tate Herbarium as *Salicornia leiostachya*, May, 1891).

Queensland. Port Alma, C.Q. (L. Hassell, in Queensland Herbarium as *S. leiostachya*, October, 1917).

The variety differs from the type in its seed, which is orbicular-reniform, reddish-brown and granular all over. It is usually a lower shrub, more spreading, and 30-50 cm. high. In the specimens from Frome River and Port Alma the position of the pericarp in the perianth is almost horizontal, instead of oblique, and although some of the seeds are ripe, the perianths have not separated from the article, and the membranous pericarp adheres more or less to the seed. The greater or lesser obliquity of the fruit does not seem to be of much importance, for in the Cootanoorinna specimen the pericarp is horizontal, but the perianths are falling from the spike. The seeds bear considerable resemblance to those of *Silene*, *Calandrinia*, and *Mesembryanthemum*.

2. **A. Lylei,** (Ewart et White) combin. nov. (Tab. xxxiv.) Haec species distat ab *A. halocnemoidi* pericarpio mamilliformi apice crustaceo horizontaliter prominente atque perianthio distincte et late trilobo herbaceo non spongioso.—*Salicornia Lylei*, Ewart et White in Jour. Roy. Soc., N.S. Wales, xlii., 195, t. 34 (1908).

A very distinct species by reason of its ovoid pericarp, which is membranous except near the summit, where it becomes crustaceous and is produced in a nipple-like point (the persistant style) beyond the 3 broad lobes of the perianth;

perianth herbaceous and somewhat fleshy, dilated and truncate at the summit, protruding conspicuously beyond the fertile articles and finally adherent to the base of the pericarp; barren articles 3-5 mm. long, 2 mm. thick, the lobes rather acute and keeled; spikes 8-22 mm. long, terminating short, opposite branches; fertile articles 5-15, 2 mm. long, 3 mm. thick; flowers in 3's, all bisexual, but (at least in the specimens examined) very few of them ripening fruit; seed compressed, ovate, $1\frac{1}{2}$ mm. long; testa reddish-brown, granular on the back, smooth in front; endopleura membranous; albumen lateral; embryo slightly curved, the cotyledons one-third as long as the radicle.

W. Australia. Cowcowing, near salt lakes (type collected by Max Koch, Sept., 1904, No. 1051); Lake Lefroy (R. Helms, Nov., 1891, "1-3 feet high, in sand on margin of lake," in the Tate Herb. as *Salicornia bidens*).

3. **A. leiostachyum,** (Benth.) Paulsen in Dansk Bot. Ark. (1918), ii., No. 8, 61, fig. 24 et tab. 5, fig. 2. (Pl. xxxv.) Erect shrub, 40-100 cm. high, branchlets and flowering spikes dark green and stouter than in other species; barren articles 5-8 mm. long, 4-7 mm. thick, very shortly 2-lobed and usually ciliolate on the margin, dilated and keeled below the lobes; spikes 10-30 mm. long, terminal and lateral; fertile articles 6-16, very short (2-3 mm. long) 4-7 mm. thick, in fruit brown and overlapping closely, so as to make the spike appear almost continuous; flowers in 3's, all bisexual; fruiting perianth spongy or fleshy, dilated at summit, adherent to pericarp, which is horny, ovate-oblong and tapering towards summit; seed slightly compressed, obovate, smooth, whitish, $1\text{-}1\frac{1}{2}$ mm. long; seedcoats coherent; embryo sometimes almost straight, not reaching the summit of the seed, so that the albumen is terminal as well as lateral; cotyledons one-third, or sometimes nearly as long as rudicle.—*Salicornia leiostachya*, Benth. Fl. Aust., v., 203 (1870). *A. Benthami*, Paulsen, *l.c.*, 62, fig. 24 et tab. 6, fig. 2 (judging from the description and the identification of a specimen collected at Port Adelaide by J. G. O. Tepper and seen by Paulsen in the Berlin Herbarium).

S. Australia. Port Adelaide River (Prof. T. G. B. Osborn, October, 1912); salt and rather swampy land behind sand dunes at the Grange, near Adelaide (J. M. B., Jan.-April, 1919); Mulgundawa, near Lake Alexandrina (J. M. B., October, 1906); Marree (J. M. B., October, 1917); Elder Expedition, May 25 (in Tate Herb. as *S. leiostachya;* no locality given, but the expedition was, on May 25, 1891, at Arcoellinna Well, at the head of the Arkaringa Creek).

N. Territory. Finke River (H. Kempe, 1881; in National Herb. of Victoria as *S. leiostachya);* 10 miles west-south-west of Stuart Range (G. F. Hill, June, 1911; in National Herb. of Victoria as *S. leiostachya);* between Crown Point and Horseshoe Bend, Finke River (S. A. White, Aug. 1913).

W. Australia. No locality (Drummond, in National Herb. of Victoria as *S. leiostachya).* This is one of Drummond's specimens, on the strength of which Bentham included Western Australia *(l.c.* 204). It strongly resembles the eastern specimens, but it has no fruit.

The coastal form is a stouter plant with thicker articles than those of the form found in the interior of the continent.

4. **A. arbuscula,** (R. Br.) Moq. Chenop. enum., 113, ann. 1840. (Pl. xxxv.) Shrub 30-80 cm high; branches often erect and rather slender; barren articles dark green, 3-4 mm. thick, contracted at summit, lobes obtuse and inconspicuous; spikes terminal and lateral, 6-10 mm. long, often reddish and spreading; fertile articles 2-6, 3-4 mm. thick, almost globular (with the exception of the obconical part concealed in the inferior article); flowers in 3's, the central one bisexual, the 2 lateral male; perianth at first membranous, afterwards rather fleshy and adherent to pericarp, contracted towards summit, persistant; fruit rather erect, triangular in outline, the style protruding beyond the perianth; pericarp horny; seed slightly compressed, obovoid, $1\frac{1}{2}$-2 mm. long, smooth, straw coloured; seedcoats membranous, coherent; embryo reaching summit of seed; albumen lateral; cotyledons half as long as the radicle.—*Salicornia arbuscula,* R. Br., Prodr., 411 (1810).

S. Australia. Salt ground along Port Adelaide River at Ethelton (J. M. B., October, 1918, April, 1919); on mud beside Port River near the Grange (Prof. T. G. B. Osborn, October, 1918); Cootanoorinna, a few miles west of Warrina (R. Helms., May, 1891; in Tate Herb. as *S. arbuscula);* Port Noarlunga (J. M. B., Jan., 1905); Murat Bay, J. M. B., Nov., 1915).

Victoria. Point Lonsdale (ann. 1867; in National Herb. of N.S. Wales as *S. arbuscula);* Wimmera (Dallachy; in National Herb. of Victoria as *S. arbuscula).*

Tasmania. I have seen a specimen from W. H. Archer's Herb. of Tasmanian plants, in the National Herb. of N.S. Wales, without locality or date.

I have here treated the East-Australian specimens as the typical *S. arbuscula.* Brown gives "M D" as his localities, "M" being the south coast from Cape Leeuwin to Wilson Promontory, and "D" Van Diemen Land (Tasmania). Of the Western Australian specimens quoted by Bentham I have only examined one of Drummond's from Swan River, which was seen by Bentham and is now in the National Herb. of Victoria. This appears to me to be specifically distinct from the eastern specimens and to belong to *A. halocnemoides*. It was probably from this source that Bentham drew his statement that all the flowers are bisexual. This is not true of *A. arbuscula*, where, if 2 pistils are found in the triad, it is quite an abnormal occurrence. The only specimens mentioned by Bentham as having been collected by Brown are those from Port Dalrymple, Tasmania, and the Tasmanian plant is the one here described and figured as *A. arbuscula*.

A. (?) *pruinosum*, Paulsen, *l.c.* 63, from Carnarvon, W. Aust., is described without fruit. The spike has 8-17 articles, and judging by the photograph, plate vi., fig. 3, it is *A. halocnemoides*.

A. brachystachyum, Paulsen, *l.c.* 64, fig. 26; tab. vi., fig. 4, is described as having 4-8 fertile articles, perianth exserted, pericarp brown and hard; seedcoat not mentioned. Also from Carnarvon, W. Aust., and possibly a poor specimen of *A. leiostachyum*.

A. bidens, Nees in Pl. Preiss., i., 632 (1844-5). I have not been able to come to any decision with regard to this species. Nees described it from a specimen without fruits collected on the banks of the Swan River. A cotype (Preiss, No. 1261) lent me from the National Herb. of Victoria, is figured on plate xxxiv. of this volume, in the hope that this may be of some assistance to future investigators. It is in such early flower that it is only possible to say that the flowers are arranged in 3's and apparently all bisexual. I have also seen another of the specimens quoted by Bentham below his description of the plant as *Salicornia bidens* (Fl. Aust., v., 204)—"margin of salt lakes, north of Stirling Range, F. Mueller, October, 1867." This specimen has rather stout branches and no unusual lobing of the barren or fertile spikes. It has one imperfect (broken) spike 40 mm. long, with 13 articles, and 2 or 3 shorter lateral spikes. All perianths and fruit have fallen from the spike. There is nothing to prove that it belongs to the same species as the Swan River specimen, or that it is not a *A. halocnemoides*. Bentham's description, *l.c.*, of some fruiting specimen which he believed to be *S. bidens*, agrees very well with *A. halocnemoides* as regards perianth and fruit. That species, it may be mentioned, sometimes shows in its lower barren articles (but not in the fertile ones) a close approximation to *A. bidens*. It seems impossible to make any further progress until some botanist re-discovers this acute-lobed plant on the banks of the Swan River and then traces it to the fruiting stage.

2. Pachycornia, Hook.f.

Branches stout; articles long-lobed; embryo almost annular	1. *P. robusta*
Branches slender; articles short-lobed; embryo almost straight	2. *P. tenuis*

1. **P. robusta,** (F. v. M.) Hook. f. in Benth. et Hook, Gen. pl. iii., 65, ann. 1883. (Plate xxxvi.) A low shrub with robust branches; sterile and fertile articles with 2 prominent, acute, spreading lobes, distinctly keeled, about 10 mm. broad at summit, the sterile ones 10-20 mm. long, the fertile ones only about 5 mm. long; spikes short and thick (10-20 mm. long), usually terminating short, opposite branches, with 4-6 articles; flowers in 3's, the central bisexual, the 2 lateral male; perianth membranous, irregularly 2-4 lobed at summit, where it is slightly contracted; pericarp soon hardening and becoming adherent to the enlarged bony axis of the spike; seed often solitary in the article, orbicular-reniform, slightly compressed, more or less completely inverted; seedcoat one, subchartaceous, reticulate; albumen central, because the embryo is almost annular; cotyledons and radicle both curved upwards, the former rather longer than the radicle.

S. Australia. Chowilla, River Murray (Jan., 1884, in Tate Herb.); Renmark (J.M. B., October, 1915).

Victoria. Mildura (H. B. Williamson).

N.S. Wales. Lake Victoria (S. A. White, Sept., 1917).

N. Territory. Alice Creek (Horn Expedition, in Tate Herb.)

2. **P. tenuis,** (Benth.) combin. nov. (Tab. xxxvi.) Fruiticulus erectus, ramis ramulisque tenuibus, sterilibus articulis 5-15 mm. longis 2-3 mm. crassis, lobis late scarioso-marginatis obtusis vel acuminatis, spicis 8-16 mm. longis ramulos oppositos terminantibus, fertilibus articulis 4-6, fructiferis subglobosis 4-5 mm. longis, floribus ternis articulo inferiore occultis, centrali bisexuali, duobus lateralibus masculis, perianthio membranaceo, pericarpio primum corneo deinde cum spicae rhachi auctâ et osseâ conjuncto, semine subcylindrico 4 mm. longo basin versus attenuato in cavo rhacheos induratae recondito (saepius per quadrantem ambitus cavi ita se circumagente ut unum semen alteri non tergo sed latere adjaceat), integumento uno membranaceo laevi albido, albumine laterali, embryone levissime curvo, cotyledonibus radiculae aequilongis.—*Salicornia tenuis*, Benth. Fl. Aust., v., 204 (1870) ex parte (quantum ad specimina quae auctor mascula existimavit); *S. Donaldsoni*, Ewart et White in Journ. Roy. Soc. N.S. Wales, xlii., 194, t. 33 (1908).

S. Australia. Without date or locality but probably near Cooper Creek (Howitt Expedition, 1861-2, in National Herb. of Victoria); Mt. Parry, between Lake Torrens and Leigh Creek (R. Tate, Sept., 1883, in Tate Herb.); Marree (J. M. B., October, 1917).

N. Territory. Henbury Station, Finke River (G. F. Hill, March, 1911, in National Herb. of Victoria as *Salicornia cinerea).*

Queensland. Georgina River (E. W. Bick, Sept., 1910, in Queensland Herb. as *Tecticornia cinerea).*

W. Australia. Lake Cowcowing (Max Koch, No. 1147, Sept., 1904, in National Herb. of Victoria as *Salicornia Donaldsoni).*

The Howitt specimen is one of those on which Bentham founded his *Salicornia tenuis,* conceiving them to be the male plant of a dioecious species. He says:—"The specimens are very few and I do not feel certain that the male and the fruiting ones are correctly matched." He was doubtless misled by the fact that Howitt's specimens are in early flower, at which stage, owing to the proterandrous character of the tribe, the stamens are much more conspicuous than the pistils. In the type specimen placed at my disposal by Professor Ewart I was able to find pistils with the characteristic hardening of the young pericarp in some of the central flowers. Usually it is possible to distinguish the species, even without flowers, by the conspicuous scarious margins of the barren articles. In the long, almost straight and cylindrical seed, tapering at the base, it differs from any other species in the tribe with which I am acquainted. During the hardening of the pericarp and rhachis of the spike the seed appears to revolve on its own axis to the extent of one-quarter of the circumference of the cavity, so that, where there are two seeds in the article, they lie side by side (as shown in pl. xxxvi., fig. 11), instead of in the normal position of back to back. To ascertain whether this change is constant would require the examination of more material than was to hand. Sometimes, through abortion, only one seed remains in the ripe article; this is also true of *P. robusta.*

J. McDouall Stuart's specimens from the "north-west interior of South Australia," which Bentham accepted as the female plant of *S. tenuis,* are in fruit, and certainly belong to the species here described and figured as *Arthrocnemum halocnemoides,* Nees. As the branches of *P. tenuis* are the more slender of the two, it seems the proper one to bear Bentham's specific name. Judging from the localities quoted by Bentham, both species occur in the Darling district of N.S. Wales.

3. Salicornia, L.

1. **S. australis**, Banks et Sol. (MSS. et ic.) ex Hook. f. Fl. N. Zel., i., 216, ann. 1853 (nomen pro synonymo *S. indicae*, Willd. perperam citatum, sed cum descriptione *S. australis*); Sol. ex Forster f. Prodr. 88, ann 1786 (nomen nudum fide Benth. Fl. Aust., v., 205, ann. 1870); *S. quinqueflora*, Bunge ex Ung.-Sternb. Vers. Syst. Salic., 59, ann. 1866. (Pl. xxxvii.) Low shrub with procumbent stems rooting at the nodes; branches usually erect, light green; barren articles 7-20 mm. long, 3-5 mm. thick, lobes short but acute, keeled; spike 10-45 mm. long, when ripe 4-7 mm. thick and often bright red; fertile articles 5-20, subglobular; flowers in 5's or 7's, rarely in 3's near summit of spike, all bisexual; stamens 1 or 2; perianth at first membranous, afterwards thickened and rather hard, dilated and truncate at summit; pericarp hyaline; seed suborbicular, compressed, $1\frac{1}{2}$ mm. diam.; testa chartaceous, straw-coloured, softly villous; endopleura membranous, enclosing separately the cotyledons and the radicle, which are of equal length and folded on one another; albumen absent.

At Port Victoria the plant grows in low, cushion-like tufts and has a strong tendency towards dioecism, the spikes in one tuft having flowers with 2 stamens, and a pistil (perhaps abortive) with very short style-branches; the spikes of another tuft have pistils with long style-branches and no apparent stamens.

S. Australia. In salt soil at Patawalonga Creek, near Glenelg; Port Adelaide River at Ethelton, Birkenhead, and the Grange; Port Elliot; Port Noarlunga; Lake Ormerod, near Naracoorte; Murat Bay; Mount Nor' West (between Lake Torrens and Lake Eyre); Port Victoria, Y.P.

Queensland. Cabbage-tree Creek, Moreton Bay; Mooloolah River (C. T. White, in Queensland Herb.).

This species, easily recognizable by the unusual number of flowers below each fertile article, appears to inhabit all the Australian States and also New Zealand.

Banks and Solander's MSS. and illustration of this species, mentioned by Hooker, as above, have not been reproduced by J. Britten in Illustrations of the botany of Captain Cook's voyage (1900-05).

Halocnemum australasicum, Moq. Chenop. enum. 110 (1840), from King George Sound, was left undecided by Bentham (Fl. Aust.,v., 202 and 205), who had not seen the specimen. In Benth. et Hook. Gen. pl. iii., 65, it is stated to be *Salicornia quinqueflora*, Bunge (= *S. australis*). If it is really that species it is strange that Moquin should have placed it in *Halocnemum*, a genus which he describes as possessing "albumen basilare et laterale, parcum, carnosum."

TECTICORNIA, Hook. f.

1. **T. cinerea,** (F. v. M.) Hook. f. in Benth et Hook, Gen. pl. iii., 65, ann. 1883. (Pl. xxxvii.) A low plant, of which I have only seen one rooted specimen (from Darwin). This has procumbent, woody stems and erect or ascending branches 4-8 cm. long. Bentham says "apparently annual," but it seems rather to be perennial, like other species within the tribe. Barren articles 5-10 mm. long, 3-4 mm. thick at the summit, which is dilated and rather acutely lobed, the scarious margin prominent; spikes usually terminal and solitary 10 to 25 mm. long, 6 to 8 mm. thick, obtuse; fertile articles 15-30, each article divided to the axis and thus transformed into 2 scarious spreading scales, the outer margin of which is thickened and herbaceous below, scarious above, and flattened vertically (*i.e.* at right angles to the scale), so that the scarious portion shelters the flowers of the scale next above it; flowers in 6's (not in 3's, as stated by Bentham), usually bisexual, horizontal, at first attached to the lower face of the scale, afterwards free; perianth finely membranous, compressed, contracted towards summit, usually 2-lobed and separating into 2 segments; pericarp hyaline and quickly seceding from the base of the perianth; seed compressed-ovate, $1\frac{1}{2}$ mm. long, much resembling that of *Arthrocnemum halocnemoides*, but the granules or papillae along the centre of the back are rather longer, sometimes almost hair-like; testa light-brown, crustaceous; endopleura membranous; albumen lateral; cotyledons nearly as long as radicle.—*Halocnemum cinereum*, F. v. M. Fragm., i., 140 (1859); *Salicornia cinerea*, F. v. M. Fragm., vi., 251 (1868); Benth. Fl. Aust., v., 203 (1870).

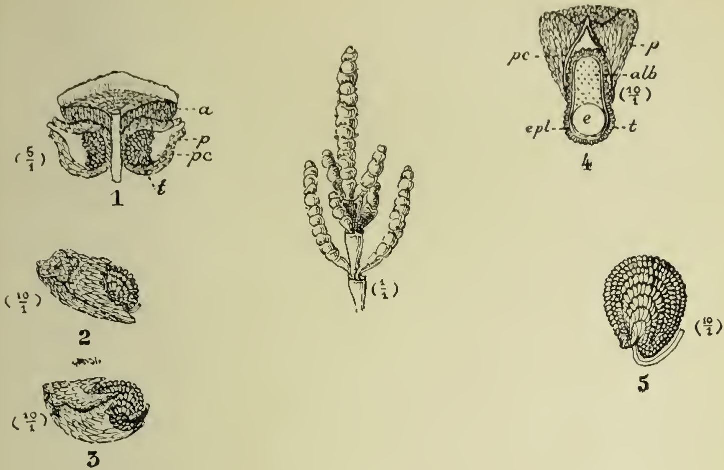
N. Territory. Sturt Creek (the type; collected by F. v. Mueller, when accompanying A. C. Gregory's Expedition in 1856). Sturt Creek lies principally in Western Australia, so that it is very probable the specimen was gathered there, but Mueller does not quote that State for the species in his 2nd Census. Darwin (M. Holtze, 1883, from National Herb. of Victoria).

Queensland. Townsville (Rev. N. Michael, June, 1918); Archer River (Rev. N. Hay; both in Queensland Herb.).

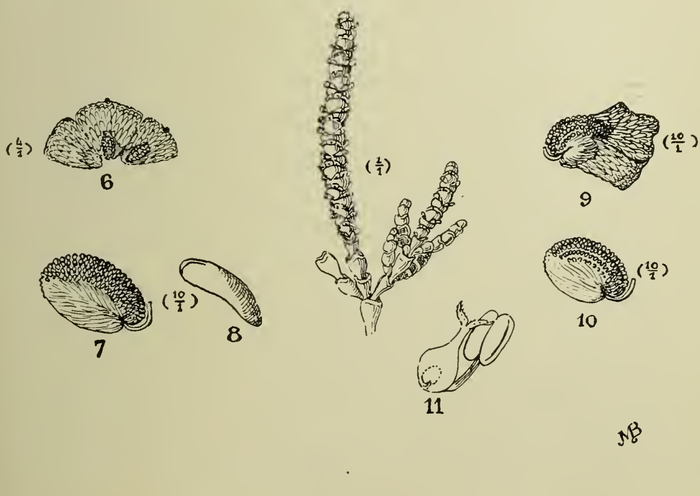
DESCRIPTION OF PLATES.

PLATE XXXIII.

Arthrocnemum halocnemoides, Nees. The central figure shows fruiting spikes. 6, 3 fruiting perianths, seen from above, 2 containing seeds (Finke River). 7, seed (Drummond's Western Australian specimen). 8, embryo. 9, perianth with seed protruding (J. McDouall Stuart's specimen). 10, seed (the same). **11,** pistil and stamen (Birkenhead).



A. halocnemoides Nees var. *pergranulatum* n.var.



Arthrocnemum halocnemoides Nees

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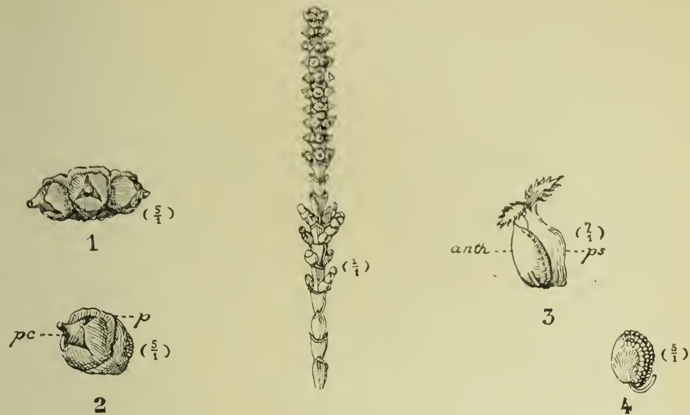
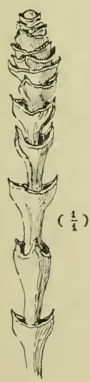


Arthrocnemum Lylei (*Ew. et White*) *comb. n.*



Arthrocnemum bidens *Nees*

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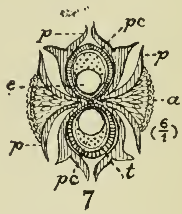
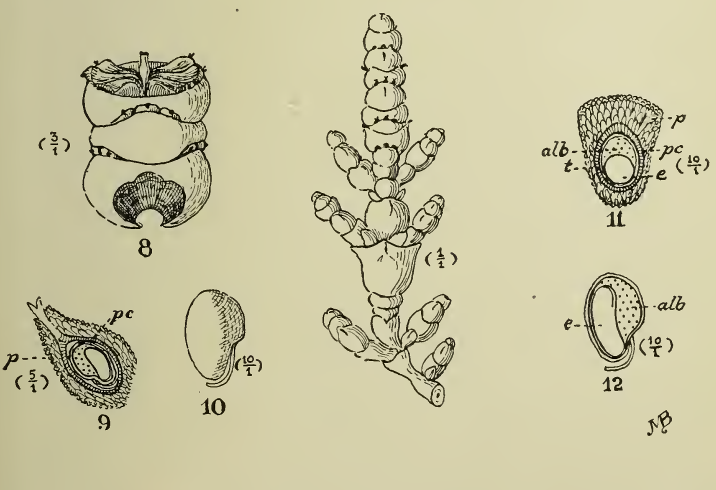


Arthrocnemum arbuscula (R Br.) Moq.



Arthrocnemum leiostachyum (Bth.) Paulsen

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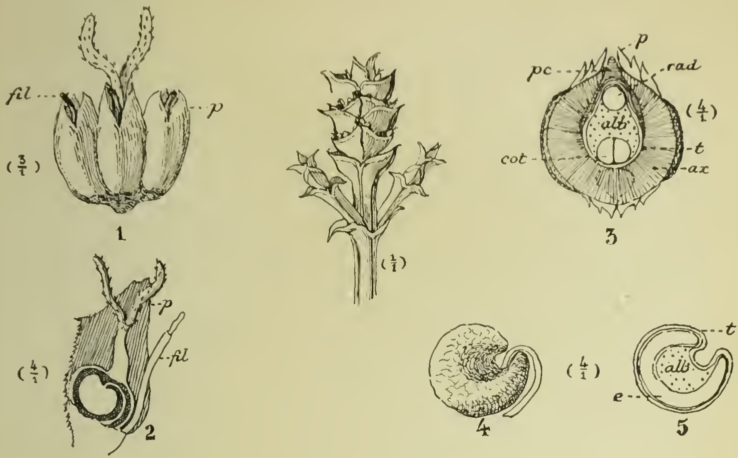
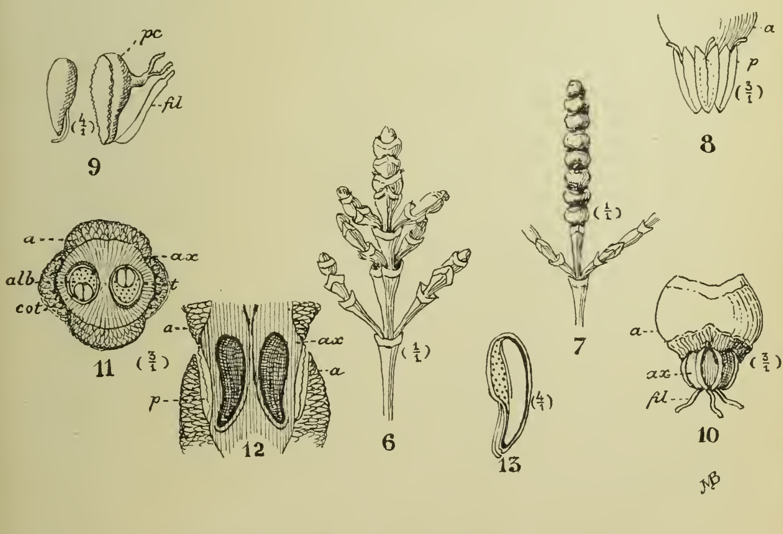


Pachycornia robusta (*F. v. M.*) *Hook. f.*



Pachycornia tenuis (*Benth.*) *comb. nov.*

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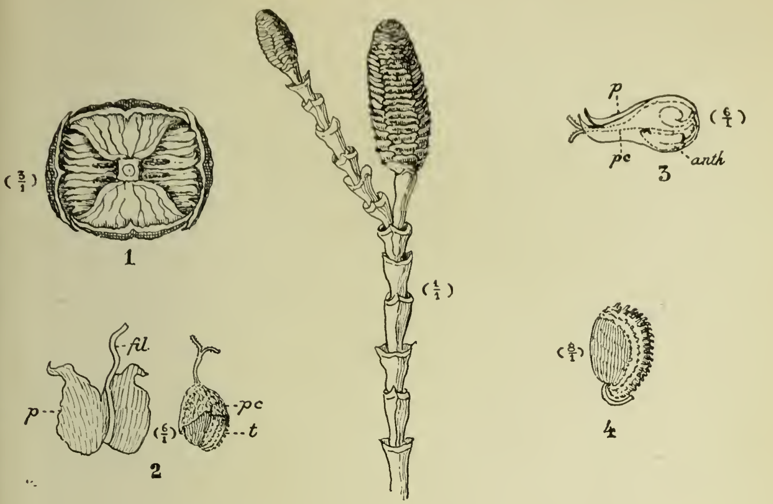
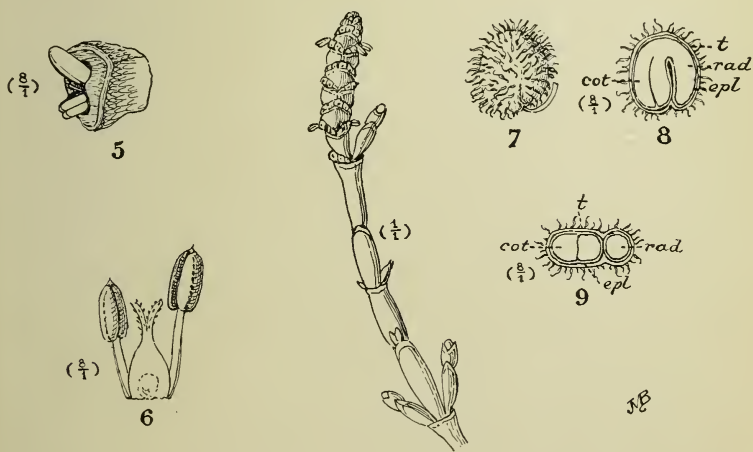


Tecticornia cinerea (F. v. M.) Hook. f.



Salicornia australis Banks et Sol.

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Var. *pergranulatum*, n. var. The central figure shows flowering spikes. 1, vertical section of an article in fruit (Grange). 2, fruiting perianth and seed (Lake Hart). 3, the same (Cootanoorinna). 4, transverse section of perianth and fruit (Cootanoorina). 5, seed (Grange).

Abbreviations for all plates: *a*, article; *alb*, albumen; *anth*, anther; *ax*, axis; *cot*, cotyledons; *e*, embryo; *epl*, endopleura; *fil*, filament; *p*, perianth; *pc*, pericarp; *ps*, pistil; *rad*, radicle; *t*, testa.

Plate XXXIV.

Arthrocnemum Lylei, (Ewart et White) comb. nov. Central figure a fruiting spike. 1, 3 perianths seen from the front. 2, central perianth and pericarp. 3, pistil and stamen. 4, seed (all from the type, Cowcowing, except No. 4, which is from Lake Lefroy).

A. bidens, Nees. A flowering spike and part of the branch (from the type, Swan River).

Plate XXXV.

Arthrocnemum arbuscula, (R. Br.) Moq. Central figure a flowering branch. 1, transverse section of a flowering article. 2, flowering article from the front. 3, pistils (all from Ethelton). 4, pericarp (fruit). 5, vertical section of seed (both from Noarlunga). 6, fruiting article, from the side (Tasmania). 7, transverse section of fruiting article (Ethelton).

A. leiostachyum, (Benth.) Paulsen. Central figure flowering branch (from the Grange). 8, 3 fruiting articles, the lowest one showing the cavity from which 3 fruiting perianths have been taken (Grange). 9, vertical section of fruiting perianth (Port Adelaide River). 10, seed (Finke River). 11, transverse section of fruiting perianth (Stuart Range). 12, vertical section of seed (Stuart Range).

Plate XXXVI.

Pachycornia robusta, (F. v. M.) Hook. f. 1, 3 perianths after the anthers have fallen. 2, vertical section of pistil with ovule somewhat advanced. 3, transverse section of fruiting article. 4, seed. 5, vertical section of seed.

P. tenuis, (Benth.) comb. nov. 6, flowering branch (Howitt Expedition). 7, fruiting spike (Georgina River). 8, 3 perianths (Mount Parry). 9, pericarp and young seed (Mount Parry and Cowcowing). 10, fruiting article (Marree). 11, transverse section of fruiting article and axis (Marree and Georgina River). 12, vertical section of fruiting article and axis, showing 2 cavities from which seeds have been removed (same localities). 13, vertical section of seed (same localities and Mount Parry).

Plate XXXVII.

Tecticornia cinerea, (F. v. M.) Hook. f. Central figure represents a flowering and a fruiting spike. 1, transverse section of spike, showing 4 scales, 2 of them supporting flowers in an advanced stage. 2, fruiting perianth spread open and fruit. 3, flowering perianth. 4, seed (all from Townsville and Darwin specimens).

Salicornia australis, Banks et Sol. 5, flowering perianth. 6, pistil and 2 stamens. 7, seed. 8, vertical section of seed. 9, transverse section of seed.

Notes on Three Species of Melaleuca

By Edwin Cheel, Botanical Assistant, Botanic Gardens, Sydney.

(Communicated by J. M. Black.)

[Read October 9, 1919.]

Plate XXXVIII.

Meluleuca pustulata, Hook. f., in Hook. Lond. Jour. Bot., vi., 476 (1847). The original description is as follows:—

"Ramis glabris albo-striatis, ramulis puberulis, foliis glaucis alternis subapproximatis erecto-patentibus subrecurvis crassis glaberrimis lineari-obovatis anguste linearibusve obtusis supra planis subter concavis punctato-tuberculatis, capitulis flavis terminalibus sessilibus plurifloris sphaericis, hypanthio breviter villoso, calycibus glaberrimis, lobis subherbaceis, phalangibus staminum 5.

"Hab. Campbell Town and Oyster Bay; *Gunn.*

"Rami graciles, lineis e basi petiolorum continuis albidis striati, ramulis puberulis. Folia $\frac{1}{4}$-$\frac{1}{3}$ unc. longa, sub 1 lin. lata, in petiolum brevem angustata. Capitula vix $\frac{1}{2}$ unc. diam. Flores parvi."

Then we have a further description in Hooker's Fl. Tasm., i., 129 (1860).

Bentham (Fl. Aust., iii., 160, ann. 1866) quotes both the above works and gives a lengthy description, with *M. halmaturorum*, F. v. M., adduced as a synonym, but as the latter is a South Australian plant, and has distinctly opposite leaves, and not alternate, as in *M. pustulata*, it would seem to me to belong to subseries i., *Oppositifoliae*, having affinities with *M. cymbifolia* and *M. cuticularis* rather than with *M. pustulata*, which is in subseries v., *Pauciflorae*, all of which species have apparently alternate leaves.

In the National Herbarium, Sydney, we have the type specimen from the east coast of Tasmania, namely, R. C. Gunn's No. 1069. There is also a specimen from Tasmania without specific locality mentioned, collected by W. H. Archer, which was identical with Gunn's specimen. A specimen labelled "Darling River, New South Wales," without the collector's name or date, seems to very closely resemble the Tasmanian specimens, but we require further fresh material to definitely decide if the New South Wales plants are identical with those from Tasmania. Bentham also quotes Wimmera, Victoria, as a locality for this species, which he says "has much shorter stamens," but as I have not seen the Victorian specimens I cannot say if they belong to *M. pustulata*, Hook. f., or the next species (*M. halmaturorum*). In *M. pustulata* the young branchlets are pubescent and the leaves alternate, while in *M. halmaturorum* the branchlets are glabrous and the leaves opposite.

Melaleuca halmaturorum, F. v. M., et Miq., in Ned. Kruidk. Arch., iv., 122 (1856). The following is a copy of the original description:—

"*Melaleuca halmaturorum*, Ferd. Müll., MSS. Foliis oppositis densis hinc nunc subquaternis patule erectis subimbricatis linearibus antice planis, acutis vel obtusiusculis, non mucronatis, 1½-2 lin. longis, ¼-⅓ latis enerviis, glaucis, glabris, petiolis adpressis, bracteis spicarum ovatis acutiusculis tubum calycis aequantibus; capsulis calycis tubo ovoideo-truncato connatis trilocularibus.

"Ad flumen Three - Wells River insulae Halmaturorum (H. Heuzenroeder). In vere.

"Habitus *M. curvifoliae*, differt foliorum situ, usque obtusiusculis, nigro-punctatis, glabritie fere perfectâ, fructibus apice minus contractis companulato - hemisphaericis, floribusque plerumque magis dissitis solitariis vel spicam paucifloram ramo altius insertam constituentibus.

"Var. *β enervis* (*M. enervis*, F. Müll., Herb.), foliis saepe impunctatis, floribus in capitulum collectis. In Nova Holl. australi passim. Boston-point, arbuscula (F. Müller).

"Var. *γ tuberculifera* (*M. tuberculifera*, F. Müll., Herb.), foliis ramorum majoribus fere semipollicaribus, ⅔ lin. latis, acutiusculis vel obtusis. In Nova Holl. australi ad Gmina-bay Holdfast-bay raro (F. Müll.)."

It will be seen from Mueller's description that he had three forms or varities under review, *viz.*, *M. halmaturorum*, from Three Wells River, on Kangaroo Island; var. *enervis*, from Boston Point, near Port Lincoln; and var. *tuberculifera*, from "Gmina" Bay and Holdfast Bay. Through the kindness of Professor Ewart I have examined specimens of the original plant, which are labelled as follows:—"*M. halmaturorum*, F. v. M. Ex insulâ. Halmaturorum ad fl., 3 wells-river. H. Heuzenroeder, November, 1849."

[I would suggest that the "Gmina Bay" mentioned above is a misprint for "Guichen Bay." The plant in question grows at Robe, and Mueller collected in this district during his residence in South Australia. The description was published in a Dutch periodical (the "Nederlandsch kruidkundig Archief"), and doubtless Mueller had no opportunity of reading a proof.—J. M. B.]

More recent records for *M. halmaturorum* are:—

South Australia.—In salt land on banks of Patawalonga River (J. M. Black, No. 1, March, 1904); numerous in salt swamps along Military Road, north of the Grange (J. M. Black, January, 1919)—at both these places the trees often reach a height of 7 or 8 m., and have a whitish bark which peels off in strips; Outer Harbour (J. M. Black, January, 1911), often a small shrub 2-4 m. high; Port Elliston (Dr. R. S. Rogers, September, 1907), recorded in Trans. Roy. Soc. S. Austr., xxxii., 264 (1908), as *M. pustulata;* Robe (C. D. Black, No. 2, October, 1910); Mount Barker, J. Staer, March, 1911); Beachport (J. M. Black, No. 3, December, 1917, near brackish water or on it, papery bark, 2-3 m. high); Port Lincoln (H. Griffith, October, 1909); Victor Harbour, at mouth of River Hindmarsh (J. M. Black, September, 1907).

Victoria.—St. Eloy (D'Alton, 1903); Lake Charm, North-west Victoria (C. Walter, March, 1887); Dimboola (H. B. Williamson, June, 1913).

M. halmaturorum is figured on pl. xxxviii., accompanying this paper. It is commonly known in South Australia as a "paper bark tea-tree," and varies in size from a small shrub to a tree of moderate height.

Melaleuca pauperiflora, F. v. M. The original description given by Mueller (Fragm., iii., 116 [1863]) is as follows:—

"Fruticosa, foliis breviusculis alternis semiteretibus vel teretinsculis acutis muticis petiolatis, capitulis multifloris, bracteis subovatus trinerviis margine membranaceis, calycis lobis enerviis antice rotundatis tubo glabro, phalangibus albidis 9-12-andris glabris profunde filamentosis, stigmate minuto, fructibus subglobosis.—In montibus Phillips Range, Maxwell."

It is also described by Bentham in Fl. Aust., iii., 161 (1866).

Diels and Pritzel, in Engl. Bot. Jahrb., xxxv., 425 (1905), refer to this species, and quote as localities in Western Australia: Wyola, Southern Cross, Bullabulling, Coolgardie. They also note its close affinity to *M. Sheathiana*, W. V. Fitzg.

In the National Herbarium, Sydney, there are a large series of specimens which, although somewhat variable as to leaf-characters, seem to be mere forms of the one species. They are as follows:—

Western Australia.—Drummond, fifth collection (No. 154), 1849. This specimen is from the British Museum, and is quoted by Bentham, *l.c.* Then we have specimens almost identical with Drummond's No. 154 from Coolgardie, collected by Dr. C. Webster in 1900; and from Camp 64, collected by R. Helms in September, 1891 (No. 15), during the Elder Expedition. A series of specimens with the leaves not quite so acute at the apex, and slightly shorter than the above, are from the following localities:—Nine miles north of Bullabulling (W. V. Fitzgerald, November, 1903), diffuse, 10 feet high; Camp 66 (R. Helms, Elder Expedition, September, 1891); 108 miles east of Kalgoorlie, in a somewhat dry swamp (6-8 feet), collected by H. Deane in July, 1909, on the Transcontinental Railway Survey; Southern Cross (J. H. Maiden, November, 1909); Israelite Bay, J. P. Brooks, September, 1915.

South Australia.—Ardrossan (J. G. O. Tepper, October, 1879, labelled "*M. ericifolia*, var. *pustulata*"); Murat, Denial, and Fowler Bays (Dr. R. S. Rogers, September, 1907); between Iron Knob and Franklin Harbour, E.P. (J. Sincock, per J. M. Black (No. 5), October, 1912); Minnipa, E.P. (J. M. Black (No. 4), November, 1915); Dublin Scrub (H. Griffith, September, 1907); a few miles north of Murat Bay (J. M. Black, November, 1915); margin of saltlake flats, Ooldea to Port Augusta (H. Deane, July, 1909); Walebing Swamp, near Kingoonya (Dr. G. Taylor, May, 1919, communicated by J. M. Black, No. 2). See also J. M. Black, in Trans. Roy. Soc. S. Austr., xlii., 49 (1918), where the species is figured on plate v.

M. Sheathiana, W. V. Fitzg., is desribed in Jour. Proc. Mueller Bot. Soc., i., (No. 9) p. 16 (1902), with the localities Lakeside and Black Flag, W.A. The type specimens are in the National Herbarium, Sydney, and a note in Mr. Fitzgerald's handwriting is as follows:—"After an examination of numerous specimens of *M. pauperiflora*, F. v. M., including the type, I am convinced that *M. Sheathiana* cannot be maintained as a distinct species."

I have carefully examined the type specimens, and have compared them with Drummond's No. 154 of *M. pauperiflora*, which is quoted by Bentham, and it seems to me that the extreme forms are so distinct that it may be advisable to regard the Lakeside and Black Flag specimens as a variety of *pauperiflora*, and to add thereto some of the other specimens from Western Australia and South Australia, when we are able to make field observations on the various forms.

It will be seen from the above that the only specimens which come under Bentham's notice are the original ones given by Mueller, *l.c.*, and those collected by Drummond. In the series of specimens now brought under review we find that the species has a very wide range, and as a consequence it is only natural that environmental conditions will cause variation.

I am indebted to Mr. J. M. Black for several notes and for the drawings on pl. xxxviii.

DESCRIPTION OF PLATE XXXVIII.

Melaleuca halmaturorum, F. v. M. 1, flower. 2, petal, 3, leaf. 4, cluster of fruits. 5, vertical section of fruit. 6, transverse section of fruit. 7, 3-celled capsule. 8, An old tree, between 7 and 8 m. high, growing beside the Patawalonga Creek, near Glenelg.

Melaleuca halmaturorum *F. v. M.*

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The Cambrian Trilobites of Australia and Tasmania.

By R. Etheridge, Jun., Director and Curator of the Australian Museum, Sydney.

[Read October 9, 1919.]

Plates XXXIX. and XL.

I. Introduction.

The present communication is an attempt to condense our previous knowledge of the above group of organisms, and to suggest certain changes in nomenclature, as a basis for sounder elaboration by those who may come after and, with access to more complete and extensive material, engage in this interesting study.

The great drawback to a satisfactory elucidation of our Cambrian Trilobites lies in the imperfection of their remains as presented to us, seldom more than portion of a cephalon or pygidium, oftener simply fragments. Omitting the minute form *Agnostus elkedraensis*, I know of only one instance where the all-but complete body is preserved, that later described as *Ptychoparia alroiensis*.

The terms Lower and Upper Cambrian have been used by some in speaking of the rocks containing these old Crustaceans. I have not adopted these divisions in pages that follow, believing we know too little as yet of the Cambrian strata throughout Australia and Tasmania to warrant the use of stratigraphical subdivisions employed either in Europe or America. On the other hand, sufficient facts have already accumulated to justify the use of the term Cambrian simply for a vast thickness of beds, in all probability synchronal with those so termed in other parts of the world; in this sense it is here used. When it becomes possible to stratigraphically synchronize our oldest fossiliferous deposits, it will be more satisfactory to apply local group names, in other words, a sequence based on local facts and conditions. Two operations will accelerate this, detailed field work and energetic collecting.

With the view of recording the opinions of others, I have in each instance quoted the horizon assigned to a given species.

II. History.

1877.—So far as my researches have progressed, the first geologist to discover Trilobite remains in Australia, afterwards shown to be of Cambrian age, was Mr. Otto Tepper.(1) We only know the bare fact that a Trilobite was found by him in the Parara Limestone, south of Parara Station. The exact horizon of this fossil was not made very clear, unless it occurred in the "variegated and dark-coloured limestone," or "white and yellow marbles."

1880.—The next in the field appears to have been our old friend Prof. Ralph Tate,(2) who exhibited at a meeting of the Royal Society of South Australia, held on November 1, 1879, "a well-preserved head of a trilobite, which showed no traces of eyes," from the "Lower Silurian" of Ardrossan, Yorke Peninsula. It would be interesting to know if this was one of the specimens afterwards described by Tate in 1892.

1882.—In this year appeared a reference,(3) probably by Prof. Tate, to the "head of a Trilobite" from Ardrossan, "apparently of the same species as previously found, but of a very much larger size. . . . The glabella is an inch and a quarter long and three-quarters wide, with three pairs of oblique furrows; its surface is ornamented with numerous close-set granules." It would also be interesting to ascertain the whereabouts of this specimen.

1882.—In this year there appeared the announcement of the occurrence of Cambrian Trilobites in Tasmania by myself, through specimens sent to me by Mr. Thomas Stephens, M.A., formerly Chief Inspector of Schools of that State. These were obtained from a decomposed ferruginous sandstone at Caroline Creek, near Latrobe,(4) and consisted for the most part of fragments beyond determination. But amongst these was a cephalon described as *Conocephalites stephensi*, and a pygidium as *Dikelocephalus tasmaniensis*. With these were some interesting glabellae that I was, and still am, quite unable to satisfactorily refer to any genus within my knowledge.

This Caroline Creek sandstone was termed by Mr. R. M. Johnston(5) the "Dikelocephalus Group" in his system of classification of Tasmanian rocks. He also stated that the first observer to draw attention to these fossils was Mr. Charles Gould in 1862, the then Government Geologist. By Mr. L.

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(1) Tepper: "Introduction to the Cliffs and Rocks at Ardrossan," Trans. Phil. Soc. Adelaide, 1877-78 (1878), p. 77.

(2) Tate: Trans. Roy. Soc. S. Austr., iii., 1880, p. xiv.

(3) Anon.: Trans. Roy. Soc. S. Austr., iv., 1882, p. 145.

(4) Etheridge: Papers and Proc. Roy. Soc. Tas., 1882-83 (1883), p. 155.

(5) Johnston: Syst. Acc. Geol. Tas., 1888, p. 33.

K. Ward the Caroline Creek beds are said to "have been definitely referred to the Upper Cambrian."[(6)]

1884.—Dr. Henry Woodward described[(7)] two imperfect cephalons from the Parara Limestone as *Dolichometopus tatei* and *Conocephalites australis;* he ascribed to them a Lower Silurian age. A re-examination of these specimens is necessary before it is practicable to say what they may be.

1888.—During this year I received from Mr. W. Howchin an Ardrossan cephalon, which I referred to *Ptychoparia* as *P. howchini.*[(8)]

1890.—The first Cambrian fossils collected in North-western Australia were obtained by Mr. E. T. Hardman,[(9)] but for many years the exact source of these fossils was in doubt. This uncertainty has now been satisfactorily set at rest by a very careful and painstaken analysis of Hardman's reports and maps by Mr. L. Glauert,[(10)] whose determinations are here adopted.

Hardman's fossils from the Ord River were first critically examined by myself at the British Museum in 1885, when I attached MS. names to several I intended to describe. Circumstances prevented this, but Mr. A. S. Foord[(11)] took up the work, and honoured me by adopting my MS. names. One, a Trilobite, was named *Olenellus forresti.*

The Ord River limestones are for the greater part hard and flaggy, rarely massive, usually grey in colour, sometimes sandy or magnesian, and seldom fossiliferous.[(12)] But in places where the rock is fossil-bearing, it is crammed with the shells of a small supposed Pteropod *(Salterella hardmani)* and innumerable pieces and bits of Trilobites. From the prevalence of the little shells I have been in the habit of referring to this rock as the "Salterella Limestone."

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(6) Ward: "The Geology of Tasmania: the Pre-Cambrian," Papers and Proc. Roy. Soc. Tas., 1909, p. 128.

(7) Woodward: Geol. Mag., i. (3), 1884, p. 342, pl. xi., figs. 2*a*, *b*, and 3.

(8) Etheridge: Trans. Roy. Soc. S. Austr., xxii., 1898, p. 1, pl. iv., figs. 1-3.

(9) Foord: Geol. Mag., vii. (3), 1890. p. 99.

(10) Glauert: Rec. W. Austr. Mus. and Art Gallery, i., pt. ii., 1912, p. 66.

(11) Foord: Geol. Mag., vii. (3), 1890, p. 99, pl. iv., figs. 2*a*, *b*, 3.

(12) Hardman: "2nd Rep. Geol. Kimberley Dist. W. Austr.," W. Austr. Parl. Papers, No. 34, 1885, p. 17, par. 124.

1892.—Prof. Tate described[13] both Molluscan and Trilobite remains from another locality on Yorke Peninsula, Curramulka. The latter were called *Microdiscus subsagittatus* and *Olenellus pritchardi.* Both at this locality and at the typical one, Ardrossan, Tate regarded the beds as Lower Cambrian or "Olenellus Zone," formerly termed by him Lower Silurian.

1895.—On the downs, five miles to the northward of Alexandria Cattle Station, Playford Creek, Northern Territory, in sinking a well, soft argillaceous rocks were met with to a depth of 200 feet. In the spoil from this well Mr. H. Y. L. Brown, the Government Geologist, found a Trilobite cephalon.[14] This I described as *Olenellus browni.*[15] The discovery and determination of this fossil, found in 1894, was the first definite record of the occurrence of Cambian rocks in the Northern Territory.[16] Mr. Brown cites a number of localities at which the lithological characters of this limestone formation are similar, and concludes by saying:—"The occurrence of Cambrian fossils near the Daly River and Alexandria Station proves that these widely-separated expanses of limestone are identical in age." [17] He had, however, previously stated his conviction that the limestone seen "at the Daly Telegraph Station, the Katherine River, and down the Victoria River was a continuation of that struck at the Alexandria Cattle Station bore." [18] In this limestone at the Katherine River, Dr. H. J. Jensen stated Mr. Brown found both *Salterella hardmani* and *Olenellus forresti*, but I am not acquainted with Brown's reference.

1896.—In 1896 appeared a paper by myself in which I suggested the presence of Cambrian rocks at Mount Ida, near Heathcote, in Victoria, basing my opinion on the presence of some fragmentary but very interesting remains, to which I gave the name of *Dinesus ida.*[19]

1902.—Two additional Trilobites from a further Cambrian locality, about 150 miles south-west of Alexandria Old Cattle Station, were obtained by Mr. Brown, and described

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(13) Tate: Trans. R. Soc. S. Austr., xv., pt. ii., 1892, p. 183, pl. ii., figs. 9, 11-13.

(14) Brown: "Report N. Territory Explorations," S. Austr. Parl. Papers, No. 82, 1895, p. 24, chart 8.

(15) Etheridge: "Off. Contrib. Pal. S. Austr.," No. 9, S. Austr. Parl. Papers, No. 127, 1897, p. 13, pl. i., fig. 1.

(16) Brown: "Northern Territory, etc., Reports Geological and General, 1905," S. Austr. Parl. Papers, No. 55, 1906, p. 14.

(17) Northern Territory, *Ibid*, p. *id.*, p. 14.

(18) Brown: "Report N. Territory Explorations," S. Austr. Parl. Papers, No. 82, 1895, p. 26.

(19) Etheridge: Proc. Roy. Soc. Vict., viii. (n.s.), 1896, p. 56.

as *Agnostus elkedraensis* and *Microdiscus significans*.[20] The precise locality is the deserted cattle station of Elkedra, in Lat. 21° S., Long. 135·22° E.

1903.—Prof. J. W. Gregory, in a paper entitled "The Heathcotian: a Preordovician Series and its Distribution."[21] described a further Trilobite from the Mount Ida beds as *Notasaphus fergusoni*. He expressed the opinion that my *Dinesus ida* comprised two forms, one of which he names as above, and further, that the deposit was not of Cambrian, but of Ordovician age.

The first record of organic remains in the Heathcote rocks was, I believe, by Prof. Sir F. McCoy, who recorded "cylindrical, flexuous markings, from one to two or scarcely three inches in length . . . usually attributed to annelid burrows, and are common in Cambrian rocks. . . . There is no reason for supposing from these specimens that the rock is older than Cambrian or Lower Silurian." [22]

Mr. E. Lidgey, in a report[23] on the general geology of the Heathcote Parish and others contiguous, refers to "micaceous mudstones containing casts of Trilobites," members of these Lower Silurian rocks occupying rather less than one-fourth of the area reported on.

An important survey was made by Mr. W. H. Ferguson "for the purpose of defining the boundaries of an outcrop of Cambrian strata known to occur in the parish of Knowsley East. The Trilobite beds outcrop along the valley of Lady Creek and consist of "micaceous mudstones very rich in fossils." From Mr. Ferguson's remarks it is clear that the geology of this district is complicated and obscure.[24] By the late Mr. T. S. Hall these bed rocks were regarded as of Lower Silurian age, "but low down in the series near the Cambrian horizon."

1904.—A further discovery of trilobite remains had been made about this time by Mr. Thomas Stephens [25] at the Florentine Valley, Humboldt Divide, West Tasmania. The fossils, casts of small Brachiopods, as well as those previously

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(20) Etheridge: "Off. Contributions," etc., Nos. 12 and 13, 1902, p. 3, pl. ii.

(21) Gregory: Proc. Roy. Soc. Vict., xv., (n.s.), pt. ii., 1903, p. 152.

(22) McCoy: Vict. Ann. Rep. Secy. Mines, 1891 (1892), p. 30.

(23) Lidgey: Geo. Survey Vict., Progress Report, viii., 1894, pp. 44 and 45.

(24) Ferguson: Geol. Survey Vict. (n.s.), No. 2, Monthly Progress Report, May, 1899, pp. 23-25.

(25) Etheridge: Rec. Austr. Mus., v., pt. 2, 1904, p. 98, pl. x.

mentioned, are preserved in a yellow, slightly micaceous, somewhat fissile mudstone. A well-marked pygidium I termed *Dikelocephalus florentinensis*, and two others were referred with some doubt to the genus *Niobe*.

The Florentine River is a tributary of the River Derwent. Mr. L. K. Ward speaks of these fossiliferous beds as the equivalents of the Caroline Creek deposit.

1905.—Not far from Wirrialpa, in the Flinders Range, Mr. Howchin discovered a shelly band in a flesh-coloured oolitic limestone, containing Brachiopoda and remains of Trilobites. One of these latter was described as a species of *Olenellus*.(26) This locality is in the vicinity of the Blinman Mines, about midway between Lake Torrens and the south end of Lake Frome.

1907.—To all interested in the Cambrian geology of South Australia, and possibly that of Australia generally, Mr. W. Howchin's paper, "A General Description of the Cambrian Strata of South Australia,"(27) will be invaluable. He divided the beds into Upper ("Purple-slate") Series and Lower Cambrian Series. With the exception of the Brighton radiolarian beds, the fossiliferous horizons are limited to two limestones high up in the upper division, as at Parara, Curramulka, Sellick Hill, Blinman, and Wirrialpa, etc. Howchin estimates the Archaeocyathinae Limestone, in which the South Australian Trilobites occur, together with Brachiopods, Pteropods, and a Calcareous Alga, to have formed "coral" reefs in the Cambrian sea from one hundred to two hundred feet in thickness.

1908.—A preliminary paper(28) by Mr. F. Chapman revealed the presence of trilobite remains at the Dolodrook River, Mount Wellington District, Gippsland, in a hard and sub-crystalline limestone. Three forms were recognizable—an *Agnostus*, a *Proetus*, and a *Cheirurus*. The age of this limestone was at this period left an open question.

1911.—In a further paper during 1911 Mr. Chapman elucidated these fragmentary remains,(29) and considered the limestone to be of Upper Cambrian age. The occurrence of *Agnostus* is confirmed; the *Proetus* represented two species of *Ptychoparia*, whilst the *Cheirurus* proved to be a *Crepicephalus*.

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(26) Etheridge: Trans. Roy. Soc. S. Austr., xxix., 1905, p. 247.

(27) Howchin: Rep. Austr. Assoc. Ad. Sci., xi., 1907 (1908), p. 414.

(28) Chapman: Proc. Roy. Soc. Vict., xxi. (n.s.), pt. i., 1908, p. 268.

(29) Chapman: Proc. Roy. Soc. Vict., xxiii. (n.s.), pt. ii., 1911, p. 305.

According to Mr. E. O. Thiele there are two limestones, a "pale grey," containing Brachiopods and *Girvanella* and a "dark bluish-grey," with the crustacean fragments in question,[30] "sections cut in all directions," says Mr. Chapman. This fragmentary condition of such remains is not uncommon in our Cambrian rocks, particularly in the Kimberley limestones and the friable sandstone of Caroline Creek.

1915.—In the "Bulletin of the Northern Territory" for December, 1915, are photo-prints of a Trilobite cast, found by Mr. Surveyor Merrotsy on the Barkly Tableland, eight miles east of Alroy Downs; "the rock matrix is a cherty replacement of limestone,"[31] which accords well with the lithological composition of the Ord River bed. This cast is described in the present communication as *Ptychoparia alroiensis*, and is the most perfect example of this group of animals yet found in the Australian Cambrian. Mr. Merrotsy's discovery is one of great importance, indicating a further extension eastwards in all probability of the series yielding *Olenellus forresti*, *O. browni*, *Agnostus elkedraensis*, etc.

1918.—Some years ago Mr. H. Y. L. Brown forwarded to me pieces of a grey-white limestone from Clinton, on the east side of Yorke Peninsula, at the head of Gulf St. Vincent. Throughout these limestone fragments are the broken-up remains of a Trilobite, which appears to me to be quite different from any one yet found in the Yorke Peninsula.

III. Observations on the Species.

Genus Agnostus, Brongniart, 1822
(Hist. Nat. Crust. Foss., 1822, p. 38).

Agnostus elkedraensis, Eth. *fil.*

A. elkedraensis, Eth., *fil.*: Off. Contributions Pal. S. Austr., No. 13 (S. Austr. Parl. Papers), 1902, p. 3, pl. ii., figs. 1-4.

Obs.—In addition to the comparsions already made in the above communication, attention may be called to another Cambrian species—*A. montis*, Matthew.[32] I have examined the specimens of this pretty Australian form, and cannot distinguish more than one thoracic segment. This absence of the second can hardly be a matter of development, as the normal number are acquired at a very early stage in the metamorphosis of the genus.

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(30) Thiele: Proc. Roy. Soc. Vict., xxi. (n.s.), pt. i., 1908.
(31) Anon.: Bull. N. Territory, No. 14, 1915, pls. ii. and iii.
(32) Matthew: Trans. Roy. Soc. Canada. v. (2), 1899, p. 48, pl. i., f. 6.

Loc.—Forty miles south-east of Elkedra Cattle Station (deserted), about 150 miles south of Alexandria Cattle Station, Barkly Tableland.

Hor.—Cambrian (Etheridge).

AGNOSTUS AUSTRALIENSIS, Chapman.

(?) *Agnostus*, sp., Chapman: Proc. Roy. Soc. Vict., xxi. (n.s.), pt. i., 1908, p. 268.

Agnostus australiensis, Chapman: *Ibid*, xxiii. (n.s.), pt. ii., 1911, p. 314, pl. lviii., figs. 9, 11, 12.

Obs.—The pygidium in this species differs from that of *A. elkedraensis* in the presence of the incipient spines at the posterior angles, and apparently by the absence of tubercles on the two lobes of the glabella.

Loc. — Dolodrook River, Mount Wellington District, Gippsland, Victoria.

Hor.—Agnostus zone, Upper Cambrian (Chapman).

Genus MICRODISCUS, Salter, 1864 [33]
(Quart. Jour. Geol. Soc., xx., 1864, p. 237).

Obs.—The name *Microdiscus* has a strange history as related by Mr. C. D. Walcott, and may have to give way to that of *Pemphigaspis*:—"If *Pemphigaspis bullatus* proves to belong to the same group [as *Microdiscus*] . . . all the species now referred to *Microdiscus* would then be replaced by *Pemphigaspis*, as Emmon's original name of *Microdiscus* would not be retained, as it appears to have been founded on a specimen of the genus *Trinucleus*." [34]

Whilst the name *Microdiscus* is retained it must be ascribed to Salter, as explained by Lake.[35]

Only one species of this strange little genus has so far been discovered in Australian rocks.

MICRODISCUS SIGNIFICANS, Eth. *fil.*

M. significans, **Eth. *fil.*: Off. Contrib. Pal. S. Austr., No. 13** (S. Austr. Parl. Papers), 1902, p. 3, pl. ii., figs. 5-9.

Obs.—I am not in possession of any additional information relating to *M. significans*, which appears to be a member of the *M. dawsoni-puctatus* group, or those forms possessing a well-marked backwardly-directed cervical spine and multi-segmented pygidium.

I have re-examined the type specimens in the light of Mr. Walcott's genus *Pagetia*, but I failed to find any trace of either "eye line" (pelpebral ridge) or eyes.

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(33) Emended: Walcott. 1886; non *Microdiscus*, Emmons.

(34) Walcott: Bull. U.S. Geol. Survey, No. 30, 1886, p. 154.

(35) Lake: Mon. Brit. Cambrian Trilobites, pt. ii., 1907, p. 30.

To the original description may be added that the surface of each cheek rises into a low blunt tubercle.

Loc.—Associated with *Agnostus elkedraensis.*

Hor.—Cambrian (Etheridge).

Genus Dinesus, Eth. *fil.*, 1896

(Proc. Roy. Soc. Vict., viii. (n.s.), 1896, p. 56).

Dinesus ida, Eth. *fil.*

D. ida, Eth. *fil.: Ibid,* p. 56, pl. i.

D. ida, Gregory: *Ibid,* xv. (n.s.), pt. ii., 1903, p. 155, pl. xxvi., figs. 8-10.

Obs.—On the subject of the fragmentary remains of this Trilobite, Mr. C. D. Walcott remarked:—"The genus *Dinesus*, Etheridge, jr., appears to be more nearly related to *Damesella* or *Dorypygella*, Walcott. Its marked characteristics are: the elongate oval glabella with the small, distinct antero-lateral and postero-lateral lobes; the small palpebral lobes; and the large pygidium with a spinose border."(36) A comparison with *Dorypyge* and several other genera will be found in the original description.

Prof. J. W. Gregory would combine the pygidia described by me as those of *D. ida* with his *Notasaphus fergusoni*, but too little of both these forms is at present known to define their respective limits.

Loc.—Near Mount Ida, near Heathcote, Victoria.

Hor.—Cambrian (Etheridge); Ordovician (Gregory); Cambrian or Lower Silurian (McCoy); Lower Silurian, "low down" (T. S. Hall).

Genus Olenellus, J. Hall, 1862

(15th Ann. Rep. N. York State Cab. Nat. Hist., 1862, p. 114).

Olenellus (?) browni, Eth. *fil.*

O. browni, Eth. *fil.:* Off. Contributions Pal. S. Austr., No. 9 (S. Austr. Parl. Papers, 1897, No. 127), 1897, p. 13, pl. i., fig. 1.

Obs.—It is impossible to assign this Trilobite to its correct generic position pending the discovery of more complete material, especially the pygidium, the structure of which would at once decide the question. So far as the characters are decipherable they appear to be those of *Olenellus*, more particularly from the fact that through the absence of facial sutures the "free cheeks" are in one with the other parts of the cephalic shield.

Loc.—Alexandria Cattle Station, Playford Creek, Barkly Tableland (110 miles north-west of Camoweal).

Hor.—Cambrian (Etheridge).

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(36) Walcott: Proc. U.S.A. Nat. Mus., xxix., 1905, p. 35.

Olenellus (?), sp.

Pl. xxxix., fig. 1.

Olenellus, sp., Etheridge: Trans. Roy. Soc. S. Austr., xxix., 1905, p. 247, pl. xxv., fig. 1.

Obs.—At present I am unable to refer this imperfect portion of a cephalon to any definite genus. The published figure does not convey a correct idea of the anterior outline, but represents the specimen terminating at the anterior margin of the glabella, whereas there is, in reality, portion of a wide concave area, anterior to the glabella, as in many other Trilobites; this alters the whole aspect of the specimen. There are but two pairs of furrows, instead of three, as I said in my former description, the basal pair complete and extending across the glabella, and an anterior pair very faintly marked, mere "nicks," in the axial furrows.

This imperfect glabella may be, as suggested by Mr. F. Chapman, an example of his *Ptychoparia thielei*, but before adopting this suggestion I prefer to await additional and more perfect material.

Loc.—Neighbourhood of Wirrialpa, Flinders Range, South Australia (Howchin).

Hor.—Cambrian (Etheridge).

Genus Ptychoparia, Corda, 1847

(Prod. Mon. böhm. Trilobiten, 1847, p. 25).

Ptychoparia (?) tatei, H. Woodward.

Pl. xxxix., figs. 2 and 3.

Dolichometopus tatei, H. Woodward: Geol. Mag., i. (3), 1884, p. 344, pl. xi., fig. 3.

Olenellus pritchardi. Tate: Trans. Roy. Soc. S. Austr., xv., pt. 2, 1892, p. 187, pl. ii., fig. 12.

Redlichia tatei, Walcott: Smithsonian Miscel. Collns., 64, No. 5, 1916, p. 539.

Sp. Chars.—Cephalon very minute, in all probability semicircular; glabella oblong and narrow, very slightly conical, arched, and apparently unfurrowed; axial furrows deeply impressed laterally, but interrupted at the distal end of the glabella by a low bridge, which crosses the anterior area to the cephalon-limb border, the area concave, and both it and the border wide. Fixed cheeks somewhat cornute in outline; ocular ridges, or "eye-lines" describing a wide obtuse curve, broad and prominent; neck ring lobate, deep; free cheeks unknown.

Obs.—The two first records of the above synonymy are founded on the study of four specimens: firstly, a replica of Dr. H. Woodward's *Dolichometopus tatei*, very kindly supplied by Dr. Smith Woodward; and secondly, Tate's three type specimens of *O. pritchardi*, lent to me with great cordiality by Prof. W. Howchin.

I am quite unable to separate the above cephalons; I believe them to represent one and the same species. I do not quite follow Mr. Walcott in his reference of "*Dolichometopus tatei*" to the genus *Redlichia*. The fixed cheeks are so differently shaped, the direction of the ocular ridges so dissimilar, that the courses of the facial sutures must have been quite unlike those of the Indian genus. At the same time I am by no means satisfied by merely placing these partial cephalons in *Ptychoparia*.

On looking round for a similar structure to that I have here termed a "bridge," uniting the anterior end of the glabella to the limb border, the genera *Alokistocare*[37] and *Acrocephalites*[38] obtrude themselves. In the former, "a low rounded boss occurs in front of the glabella, that usually extends across the frontal limb (area) on to the frontal rim so as to interrupt the furrow delimiting the two"; the boss appears to be variable in development according to species. In the latter of the two foregoing genera this bridge is referred to as "a knob-shaped elevation," but in a cephalon placed in this genus with reservation by Mr. Walcott, the glabella is connected with the limb by a well-defined narrow median ridge.

Loc.—Curramulka (or Parara[?]), Yorke Peninsula, South Australia (Tate).

Hor.—Parara Limestone, Lower Cambrian (Tate); Upper Cambrian (Howchin); Cambrian (Etheridge).

PTYCHOPARIA (?) SUBSAGITTATUS, Tate.

Pl. xxxix., figs. 4 and 5.

Microdiscus subsagittatus, Tate: Trans. Roy. Soc. S. Austr., xv., pt. 2, 1892, p. 187, pl. ii., fig. 12.

Obs.—Tate's "*Microdiscus subsagittatus*" has no connection with the genus of that name. I have before me Tate's two specimens and two others lent to me by Prof. Howchin.

The resemblance between Tate's examples of his "*Olenellus pritchardi*" and "*Microdiscus subsagittatus*" is remarkable. In neither of the two type specimens of the latter is the true outline of the cephalon shown, but the fixed cheeks are slightly more cornute that in "*O. pritchardi*," the ocular ridges somewhat more sigmoidal. What, however, is of more

(37) Walcott: Smithsonian Miscel. Collns., 64, No. 3, 1916, p. 182.

(38) Walcott: *Ibid*, p. 174.

importance is the occurrence of traces of three pairs of very minute, ill-defined, and perhaps continuous glabella furrows. In the latter characters the replica of "*Dolichometopus tatei*" and the three examples of "*Olenellus pritchardi*" are indecisive; the neck ring of the most perfect of the *M. subsagittatus* specimens displays a well-marked central tubercle.

For some time I regarded these three—"*Dolichometopus tatei*," "*Olenellus pritchardi*," and "*Microdiscus subsagittatus*"—as one and the same, and I am not even now sure that I have done right in separating the last named from the other two; however, this course will probably please those who deal in microscopic specific differences.

Of Tate's illustrations that of "*O. pritchardi*" is substantially correct, but that of "*M. subsagittatus*" is imaginary.

Loc. and Hor.—Similar to last.

There is evidence of yet another Trilobite in these Yorke Peninsula Cambrian beds, as previously stated. Some years ago Mr. H. Y. L. Brown, late Government Geologist, presented to the Australian Museum examples of a whitish-grey limestone from Clinton, near the north-west corner of Gulf St. Vincent. Scattered throughout these hand specimens are portions of cephalons, thoracic segments, etc., but all fragmentary.

The glabella was of the same elongately-oblong type, slightly narrowing forwards as in the two last described forms. There are three pairs of furrows, the basal pair circumscribed, the two anterior pairs short, deep, and apparently not complete. The anterior area was very wide, concave, and with upturned limb, and, so far as I can see, an absence of the bridge uniting the anterior end of the glabella with the limb. The fixed cheeks are deltoid more or less; neck-ring wide with a central backwardly directed spine; the whole surface is minutely granular.

I do not think this can possibly be identical with any of the previously described cephalons, allowing for our limited knowledge of their complete structure, unless it be with *P. subsagittatus*. The very wide and concave area anterior to the glabella and upturned anterior limb seems to point to this.

Ptychoparia (?) australis, H. Woodward.

Pl. xxxix., fig. 6.

Conocephalites australis, H. Woodward: Geol. Mag., i. (3), 1884, p. 344, pl. xi., fig. 2*a*, *b*.

Sp. Chars.—Glabella oblong, almost parallel-sided posteriorly, the lateral margins barely tapering until near the front, which is broadly rounded; glabella furrows in two pairs, the first pair all but circumscribing the basal lobes; axial furrows deep and well marked. Neck lobe in comparison to the size of the glabella broad and large, its furrow particularly deep. Fixed cheeks only partially preserved, but apparently wide. Surface minutely granular.

Obs.—The replicas do not display any traces of the facial sutures, ocular ridges, or eyes, nor is there any trace of the oblique striae "seen on the cheek in advance of the eye which spread from it to the anterior border of the glabella." The space occupied by an eye "on the anterior half of the head," as well as that by the oblique striae, appear to me merely as fractured matrix surfaces.

Loc.—Yorke Peninsula, South Australia (Woodward).

Hor.—Parara Limestone, Lower Silurian (Woodward); Lower Cambrian (Tate); Upper Cambrian (Howchin); Cambrian (Etheridge).

Ptychoparia (?) howchini, Eth. *fil.*

Pl. xl., fig. 7.

***P. howchini*, Eth. *fil.*:** Trans. Roy. Soc. S. Austr., xxii., 1888, p. 2, pl. iv.

Obs.—At the time I described this imperfect cephalon I compared it with Woodward's "*Conocephalites australis*," but relying on the supposed accuracy of the figures given, believed them to be distinct. I now find the general aspect of the glabella of *P. howchini* to so closely resemble that of the replicas of Woodward's species that suspicion is raised of the identity of the two; but like so many other questions connected with these Cambrian Trilobites, this possibility must remain in that sense only for the present.

Loc.—Ardrossan, North-east Yorke Peninsula (Howchin).

Hor.—Lower Cambrian, or "Olenellus Group" (Tate); Upper Cambrian (Howchin); Cambrian (Etheridge).

Ptychoparia alroiensis, n. sp.

Pl. xl., fig. 8.

Trilobite cast., Anon.: Bull. N. Territory, No. 14, 1910, pls. ii. and iii.

Sp. Chars.—Cephalon semicircular (when perfect). Glabella obtusely conical, rounded in front, separated from the fixed cheeks and anterior limb by well-marked deep axial grooves; two pairs of furrows, the basal pair circumscribing prominent basal lobes; fixed cheeks comparatively large, but less convex than the glabella; palpebral lobes small, the connecting eye-lines, or ocular ridges, situated just in advance of the anterior pair of glabella furrows, anterior limb like the fixed cheeks gently convex, in the same plane as the glabella, separated from the anterior margin or fillet, which is cord-like and prominent, by a shallow groove; neck-ring in its median portion comparatively thick, its groove well defined. Facial sutures in front of the palpebral lobes almost longitudinally straight, really very slightly convex, posterior to them curving downwards with a concave sweep and sharply outwards in the direction of the genal angles.

Thoracic somites fourteen[39]; axis elongately and narrowly obconical, gently convex; axial grooves wide and open. Pleurae arched, angular in the middle line, each strongly grooved or furrowed, the proximal half horizontally so, the distal obliquely bent. Pygidium small, of two (or perhaps three) coalesced segments, and a small terminal appendage; those of the pleurae deflected backwards to a slight degree; posterior margin truncate and nearly straight.

Obs.—I am indebted to both the Federal Director of Mines at Darwin and Corporal A. L. Merrotsy, 13th Field Company, Australian Engineers, for replicas of this Trilobite, from which the foregoing description was drawn up. I believe this to be the most complete Cambrian form yet found in Australia, and a very compact little body it is.

There appears to be, judging by Mr. C. D. Walcott's numerous figures, considerable latitude in the number of glabella furrows and tail segments in *Ptychoparia;* in the former from none to three (the last predominating), and in the latter from four to seven (again the last typical). In the present instance the facial sutures and number of thoracic segments are in order, but in the possession of only two pairs of glabella furrows, and a decreased series of pygidical segments, it is not in accord with strict precedent.

Loc.—Eight miles east of Alroy Downs, Barkly Tableland, Northern Territory (Merrotsy).

Hor.—Cambrian (Etheridge).

Genus Redlichia, Cossmann, 1902.

Hoeferia, Redlich: Cam. Fauna E. Salt Range (Pal. India, n.s., i., pt. 1, 1899), p. 2.

Redlichia, Cossmann: Revue Crit. Pal., 6th Ann., No. 1, 1902, p. 52.

Redlichia, Walcott: Proc. U.S. Nat. Mus., xxix., 1905, p. 24.

Obs.—Described by Dr. Redlich as a Trilobite with a semicircular cephalon, and free cheeks armed with genal spines; a cylindrical glabella provided with four pairs of furrows, and palpebral lobes which surround the glabella in

(39) The first thoracic segment is not shown in the figure; it is more or less tucked under the neck ring.

continuous curves independent of the latter, and not confluent as in *Olenellus*. The fixed cheeks are very narrow, whilst the facial sutures are much pinched-in at the anterior ends of the palpebral lobes, giving to the antero-central portion of the cephalic shield a very characteristic "halbert"-shaped appearance.

To this genus I now refer *Olenellus* (?) *forresti*, Eth. *fil.*, and Foord, from Kimberley. A glance at Mr. A. H. Foord's figure(40) will at once reveal the very close resemblance existing between *O.* (?) *forresti* and Redlich's *Hoeferia noetlingi*, the type species of *Redlichia*, and following Mr. Walcott's suggestion(41) I now transfer it to that genus.

REDLICHIA FORRESTI, Eth. *fil.* and Foord.

Olenellus (?) *forresti*, (Eth. *fil.*, m.s.) Foord: Geol. Mag., vii. (3), 1890, p. 99, pl. iv., figs. 2*a*, *b*.

Protolenus forresti, Matthew: Canadian Rec. Sci., v., 1892, p. 253.

Obs.—Mr. G. F. Matthew suggested the reference of this Trilobite to his genus *Protolenus* on account of its continuous eye lobes. He remarked that these continuous eye lobes "are close to the glabella, leaving a very narrow fixed cheek. The eye lobes and the middle piece of this head-shield are well defined, and give no reason for supposing that the outer cheek was fixed, without which the reference to *Olenellus* is inadmissible."

In opposition to Mr. Matthew's suggestion I would observe:—

1. The general appearance of the glabella, fixed cheeks, and eye lobes respectively in *Olenellus* (?) *forresti* is very different from that of Matthew's type, *Protolenus elegans*.

2. The glabella in *Protolenus* bears three pairs of lateral furrows, but in the Australian Trilobite these furrows are continuous, and said to be four in number.

3. In Matthew's type a pygidial telson is unknown, but he informs us that "such an appendage exists in a Sardinian species, and is like that of Paradoxides (or Olenus)." Mr. Foord remarked:—"From the same locality as the head just described there is a short spine (fig. 2*a*), probably belonging to the present species; if so, it would be the telson."(42) I, however, suggest it may be one of the genal spines and therefore quite in keeping with the structure of *Redlichia*.

(40) Foord: Geol. Mag., vii. (3), pl. iv., figs. 2*a*, *b*.

(41) Walcott: Smithsonian Miscel. Collns., 64, No. 1, 1914, p. 62.

(42) Foord: Geol. Mag., vii. (3), 1890, p. 99.

Again, Mr. Foord figured the half of a thoracic segment precisely like those ascribed to the same genus, grooved pleurae terminating distally in a short backwardly directed spine.

Loc.—(1) Elvira River bed, south of base line Z, 27 (H. B. 27); (2) Ord River bed, five miles below the Elvire Junction, opposite Hill J., 38 (H. B. 84).[43]

Hor.—Salterella Limestone, Cambrian (Etheridge).

I have before me a single poorly preserved specimen, like and yet unlike *R. forresti.* The glabella and fixed cheeks are the only portions of the cephalic shield clearly distinguishable. The former is narrow and cylindrical, decreasing in width forwards, with three continuous grooves. The fixed cheeks are wider than in *R. forresti*, and the palbebral lobes describe wider semicircles. The neck lobe is prominent and large, with a small central granule just above the posterior margin. There are five thoracic segments attached, each apparently bearing a central granule, or perhaps even a spine base, as that on the fifth axis is larger than the others, and projects exactly as the broken base of a spine would. The pleurae are short and, so far as the condition of preservation permits one to judge, of the *Redlichia* type. The fifth is distally terminated (seen on right-hand side) by a much longer, backwardly-directed acuter spine, longer than in the corresponding part of either *Redlichia noetlingi* or *R. forresti.* The precise relation of this fossil to the lastnamed Trilobite is not at present clear; it may be distinct, or, on the other hand, notwithstanding the trivial differences pointed out above, possibly an advance in the known structure of *R. forresti.*

Loc.—Kelley Creek, Ord River Station (Miss E. Helms).

Hor.—Salterella Limestone, Cambrian (Etheridge).

Redlichia thielei, Chapman.

Ptycoparia thielei, Chapman: Proc. Roy. Soc. Vict., xxiii., pt. ii., 1911, p. 316, pl. lviii., figs. 2, 3, 5, 7, 10.

Redlichia thielei, Walcott: Smithsonian Miscel. Collns., 64, No. 1, 1914, p. 62.

Obs.—By Mr. Walcott this species is referred to *Redlichia*,[44] and is remarkable in the possession of four pairs of glabella furrows. The presence of the long narrow glabella reminds us of that of those termed *Ptycoparia subsagittatus* and *P. tatei.*

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[43] Glauert: Rec. W. Austr. Mus. and Art Gallery, i., pt. 2, 1912, p. 72.

[44] Walcott: Smithsonian Miscel. Collns., 64, No. 1, 1914, p. 62.

Loc.—Dolodrook River, Mount Wellington District, Gippsland, Victoria (Chapman).

Hor.—"Agnostus zone," Upper Cambrian (Chapman).

REDLICHIA (?) MINIMA, Chapman.

Ptychoparia minima, Chapman: Proc. Roy. Soc. Vict., xxiii. (n.s.), pt. ii., 1911, p. 318, pl. lviii., figs. 1 and 6(?), pl. lix., fig. 22.

(?) *Proetus* (?), sp. nov., Chapman: *loc. cit.*, xxi. (n.s.), pt. i., 1908, p. 269.

Obs.—I think this form will be more appropriately placed in *Redlichia* than in *Ptychoparia*. The distinguishing features are the peculiarly dwarfed and semicircular palpebral lobes, which lend to this cephalon a somewhat remarkable appearance, and the "neck-ring showing traces of a slight ridge bearing three small blunt spines directed posteriorly."

Loc.—Dolodrook River, Mount Wellington District, Gippsland, Victoria.

Hor.—"Agnostus zone," Upper Cambrian (Chapman).

Genus DIKELOCEPHALUS, D. D. Owen, 1852

(Rep. Geol. Sur. Wisconsin, Iowa, and Minnesota, 1852, p. 573).

DIKELOCEPHALUS FLORENTINENSIS, Eth. *fil.*

D. florentinensis, Eth. *fil.*: Rec. Austr. Mus., v., No. 2, 1904, p. 25, pl. x., fig. 4.

Obs.—Known only as a pygidium, presenting the typical features of that of the genus. The axis consists of seven segments and a terminal appendage. The flattened side lobes consist of seven or eight pleurae, and there is a wide striated limb. From the ventral margin, opposite to the last but one pleura on each side, projects a short pygidial spine.

Loc.—Florentine Valley, Western Tasmania (T. Stephens).

Hor.—Cambrian (Etheridge).

Genus CREPICEPHALUS, D. D. Owen, 1852 (45)

(Rep. Geol. Sur. Wisconsin, Iowa, and Minnesota, 1852, p. 576).

CREPICEPHALUS ETHERIDGEI, Chapman.

(?) *Cheirurus*, Chapman: Proc. Roy. Soc. Vict., xxi. (n.s.), pt. i., 1908, p. 269.

Crepicephalus etheridgei, Chapman: *Ibid*. xxiii. (n.s.), pt. ii., 1911, p. 319, pl. lviii., fig 8.

Crepicephalus etheridgei, Walcott: Smithsonian Miscel. Collns., 64, No. 3, 1916, p. 203.

Obs. — The hitherto existing confusion between the genera *Dikelocephalus* and *Crepicephalus* has been dispelled

(45) Redefined, Walcott, 1916.

by the labours of Mr. C. D. Walcott. So far as the pygidia are concerned, those with broad flattened borders, or limbs, and the posterior spines when present short and thorn-like are *Dikelocephali*, whilst, on the other hand, similar pygidia with the spines extending backwards from a broad base long, narrow, and sharp; or the spines in question attached to the sides of the pleural lobes, appertain to *Crepicephalus*.

Loc.—Dolodrook River, Mount Wellington District, Gippsland, Victoria (Chapman).

Hor.—"Agnostus zone," Upper Cambrian (Chapman).

CREPICEPHALUS TASMANICUS, Eth. *fil.*

Dikelocephalus tasmanicus, Eth. *fil.*: Proc. Roy. Soc. Tas., 1882 (1883), p. 155, pl. i., fig. 4.

(?) *Conocephalites stephensi*, Eth. *fil.*: *Loc. cit.*, p. 153, pl. i., figs. 1-3.

Obs.—Misled formerly by the descriptions of the late Prof. James Hall, of Albany, I referred this pygidium to *Dikelocephalus*, but it appears to be that of a *Crepicephalus*, although not a highly typical one, owing to the narrowness of the posterior portion of the limb.

I am now of opinion that this pygidium, and the part cephalon I described at the same time as *Conocephalites stephensi*, will prove to be portions of one and the same species. Since my paper was written, now many years ago, I have examined a quantity of the Caroline Creek deposit. One result of this is an inability to find any pygidia likely to associate themselves with the "Conocephalites" cephalon other than the "Dikelocephalus" tail, or *vice-versa*. I can, therefore, only conclude they are one and the same.

The cephalon called *C. stephensi* was, I believe, one of the first, if not the first, Cambrian Trilobite portion to be described in detail from Australasia.

Loc.—Caroline Creek, near Latrobe, Tasmania (T. Stephens).

Hor.—Potsdam Sandstone or Lingula Flags (Etheridge); "Dikelocephalus Group" (R. M. Johnston); Upper Cambrian (L. K. Ward); Cambrian (Etheridge).

Genus NOTASAPHUS, Gregory, 1903

(Proc. Roy. Soc. Vict., xv. (n.s.), pt. ii., 1903, p. 155).

NOTASAPHUS FERGUSONI, Gregory.

N. fergusoni. Gregory: *Loc. cit.*, p. 155, pl. xxvi., figs. 11-13.

Obs.—The cephalon of *Notasaphus*, so far as known to us, is certainly distinct from that of *Dinesus*, but if the figures are a correct representation of the fossil, it is very difficult to say to what genus the remains really belong; amongst other genera *Corynexochus*, or perhaps *Blountia*, may put in a claim.

Loc.—Neighbourhood of Mount Ida, Heathcote, Victoria (Gregory).

Hor.—Ordovician (Gregory); Cambrian (Etheridge).

Caroline Creek Trilobite Remains.

In my early account of these casts I figured, but left unnamed, portions of four cephalons. In each instance a glabella was preserved, parts of the neck-rings and anterior limbs, and traces of the fixed cheeks. All four types have certain features in common, such as the broad, short glabellae, deeply excavate anterior areas with thick and prominent limbs, and deep neck furrows; they differ only in proportional measurements and numbers of pairs of glabella furrows.

Since 1882 I have had opportunities to examine other examples of the Caroline Creek grit in which these remains occur plentifully, but always found the latter in the same tantalizing imperfect condition. In the absence of complete fixed and free cheeks it is most difficult to suggest a generic reference with any degree of certainty, but in my original remarks I compared one to *Loganellus*, Devine, and another to *Bathyurus*, Billings.(46) In a later communication I suggested *Ptychoparia*,(47) and for merely descriptive purposes perhaps here these cephala had better remain tentatively. At the same time other genera than those mentioned put in a claim, such as *Bathyurellus*, Billings; *Chuangia*, Walcott; or even *Pagodia*, Walcott.

Ptychoparia (?) carolinensis, n, sp.

Head shield, (?) *Conocephalites*, Etheridge: Proc. Roy. Soc. Tas., 1882 (1883), pp. 156 and 162, pl. i., figs. 8 and 9, (?) fig. 11.

Loganellus (?) or *Conocephalites* (?), Johnston: Syst. Acc. Geol. Tas., 1888, p. 37.

Chars.—Glabella broad-oval or oblong, rounded anteriorly, and all but in contact with the fillet of the anterior limb, broad posteriorly; fillet and neck-ring prominent, the neck furrow deep; two pairs of glabella furrows, basal and middle.

Obs.—The outline of the glabella (figs. 8 and 9) and that of fig. 11 are remarkably alike, and it is possible they may be identical as to species.

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(46) Etheridge: Papers and Proc. Roy. Soc. Tas., 1882-3 (1883).

(47) Etheridge: Trans. Roy. Soc. S. Austr., xxxii., 1882, p. 3.

PTYCHOPARIA (?) JOHNSTONI, n. sp.

Second species, Etheridge: Proc. Roy. Soc. Tas., 1882 (1883), pp. 157 and 162, pl. i., fig. 10.

Loganellus (?) or *Conocephalites* (?), sp., Johnston: Syst. Acc. Geol. Tas., 1888, p. 37.

Cars.—Glabella slightly pyriform, narrowing posteriorly, its anterior margin separated from the limb-fillet by a wide and deep frontal groove; limb-fillet thick and prominent; axial grooves deep and well marked; two pairs of pit-like furrows, basal and middle.

Obs.—Name suggested in memory of the late Mr. R. M. Johnston, Government Statist of Tasmania, etc. This is, in all probability, quite distinct from the original figs. 8, 9, and 11.

PTYCHOPARIA (?) TASMANIENSIS, n. sp.

Fragmentary head shield, allied to Bathyurus, Etheridge: Proc. Roy. Soc. Tas., 1882 (1883), p. 157, pl. i., fig. 12.

Bathyurus (?), sp., Johnston: Syst. Acc. Geol. Tas., 1888, p. 37.

Sp. Chars.—Glabella nearly quadrate, short, blunt anteriorly, but with the margin slightly rounded, expanding very little forwards; fillet of the limb narrow but prominent; fixed cheeks probably broad; neck furrow deep.

Obs.—Furrows are not visible on this glabella; it is shorter than either of the other forms, and blunter anteriorly.

In addition to the cephalic portions already described, there occur both in the Caroline Creek beds and those of the Florentine Valley certain pygidia of a very marked character.

Those from the first locality I tentatively referred to two forms of *Asaphus*.(48) They are nearly semicircular, differing rather in outline, but both with pronounced segmented axes, one with ten, the other eight segments. Both have well-marked striated limbs, but in one (fig. 6), the axis enlarges forwards much more rapidly than that of fig. 5.

The imperfection of the record renders accurate recognition of these pygidia difficult. A reference to *Bathyurus* even is, to some extent, possibly permissible, for although in most species of *Bathyurus* the pygidial pleurae are segmented, in *B. saffordi*, Billings,(49) only the axis is so, precisely as in the fossils under review. Furthermore, the glabellae, fixed cheeks, etc., are remarkably similar to those of that genus. In the same category stands *Asaphiscus*, Meek, but

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(48) Etheridge: Proc. Roy. Soc. Tas., 1882 (1883), p. 156, pl. i., figs. 5 and 6.

(49) Billings: Canadian Pal. Foss., i., 1865, p. 259, fig. 241.

Fig. 1.

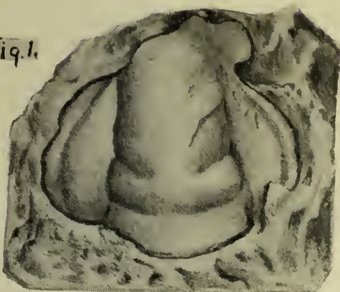

Fig. 2.

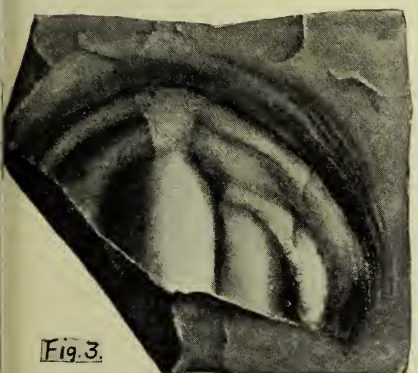

Fig. 3.

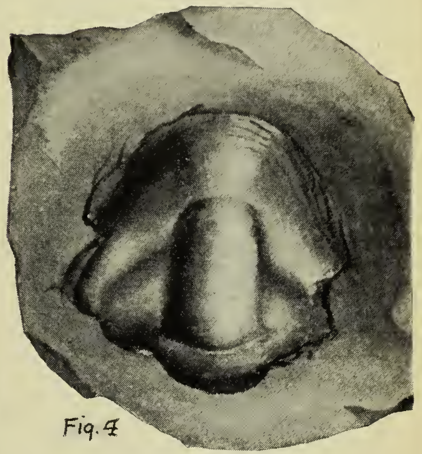

Fig. 4.

Fig. 5.

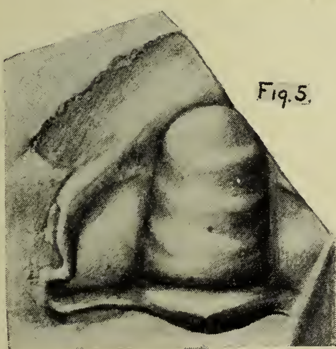

Fig. 6.

J. R. Kinghorn, Austr. Mus., del.

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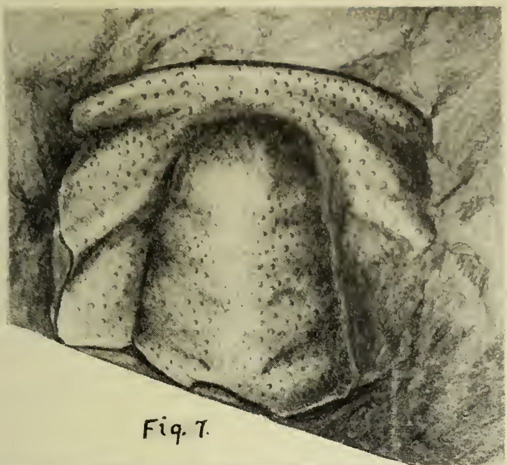

Fig. 7.

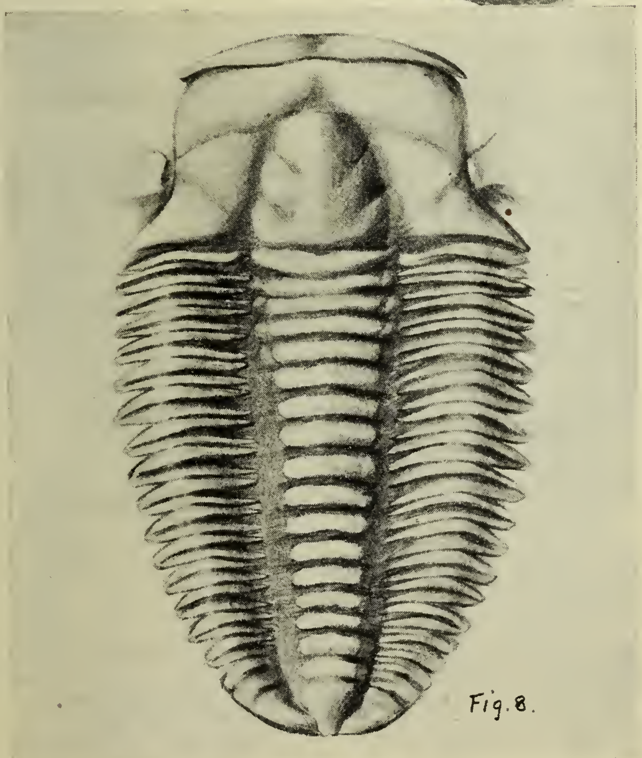

Fig. 8.

J. R. Kinghorn, Austr. Mus., del.

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here we are faced by the negative fact that no *Asaphiscus*-like cephalons have so far been discovered at Caroline Creek, that is to my knowledge.

In the Florentine Valley extension there also occur very similar isolated pygidia that I referred to *Niobe*.(50) In these tails, varying from semicircular (correct outline) to deltoid-triangular (distorted outline), are long, narrow, segmented axes, with indistinct traces of pleural subdivision on the lateral lobes. The limbs, as in those of the Caroline Creek specimens, are broad and continuous. In all probability, to whatever genus these latter pygidia may in the future be relegated, those occurring in the Florentine Valley will follow suit.

DESCRIPTION OF PLATES.

Plate XXXIX.

Olenellus (?), sp., or *Ptychoparia* (?), sp.

Fig. 1. Fragmentary cephalon (figured in Trans. Roy. Soc. S. Austr., xxix., pl. xxv., fig. 1). ×2 diam.

Ptychoparia (?) *tatei*, H. Woodward, sp.

Fig. 2. Imperfect cephalon, from a replica of Woodward's original specimen of *Dolichometopus tatei* (figured in the Geol. Magazine, i., 1884, pl. xi., fig. 3). ×8 diam.

Fig. 3. Imperfect cephalon, from one of Tate's original specimens of *Olenellus pritchardi* (figured in Trans. Roy. Soc. S. Austr., xv., pt. 2, 1892, pl. ii., fig. 11). ×4 diam.

Ptychoparia (?) *subsagittatus*, Tate, sp.

Fig. 4. Imperfect cephalon, from one of Tate's original specimens of *Microdiscus subsagittatus* (figured in Trans. Roy. Soc. S. Austr., xv., pt. 2, 1892, pl. ii., fig. 12). ×6 diam.

Fig. 5. Another similar example of Tate's, but not previously figured. The glabella furrows are distinctly visible in this specimen. ×6 diam.

Ptychoparia (?) *australis*, H. Woodward, sp.

Fig. 6. Imperfect cephalon, from a replica of Woodward's original specimen of *Conocephalites australis* (figured in the Geol-Magazine, i., 1884, pl. xi., figs. 2*a*, *b*). Nat,

Plate XL.

Ptychoparia (?) *howchini*, Eth. *fil.*

Fig. 7. Greater portion of a cephalic shield, from the original specimen (figured in Trans. Roy. Soc. S. Austr., xxii., 1888, pl. iv.). ×2 diam.

Ptychoparia alroiensis, Eth. *fil.*

Fig. 8. Nearly complete Trilobite, from a replica of the original specimen (figured in the Northern Territory Bulletin, 1910, pls. ii. and iii.). ×4 diam.

The illustrations were obligingly prepared for the writer by Mr. J. R. Kinghorn, of the Australian Museum, Sydney.

(50) Etheridge: Rec. Austr. Mus., v., No. 2, 1904, p. 26, pl. x., figs. 1-3.

Descriptions of Six New Species of Australian Polyplacophora (Four Acanthochitons and Two Callistochitons), with other Notes.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read October 9, 1919.]

Plates XLI. and XLII.

Acanthochiton pilsbryi, Sykes.

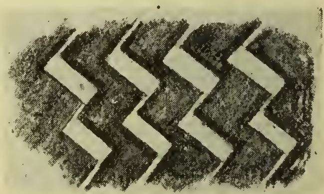
Pl. xli., figs. 1 to 3.

A. pilsbryi, Sykes: Proc. Mal. Soc., vol. ii., pt. 2, July, 1896.

A. maughani, Torr and Ashby: Trans. Roy. Soc. S. Austr., vol. xxii., 1898.

I am indebted to Mr. James A. Kershaw, of the National Museum, Melbourne, for the opportunity of examining Sykes' type of the above shell. Sykes states that he had only the single specimen and did not disarticulate the anterior valve. An examination of the type at once gives the reason, for that valve, in common with several of the others, is badly broken. Further, the marked character of the sculpture of this shell is much obscured in the type owing to erosion and fracturing, but still more to the extensive limy encrustations, the deep interspaces between the pustules being in most cases entirely filled in with the accretions.

The very faulty drawings and description in Sykes' paper are undoubtedly due to this feature. Both Mr. Sykes and Dr. Pilsbry, to whom he submitted the type, emphasize the character of the dorsal area, narrow and well defined, but both ignore the characteristic feature of the shape and arrangement of the general sculpture so striking in good specimens of this shell.



A. pilsbryi, method of sculpture in pleural area.

Description of sculpture referred to:—In the pleural area the pustules are about twice as long as broad, are square-ended and set in rows on the diagonal, so that one corner only reaches the upper line, the interspaces between the rows being a series of almost square hollows, the direction of the row of pustules is parallel with the dorsal area. A limited amount of bridging connects the pustules of one row with those of the next row. In the lateral area the row becomes curved and the pustules larger, more raised, and rounded.

Hab.—Victoria and South Australia.

ACANTHOCHITON PILSBRYI MAUGHANEANUS, n. sp.

Pl. xli., fig. 4.

Differs from *A. pilsbryi*, Sykes, in having pustules less raised and rounded. The pustules are even more rectangular than is the case in the dominant form; in the anterior valve they are about twice as long as wide, straight-sided and square-ended, narrower as well as being less raised. While probably the number of pustules is about the same, owing to their being more slender the interspaces are proportionally wider. In the median valves the pleural area is markedly different from *A. pilsbryi* in that the pustules are very slightly raised, are long and slender, with greater space between the rows. Also the bridging in the species under description is more complete, a raised ridge joining the posterior portion of one pustule to the anterior portion of the corresponding one in the row above, thereby increasing the honeycomb appearance so characteristic of the southern and dominant species. The pustules in the lateral area are more raised and larger than in the pleural, but this feature is less pronounced than in *A. pilsbryi*.

Hab.—Sydney Harbour, New South Wales.

Remarks.—Owing to the recognition of Dr. Torr's and my *A. maughani* as Sykes' shell, that name becomes a synonym of *A. pilsbryi*. I am therefore preserving the name of Mr. M. M. Maughan, the ex-Director of Education in this State, by naming the subspecies after him.

The type I am presenting to the South Australian Museum; it was collected by myself at Middle Harbour, Sydney, New South Wales.

Genus ACANTHOCHITON, Gray, 1821.

Subgen. NOTOPLAX PORCINA, n. sp.

Pl. xli., figs. 7 to 10.

General appearance.—Shell elongated, glossy, carinated, side slope straight, all valves more or less covered with fine longitudinal ribbing.

Colour and markings.—Light vinaceous-cinnamon, mottled with congo pink in the dorsal areas (Ridgway's Colour Standards, pl. xxviii. and xxix.).

Anterior valve.—Has five shallow undulations or ray ribs, is fairly evenly covered with wavy, concentric ribbing; in character these resemble "ripple marks" on the sea sand. These marks turn inwards towards the apex of valve along the central rib. Near the apex the "ripple marks" are crowded and broken into incipient, flattened pustules. Insertion plates, porcelain white, slits five, broad.

Posterior valve.—Mucro very distinct, posterior, the anterior portion of valve is similar in sculpture to the pleural and lateral areas in other valves. A diagonal depression separates this from the posterior portion, the ribbing being deflected downwards and its character somewhat altered, the ribs here showing a tendency to become granulose, still further changing when the posterior part of valve is reached, the shell there being covered with closely-packed granules without any system of arrangement. Insertion plates white, one broad slit on each side and four, and suggestion of a fifth, immediately behind the mucro.

Median valves.—The dorsal area is longitudinally lined with whitish lines separated from one another by darker lines which look like grooves, but under a stereoscopic microscope the surface is found to be practically ungrooved longitudinally, but crossed by shallow transverse sulci. Strictly speaking there is some evidence of shallow longitudinal grooving existing in places; this feature may be more marked in other specimens.

The pleural area is covered with close, wavy, longitudinal ribbing, the ribs are more abrupt on the lower side, and the trough between them is broad and shallow; both ribs and trough are diagonally scratched or minutely grooved. The lateral area is sculptured in a similar manner to the pleural, but the ridges are deflected upwards on reaching the diagonal undulation, it can barely be called a rib, which separates the two areas; the lateral area is very small compared with the pleural. Inside of shell white, median valve one slit, sutural laminae produced very little forward, sinus broad and sinuate.

Measurements.—35 mm × 11 mm. in dried specimen.

I am indebted to Dr. W. G. Torr for the opportunity of describing this very fine *Acanthochiton;* it was dredged in Gulf St. Vincent, South Australia. Up to the present only one specimen has been met with. The type will remain for the present in Dr. Torr's collection, but ultimately it will be placed in the South Australian Museum.

Remarks.—This species can easily be distinguished from *Notoplax matthewsi*, Bed. and Pils., by the ribbing being continuous and not broken into granules, the ridges are less strong, and the pinnatifid character of the dorsal area, so marked in *N. matthewsi*, is almost absent in this species. It is more nearly allied to that species than to any other *Acanthochiton* known to me. The specific name is derived from the Latin *porca*, meaning a ridge between furrows.

Acanthochiton maxillaris, n. sp.

Pl. xli., figs. 5 and 6; pl. xlii., fig. 1.

General appearance.—Shell long, rather flat, sides slightly rounded, dorsal area much rounded, width of shell less than half its total length, dorsal area broadly wedge-shaped, all the valves are covered with longitudinal rows of rather large, rounded, mostly porcelain-white pustules, the outer row or rows being irregular in arrangement, all pustules in these being much larger than those in the upper rows and some being twice as long as their neighbours and mammiliform; here and there there is a tendency for these large pustules to coalesce.

Colour.—Shrimp-pink varying in places to geranium-pink (Ridgway's Colour Standards, pl. i.), the girdle is Brussels brown, this colour occurring also in places in the ground-colour of the shell mottled in with the pink. The milk-white or porcelain-white pustules contrast strikingly with the general ground-colour of the shell.

Anterior valve.—This valve is too broken to disarticulate, is clothed with white pustules smaller towards the apex, and larger and more rounded towards the girdle; there are evidences of ray ribs, probably five, this feature being so common to Acanthochitons.

Posterior valve.—Mucro posterior, dorsal area similar to median valves, broadly wedge-shaped and flat and transversely finely ridged. Balance of valve covered with closely-packed granules, greyish or transparent white, but the granules of the outer row forming the edge of the tegmentum are twice as large as the rest, broad and round, packed closely together, and porcelain-white in appearance. This outer row of pustules gives a scalloped look to the margin of the tegmentum. Inside white, tinged in places with pink, slits two, the sutural laminae form almost three sides of a square with rounded corners.

Median valve.—Dorsal area very broad, subcutaneously lined with olive lines, transverse and longitudinal striae, the latter very indistinct. Apex is formed into a broad, rounded, flat beak, which overhangs and is distinctly rugose. The pleural and lateral areas are hardly separable, and there is a considerable margin of variance between the different valves but all show three or four longitudinal rows of rounded or oval, distinctly separated, milk-white pustules, those next the dorsal area are rather smaller than the lower row, then follows a row of milk-white pustules, fully three times the size of the upper row, and more or less placed alternately, short and long, looking like a row of irregular, rounded teeth set in a jaw, between this row, which rather follows the lines of growth than being strictly longitudinal, and the outer margin, are a few irregularly-placed elliptical or rounded pustules, some milk-white, others dark. Inside white, slits one, ill defined, and placed far back on the insertion plate, suture broad.

Hab.—Marino, South Australia. Collected by myself; only one specimen on rocks at low tide.

Girdle.—Spongy, but in places scattered minute spicules can be detected, towards the outer margin there are evidences of minute scales; it is possible that the scales have broken away from the older parts of the girdle. A fairly conspicuous hair-tuft is placed at each suture, but the spicules are short.

Measurement.—7 mm. × 3 mm.

Remarks.—This beautiful and striking *Acanthochiton* is easily distinguished from any known species by the row of exceptionally large milk-white pustules suggesting a row of rounded teeth set in a jaw, present in the median valve. The name is derived from the Latin *maxilla*, a jaw. The type I am for the present keeping in my own collection, but ultimately I hope to place it in the South Australian Museum.

Acanthochiton gatliffi, n. sp.

Pl. xlii., figs. 2 to 5.

General appearance.—Shell twice as long as broad (dried specimen), side slope very slightly curved, dorsal area broadly wedge-shaped, much raised, rounded transversely and longitudinally, valves covered with curved longitudinal rows of rather large, raised, flat pustules.

Colour.—The dorsal areas are deep Hellebore red, and the girdle and most of the ground-colour of the rest of the shell Dresden brown, the red merging into the brown; the pustules are a lighter shade than the portion of shell on which they are placed. (Ridgway's Colour Standards, pls. x., xxviii., and xv.)

Anterior valve.—Five rays or undulations, the whole valve uniformly clothed with whitish, elliptical, raised pustules, well separated from one another but not placed in defined rows; these pustules are smaller and less flat than are those on the median valves. Inside and insertion plates deep pink, five slits, teeth sharp.

Posterior valve.—Very small, mucro slightly posterior, dorsal area wedge-shaped but smaller in proportion than the other valves. The portion of shell to the front of the mucro is ornamented with a few large flat pustules in two rows, the posterior portion of valve decorated towards its margin with two rows of small granules. Inside pink, slits three, the insertion plates are produced posteriorly for a width almost equal to half of the exposed portion of valve, sutural laminae are produced sideways to an unusual degree almost forming a point, sinus broad.

Median valves.—The dorsal area broadly wedge-shaped, highly arched, longitudinally convex, beaked, pinnatifid. The markings and sculpture are a little difficult of definition, there is present a series of whitish spots arranged longitudinally on a dark-pink ground, the wavy longitudinal and transverse striae together with the colour markings give a granulose appearance to the whole of this area, which may be described as looking like strings of very small granules separated by dark-pink lines. The pleural and lateral areas are inseparable, are traversed by widely spaced, rather coarse, raised but flat pustules, under microscope they look like whitish, flat topped flagstones laid on the crown of raised portions of the tegmentum. Inside pink, insertion plates pink, slit one.

Girdle.—Spongy, a few scattered short spicules and an incipient fringe. Hair tufts well defined, spicules short.

Measurement.—The type (dry) measures 5 mm. × $2\frac{1}{2}$ mm., being a little curved, probably 6 mm. would be nearer correct. Mr. Gatliff's shell 6 mm. × 3 mm. and Mr. Gabriel's shell 8 mm. × 4 mm.

The type remains for the present in my collection but I shall hope ultimately to place it in the South Australian Museum.

Hab.—I collected the type myself at Port Lincoln, South Australia, and sent two others, collected at the same place and time, to Mr. Iredale as being the same; but until these are returned to me and I can examine them under a microscope I cannot absolutely determine their identity. Messrs. Gatliff and Gabriel have both loaned me single specimens obtained off Point Cook, Port Phillip, Victoria, in 8 fathoms.

Remarks.—I am indebted to the two gentlemen above named for the oppportunity of examining their specimens; they exhibit a few minor differences. Neither show the pink colouration which is such a marked feature in the type; it is possible that their specimens may at one time have been in spirit which would remove the colour. Mr. Gabriel's shell, which is the largest of the trio, has a distinctly rugose dorsal area, becoming granulose toward the beak; the pinnatifid character of this area is more distinct, and there are evidences of very minute scales on the girdle and of a girdle fringe.

This interesting little Acanthochiton has been in their collection for some years, but was wrongly identified by them as Sykes' shell *A. pilsbryi*, a species dealt with in the earlier portion of this paper.

I am naming this shell after Mr. Gatliff, who with his colleagues has done much good work on the Victorian fauna.

Callistochiton antiquus meridionalis, n. sp.

Pl. xlii., fig. 7.

Introduction.—In setting out to describe a new form of *Callistochiton* I collected on the North-west coast of Tasmania I have been compelled to examine specimens from the type locality, New South Wales, which was described under the name *C. antiquus* (pl. xlii., fig. 6) by Reeve in 1847, and compare them with the Tasmanian shells and South Australian shells, with the result that I find that our South Australian shell must receive a distinguishing name before the new Tasmanian shell can be put in its right niche in our classification.

Description of differences.—In the South Australian shell the longitudinal ribbing in the pleural area is broader, less elevated, more wavy and granulose than in the shell from New South Wales, also instead of running parallel to the midline they are deflected somewhat towards it. The bridging of the South Australian shell is only slightly lower than the ribs, whereas in the northern shell the bridging is deep, not standing up nearly as high as the longitudinal ribs; also the transverse ridges on the two lateral ribs are less elevated, further apart, and more numerous in the South Australian form. A still more striking difference is revealed when the valves are disarticulated. The anterior margin of the tegmentum is almost straight in the Sydney shell, but in the South Australian one it is produced forward almost to a point. The sutural laminae are broad and straight-edged in the northern shell, but are narrow and more produced forward in the South Australian shell. Another marked feature is that while in both the articulamentum is continued in front of the tegmentum across the sinus, in the South Australian shell it is divided into minute teeth—I counted 10 slits—the edge of each of the minute teeth is curved, giving a scalloped margin to this portion of the articulamentum, whereas in the Sydney shell it is straight-edged, the slits being suggested by slight grooves. I am suggesting the subspecific name of *meridionalis* for the South Australian shell. I have found this shell whereever I have collected in this State.

Type is from Marino. I am presenting it to the South Australian Museum.

Callistochiton antiquus mawlei, Iredale and May.

This species was described from Port Arthur, South-eastern Tasmania by Messrs. Iredale and May. It differs again from either of the foregoing in that the longitudinal ribbing is persistent right over the dorsal area, the irregular network present in the two former being absent. The longitudinal ribbing corresponds with the South Australian shell in the width of the ribs, but they are almost straight, nearer together, the bridging greatly thickened and proportionately shorter.

The transverse ridges in the two lateral ribs are present as mere nodules, irregularly spaced and not as sharp strongly elevated ridges as in the two preceeding. This form easily takes its place as a subspecies of Reeves' *Callistochiton antiquus.*

CALLISTOCHITON ANTIQUUS MAYI, n. sp.

Pl. xlii., figs. 8 and 9.

The only opportunity I have had of collecting Chitons in North-western Tasmania was limited to one afternoon on October 11, 1916, when I had an hour or so on the rocks at a place called Penguin. Amongst the shells then collected was a small *Callistochiton* quite new to me, which I concluded and put aside as being Iredale and May's new Callistochiton *C. mawlei*, which I had not then seen. Since then my friend Mr. May has given me a specimen of that shell, and I find that the Penguin shell is quite distinct. I sent it over to Mr. May for his opinion, and he concurs with my view. I propose naming if after Mr. May as an acknowledgement of the help he has been in the elucidation of Tasmanian Chiton fauna.

Description of differences.—This species differs from any of the preceeding in the entire absence of longitudinal ribbing. The whole pleural area is reduced to a network of which the strands are so thick that the holes between are nearly filled in, in the dorsal area this is absolutely the case, nothing but fine granulose sculpture remaining.

Under a pocket lens the pleural and dorsal areas appear simply granulose, the network origin of the sculpture is quite lost. Under a higher power, however, the network sculpture survives in the form of numerous pits scattered towards the anterior margin.

The transverse ridges in the lateral ribs are almost as defined as in the South Australian shell, but these ridges are more numerous and closer together. Measurement, 8 mm. × 5 mm. I consider this species diverges most from the dominant form of all the subspecies here dealt with.

Remarks.—In the absence of the examination of the Victorian *Callistochiton* fauna, our knowledge of the effect or otherwise of the Bassian Isthmus (Hedley: Proc. Linn. Soc. N.S. Wales, xxvii., 1904) on the distribution of this genus is very incomplete. In some respects the South-eastern Tasmanian shell shows affinities with the Sydney shell; but the North-western Tasmanian shell is certainly more closely allied to the South Australian than either of the other two. This is certainly suggestive but inconclusive, until more Victorian material is examined. I hardly think any additional word is needed to justify the placing of the four very distinct forms herein dealt with under the specific name of *C. antiquus*, Reeve, as subspecies thereof. I take it that true science is better served in showing their affinities, rather than magnifying their differences. We may conclude that all four species have a common ancestry, but that each of the widely separated localities has developed a fixed type of its own.

In conclusion.—In my list of Australian Polyplacophora (Trans. Roy. Soc. S. Austr., vol. xlii., 1918) under the heading *Callistochiton*, two species and one subspecies were given, *viz.*, *C. antiquus*, Rve., 1847; *C. recons*, Thiele, 1911; and *C. mawlei*, Ire. and May, 1916, the lastnamed being recorded as from both South Australia and Victoria. As regards the first it certainly was incorrect, and as far as I am aware it has not yet been found in Victoria.

Two more must be added to the list now, bringing the total to five, and it is very probable that the very beautiful shell described by Dr. Torr as *Ischnochiton bednalli*, may have ultimately to be referred to this genus; I have not yet seen a disarticulated specimen, so cannot express a definite opinion. Undoubtedly the network sculpture is suggestive of this genus, but in some other respects it does not show any very close affinity with any of our known Australian forms.

Since finally typing the foregoing paper I have turned up Iredale and May's description of *C. mawlei* (Proc. Roy. Soc., vol. xii., pts. ii. and iii., Nov. 1916) and cannot refrain from quoting their concluding remarks on the differences: "in the formation of the sutural laminae, these are continuous, whereas they are widely separated in the species *C. antiquus*, Reeve, and even more so in the South Australian species."

Mr. S. Stillman Berry, of California, writes me on July 1, 1919:—"Your alcoholic specimens of *Callistochiton* (from South Australia) do not look like the dry *antiquus* from Sydney." I think it probable that when the Victorian fauna is fully investigated we shall recognize two distinct species, *C. antiquus*, extending from Queensland down the East Coast, finding its extreme southern limit in Port Arthur, in Tasmania, where the subspecies *C. mawlei*, I. and M., is its representative, and a western species, extending from the submerged Bassian Isthmus through South Australia and Western Tasmania to Western Australia, of which the dominant form will be *C. meridionalis*, herein described, with *C. mayi*, also described herein, as its subspecies.

Addenda.—After completing the draft of the foregoing paper I received from Mr. C. J. Gabriel, of Melbourne, an *Acanthochiton* which he had compared and identified with Sykes' type of *A. pilsbryi* in the Melbourne Museum. Mr.

Gatliff had previously sent me a smaller shell of same species that he had also identified with Sykes' type. I felt that to go counter to two such able conchologists needed assurance made doubly sure, and therefore wrote Mr. Kershaw asking that he would be good enough to loan me Sykes' type again with permission to disarticulate another valve and clean same, because in its then encrusted and stained condition an element of almost intuition enters into its determination. Mr. Kershaw has sent me the type with the permission asked for. I was disappointed at finding that every valve was fractured, but have successfully disarticulated the second valve, which although considerably broken has sufficient sculpture remaining for the purpose. I can, now it is cleaned, authoritatively state that *Acanthochiton maughani*, Torr and Ashby, is cospecific with Sykes' shell *A. pilsbryi*, and is therefore a synonym; also that Messrs. Gatliff and Gabriel's shells from Point Cook, Port Phillip, Victoria, are fine specimens of my Port Lincoln shell that I am naming *A. gatliffi*. I have photographed under a high magnification the cleaned valve of Sykes' type with a corresponding valve of *A. maughani* from the type locality, Port Victor. This photo is reproduced herein, and will, I trust, demonstrate to the satisfaction of all workers my contention.

Photography.—I have contended for a long time that for purposes of accurate determination photography should be much safer than the work of an artist however well executed. While good photographs are comparatively easy at low magnifications, its difficulty is greatly increased under high magnification; this of course is especially the case with the carinated shells of Chitons. Further special methods of lighting have to be made use of to bring out the sculpture. The species under review has been figured three times—Proc. Mal. Soc., vol. ii., pl. ii., July, 1896, drawn by J. Green for Sykes; again in Trans. Roy. Soc. S. Austr., vol. xxii., 1898, figs. 5, *a*, *b*, *c*, *d*, and *f*, pl. vii., under the name of *A. maughani*, drawn by C. Hedley for Torr and myself; and lastly, the New South Wales form in Rec. Austr. Mus., vol. vii., No. 4, 1909, figs. 24, 25, 26, and 27, pl. lxxiv., drawn by Miss W. West for Messrs. Hedley and Hull. While the lastnamed figures are beautifully executed and a great advance on earlier attempts, the true character of the remarkable sculpture of the pleural area is not delineated. No further apology is needed for the presentation of the photos of this shell as attached to this paper. It is a satisfaction to have been able to clear up a long standing difficulty, and my thanks are due to Dr. Torr and Messrs. Kershaw, Gatliff, and Gabriel for the examination of material that has helped towards the solution of the problem.

DESCRIPTION OF PLATES.

Plate XLI.

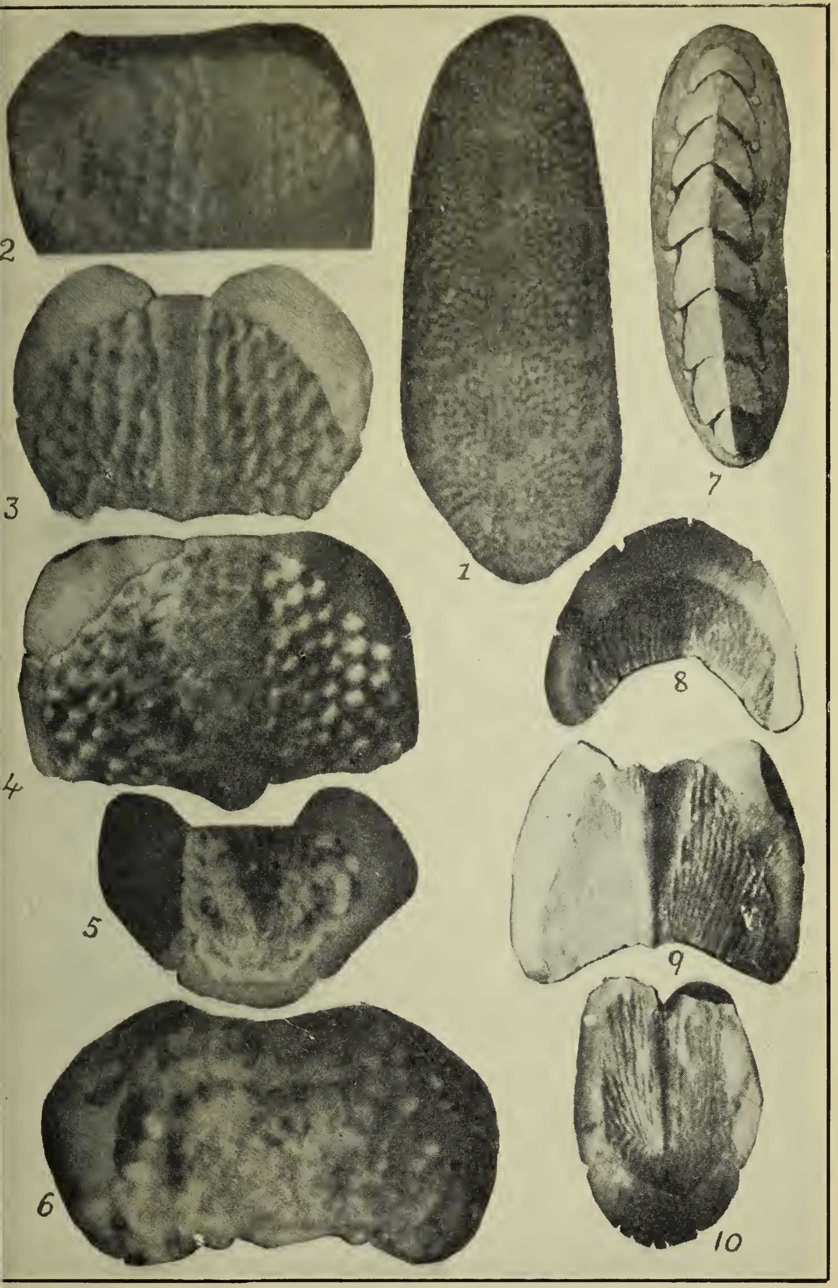
Australian Polyplacophora.

Fig. 1. *Acanthochiton pilsbryi*, Sykes, ×10, from S. Austr.
,, 2. ,, ,, ,, ×23, type, median valve.
,, 3. ,, ,, ,, ×23, from S. Australia, median valve.
,, 4. ,, ,, *maughaneanus*, Ashby, ×28, median valve.
,, 5. ,, *maxillaris*, Ashby, ×28, posterior valve.
,, 6. ,, ,, ,, ,, median valve.
,, 7. ,, *porcina*, Ashby, ×1¾.
,, 8. ,, ,, ,, ×6, anterior valve.
,, 9. ,, ,, ,, ,, median valve.
,, 10. ,, ,, ,, ,, posterior valve.

Plate XLII.

Australian Polyplacophora.

Fig. 1. *Acanthochiton maxillaris*, Ashby, ×10.
,, 2. ,, *gatliffi*, Ashby, ×11.
,, 3. ,, ,, ,, ×28, anterior valve.
,, 4. ,, ,, ,, ,, posterior valve.
,, 5. ,, ,, ,, ,, median valve.
,, 6. *Callistochiton antiquus*, Reeve, ×15, median valve, from New South Wales.
,, 7. ,, ,, *meridionalis*, Ashby, ×15, median valve, from S. Austr.
,, 8. ,, ,, *mayi*, Ashby, ×15, median valve, from Tasmania.
,, 9. ,, ,, ,, Ashby, ×15, anterior valve, from Tasmania.



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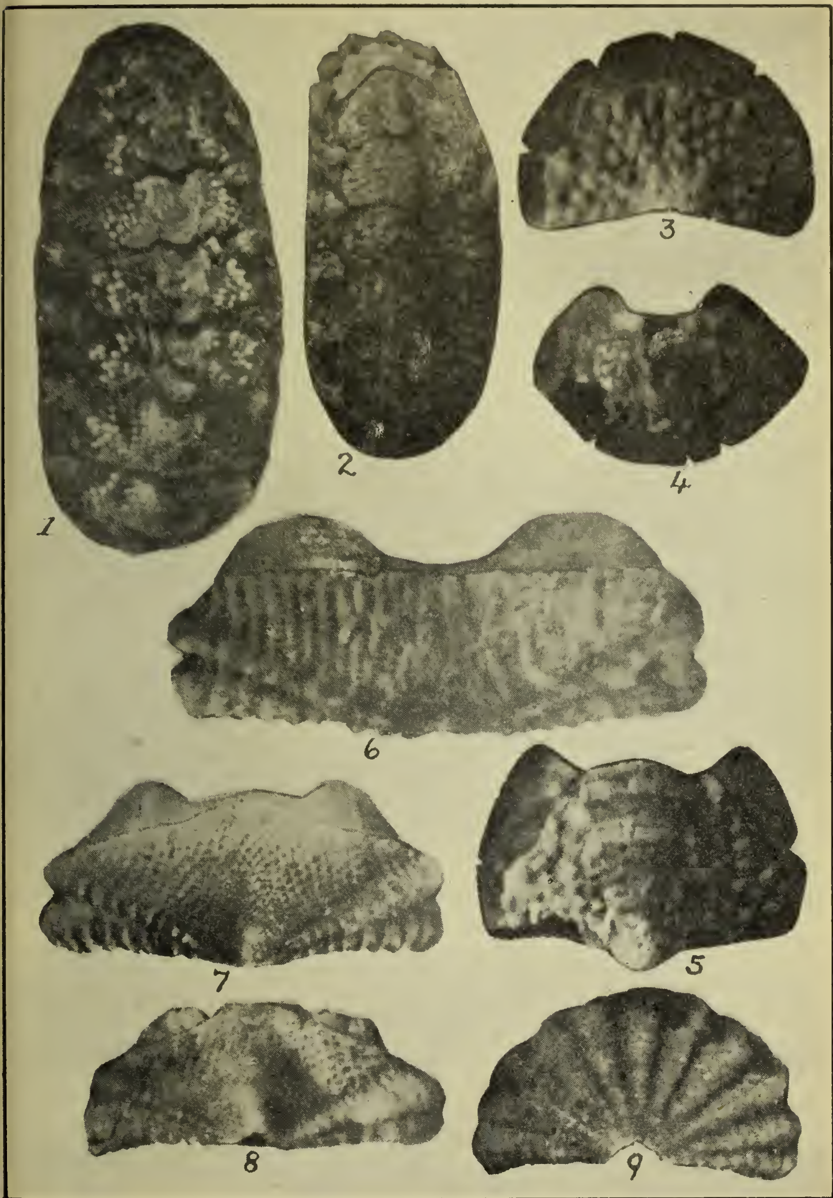

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Physical Properties of Some South Australian-Grown Pines.

By Professor R. W. Chapman, M.A., B.C.E.

[Read October 9. 1919.]

The tests about to be discussed were made upon timbers supplied to the Engineering Laboratory at the University by the courtesy of Mr. Walter Gill, Conservator of Forests. They reached the Laboratory in June, 1917, in the form of beams 6 ft. 6 in. long, and either 6 in. × 4 in. or 4 in. × 2 in. in section, all cut from recently-felled tress grown under inside plantation conditions. They were of three species, *i.e.*, Canary Island Pine *(Pinus canariensis)*, Remarkable Pine *(Pinus insignis)*, and Maritime Pine *(Pinus maritima)*, all of which have been extensively planted in this State. The specimens of *Pinus canariensis* were from two trees grown in Plantation A, Bundaleer Forest Reserve, and felled on May 21, 1917. One tree was 68 and the other 71 ft. high, and each was 15½ in. in diameter at the base, and showed 39 rings. The *Pinus insignis* species were from two trees grown on a sandy loam over clay subsoil at Wirrabara Forest Reserve, one being 20 and the other 30 years old at the time of felling, and from a tree 33 years old grown on a loamy flat over a volcanic deposit at Mount Burr Forest Reserve. The species of *Pinus maritima* come from a tree 30 years old grown at Wirrabara and from another tree 33 years old grown at Mount Burr. All the trees had been freshly felled about a fortnight before the timber reached the Laboratory.

When the timber was received each piece was properly branded and weighed, and a remarkable difference was noticed between the weights of timbers of the same species from different trees. Thus the average weight of the 6 in. × 4 in. pieces of *Pinus insignis* from the 30-year-old tree from Wirrabara was 38·42 lbs., or 35·46 lbs. per cub. ft., those from the 20-year-old tree in the same locality averaged 56·83 lbs., or 52·46 lbs. per cub. ft.; while those from Mount Burr averaged no less than 72·25 lbs., or 66·69 lbs. per cub. ft., being actually heavier than water. This difference, however, turned out to be almost entirely due to the moisture contents of the wood, and after storing for two years in the Laboratory the average weights per cub. ft. for these three trees were 25·94, 28·90, and 29·69 lbs., respectively, or an average of 27·86 lbs. per cub. ft. for the whole. Similarly the *maritima* 6 in × 4 in. pieces from Wirrabara in June, 1917, averaged 59·33 lbs. or 54·76 lbs. per cub. ft.; while those from Mount

Burr weighed 65·58 lbs., or 60·53 lbs. per cub. ft. But after seasoning for two years the weights per cub. ft. were 31·29 and 35·69 lbs., respectively, the whole set averaging out at 32·96 lbs. per cub. ft. The 6 in. × 4 in. pieces of *Pinus canariensis* weighed on the average 65·42 lbs., or 60·4 lbs. per cub. ft. on receipt at the Laboratory, but reduced finally to 41·83 lbs. per beam, or 38·61 lbs. per cub. ft. Some of the *insignis* beams from Mount Burr contained as much as 158 per cent. of moisture, calculated on the dry weight of the timber, but the moisture contents of all the timbers had fallen to about 11 or 12 per cent. by March, 1919.

Even when dried to approximately the same percentage of moisture contents there was a considerable difference in the weights per cub. ft. of the timber from the three trees from which the *insignis* beams were cut, and an analysis of the results of the tests on the seasoned wood shows that this difference in weight was accompanied by a corresponding difference in strength. With the notable exception of the beam tests for the 20-year-old tree from Wirrabara the strengths were very nearly proportional to the densities of the timber, as the following table shows:—

Ratios of Densities and Strengths of *Pinus insignis*.
Timber from Different Trees.

	From Wirrabara.				From Mount Burr.
	30 years old.		20 years old.		33 years old.
Ratio of densities	1	:	1·11	:	1·14
Ratio of strengths in compression along the grain ...	1	:	1·08	:	1·21
Ratio of shearing strengths ...	1	:	1·09	:	1·20
Ratio of strengths of beams	1	:	0·91	:	1·17

Similar results, however, were not found to apply to the *maritima* tests. Here again the timber from Mount Burr was considerably heavier than that from Wirrabara, both when green and when seasoned; but the tests showed that the Mount Burr timber was distinctly the weaker. Tested as beams the ratio of the strength of the Mount Burr timber to that from Wirrabara was 13 : 21, and in all tests except shearing the denser timber was inferior to the other. Density is evidently by no means the only factor in determining the strengths of woods, even of the same species.

The tests made upon the timbers comprised measurements for shrinkage with seasoning, transverse tests carried out on beams 6 ft. between supports and either 6 in. × 4 in. or 4 in. × 2 in. in section, shearing tests, and determinations of the strength of the timber in compression both longitudinally and across the grain. The tests were made in the same manner as those described in the author's paper on "The Strength of South Australian Timbers," in Trans. Roy. Soc. S. Austr., vol. xxxii. On the whole over 350 tests were made on the three species, so that fair average determinations could be made. In addition a number of tests were made upon samples of oregon purchased at local timber mills. As this is an imported timber largely used for construction it was thought that the comparison would be useful.

With every test a determination was made of the moisture contents of the wood as soon as possible after the test was completed. In the case of beams this was done by boring two large auger holes into the beam near the break. The shavings from these holes were then put into weighing bottles, to protect them from the drying effects of the air, and weighed. The bottles were then put in a drying oven, the tops being removed, and they were kept there at a temperature of about 104° C. for 5 hours. The tops of the bottles were then replaced and, after being allowed to cool the bottles were again weighed. The moisture determination is very essential, because the strength of many species of wood diminishes very greatly as the moisture contents increase, and a test of its strength is practically valueless unless it is accompanied by a measurement of the moisture contained in it. It makes no difference whether this moisture be in the form of the original sap or whether it be due to water that has soaked into the wood after seasoning. In either case the strength of the wood with a given percentage of moisture will be the same.

In order to examine the question of the variation of strength with moisture contents more thoroughly than could be done by making tests on the timber as it was seasoning, 48 blocks, each 2 in. × 4 in. and 5 in. long, were cut out of a seasoned beam of *Pinus insignis.* The determinations showed that this beam contained 11 per cent. of moisture, as calculated on the dry wood, and as it had been stored in the Laboratory for two years in a dry place, the moisture contents were fairly uniformly distributed. The blocks were each separately marked and weighed, and three of them were tested in compression along the grain, the average strength being 4,462 lbs. per sq. inch. The remainder were then kept immersed in water for four days. They were then removed and allowed to gradually dry out to their original condition. At first they dried rapidly, and two or three blocks were weighed each day, to determine their moisture contents, and then tested. The first block tested had 50 per cent. moisture, and its strength had fallen to 1,710 lbs. per sq. inch. Afterwards the process of drying was slower and the interval of time between the tests was made greater. After 12 weeks the moisture contents were down to 13 or 14 per cent. The relation between the crushing strength of the wood in pounds per sq. inch and the percentage of moisture in the wood, as determined in this way, is shown in

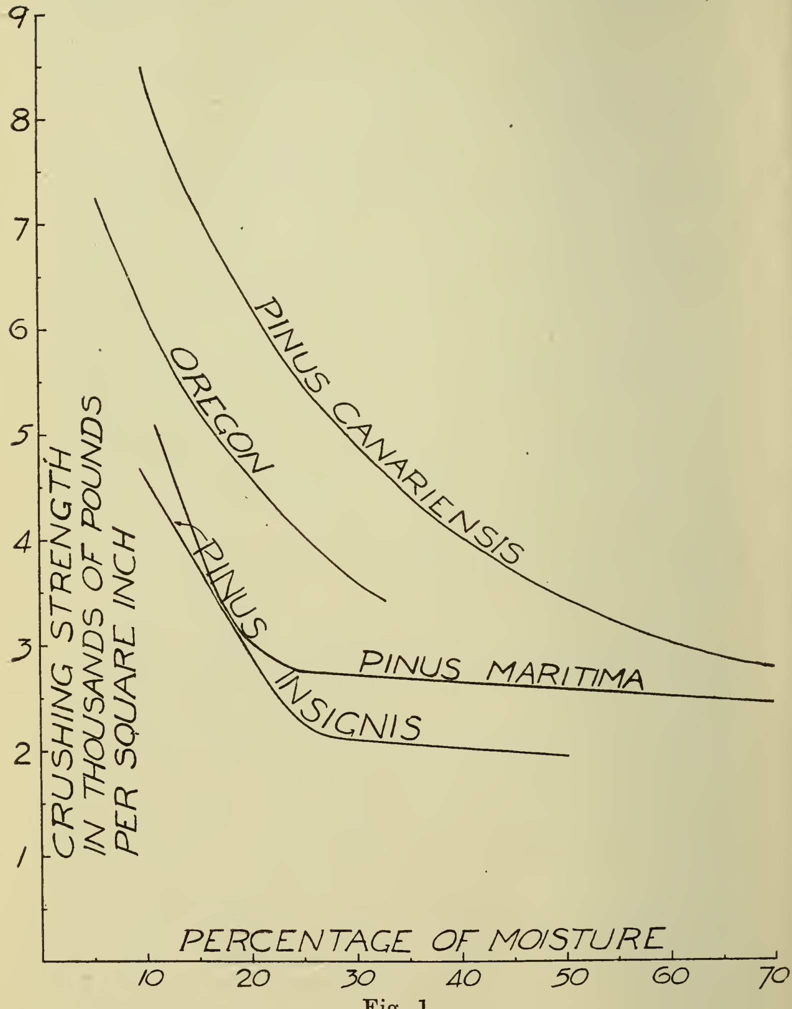

Fig. 1.

the curve for *Pinus insignus* in fig. 1. It was found that the average results of tests made in the ordinary way, as the timber was seasoning, fitted well on the curve thus obtained, showing that the strength of the wood was the same whether the moisture was obtained from soakage in water or whether it consisted of the natural sap. It will be seen from the curve that the strength in compression falls off very rapidly as the moisture increases above the 10 per cent. or thereabouts contained in well-seasoned wood in this climate, the diminution in strength being practically proportional to the increase in the percentage of moisture until the strength becomes less than half that of well-seasoned wood when the moisture contents amount to 25 per cent. of the dry weight. From this point on the diminution in strength will further increase in moisture is much less marked. With 10 per cent. of moisture the average crushing strength is 4,600 lbs. per sq. inch, at 25 per cent. it has fallen to 2,250, and at 50 per cent. of moisture it is 1,940 lbs. per sq. inch.

Similar sets of tests were made upon blocks of *Pinus maritima*, *Pinus canariensis*, and oregon, with results that are shown upon the curves of fig. 1. The curve for *Pinus maritima* is very similar to that of *Pinus insignis*. At 10 per cent. of moisture it indicates a strength of 5,600 lbs. per sq. inch, and at 25 per cent. a strength of 2,750, a little less than half, while with a further increase of moisture up to 70 per cent. the strength is reduced only to 2,450 lbs.

Wood when placed in water not only increases in weight by absorption but expands in volume. This is a feature that causes much practical difficulty to engineers when using wood blocks for street paving, but the author is not aware of any attempts having been made to measure the force which the wood can exert in this way when prevented from expanding. With this object in view a rectangular block of *Pinus insignus*, $3\frac{3}{4}$ in. × 3 in. and 4 in. high was placed in a flat dish on the compression table of the Riehlé testing machine. The grain was horizontal and the rings as shown in fig. 2. A tightening load of 600 pounds was put upon it, and the block was thus held between two cast iron plates, top and bottom, which could not move, but the upward force on the top plate could be measured at any time by balancing the lever of the machine. Water was then placed in the dish, nearly, but not quite up to the top of the block. This was done at 10 a.m. and gradually throughout the day, as the block absorbed more water, it exerted a greater and greater upward force on the top block. By noon this force was 1,100 lbs., and at 5 p.m. it was 1,520 lbs. It was left all night and next morning it had dropped to 1,360 lbs., and continued to drop slightly throughout the day. Next morning it was down to 1,280 lbs. On removal from the machine it was found that the block exhibited a typical compression failure, as though it had actually burst itself in the effort to expand. The character of the failure is shown in the second figure (fig. 2). Another similar block of *insignis*, $2\frac{3}{4}$ in. × $3\frac{3}{4}$ in. in area, treated in the same way, gave a maximum load of 1,460 lbs. This also failed in compression. The average maximum pressure exerted by the two blocks was 139 lbs. per sq. in. A block of *Pinus canariensis* was dealt with in the same way, and for three days it was left in the testing machine, and gave a pressure gradually increasing up to 128 lbs. to the sq. in., when it had to be removed to make way for other tests. This block showed no sign of failure.

When the timber was first received small cylinders about 3 in. in diameter and 1 in. long were accurately turned out of the green wood from blocks whose moisture contents had just been determined. These were then weighed and accurately

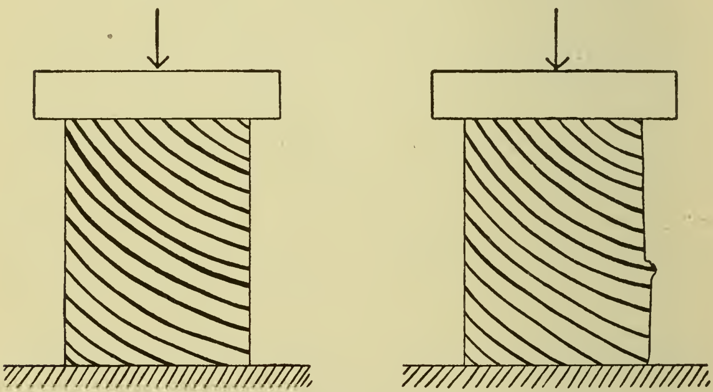

Fig. 2.

measured along marked diameters in directions parallel and perpendicular to the rings. The average measurements in August, 1917, at the end of March, 1918, and in October, 1919, are shown in Table I. It will be seen that by the end of March, 1918, these small pieces had lost all the moisture they were free to lose and at that time of the year showed a percentage of only 7 to 9 per cent. The contraction in the direction parallel to the rings was in all cases greater than that in the perpendicular direction, and was most for *Pinus maritima* and least for *insignis*. For *Pinus maritima* it amounted to 4·8 per cent., which is less than half the contraction that might be expected from a Eucalypt with the same initial quality of moisture. It will be noticed that when measured again in October, this year, the blocks all showed an

TABLE I.

Shrinkage of small cylinders of wood on drying, in directions parallel and perpendicular to the rings.

Timber.	Average Diameters ∥ to Rings.			Average Diameters ⊥ to Rings.			Per cent. Moisture.		Per cent. Decrease on 26/3/18.	
	13/7/17.	26/3/18.	7/10/19.	13/7/17.	26/3/18.	7/10/19.	13/7/17.	26/3/18.	∥ to Rings.	⊥ to Rings
Pinus maritima ...	2·994	2·846	2·871	2·9965	2·9315	2·941	80	9·3	4·88	2·09
Pinus canariensis...	3·002	2·890	2·902	3·001	2·937	2·9475	55	8	3·73	2·13
Pinus insignis ... (Mount Burr)	2·994	2·890	2·907	2·996	2·9345	2·952	140	7	3·35	2·04
Pinus insignis ... (Wirrabara)	2·987	2·895	2·913	2·990	2 937	2·947	100	7	3·07	1·77

expansion due to the absorption of moisture from the atmosphere during damp weather.

In order to further investigate the relation between the expansion of the wood and its moisture contents two small cylinders about 3 in. in diameter and 1 in. long were cut from beams of each species. These were measured along marked diameters, parallel and perpendicular to the rings, and weighed. They were then kept immersed in water for two

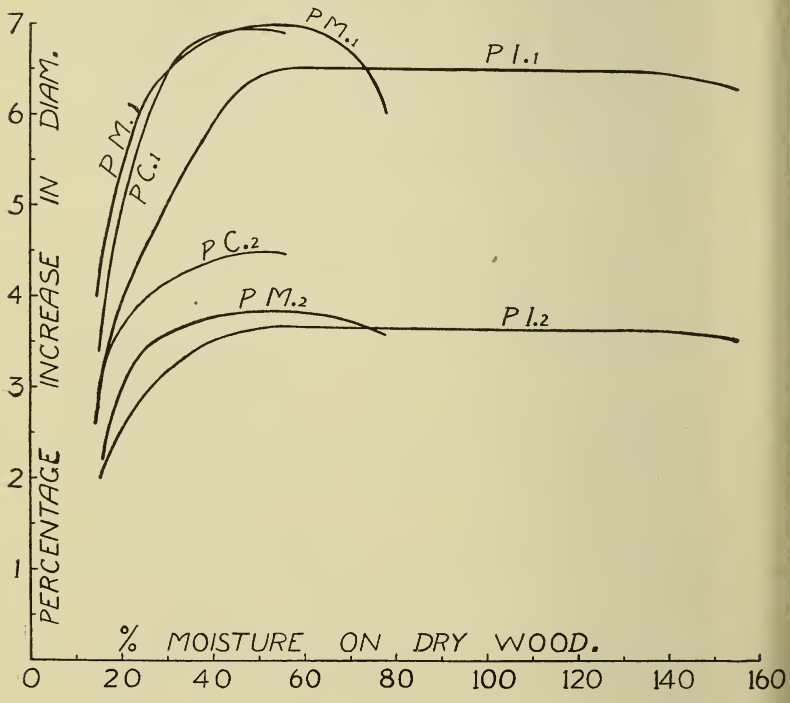

Fig. 3.

Showing contraction of wood on drying after immersion in water.
P.M. refers to *Pinus maritima*. P.I. refers to *Pinus insignis*.
P.C. refers to *Pinus canariensis*.
The suffix 1 indicates the curves showing contraction parallel to the rings.
The suffix 2 indicates the curves showing contraction perpendicular to the rings.

days, after which they were removed and again weighed and measured. It was found that the moisture contents of the *insignis* blocks now amounted to over 150 per cent. of the dry weight of the wood. The *maritima* blocks did not absorb much more than half as much, their moisture contents being now 78 per cent. The *canariensis* blocks carried only 55 per cent. The blocks were now allowed to dry gradually over a period of about eight weeks and were weighed and measured at intervals. Finally, when they had dried down to less than their original weights when freshly cut out of the beams, they were put in a drying oven and kept at a temperature of a little over 100° C. for seven hours. They were then taken out one by one and rapidly weighed and measured. From this series of measurements the curves shown in fig. 3 have been plotted, showing the relation between the moisture contents, as expressed in percentage of the dry weights, and the diameters expressed as percentages of the diameter of the dry block.

As soon as the blocks were taken out of the water they at once started to dry out and decrease in weight, but, curiously enough, continued to still further expand for a day or two, although they were losing moisture. After that the *insignis* blocks, which had absorbed the greatest quantity of water, remained practically of the same diameter until the moisture contents were reduced to about 50 per cent., as measured on the dry wood, when contraction began to take place. Contraction then took place at an accelerating rate as the wood further dried, and in all cases the greatest amount of contraction for 1 per cent. loss of moisture took place as the wood finally dried down to the 10 or 12 per cent. of moisture that is permanently contained in seasoned timber. This explains why the doors of our houses sometimes stick in the winter. The alteration of the moisture contents of seasoned wood with the humidity of the air only ranges over 2 or 3 per cent., but it occurs just at the point where the rate of contraction or expansion is greatest.

The somewhat remarkable behaviour of the wood under the conditions of the tests seems to be capable of explanation when the fact is taken into consideration that the water in the wood exists partly as free water within the cells and partly as absorbed water in the cell walls. The contraction or expansion of the wood is due to a change in the moisture contents of the cell walls. An alteration of the amount of free water within the cells will of itself produce no effect on the dimensions of the block. The complete saturation of the cell walls evidently takes time and when the *insignis* blocks were first removed from the water, although the cells were full the walls had not yet absorbed quite as much as they were capable of absorbing. The process of saturation of the walls would then still go on, as long as there was free water within the cells, and the blocks in consequence still expanded. After that the water gradually dried out from within the cells, but, so long as there was any free water at all within the cells, the walls remained saturated and no change consequently took place in the dimensions of the block. The stage shown by the curves of fig. 3 where the *insignis* blocks show no contraction at all as they dry out from about 140 to about 50 per cent. of moisture represents the phase therefore when the free water is drying out from within the cells, but the cell walls are still

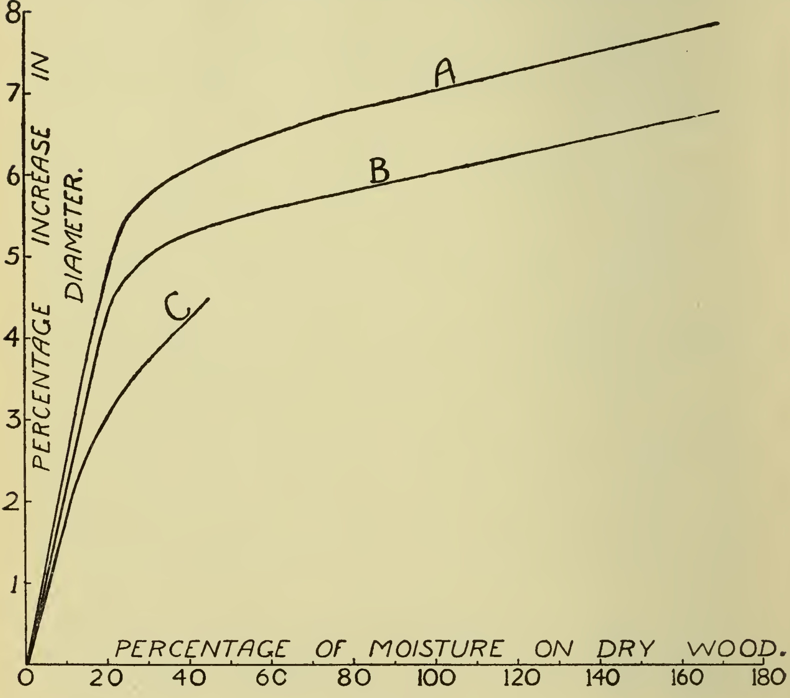

Fig. 4.

Showing expansion with moisture of *Pinus maritima*.
A, sapwood parallel to rings. B, sapwood perpendicular to rings. C, heartwood.

saturated. Beyond that, when the cells have lost all their free water, moisture is then given out by the cell walls and contraction begins to take place, this contraction being much more marked in the direction parallel to the rings than in the radial direction.

The blocks from which the curves of fig. 3 were drawn were cut from near the centre of the tree and contained a

The numbers in parentheses show the number of tests.

Timber.	Tree from	Beam Tests.			Shearing.				Compression.				
									Along the Grain.		Across the Grain.		
		f	E	Moist. %	⊥ Rings	∥ Rings	∟45° to Rings.	Moist. %	Strength.	Moist %	3 % Deflect	15 % Deflect	Moist. %
Pinus insignis ...	Wirrabara Forest (Age, 20 years) ...	6,214 (12)	1,203,282 (11)	11	784·5 (4)	688 (4)	839 (10)	11	4709 (30)	11	1773 (4)	2337 (4)	11
		4,246 (1)	658,000 (1)	100					2257 (2)	100	686 (1)	1045 (1)	100
	Wirrabara Forest (Age, 30 years) ...	6,810 (12)	1,443,267 (12)	11	421 (2)	546 (3)	765 (7)	11	4345 (19)	11	918 (3)	1382 (3)	11
	Mount Burr Forest (Age, 33 years) ..	8,019 (10)	1,415,620 (10)	11	687·5 (2)	900 (2)	925 (6)	11	5264 (6)	11	729 (1)	1029 (1)	140
		4,430	732,000	140					2855 (2)	140			
	Average of Trees ...	6,856 (35)	1,376,211 (34)	11	669 (8)	688 (9)	906 (23)	11	4626 (57)	11	1269 (10)	1618 (10)	12
Pinus maritima	Wirrabara Forest (30 years old) ..	6325 (12)	1,563,958 (12)	11	570 (2)	730 (1)	758 (9)	11	5320 (11)	11	1264 (2)	2134 (2)	11
	Mount Burr Forest (33 years old) ...	3,954 (10)	1,171,440 (10)	11	667 (1)	840 (1)	901 (6)	11	5240 (6)	11	1898 (4)	2583 (3)	11
		4,473 (1)	820,000 (1)	80					3207 (2)	80	744 (1)	1272 (1)	80
		4,700 (1)	586,000 (1)	44					2990 (1)	44			
	Average	5,280 (22)	1,399,677 (22)	11	602 (3)	785 (2)	815 (15)	11	5233 (17)	11	1700 (6)	2407 (5)	17
Pinus canariensis	Bundaleer Forest Reserve	11,724 (10)	1,925,990 (10)	12	832 (1)	1318 (1)	1433 (2)	12	8293 (4)	11	2460 (3)	3280 (3)	14
		7,926 (2)	1,248,500 (2)	62					3420 (3)	65	1422 (1)	2134 (1)	69
Oregon Pine ...		7,322 (13)	1,827,438 (13)	17	481 (4)	407 (4)	—	15	7943 (13)	15	1244 (10)	1425 (9)	15

little heartwood. It became evident that there was a marked difference in the behaviour of the heartwood and sapwood with regard to their powers of absorption, and so tests were made in which blocks were cut out of heartwood and sapwood separately. The result of such tests on *Pinus maritima* are shown in fig. 4. In this case the sapwood blocks absorbed water up to 170 per cent., but under the same conditions the heartwood blocks only absorbed 45 per cent., and the curves indicate that the heartwood cells could hold very little free water.

The combined average results of all the strength tests is given in Table II. The outstanding feature of these is the very great superiority, so far as strength is concerned, of *Pinus canariensis*. In every respect this timber exhibited quite remarkable strength for a soft wood, and although most of the tests upon it were made while it contained 12 per cent. of moisture, as against 11 per cent. for *Pinus insignis* and *Pinus maritima*, it was far stronger in every respect. Both as a beam and in direct compression along the grain its strength is comparable with that of our hardwoods. Thus the average of all the beam tests indicates that a beam 12 in. × 12 in. and 12 ft. long will carry a central load of about 42 tons, if the wood is *canariensis*, before it breaks down. If the wood is *insignis* it will carry 24 tons, if *maritima* 19 tons, and beams of the same size of oregon, of the quality of those tested, would carry 26 tons. The superiority of the *canariensis* both in resistance to shear and in compression is equally well marked. A short column of *canariensis*, 12 in. sq., will carry a load of 533 tons before it actually fails. While a column of the same size of *insignis* will carry only 297 tons, and a column of *maritima* 336 tons. The value of *Pinus canariensis* for all structural purposes is so very great, and so much greater than that of the other pines, that it is eminently desirable in the State interests that it should be extensively planted in our forests.

The following notes on *Pinus canariensis* have been kindly supplied to me by Mr. H. H. Corbin, B.Sc., Lecturer on Forestry at the Adelaide University:—"This pine has been planted in a very diffuse way since the days of the earliest settlement in Australia. The tree, notwithstanding this, has not been appreciated at its correct value by our foresters. The area of Canary pine woods in the whole of Australia is certainly not more than a hundred or two acres. In South Africa it is very extensively planted. It has an erect habit even when growing in the open. It will grow in 20 years about 50 ft., at 35 years it is, under favourable conditions, a tree about 2½ ft. in diameter and 90 ft. high. It will grow in any soil which is not too wet or sandy. It flourishes in the

18-20 in. rainfall areas, but does best in the 20-25 in. rainfall areas on the heavier soils. It develops a tap root as a little one-year-old nursery tree, and if transplanted 'open root' needs shelter from hot winds till established. In pots the tap root invariably coils round in the bottom of the pot and it is very unsatisfactory to plant; many die when treated in this way. The tree is certainly well adapted to planting in proper woods in the drier areas of this State. At Bundaleer it is seen withstanding the long dry summer on rough quartzite rock. It is free from disease. It yields an extraordinary amount of resin and turpentine. The younger trees up to 40 years old if felled coppice, but this is of little economic value. The tree has all the virtues of the *insignis*, but is 15 per cent. slower in its growth. When the drought is killing *insignis* trees the Canary Island pines are thriving. Further, pests do not attack it and fire will not wipe it out, as it sprouts again and continues its growth."

Pinus insignis has been commonly regarded as a rather poor timber, but the results show that its strength compares quite well with that of oregon. It is not quite so good as a beam, though the difference is not very great, but it has a greater resistance to splitting and shearing along the grain, and it is less easily compressed across the grain. It is quite a useful timber for structural purposes. *Pinus maritima* is not so good as *Pinus insignis* as a beam, nor has it so great a resistance to shearing, but its strength in compression is greater than that of *insignis*.

A large amount of work is involved in carrying out such a series of tests, both in the actual experiments and in the numerical reduction. For very considerable help in all this I wish to acknowledge my indebtedness to Mr. H. H. Cartledge, who was till recently my assistant, and also to Messrs. Altmann, Francis, James, and Robin, students in the Engineering School at the University.

MISCELLANEA.

Notes on Occurrences during Summer Recess, 1918-19.

Fellow Members—I was very pleased when the printers forwarded to me, just before the end of 1918, vol. xlii. of the Transactions and Proceedings of the Royal Society of South Australia (Incorporated). It is not so large a volume as we have been compiling during the past four or five years. That we knew would be the case because the Adelaide Museum, the Curators of the different departments of which have supplied us with abundant material in bygone years, now publishes its own Records. This is an event which was bound to arise, which is quite in order, and which we welcome. It is satisfactory to find that, notwithstanding this, our volume appears with 340 pages of letterpress and 32 plates, and its contents embrace quite an interesting variety of subjects and are very well illustrated. If we can maintain a yearly output of this quantity and quality—and it should improve as the years go by—we shall justify our existence, retain our present exchange with other societies, and be contributing our quota to the accumulating scientific knowledge of the world.

May I be allowed now to offer a sheaf of congratulations?

First, we have to congratulate Professor Howchin on his very valuable work, "The Geology of South Australia," published towards the end of last year. It supplies what has been a recognized want in Australia, a text book for Australian students providing, where possible, local examples and illustrations. His own extensive discoveries in the geology and palaeontology of our State first published in our Transactions, and of world-wide notoriety, have furnished no little part of the material for his text book. We congratulate him further on one result of his effort, namely, the recognition of its merit by the Council of the University of Adelaide, which has conferred on him, in addition to his previous title of Lecturer on Geology and Palaeontology, that of Honorary Professor. We shall have the pleasure for the future of addressing him as Professor Howchin.

We have also to congratulate Dr. Pulleine upon the issue, in collaboration with Mr. Rainbow, of their fine Monograph, "The Australian Trapdoor Spiders." As we well know, he has been working at this subject for several years, and their paper in the Records of the Australian Museum, covering more than 80 quarto pages and illustrated by 13 plates of beautifully executed photographs, is a valuable addition to the literature of the group, and a result in which they may feel a proper pride and satisfaction. We are pleased to know we may expect the publication by these authors in the same style of excellence of further contributions to the natural history of other groups of Australian Spiders.

We are also glad to offer our felicitations to Mr. W. B. Poole, who has completed 50 years of service with the Savings Bank of South Australia, in which he rose to the highest office, and who has been now released to pass his remaining days at leisure. It has been our good fortune for nine or ten years to have had him as our Honorary Treasurer after being, as we may say, specially trained for us as an expert in finance. We trust he will enjoy for many years this responsible, but happily not very onerous post, and so free the Society from all anxiety about its accounts, and we wish him full enjoyment not only of this useful service, but of his freedom from the ties and worries of the large State business concern, the present proportions of which must in measure be credited to him.

We will also take this opportunity of referring with pleasure to the safe voyage of Mr. Edwin Ashby across somewhat perilous seas to and from America, and to the title which has been conferred upon him of C.F.A.O.U. (Corresponding Fellow of the American Ornithological Union) in recognition of the work he has done in connection with Australian birds.

But we have also the sad duty of referring to the decease of two of our Fellows.[1]

Miss Ellen Milne Bundey, the daughter of Sir W. H. Bundey, formerly one of our Judges, was elected a Fellow of our Society in 1906. She had the unique distinction of being our only lady Fellow. Her tastes were literary and musical rather than scientific, and as Lyell Dunne she occasionally contributed verses to the daily Press, and under the stress of an intense patriotism strove to assist various organizations in the same way. She was a Bachelor of Music of our University since 1900. Through ill-health she has been debarred from attendance at our meetings, but has always taken a keen interest in the work of the Society, and appreciated its records in our Transactions. Her interest is practically shown by a gift to our Library of sixteen volumes of Lloyd's Natural History.

Jos. C. Verco, President.

Evening Meeting, April 10, 1919.

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[1] An obituary notice of the late Sir Edward C. Stirling will be found on page 1 of this volume.—Ed.

The Amethystine Colouration produced in Glass by Ultra-violet and X-Ray Radiation.

The amethystine colouration of bottles from the Far North of South Australia, where they have been exposed to sunlight, has upon several occasions been brought to the notice of the Society.

In these cases, the colouration was presumably caused by solar ultra-violet radiation. The tabled exhibit showed a similar colouration produced in glass owing to bombardment by X-rays produced by the "Coolidge" Electron type of X-ray tube.

In the walls of the "Coolidge" tube itself, the colouration is very beautifully shown, unless masked by a deposit of tungsten, caused by volatilization at the focal spot, due to excessive energy imputs. In the old gas tubes, it was similarly masked, where present, owing to the deposit of tiny particles of platinum torn from the target by the bombardment of cathode rays.

Reference was made to various work relative to the subject, including that of Dr. M. Luckiesh, of the Nela Research Laboratory, who possessed samples of glass showing a bluish tinge in the case of potash and a yellowish-green tint in the case of sodium glass, produced by exposure to solar radiation. A sample of lead glass exhibited a muddy yellow colour after exposure to X-rays.

The purplish colour is assumed to be due to a change in the chemical or physical state of the manganese contained in the glass. The colouration is quite unstable, and disappears upon the application of heat. There appears to be no agreement as to whether the manganese is present as in solution, or in the colloidal form.

The effect when brought about by solar radiation is supposedly due entirely to the ultra-violet rays. In manganese glass used in connection with electric lighting, the colour has only been observed where the electric source of light is very rich in ultra-violet rays, such as in a powerful arc.

The big variation in wave lengths of the ultra-violet and the X-rays, which are roughly of the order of 10^{-5} cms, and 10^{-8} cms., respectively, is an interesting consideration, in view of the similarity of effects on the manganese constituents of the glass.

Why the effect apparently ceases so abruptly when the wave lengths pass from the ultra-violet to the visible radiation is a point also worthy of investigation.

A. R. Riddle.

Evening Meeting, August 14, 1919.

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia

(Incorporated)

FOR 1918-19.

Ordinary Meeting, November 14, 1918.

The President (J. C. Verco, M.D., F.R.C.S.) in the chair.

Nomination.—The Rev. D. T. Whalley as a Fellow.

The President made the following appreciative remarks about the late Dr. W. L. Cleland:—

"It is only fitting that we should make more than a passing reference to the death during the past month of Dr. W. L. Cleland, who for thirty-seven years was a Fellow of our Society. He was elected a member in 1879, just at the time the Adelaide Philosophical Association was converted into the Royal Society of South Australia. In 1882 he accepted the very onerous position of Hon. Secretary, which he retained for fifteen years. When we recall that during six of those years he was also Hon. Secretary to the South Australian Branch of the British Medical Association and also to the Medical Benevolent Association of South Australia, one begins to realize what a mass of work he carried out in his quiet, unostentatious way. He only received his deserts when on transferring the Secretariat of the Royal Society to Mr. G. G. Mayo he was granted the highest honour we could confer and was elected President, in which office he served for two years. He fulfilled it with the same assiduity and reliability as in his more humble post, for the Minutes show that on only two occasions during the Presidency was he absent from his official chair. When he retired from this he was for two years in succession chosen Vice-President, and after that a member of the Council, a sure sign of his reliability and worth.

"In 1887 he read a short paper describing the geological features of the country about the head of Lake Gilles, where were some polished rock surfaces.

"In 1899 his Presidential address dealt with the aboriginals of Australia, while that of 1900 was in extension of the same subject, on 'Factors producing Uniformity of Type amongst Australian Aboriginals,' illustrated by photographs of the natives from various districts in our continent.

"When we review his association with our Society we cannot but pay very cordial and eulogistic tribute to his memory as one of our most helpful and efficient Fellows."

Exhibits. — Mr. Walter Howchin exhibited a large cylinder of flint obtained by Mrs. Pascoe of Port MacDonnell from the flint-pebbles deposit, situated on the beach about five miles to the westward of Port MacDonnell. The specimen measures 26 inches in height and 55 inches in circumference. It has a certain superficial resemblance to a fossil tree, but as it was formed by segregation in a marine bed and consists of small marine organisms that have become silicified by infiltration, the idea of a fossil tree cannot be entertained. The flint that occurs in the MacDonnell Bay is interbedded with the lower marine Tertiary beds, and is often of abnormal size and shape, some further examples of which were exhibited by Mr. Howchin at the same time. Mr. Edgar R. Waite exhibited a snake obtained by Messrs. Edgar Savage and F. Angel, at Moolooloo, on the Great Northern railway line. It proved to be an example of *Denisonia suta*, Peters, and is, perhaps, only the third specimen recorded under this name, the type being in Berlin, and a second example in the British Museum. All are from South Australia. He also drew attention to the general similarity of *D. frontalis*, Ogilby, and *D. forresti*, Boulenger, to the snake exhibited. He also showed photographs of the large blue whale, 87 ft. 10 in. long, stranded at Corvisart Bay, and later towed to Streaky Bay, where the skeleton was obtained for transmission to the South Australian Museum. Samples of the raw oil were likewise exhibited. Capt. S. A. White exhibited eggs of the wedge-tailed eagle *(Uroaetus audax)*, showing great variations in markings and colouration; also eggs of the letter-winged kite *(Elanus scriptus)*, taken on the Diamantina River, Western Queensland, by Mr. S. W. Jackson, for Mr. H. L. White, of Scone, New South Wales. In Gould's Handbook of Australian Birds, vol. i., p. 55, the author stated:—"Capt. Sturt obtained it at the Depôt, and Mr. White, of the Reedbeds, South Australia [Capt. White's father], informs me that he found this species in great numbers on Cooper Creek, between latitudes 27° and 28° in 1863. They were always in companies of ten to twenty or thirty." Mr. A. M. Lea exhibited some gall insects of the genus *Brachyscelis;* the female insect is wingless and is enclosed within a gall with three long horns; the male insect on maturity is winged, but in its earlier stages is enclosed within a much smaller gall than that of the female. He also exhibited some Canadian wonder beans that had been destroyed by a root-eating mite *(Rhizoglyphus echinopus).* Beans and peas are often prevented from growing by these mites, which occur in the soil in countless thousands. Mr. S. DIXON stated that the grass shown by him on September 12 proved to be an importation from South Africa, *Ehrharta villosa*, var. *maxima*. Mr. W. J. KIMBER showed several fossils and fossil casts from Port Willunga. Mr. F. R. ZIETZ, on behalf of the South Australian Museum, exhibited a specimen of the Wilson or yellow-webbed storm petrel *(Oceanites oceanicus exasperatus)*, picked up dead on the beach at Port Elliot. Although this bird is said to be numerous out at sea, it is rarely seen close inshore. Mr. A. R. RIDDLE showed electrical apparatus recently imported for the Keswick Military Hospital for enabling radiographs to be taken with very short exposures, thus eliminating any indistinctness from motion due to the action of the heart or lungs.

FLINDERS CHASE.—Capt. S. A. WHITE reported that a strong effort had been made to secure the passage of a Bill for the reservation of Flinders Chase, and that although it could not be carried through this session, he had no doubt of its becoming law in the next.

PAPER.—"Vitality of Seeds," by ALF. G. EDQUIST.

ORDINARY MEETING, APRIL 10, 1919.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

NOMINATIONS.—Edward Charles Grigson and O. A. Glastonbury as Fellows.

ELECTION.—Rev. D. T. Whalley as Fellow.

THE ADVISORY COUNCIL of Science and Industry wrote that their publication, "The Australian Environment," by Dr. Griffith Taylor, could be purchased for 5s., or the set of contour and rainfall maps of Australia separately for 1s. 6d.

THE PRESIDENT referred to the death of Sir Edward C. Stirling and other events which had occurred during the recess. *(Vide* page 1 and MISCELLANEA.)

FLINDERS CHASE.—Capt. S. A. WHITE reported as follows:—"Years ago the Fauna and Flora Protection Committee of our Field Naturalists' Section wisely decided that a reserve was necessary to enable the perpetuation of the country's fast diminishing fauna and flora, especially the former, and steps were taken to have set aside for the purpose a portion of Kangaroo Island. The late Hon. T. Price, when Premier, approved of the proposal, and the western end of the island was reserved, but it was never legally constituted. In due course, however, a Bill was prepared with that end in view, but, for one reason or another, it was not developed, although Government after Government promised to carry it through. Last year a committee of three—Messrs. S. Dixon and J. M. Black and myself—was appointed by the Royal Society, and an application was made for the reservation of 1,000 square miles of country, toward the preparation of which two prominent citizens had promised to contribute £4,000. Death, unhappily, removed those two public-spirited gentlemen before their offer could be accepted, but the Hon. John Lewis, M.L.C., said he would fence the area. Owing mainly, it is understood, to the great extent of the area specified, strong opposition was offered to the scheme by some of the residents on the island, and eventually a special meeting of the District Council was held at Kingscote, and was attended by Mr. Laffer, M.P., one of the Parliamentary members for the district, and myself. The subject was thoroughly discussed in all its aspects, and finally the Council agreed not to offer any further opposition, a fact which was subsequently conveyed to the Premier (Hon. A. H. Peake), together with an intimation favouring the carrying out of the project. All that remains to make the long-desired Flinders Chase a reality is for the Bill already prepared to be brought up to date and to receive the sanction of Parliament, which, no doubt, will provide for the appointment of a Board of Governors to control the property. The area involved is approximately 200 square miles, west of a line from Cape Forbin on the north, to the Rocky River, round the Rocky River freehold, and thence south-west to the sea."

Exhibits.—Prof. Osborn exhibited specimens of diseased cabbages from a market garden at Piccadilly affected by "black leg." This disease is caused by a fungus, *Phoma Lingam* (Tode), Desmaz. The symptoms commonly observed are a wilt of the tops of certain plants representing from a few to 50 per cent. or more of the crop. The wilted plants are found to have their tap-roots destroyed and somewhat blackened. The fructifications of the fungus are observed as minute black spots around the diseased portions. The fungus also attacks the leaves and stems, flower stalks, and fruit pods. It has recently been shown by Henderson, working at Wisconsin, U.S.A. (Phytopathology, viii., pp. 379-431, 1918), that seed in the pod below such diseased areas is also infected, and will produce infected seedlings. Ample evidence of seed-bed infection was found at Piccadilly. An account of preventive measures was given. He also exhibited shells of the common cockle *(Chiones scalarina)* on which *Cladophora*, sp., was growing. The shells were collected near the mouth of the American River, Kangaroo Island, from a large area of clean tide-scoured sand. The alga was only found on living shells or those of recently-dead fish, and only growing healthily in the former case. Live cockles are the only objects to which the *Cladophora* can fix itself in this area. The alga was always fixed at the posterior end near to the dorsal hinge. This is the portion of the shell nearest the surface of the sand, but it is also near the exhalent syphon. The suggestion was offered that the alga might benefit by such proximity to the current of water leaving the animal, which would be richer in carbon-dioxide from its passage over the gills of the animal and in nitrogenous material voided into the cloacal cavity. Mr. Edwin Ashby showed some Jonathan apples, which were clean when gathered, but had after a time become spotted with "bitter pit"; also the following birds:—*Phaps chalcoptera*, Lath. (Bronzewing Pigeon); *Cosmopelia elegans neglecta*, Mat. (Brush Bronzewing), from Karoonda; *Hypotaenidia philippensis australis*, Pel. (Eastern Buff-banded Rail); *Porzanoidea plumbea immaculata*, Swain. (Eastern Spotless Crake); *Porzana fluminea whitei*, Mat. (Southern Spotted Crake), from near Paradise, 19/12/18, where the two preceding species and *Zapornia pusilla palustris*, Gld. (Eastern Little Crake), have this season been very numerous, also from a waterhole in the mallee, near Karoonda; *Myzantha melanotis*, Wilson (Black-eared Minah); *Gliciphila albifrons incerta*, Mat. (Eastern White-fronted Honey-eater); *C. melanops chandleri*, Mat. (Tawny-crowned Honey-eater)—the latter for the last few weeks has been singing or whistling freely at Blackwood. Mr. A. M. Lea exhibited a so-called hermaphrodite butterfly, *Delias mysis*, from North Queensland, its right side having the typical markings of a male, and its left side those of a female; normal specimens were shown for comparison. Mr. A. G. Edquist showed a beetle, the abdomen of which was merely an empty skin. It had refused to feed, and had soon died. Mr. F. R. Zietz exhibited a complete set of Australian Falcons, *viz.*, *Falco longipennis* (Little Falcon), *F. hypoleucus* (Grey Falcon), *Rhynochodon peregrinus* (Black-cheeked Falcon), and *Notofalco subniger* (Black Falcon). Mr. E. R. Waite showed a plate of baleen (whalebone) from the blue whale in the South Australian Museum; also the jaw of a small-toothed whale. Mr. W. J. Kimber showed a fish *(Pegasus)* from Port Lincoln, and various fossil shells from Port Willunga and Troubridge for identification. The President showed a volume of newspaper cuttings (one of a set of 120) containing one referring to the boyhood of John Gould, the ornithologist.

PAPER. — Prof. OSBORN laid on the table and briefly described a paper, "Australian Fungi: Notes and Descriptions, No. 2," by J. B. CLELAND, M.D., and EDWIN CHEEL.

ORDINARY MEETING, MAY 8, 1919.

THE PRESIDENT (J. C. Verco, M.D., F.R.C.S.) in the chair.

ELECTIONS.—O. A. Glastonbury and Edward Charles Grigson as Fellows.

THE PRESIDENT referred with congratulations to the distinction which had been conferred upon our Fellow, Dr. Chas. Fenner, F.G.S., namely, the Sachse Gold Medal, as a recognition of the merit of his paper, read last year before the Royal Society of Victoria, on the "Geology and Physiography of the Werribee River Basin." He also expressed regret at the decease of Mr. E. H. Wainwright, B.Sc. (Lond.), who had been a Fellow of the Society for thirty-six years. He was in former days a teacher of chemistry at the Collegiate School of St. Peters.

EXHIBITS.—Prof. HOWCHIN exhibited a whale barnacle that was picked up by Professor Rennie at Encounter Bay. The barnacles are an abnormal group of the crustacea classed as the Cirripedia. The best-known families in this group are the Lepadidae, or "goose barnacles," and the Balanidae, or "acorn barnacles." The former are attached by a fleshy stalk, and obtained their popular name from the old-world notion that they turned into geese. The Balanidae, or "acorn barnacles," have a cup-like shell, and are sessile, and the typical genus, *Balanus*, is the common form that covers ship bottoms and almost all objects in shallow water. The specimen shown belonged to the Balanidae, and could be referred to the genus *Coronula*, and was probably *C. diadema*. It differs from *Balanus* in that while the latter has a simple turreted shell, in the *Coronula* the inner wall of the shell is deeply infolded, by which the lower part of the shell is divided up into radial chambers. It has the habit of attaching itself to whales, and on that account is known as the whale barnacle. Mr. EDWIN ASHBY exhibited Humming Birds from America, and gave notice of motion for the July meeting as follows:—"That this Society supports the endeavours of the Ornithological Association of South Australia to secure the introduction into Australia of the Humming Birds of America." Capt. WHITE showed two specimens of Sparrow-Hawk *(Accipiter cirrocephalus)*, showing the great change in colouration and colour pattern which takes place in the mature bird; also two specimens of Australian Goshawk *(Urospiza fasciata)* showing the same change. Mr. A. M. Lea exhibited a drawer containing some insects whose sexes are strikingly different in general appearance; in some cases the males are provided with large wings, whilst the females are wingless, or almost so; in others the males are considerably smaller and differently coloured from their females, or are provided with processes on the head that are absent from the females.

Flinders Chase.—Capt. S. A. White reported on the progress made towards the reservation of Flinders Chase.

Papers.—"Additions to the Flora of South Australia, No. 15," by J. M. Black; and "A Review of the Genus *Loricella* (Order Polyplacophora) with Notes on Features previously unnoted and Description of a New Species," by Edwin Ashby, F.L.S., M.B.O.U.

Ordinary Meeting, June 12, 1919.

The President (Sir Joseph Verco, M.D., F.R.C.S.) in the chair.

Prof. E. H. Rennie, M.A., D.Sc., F.C.S., Vice-President, referred to the honour of knighthood recently conferred upon the President, and to the fact that he had been a Fellow of the Society for forty-one years and President continuously for seventeen years, during which time he had rendered the Society valuable service, both personal and financial. He moved—"That this Society offers to Dr. Verco its heartiest congratulations upon the receipt by him of the honour of knighthood." Lieut.-Col. R. S. Rogers, M.A., M.D., Vice-President, seconded the motion, which was carried by acclamation. Sir Joseph Verco suitably responded.

Prof. Walter Howchin, F.G.S., laid on the table a progress report of the Australasian Association for the Advancement of Science. The biennial meetings, suspended during the war, would now be resumed, the next being held in January at Hobart.

Nomination.—Miss Helen M. Mayo, M.B., B.Sc., was nominated as Fellow.

The President laid on the table correspondence referring to the suggested establishment in Australia of a National Research Council in affiliation with the International Research Council recently inaugurated. In this connection the Royal Society of New South Wales proposed a conference in Sydney in July. Resolved—"That the Hon. Secretary reply that the Society saw objections in the way of fixing an early date for the Conference, owing to the dislocation of travelling facilities through the coal strike and the influenza epidemic, especially as it would be too late in any case to send representatives from such Conference to the General Conference at Brussels. If, however, an early meeting is considered advisable, it would be well to fix a date when all or most of the Universities would be in recess. So soon as the exact date is fixed, the Council would appoint delegates."

EXHIBITS.—Dr. PULLEINE exhibited a new species of trap-door spider, genus *Aganippe*, and nests of same, from the banks of the American River, Kangaroo Island, just above high water; also portions of the bird-catching plant *Pisonia Brunoneana*. Mr. A. M. LEA showed a drawer of British beetles, including many which occur in nests of ants.

PAPER.—"Geological Memoranda" (first contribution), by Prof. WALTER HOWCHIN, F.G.S.

ORDINARY MEETING, JULY 11, 1919.

Prof. E. H. RENNIE, M.A., D.Sc., F.C.S. (Vice-President), in the chair.

ELECTION.—Helen M. Mayo, M.B., B.Sc., was elected a Fellow.

INTERNATIONAL RESEARCH COUNCIL.—The conference at Sydney having been fixed for August 20, the appointment of two delegates was left to the Council.

EXHIBITS.—Prof. CHAPMAN showed results of experiments upon the pressure exerted by wood blocks by expansion when soaked in water. Mr. A. M. LEA exhibited some olives thickly covered with black scale insects *(Aspidiotus rossi)* which cause a serious diminution in the yield of oil, besides injuring the tree by attacking the leaves and twigs; also a rust fungus, received from Mr. Henry Greenfield, of Bugle Ranges, from Purple Downs Station, near Port Augusta. This was afterwards identified by Mr. J. M. Black as *Salsola kali* (Family Chenopodiaceae). Mr. EDGAR R. WAITE exhibited photograph of a native of Lihir Island which he had taken during the Museum Expedition last year; also the skull of a native from the island, presented to the Museum by Captain G. W. Mostyn. Both the photograph and the skull were shown to illustrate a practice of the natives of this island which lies off New Ireland in about 3° S. latitude. Shortly after a baby is born the bone of the forehead is either broken with a sharp stone or cut with an obsidian knife, the result being the production of permanent deep vertical grooves; the photograph of the living girl shows two, and the skull four such grooves. He likewise exhibited the skull of a native of New Britain obtained by the late Dr. A. C. Magarey. In this specimen the third molar, or wisdom tooth, instead of appearing in normal position, had erupted towards the angle of the jaw. Another skull from the same source, showing remarkable sutural development, was also exhibited. Attention was also directed to two artificially distorted skulls from Southern New Britain—a tight wrapping around an infant's head induces an elongated skull. In one of the exhibits the supraorbital region had been included in the wrapping and the ridges had not developed in consequence; in the second head the eyebrows had not been included in the wrapping, and the supraorbital bones had therefore grown to more normal condition. Capt. S. A. White showed ten specimens of *Platycercus*. Two were from the type locality of *P. elegans fleuriensis*, Ashby, one being the typical dark red of the old birds, the other a light phase. Two from Myponga, a few miles north of the above locality, have been classed as *P. elegans adelaidensis*, one being in the green immature plumage. Two from the Adelaide plains are very bright birds. One from Mount Pleasant is also a very bright bird. One from South Para is much lighter. Two from Mount Remarkable are of a decided pale form, and have been looked upon by some ornithologists as being more closely allied to *Platycercus flaveolus* than to *P. elegans adelaidensis;* with this he did not agree, for to his mind this form partakes more of *adelaidensis* than *flaveolus*. He also showed a stone from slate outcrops at Mount Remarkable, ripple marked, showing that it had been deposited in shallow water. Mr. F. R. Zietz showed a pink-eared duck (*Malacorhyncus membranaceus*) from the Lower Murray. Mr. E. Ashby showed a pyrites concretion from the Tapley Hill slate.

Papers.—"Notes on the Occurrence of Aboriginal Remains below Marine Deposits at the Reedbeds, Fulham, near Adelaide, by S. A. White, C.M.B.O.U.; "Supplementary Notes on the same, with Remarks on the Geological Section," by Prof. Walter Howchin, F.G.S.; "A New Species of *Aganippe* from Kangaroo Island, with Notes on the Distribution of the Genus in Australia," by R. H. Pulleine, M.B.; "Notes on Australian Polyplacophora, including descriptions of two new genera, a new variety, and the description and proposed recognition of W. T. Bednall's *Stenochiton pilsbryanus*," by Edwin Ashby, F.L.S., M.B.O.U., etc.; and "The Occurrence and Origin of certain Quartz-Tourmaline Nodules in the Granite of Cape Willoughby," by C. E. Tilley, B.Sc. (communicated by Prof. Howchin).

Ordinary Meeting, August 15, 1919.

The President (Sir Joseph Verco, M.D., F.R.C.S.) in the chair.

Letter received from the INTERNATIONAL RESEARCH COUNCIL, enclosing Agenda of the Conferenec to be held in Brussels on July 18, 1919; also letter from the Royal Society of New South Wales *re* Conference to be held in Sydney on 21st inst. Resolved—"That our Hon. Fellows, Professor David and R. Etheridge, jun., be asked to represent this Society at the Sydney Conference, or, in case of their not being able to do so, then our Hon. Fellows Charles Hedley and Professor Wilson."

PAPERS.—"A Contribution to the Study of Habronemiasis," by LIONEL B. BULL, D.V.Sc. A paper on "The Phaestos Disk: its Cypriote Origin," by ALAN ROWE (communicated through the President), was laid on the table, and its reading was postponed until the next meeting.

ORDINARY MEETING, SEPTEMBER 12, 1919.

THE PRESIDENT (Sir Joseph Verco, M.D., F.R.C.S.) in the chair.

NOMINATIONS.—Prof. T. Braileford Robertson and Alan Rowe were nominated as Fellows.

EXHIBITS.—Prof. WALTER HOWCHIN exhibited a tympanic (ear) bone of a whale obtained from the Abattoirs bore, near Dry Creek, about 400 feet from the surface. The specimen probably belongs to the genus *Balaena*, or the Right Whales, as they are known by whalers, and most likely formed part of an immature individual of *Balaena australis*, one of the chief specific representatives of the Balaenidae in the Southern Hemisphere. The bed from which it was obtained is of Upper Pliocene Age. Remains of the Balaenidae are very common in beds of similar age in England and on the Continent of Europe. Fragments of another example were also obtained from the same bore. Capt. S. A. WHITE showed remains of oranges from Fulham, near Adelaide, from which the whole of the pulp and pith had been extracted by black rats, leaving only the rind. Mr. A. M. LEA exhibited a gigantic longicorn beetle *(Batocera wallacei)* from New Guinea, measuring 18 inches across the extended antennae. Mr. A. R. RIDDLE showed a glass-headed pin in which the glass had assumed an amethystine tint from exposure to X-rays. *(Vide* MISCELLANEA.)

PAPERS.—"The Phaestos Disk: its Cypriote Origin," by ALAN ROWE (communicated by the President); "Australian Coleoptera, Part I.," by ALBERT H. ELSTON, F.E.S.; "The Petrology of the Granitic Mass of Cape Willoughby, Kangaroo Island, Part I.," by C. E. TILLEY, B.Sc. (communicated by Prof. Walter Howchin); "Notes on some Miscellaneous Coleoptera, with Descriptions of New Species, Part V.," by

Arthur M. Lea, F.E.S., and "Australian Fungi: Notes and Descriptions, No. 3," by J. B. Cleland, M.D., and Edwin Cheel.

Annual Meeting, October 9, 1919.

The President (Sir Joseph Verco, M.D., F.R.C.S.) in the chair.

Election.—Professor T. Brailsford Robertson and Alan Rowe were elected Fellows.

The Annual Report and Balance-sheet were read and adopted.

Election of Officers.—The following were elected for the year 1919-20:—*President*, Sir Joseph Verco, M.D., F.R.C.S.; *Vice-Presidents*, Major R. H. Pulleine, M.B., and Edwin Ashby, F.L.S., M.B.O.U.; *Hon. Treasurer*, W. B. Poole; *Members of Council*, Professor E. H. Rennie, M.A., D.Sc., F.C.S., Lieut.-Colonel R. S. Rogers, M.A., M.D., Professor Walter Howchin, F.G.S., Professor R. W. Chapman, M.A., B.C.E., F.R.A.S., and Captain S. A. White, C.M.B.O.U.; and the resignation of Samuel Dixon was accepted; *Auditors*, W. L. Ware and Howard Whitbread; *Representative Governor* on Board of Public Library, etc., Professor Walter Howchin, F.G.S.

Resolutions were passed recording the Society's appreciation of the service renderd by Capt. S. A. White in obtaining the passage through Parliament of the Flinders Chase Bill, and also of the long service of Mr. Samuel Dixon as a member of the Council, with special reference to his exertions in connection with the reservation of Flinders Chase.

Exhibits.—Mr. E. Ashby exhibited three plants from Kangaroo Island—an Aster, an Eriostemon, and *Prostanthera speciosa;* also a fungus, commonly known as "native bread," from Gippsland, which, after being brought to Balaklava had grown mushroom-shaped protuberances which would apparently become spore-bearing. Mr. A. M. Lea showed some night-feeding caterpillars (cut-worms) from Bordertown, where on one farm similar caterpillars had completely destroyed 12 acres of wheat; other parts of South Australia had also been badly affected. He also showed some predaceous water bugs *(Dyplonychus)*, the females of which lay their eggs on the backs of the males; they were obtained at Murray Bridge by Mr. H. Hale. Mr. W. H. Selway showed a granite erratic from Inman River, showing signs of glaciation; also a chalcedonous nodule from north of Marree. Mr. B. S. Roach, on behalf of Mr. Lipson Hancock, showed and presented to the Society three enlarged photographs of aborigines taken at Ooldea, on the Port Augusta-Kalgoorlie railway.

Papers.—"Notes on Three Species of Melaleuca," by Edwin Cheel (communicated by J. M. Black); "A Revision of the Australian Salicornieae," by J. M. Black; "Description of Six New Species of Australian Polyplacophora," by Edwin Ashby, F.L.S., M.B.O.U.; "Additions to the Flora of South Australia, No. 16," by J. M. Black; "The Physical Properties of Some South Australian-grown Pines," by Prof. R. W. Chapman, M.A., B.C.E., F.R.A.S.; and "The Cambrian Trilobites of Australia and Tasmania," by R. Etheridge, jun.

ANNUAL REPORT, 1918-19.

The Annual Volume of the Society's Transactions will this year comprise papers dealing with a more varied selection of subjects than usual. While Australian Fungi are further dealt with by Dr. J. B. Cleland and Mr. Cheel, and various other branches of natural history and geology by Professors Howchin and Chapman, Dr. Pulleine, and Messrs. Ashby, Black, Cheel, Elston, Etheridge, Lea, and Tilley, Dr. Bull contributes an interesting paper on a veterinary pathological subject, Mr. Rowe a discussion of a matter of great archaeological interest, and Captain White and Professor Howchin a description of the discovery near Adelaide of aboriginal remains of considerable antiquity.

The interest of the evening meetings has been maintained by the varied exhibits shown by members.

Steps are being taken to reorganize the regular exchange of our publications with those of other scientific bodies, many of which have fallen into arrear owing to the difficulty of transit during the war.

In October, 1918, an International Conference of Scientific Associations was held in the rooms of the Royal Society of London, and attended by delegates from all the allied countries, with a view to establishing an International Research Council for the promotion of scientific research and the dissemination of the results throughout the affiliated organizations. A further meeting was held in Paris in November, 1918, when the movement was definitely launched. This and other scientific societies of Australia have been invited to form an Australian branch, and a conference to consider the proposal was held in Sydney last August, and was attended by representatives from this Society. It is hoped that the result will be our affiliation with what will eventually become a world-wide organization for the extension and dissemination of science.

The long sought dedication of the western portion of Kangaroo Island as a reserve for the conservation of our fauna and flora will soon be an accomplished fact, the Flinders Chase Bill having passed both houses of Parliament, and now only awaiting the vice-regal assent.[1] As this Society and the University of Adelaide are each to be represented upon the board of control, there is every reason to hope that, although the area reserved is smaller than was desired, the best use will be made of the land for the fulfilment of the objects aimed at. The success of the thirteen years' campaign by this Society is very largely due to the continued work of three of our Fellows: Mr. Ashby, Mr. Dixon, and Captain White, the last especially having been untiring in his efforts to ensure the passage of the Bill through Parliament.

The President of the Society having been created a Knight Bachelor, the Fellows took the first opportunity to offer to Sir Joseph Verco their hearty congratulations upon the honour conferred upon him by His Majesty.

The Endowment Fund has been augmented by a donation of £100 from Mrs. Ellen Peterswald. The claims of this fund are urged upon those who are able by their contributions to enlarge the usefulness of the Society.

There have been several losses from our Fellowship by deaths, including that of Sir Edward C. Stirling, a notice of whose valuable work in the service of science will appear in our annual volume.

The present membership of the Society is 10 Honorary Fellows, 5 Corresponding Members, 75 Fellows, and 1 Associate.

Jos. C. Verco, *President.*

Walter Rutt, *Hon. Secretary.*

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(1) The Bill has since received the endorsement of His Excellency the Governor and become law.—Ed.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Revenue and Expenditure for 1918-19.

	£ s. d.	£ s. d.
To Balance October 1, 1918		391 11 6
,, Subscriptions—		
Royal Society	76 18 0	
Field Naturalists' Section ...	23 2 6	
		100 0 6
,, Grants from Government—		
On Subscriptions	54 6 9	
For Printing Reports and Scientific Investigations ...	150 0 0	
		204 6 9
,, Receipts for use of Room by other Societies		5 18 6
,, Sale of Publications		4 3 11
,, Savings Bank Interest		6 0 1
,, Interest transferred from Endowment Fund		130 15 8
		£842 16 11

	£ s. d.	£ s. d.
By Transactions—		
Printing	134 13 8	
Illustrating	90 8 6	
Publishing	2 17 11	
		228 0 1
,, Grant—		
Field Naturalists' Section		25 0 0
,, Library—		
Librarian, Cataloguing, Receiving and Issuing		19 7 4
,, Sundries—		
Cleaning and Lighting ...	13 5 10	
Printing, Postages, Stationery	18 2 4	
Advertising	2 8 6	
Insurance	2 10 8	
		36 7 4
,, Balance September 30, 1919—		
Savings Bank of S.A.	361 15 2	
Bank of Australasia	172 3 10	
Cash in Hand	0 3 2	
		534 2 2
		£842 16 11

Audited and found to be correct—

B. S. Roach,
Howard Whitbread, } *Hon. Auditors.*

W. B. Poole, *Hon. Treasurer.*

Adelaide, October 3, 1919.

ENDOWMENT FUND.

(CAPITAL, £3,579 17s. 6d.)

	£	s.	d.	£	s.	d.
1918—October 1.						
To Balance	3,479	17	6			
Donation	100	0	0			
				3,579	17	6
,, Interest received on Government Stock	130	12	6			
,, Savings Bank Interest	0	3	2			
				130	15	8
				£3,710	13	2

	£	s.	d.	£	s.	d.
1919—September 30.						
By £2,000 S.A. Government $3\frac{3}{4}$% Inscribed Stock at cost ...	1,997	10	0			
,, £450 S.A. Government $3\frac{3}{4}$% Inscribed Stock at cost ...	432	0	0			
,, £800 S.A. Government $3\frac{3}{4}$% Inscribed Stock at cost ...	753	10	8			
,, £500 S.A. Government Consolidated 3% Stock at cost ...	292	8	9			
,, £100 S.A. Government 5% Inscribed Stock	100	0	0			
,, Savings Bank Account	4	8	1			
				3,579	17	6
,, Interest transferred to Revenue Account				130	15	8
				£3,710	13	2

Audited and found correct—

B. S. ROACH,
HOWARD WHITBREAD, } *Hon. Auditors*

W. B. POOLE, *Hon. Treasurer.*

Adelaide, October 3, 1919.

DONATIONS TO THE LIBRARY

FOR THE YEAR ENDED SEPTEMBER 30, 1919.

TRANSACTIONS, JOURNALS, REPORTS, ETC., presented by the respective governments, societies, and editors.

AUSTRALIA.

AUSTRALASIAN INSTITUTE OF MINING ENGINEERS. Proc., n.s., no. 31-34. Melb. 1918-19.

AUSTRALIA. *Advisory Council of Science and Industry.* Bull. 8-13. Melb. 1918-19.

——— ——— Mem., no. 1. Melb. 1918.

——— ——— Report, 1918. Melb.

——— *Institute of Science and Industry.* Science and industry, v. 1, no. 1-4. Melb. 1919.

——— *Bureau of Census and Statistics.* Yearbook, 1918.

——— *Bureau of Meterology.* Monthly report, v. 4, no. 8-9.

——— ——— Orographical maps.

——— ——— Rainfall observations in S.A. and the N.T., 1917-18.

——— *Fisheries.* Zoological results of fishing experiments carried out by F.I.S. "Endeavour," v. 4, pt. 6; 5, pt. 1.

——— *Northern Territory.* Bull., no. 18. 1918.

——— ——— Report of administrator, 1918.

NEW SOUTH WALES.

AUSTRALIAN MUSEUM. Records, v. 12, no. 6-10.

——— Report of the trustees to June, 1918. Syd.

LINNEAN SOCIETY OF N.S.W. Proc., v. 43, pt. 3-4; 44, pt. 1.

MAIDEN, J. H. Critical revision of the genus Eucalyptus, pt. 36-38. Syd. 1918-19.

NEW SOUTH WALES. *Botanic Gardens.* Report, 1917.

——— *Board of Fisheries.* Report, 1917. Syd.

——— *Dept. of Agriculture.* Agricultural gazette of N.S.W., v. 29, pt. 10-12; 30, pt. 1-9. Syd. 1918-19.

——— *Dept. of Mines.* Annual report, 1918. Syd.

——— ——— Mineral resources, no. 25. Syd. 1919.

——— *Dept. of Public Health.* Report, 1917. Syd. 1919.

——— *Geological Survey.* Mem., ethnological ser., No. 3.

ROYAL SOCIETY OF N.S.W. Proc., v. 51. Syd. 1917.

SYDNEY UNIVERSITY. Calendar, 1919.

QUEENSLAND.

QUEENSLAND. *Dept. of Agriculture.* Botany bull., no. 21.
——— ——— Jour., v. 10-11; 12, pt. 1-3. 1918-19.
——— *Geological Survey.* Publications 262-264. 1918.
QUEENSLAND MUSEUM. Mem., v. 6. Brisb. 1918.
ROYAL SOCIETY OF QUEENSLAND. Proc., v. 30. 1918.

SOUTH AUSTRALIA.

PUBLIC LIBRARY, MUSEUM, AND ART GALLERY OF S.A. Report, 1917-18. Adel. 1918.
——— Records of the S.A. Museum, v. 1, no. 2. 1919.
SOUTH AUSTRALIA. *Dept. of Mines.* Review of mining operations in S.A., no. 28-29. Adel. 1918.
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*Miss Bundey bequest.

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HOLLAND.

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LIST OF FELLOWS, MEMBERS, Etc.,

AS EXISTING ON

SEPTEMBER 30, 1919.

Those marked with an asterisk have contributed papers published in the Society's Transactions.

Any change in address should be notified to the Secretary.

Note.—The publications of the Society will not be sent to those whose subscriptions are in arrears.

Date of Election.

Honorary Fellows.

1910. *Bragg, W. H., C.B.E., M.A., F.R.S., Professor of Physics, University College, London (Fellow 1886).
1893. *Cossmann, M., 110, Faubourg Poissonnière, Paris.
1897. *David, T. W. Edgeworth, C.M.G., B.A., D.Sc., F.R.S., F.G.S., Professor of Geology, University of Sydney.
1890. *Etheridge, Robert, jun., Director and Curator of the Australian Museum of New South Wales, Sydney.
1905. Gill, Thomas, C.M.G., I.S.O., Under-Treasurer, Adelaide.
1905. *Hedley, Chas., Assistant Curator, Australian Museum, Sydney.
1892. *Maiden, J. H., I.S.O., F.R.S., F.L.S.. Director Botanic Gardens, Sydney, New South Wales.
1898. *Meyrick, E. T., B.A., F.R.S., F.Z.S., Tohrnhanger, Marlborough, Wilts, England.
1894. *Wilson, J. T., M.D., Ch.M., Professor of Anatomy, University of Sydney, New South Wales.
1912. *Tepper, J. G. O., F.L.S., Elizabeth Street, Norwood (Corresponding Member 1878, Fellow 1886).

Corresponding Members.

1913. *Carter, H. J., B.A., Wahroonga, New South Wales.
1909. *Johncock, C. F., Clare.
1893. *Stretton, W. G., Darwin, Northern Territory.
1905. Thomson, G. M., F.L.S., Dunedin, New Zealand.
1908. *Woolnough, Walter George, D.Sc., F.G.S., Professor in Geology, University of Perth (Fellow 1902).

Fellows.

1918. Andrew, H. W., North Street, Collinswood.
1895. *Ashby, Edwin, F.L.S., M.B.O.U., Blackwood.
1917. Bailey, J. F., Director Botanic Garden, Adelaide.
1902. *Baker, W. H., F.L.S., King's Park.
1907. *Black, J. McConnell, 1, Brougham Place, North Adelaide.
1912. *Broughton, A. C., Young Street, Parkside.
1911. Brown, Edgar J., M.B., D.Ph., 3, North Terrace.
1883. *Brown, H. Y. L., 286, Ward Street, North Adelaide.
1893. Brummitt, Robert, M.R.C.S., Northcote Ter., Medindie.
1916. *Bull, Lionel B., D.V.Sc., Laboratory, Adelaide Hospital.

1907. *Chapman, R. W., M.A., B.C.E., F.R.A.S., Professor of Mathematics and Mechanics, University of Adelaide.
1904. Christie, W., 49, Rundle Street, Adelaide.
1895. *Cleland, John B., M.D., Government Bureau of Microbiology, Sydney, New South Wales.
1907. *Cooke, W. T., D.Sc., Lecturer, University of Adelaide.
1912. Corbin, H. H., B.Sc., University of Adelaide.
1914. Cornish, K. M., on Active Service.
1916. Darling, H. G., Franklin Street, Adelaide.
1887. *Dixon, Samuel, Bath Street, New Glenelg.
1915. Dodd, Alan P., Kuranda, Queensland.
1911. Dutton, H. H., B.A. (Oxon.), Anlaby,
1902. Edquist, A. G., 20, King Street, Mile End.
1918. *Elston, A. H., F.E.S., Childers Street, North Adelaide.
1917. Fenner, A. E., D.Sc., F.G.S., Education Department, Adelaide.
1914. Ferguson, E. W., M.B., Ch.M., Gordon Road, Roseville, Sydney.
1919. Glastonbury, O. A., Adelaide Cement Co., Brookman Buildings.
1904. Gordon, David, c/o D. & W. Murray, Gawler Place, Adelaide.
1880. *Goyder, George, A.M., F.C.S., Gawler Place, Adelaide.
1910. *Grant, Kerr, M.Sc., Professor of Physics, University of Adelaide.
1904. Griffith, H., Brighton.
1919. Grigson, E. C., 99, Grant Avenue, Rose Park.
1916. Hackett, W. C., Rundle Street, Adelaide.
1916. Hancock, H. Lipson, A.M.I.C.E., M.I.M.M., M.Am.I.M.E., Kennedya, Wallaroo Mines.
1896. Hawker, E. W., F.C.S., East Bungaree, Clare.
1883. *Howchin, Walter, F.G.S., Professor of Geology and Palaeontology, University of Adelaide.
1918. Ising, Ernest H., Loco. Department, Islington.
1912. Jack, R. L., B.E., Assistant Government Geologist, Adelaide.
1893. James, Thomas, M.R.C.S., Tranmere, Magill.
1918. Jenison, Rev. J. C., Mount Barker.
1910. *Johnson, E. A., M.D., M.R.C.S., 295, Pirie Street, Adelaide.
1918. Kimber, W. J., Gaza.
1915. *Laurie, D. F., Agricultural Department, Victoria Square.
1897. *Lea, A. M., F.E.S., South Australian Museum, Adelaide.
1884. Lendon, A. A., M.D. (Lond.), M.R.C.S., Lecturer in Obstetrics, University of Adelaide, and Hon. Physician, Children's Hospital, North Adelaide.
1888. *Lower, Oswald B., F.Z.S., F.E.S., 18, Bartley Crescent, Wayville.
1914. Mathews, G. M., F.R.S.E., F.L.S., F.Z.S., Foulis Court, Fair Oak, Hants, England.
1905. *Mawson, Sir Douglas, D.Sc., B.E., Lecturer in Mineralogy and Petrology, University of Adelaide.
1874. Mayo, Geo. G., C.E., 90, Hill Street, North Adelaide.
1919. Mayo, Helen M., M.B., B.Sc., 47, Melbourne Street, North Adelaide.
1907. Melrose, Robert Thomson, Mount Pleasant.
1897. *Morgan, A. M., M.B., Ch.B., 46, North Terrace, Adelaide,

1913. *Osborn, T. G. B., M.Sc., Professor of Botany, University of Adelaide.
1886. Poole, W. B., 6, Rose Street, Prospect.
1911. Poole, His Honor Justice T. S., K.C., B.A., LL.B., *Register* Chambers, Grenfell Street.
1908. Pope, William, Eagle Chambers, Pirie Street.
1907. *Pulleine, Major R. H., M.B., 3, North Terrace, Adelaide.
1916. Ray, William, M.B., B.Sc., Victoria Square, Adelaide.
1885. *Rennie, Edward H., M.A., D.Sc. (Lond.), F.C.S., Professor of Chemistry, University of Adelaide.
1913. *Riddle, A. R., 127, Park Terrace, Wayville West.
1911. Roach, B. S., Education Department, Flinders Street, Adelaide.
1905. *Rogers, Lieut.-Col. R. S., M.A., M.D., Flinders Street, Adelaide.
1869. *Rutt, Walter, C.E., College Park, Adelaide.
1891. Selway, W. H., Treasury, Adelaide.
1906. Snow, Francis H., National Mutual Buildings, King William Street.
1910. *Stanley, E. R., Government Geologist, Port Moresby, Papua.
1907. Sweetapple, H. A., M.D., Park Terrace, Parkside.
1897. *Torr, W. G., LL.D., M.A., B.C.L., Brighton, South Australia.
1894. *Turner, A. Jefferis, M.D., F.E.S., Wickham Terrace, Brisbane, Queensland.
1878. *Verco, Sir Joseph C., M.D. (Lond.), F.R.C.S.
1914. *Waite, Edgar R., F.L.S., Director South Australian Museum.
1912. Ward, Leonard Keith, B.A., B.E., Government Geologist, Adelaide.
1878. Ware, W. L., King William Street.
1907. Webb, Noel A., Barrister, Westall Street, Hyde Park.
1919. Whalley, Rev. D. T., Prince's Street, Alberton.
1904. Whitbread, Howard, c/o A. M. Bickford & Sons, Currie Street, Adelaide.
1912. *White, Captain S. A., C.M.B.O.U., "Wetunga," Fulham, South Australia.
1912. *Zietz, F. R., South Australian Museum.

Associate.

1904. Robinson, Mrs. H. R., "Las Conchas," Largs Bay, South Australia.

APPENDICES.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated)

THIRTY-SIXTH ANNUAL REPORT OF THE COMMITTEE.

For the Year Ended September 30, 1919.

The following Officers were elected at the last Annual Meeting:—*Chairman*, Mr. W. J. Kimber: *Vice-Chairmen*, Dr. C. Fenner, F.G.S., and Mr. J. F. Bailey; *Hon Treasurer*, Mr. B. B. Beck; *Hon. Librarian*, Miss I. Roberts; *Hon. Secretary*, Mr. E. H. Ising; *Hon. Assistant Secretary*, Miss E. Ireland; *Press Correspondent*, Mr. D. J. McNamara; *Committee*, Prof. T. G. B. Osborn, M.Sc., Mr. E. H. Lock, F.R.H.S., Mr. P. Runge, Mr. W. H. Selway, Mr. A. H. Elston, Mr. W. Ham, Mr. E. S. Hughes, Mrs. F. J. Mellor, and the Chairman and Secretary of the Fauna and Flora Protection Committee *(ex officio)*; *Hon. Auditors*, Messrs. Walter D. Reed, F.C.P.A., and W. A. Drummond.

The Fauna and Flora Protection Committee was elected as follows:—Capt. S. A. White, Mr. E. Ashby, Dr. W. Ramsay Smith, Messrs. W. H. Selway, A. M. Lea, S. Angel, J. M. Black, and A. H. Elston, Dr. Fenner, Messrs. J. F. Bailey, P. Runge, H. W. Andrew, and A. R. Riddle, and Chairman and Secretary of the Section *(ex officio)*.

The membership of the Section is now 125.

The following Evening Meetings were held:—

September 17, 1918—Annual Meeting.

October 1, 1918—Address: "The Attractions of Port Willunga to the Nature Study Student."

October 15, 1918—Exhibits by Members.

November 19, 1918—Description by Members of Excursion to Moolooloo, in the Flinders Range.

April 15, 1919—Lecture: "Palms and Cycads." Mr. J. F. Bailey.

May 20, 1919—Lecture: "Climatic Control of Civilization." Dr. C. Fenner.

June 17, 1919—Lecture: "Travel Chat." Sir William Sowden.

July 15, 1919—Lecture: "The earth as an abode of Life." Mr. G. F. Dodwell, B.A.

August 22, 1919—Lecture: "American Birds at Home." Mr. E. Ashby.

September 22, 1919—Lecture: "The Old Dutch Houses at the Cape." Capt. S. A. White.

The following Excursions were held:—

September 21, 1918—Tea Tree Gully: Ornithology. Capt. S. A. White.

September 28, 1918—Blackwood to Eden: Physiography. Mr. A. G. Edquist.

October 5, 1918—Aldgate to Bridgewater: Native Flora. Mr. W. H. Selway.

October 9, 1918—Cherry Gardens: Botany. Mr. W. Ham.

October 19, 1918—Paradise: Introduced Plants. Mr. H. W. Andrew.

October 26, 1918—Gilles Plains: Fruit Culture. Mr. W. J. Kimber.

November 30, 1918—Marino: Shells and Marine Life. Mr. W. J. Kimber.

January 18, 1919—Port River: Dredging Excursion. Mr. W. J. Kimber.

February 8, 1919—Blackwood: Experimental Orchard. Mr. G. Quinn.

March 15, 1919—Port River: Dredging Excursion. Mr. E. R. Waite.

Easter, April 18-21, 1919—New Era: The Murray River. Mr. E. H. Lock.

April 26, 1919—Bridgewater: Native Flora. Mr. E. H. Lock.

May 12, 1919—Sturt River: Geology. Professor W. Howchin, F.G.S.

May 24, 1919—Morialta Gorge: Physiography, etc. Dr. C. Fenner, F.G.S.

June 3, 1919—Port Noarlunga: Fossils and Shell Life. Dr. C. Fenner and Mr. W. J. Kimber.

June 13, 1919—Mount Pleasant: Geology, etc. Mr. W. Ham.

July 12, 1919—National Museum: Mr. E. R. Waite, F.L.S., Director.

July 26, 1919—Botanic Gardens: Trees and Shrubs. Mr. J. F. Bailey.

August 9, 1919—Slape Gully: Plant Life. Mr. W. H. Selway.

August 23, 1919—Henley Beach South: Dune Flora. Mr. G. H. Ising.

September 6, 1919—Blackwood: Native Flora. Mr. A. G. Edquist.

Detailed accounts of the various Lectures and Excursions are published in *The South Australian Naturalist.*

THIRTIETH ANNUAL REPORT OF THE NATIVE FAUNA AND FLORA PROTECTION COMMITTEE.

Four committee meetings were held during the year, and the attendance, on the whole, was good.

Many important matters have received the attention of committee during the year. One event took place which is one of the most important occurrences since the committee was formed, *viz.*, the constituting of Flinders Chase.

Flinders Chase (Kangaroo Island Reserve).

Early in the year the Chairman, accompanied by Mr. G. R. Laffer, M.P., a representative for the district (the Hon. A. H. Peake was prevented from going at the last moment), visited Kangaroo Island. The whole question was personally put forward at a meeting of the Kingscote District Council. After a protracted discussion it was agreed that local opposition to the proposal should cease, and that the Council was willing to have the boundaries of the reserve fixed from Cape Forbin, on the North Coast, running south to the Rocky River Freehold, thence following the freehold south, and then west to the coast. On returning to the city this action was followed up by the chairman having repeated interviews with the Hons. the Premier and the Attorney-General to ensure having the reserve properly constituted under Act of Parliament. Subsequently a promise was given by members of the Ministry that the Flinders Chase Reservation Bill would be introduced early in the middle session. This promise has been carried out and the Bill has now passed both Houses, practically without alteration. Thus after twelve years' hard struggle the Chase has been constituted. The area—about 200 square miles—is not large enough, but the Act provides for extension.

The Game Bill.

The Game Bill, drafted with a view to securing better protection of wild animals and birds, which lapsed in the first session of Parliament, was restored early in the second session, as promised, and after being much mutilated has become law; although several strong measures were lost, still it is a vast improvement on the old Act, and we must hope for amendments in the future.

Seals.

As a result of persistent representations made to the Honorable the Attorney-General, the chairman reported that both Gulfs had been closed against the slaughter of these animals. All waters and islands within a line drawn from Cape Borda to Cape Catastrophe, and from Cape Willoughby to Victor Harbour, including The Pages, now forms a sanctuary for seals.

Infringements of Animal Protection Laws.

The wrongful capture of seagulls near Glenelg and slaughter of kangaroos were discussed, and action deemed appropriate by the committee was taken. The Coorong Islands were visited by the Chairman, in company with Mr. G. R. Laffer, M.P., Chairman of Committees, and the Chief Inspector of Fisheries, and a number of notice boards, *re* absolute protection of birds, placed thereon.

Destruction of Native Flora.

The Local Government Department was communicated with respecting the indiscriminate destruction of native flora on public highways in certain districts.

Conclusion.

Personal efforts put forth by the Chairman towards finalizing the reservation of Flinders Chase and the gazetting of both gulfs as sanctuaries for seals were endorsed by the committee, and congratulations unanimously extended to him.

A letter of thanks was sent to the Press expressing appreciation for prominence given to Flora and Fauna Protection questions.

S. A. White, *Chairman.*

H. W. Andrew, *Hon Secretary.*

Field Naturalists' Section of the Royal Society.

Statement of Receipts and Expenditure for Year ended September, 1919.

General Account.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
By Balance brought forward	5	1	3	To Members' Subscriptions paid to Royal Society	23	2	6
,, Grant from Royal Society	25	0	0	,, Postages	8	4	11
,, Members' Subscriptions	23	2	6	,, Stationery	0	14	10
,, Bank Interest	0	10	11	,, Hire of Hall and Lantern	5	10	4
				,, Printing	9	14	0
				,, Advertising	0	18	0
				,, Binding Library Books	0	6	6
				,, Balance carried forward	5	3	7
	£53	14	8		£53	14	8
By Balance £5 3 7							

Excursion Account.

	£	s.	d.		£	s.	d.
By Balance brought forward	7	11	3	To Hire of Motors	30	0	0
,, Excursion Fares	39	1	0	,, Hire of Steam Tug	5	5	0
				,, Refreshments	0	6	6
				,, Gratuities to Sailors	0	10	0
				,, Cartage of Dredge	0	13	4
				,, Credit Balance	9	17	5
	£46	12	3		£46	12	3
By Balance £9 17 5							

Audited and found correct,

WALTER D. REED, F.C.P.A., } *Auditors.*
A. M. DRUMMOND,

September 15, 1919.

GENERAL INDEX.

[Generic and specific names printed in italics indicate that the forms described are new to science.]