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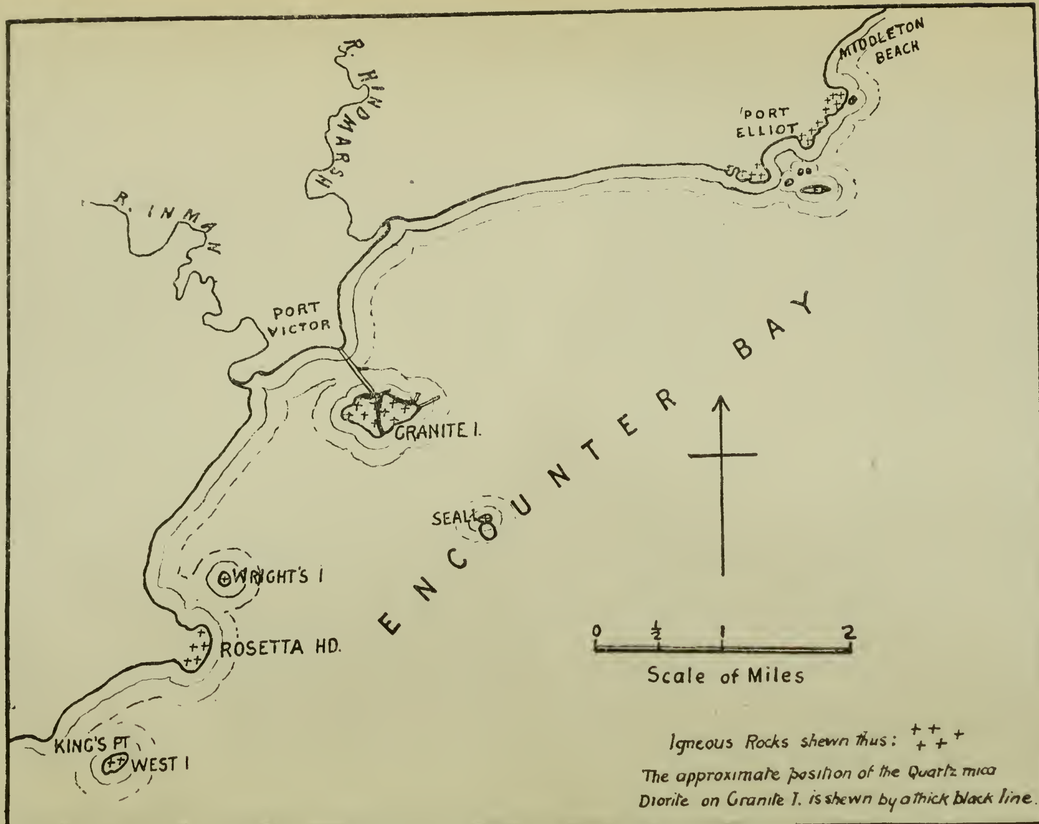

Fig. 1.

Map of part of Encounter Bay, showing approximately the extent of the igneous outcrops.

THE

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THE IGNEOUS ROCKS OF ENCOUNTER BAY, SOUTH AUSTRALIA.

By W. R. Browne, B.Sc.
(Communicated by Professor Walter Howchin.)

[Read November 13, 1919.]

Plates I. to IV.

Contents.

1. Introduction.

In the literature of South Australian geology the country around Encounter Bay has received a certain amount of attention principally on account of the very marked evidences of the Permo-Carboniferous glaciation which abound thereabouts.(1) Of systematic petrological investigations of the igneous rocks there are, however, very few records. A brief petrographical description of a biotite granite from Port Victor has been given by J. C. Moulden,(2) who also describes an axinite amphibolite from Rosetta Head. H. W. Gartrell(3) investigated the chemical and optical properties of the felspar phenocrysts of the granite, and Dr. Chewings(4) briefly described a uralitic diabase from Port Elliot.

The field work on which the present paper is based was carried out some years ago while the author was Acting-Lecturer in Petrology in the University of Adelaide. A few visits were made to the localities on the mainland where outcrops of the igneous rocks occur, but it was found impracticable to visit the granitic islets lying off the coast, except, of course, Granite Island, which is artificially connected with the mainland. Unfortunately, since the laboratory work was undertaken in Sydney no opportunities have been available of revisiting the localities, and certain questions requiring further field examination, which have presented themselves in the course of the work, have had to remain uninvestigated. This fact, coupled with the loss of a number of specimens in transit to Sydney, must be the excuse for any incompleteness in the present paper.

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(1) Howchin: Trans. Roy. Soc. S. Austr., 1904, 1906, 1910, etc.; Howchin: Geology of South Australia, Adelaide, 1918.

(2) Trans. Roy. Soc. S. Austr., vol. xix., 1894-5, p. 70.

(3) Trans. Roy. Soc. S. Austr., vol. xxvii., 1903, p. 256.

(4) Ein Beitrage zur Kenntniss Geologie und Petrologie Sud und Central Australiens, Heidelberg, 1894.

II. Coastline Physiography.

A glance at the map (fig. 1) will show the distribution of the igneous rocks, and at the same time serve to indicate how the coast owes its configuration to the presence of the resistant masses of granite. The coastline has a general N.E.-S.W. trend, with two prominent projections at Port Elliot and Rosetta Head respectively. Not quite midway between these Granite Island lies, just off Port Victor, separated from the blunted point of land by a very shallow expanse of water, and evidently but recently severed from the mainland. On the other side of Rosetta Head the coastline curves round to another minor projection, King Point, off which lies West Island, which, like Granite Island, was at no distant geological date connected with the mainland.[5]

The two main projections, as well as the two islands referred to, are composed of granitic rocks which have offered a stubborn resistance to the attacks of the sea, which has eroded those portions of the coast not so protected. This has resulted in the production of the long unbroken cuspate stretches of sandy beach with nodes at Port Elliot, Port Victor, and Rosetta Head, as well as the concave stretch of coastline between Rosetta Head and King Point.

Prof. Howchin has inferred from the glacial evidences in the vicinity that a great granitic mountain mass formerly extended to the east and south of the present coastline in Permo-Carboniferous times, which has since foundered, and of which Granite Island, West Island, and a number of smaller islets off the coast, form a remnant.

The original boundary of the granite outcrop was evidently not far inland from the present coastline.

III. Genral Field Relations of the Igneous Rocks.

The igneous rocks are intrusive into mica-schists, which Prof. Howchin considers to be "probably Lower Cambrian,"[6] and the contact can be studied at the north side of Rosetta Head, where a fine section is exposed. Lying unconformably on the schists are the practically level-bedded glacial deposits of the Permo-Carboniferous: these outcrop prominently just close to the granite on the south-west side of Port Elliot, at various points near sea level between Port Elliot and Port Victor, and along the coast with little interruption round to Rosetta Head. On top of these there is in places a covering of nodular "travertine" or kunkar, which is extensively

(5) Howchin: Trans. Roy. Soc. S. Austr., vol. xxxiv., 1910, p. 7.

(6) Geology of South Australia, p. 363.

developed, and is of comparatively recent geological age. It transgresses over the granite at Port Elliot, and patches of it are to be seen on the east and south of Granite Island as well as at Rosetta Head.

The igneous rocks form a complex of distinct but closely-related intrusions comprising granite of two different kinds, albite syenite, quartz mica diorite, soda granophyre and aplite, and potash aplite. A number of doleritic intrusions are, as will be shown, possibly related to the more acid rocks.

As indicated above, the igneous rocks outcrop only at the three prominent points—Port Elliot, Granite Island, and Rosetta Head—in addition to the small islets, which were not visited.

(1) GRANITE ISLAND.

Porphyritic Granite.—The island is composed for the most part of porphyritic granite, which is the normal or preponderating type, and is found also at Port Elliot and Rosetta Head, as well as on West Island, and apparently on most of the other islets too. It is a coarse-grained biotite granite, very conspicuously porphyritic in felspar of a greyish-pink colour, and studded with bluish opalescent quartz crystals and grains up to nearly half an inch in length, which impart to the rock a very striking and characteristic appearance. The granite weathers in such a way that the felspar phenocrysts, some of them upwards of 2 in. in length by about 1 in. in breadth, stand out from the rest of the rock, causing it to have, from a little distance, the appearance of a conglomerate or breccia (pl. i., fig. 2).

Jointing is very conspicuous, and is very noticeable near the breakwater, where the direction of the joints is a little east of north. Here the joint-faces exposed by quarrying show slickensides, as well as a skin of sericitic mica, resulting doubtless from differential movement during the uplifts and subsidences to which the area has been subjected since the consolidation of the granite.

Inclusions, both small and great, of the invaded schists are fairly numerous: one of these, on the west side of the island, is about 12 ft. long. As a rule the boundaries of these inclusions are quite sharp, no apparent assimilation having taken place. In a number of cases, however, small inclusions, about 3 or 4 in. long, appear to have been altered and partially assimilated.

Quartz Mica Diorite.—The granite is traversed in a roughly meridional direction, from side to side of the island, by two broad dyke-like masses of dense bluish rock, in parts fairly thickly studded with large felspars and smaller quartz crystals similar to those of the porphyritic granite, but in other places quite even-grained and very dark and compact. As one goes round the northern margin of the island, walking eastwards from the end of the jetty, the first of these masses is to be seen commencing from behind the tramshed, while the other is encountered a little further along. The width of the two masses together is about 60 yards.

The first mass may be traced for some distance up the slope in a southerly direction, but is soon lost; the other passes up behind the harbour-master's house, and appears again in a good strong section on the south side of the island. Another section on the cliffs of the south side, but more to the west, may be the continuation of the first mass, but the capping of "travertine" and soil which covers the higher parts of the island makes it difficult to trace the outcrops.

Of the two sections seen on the north side of the island the first, or more westerly, is the denser and finer in grain; the other is rather more coarsely crystalline and richer in the large felspar and quartz crystals. On the whole there is a gradual increase from west to east in grainsize and in proportion of large crystals. This is not maintained on the cliff-sections on the south side of the island, where the rock is moderately studded with phenocrysts, which are rather more numerous near the contact with the granite and decrease towards the centre of the mass.

The field relations between the granite and the finer-grained rock are such that the determination of relative age is difficult. On the one hand, inclusions of the diorite are found in the granite, like basic secretions; but on the other hand, at the contact tongues of diorite are seen to penetrate the granite and *vice versâ*, so that at one time the diorite, at another the granite, seems to be the intrusive rock.

The boundaries of the two rocks are not sharply defined, and this is best seen on the south side of the island. The junction lines are frequently curved and twisted, and there is a suggestion of blending, as if at the time of intrusion both rocks had not been wholly solidified. No chilled contacts were observed.

At all events, whichever of the two was injected first, it is certain that no great time-interval separated the acts of intrusion, and the precise order is of no great moment.

Both the granite and the quartz mica diorite are diversified in places by veins and veinlets of pink aplitic rock.

(2) ROSETTA HEAD.

Porphyritic Granite.—This is similar to that of Granite Island.

Albite Syenite.—The porphyritic granite has associated with it a mass of albite mica syenite. This is a coarse-grained rock, typically containing large phenocrysts, up to 2 in. long by about 1¼ in. broad, and simply twinned. The remainder of the rock is composed, megascopically, of smaller felspars, with a varying amount of silvery-grey chloritic mica. The porphyritic character is sometimes lacking, and in these circumstances mica is usually very abundant. The white colour and the absence of megascopic quartz clearly differentiate this rock in the field from the porphyritic granite.

Probably owing to the presence of chlorite the rock is extremely tough, and good specimens are rather difficult to procure.

On the northern side of the headland, near the old wharf, the syenite is in contact with the invaded schists, which it has altered considerably and into which it has thrust long tongues of non-porphyritic material, as well as numbers of veins, large and small, composed of quartz and mica.

Following the shore-line round to the east and south one finds the syenite continuing for some distance, but it is soon replaced by granite, the boundary of the two rocks sloping upward towards the south.

On the southern side of Rosetta Head the syenite is again seen, and for a considerable distance on the landward side it is the rock in contact with the schists. In spite of all the exposures, however, a junction showing clearly the relations of granite and syenite was not found.

Enclosures of the country rock, sometimes several yards in diameter, are found in both the syenite and the granite, and occasional pipes of potash aplite cut through the coarser-grained rocks.

Uralitic Dolerite.—A number of altered basic dykes are to be seen in the neighbourhood of Rosetta Head. One of these runs in an approximately meridional direction behind the headland among the schists; another, following the strike of the schists, is encountered on the shore between the headland and King Point, while a third, not more than 3 ft. wide, cuts the granite and can be seen outcropping on the top of the headland somewhat on the southern side. This is traceable through the plutonic rock for a distance of about 40 yards.

Prof. Howchin has recorded the existence of numerous other similar dykes at various points inland from Rosetta Head, and the present writer has observed one exactly comparable with those at Rosetta Head, about 6 miles up the valley of the Inman.

(3) PORT ELLIOT.

At Port Elliot we get more variations in the igneous rocks than elsewhere. They form a fringe of rocky coast extending for about a mile and a half, notched by sandy bays of various sizes, the largest being about 600 yards wide. These are due in some measure to the jointing of the granite (fig. 2).

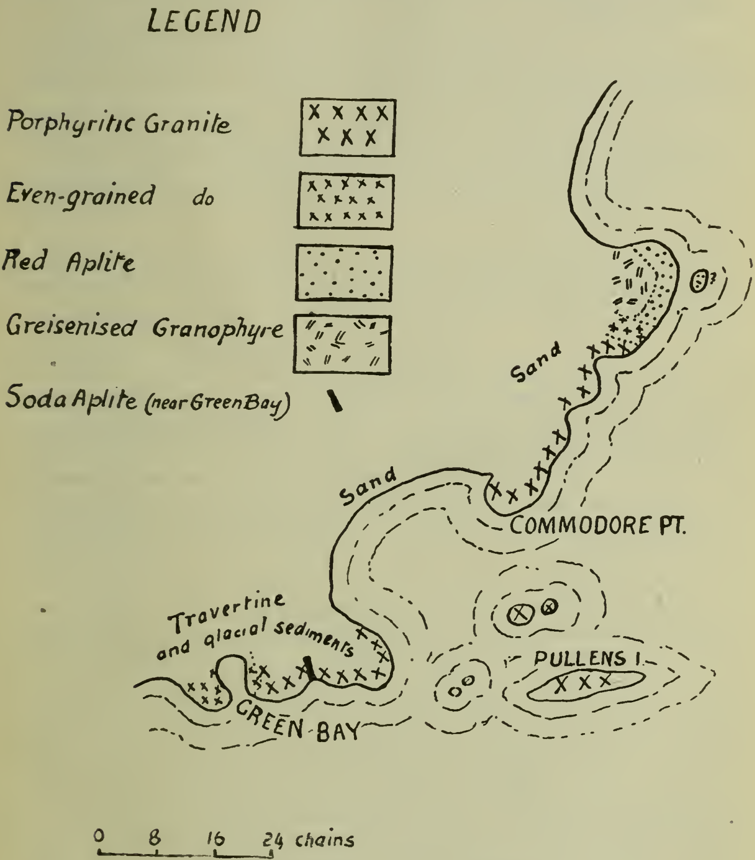

Fig. 2. Coastline at Port Elliot.

The igneous rock never extends for more than 300 yards inland, and indeed in places does little more than form the face of a scarp sloping to the sea. The real landward extent of the outcrop cannot be determined, as it is overlain by a deposit of "travertine," and at its western extremity disappears under the horizontally-stratified Permo-Carboniferous glacial beds.

In addition to the porphyritic granite the rocks of Port Elliot include a more acid, even-grained granite, a relatively coarse-grained mass of red aplite, another mass of greisenised soda granophyre, and a dyke of soda aplite. The granites are intersected by pipes and narrow dykes of potash aplite and veinlets of coarse pegmatite, with frequent patches of quartz and tourmaline.

Porphyritic Granite.—This constitutes the greater part of the igneous rock at Port Elliot. It extends from about Green Bay right around past Commodore Point, with one wide gap which is occupied by a sandy bay.

In general appearance it bears a certain resemblance to the Granite Island rock, but on the more southerly parts of the outcrop the phenocrysts are smaller and the opalescent quartz crystals are perhaps more abundant and of a deeper blue.

Sharply-bounded inclusions of schist are found, some of large dimensions, and in one place a rounded enclosure of porphyritic diorite, similar to that of Granite Island, was seen.

The weathering of the granite is distinctive. Whereas the Granite Island rock has a rough and breccia-like surface, that of Port Elliot is smooth, the felspar phenocrysts being by no means prominent. This is due, in part at least, to the fact that much of the rock is being constantly wetted by waves or spray, which protect it from the destructive influences, both mechanical and chemical, of the atmosphere; at Granite Island, in the region of calm water, this protection is not available.

Even-grained Granite.—Megascopically this bears some slight resemblance to the porphyritic granite, but differs from it in the absence of large crystals of felspar and quartz, in the smaller proportion of ferro-magnesian constituents, and in the finer grain. This type of rock is first met as one approaches Port Elliot along the shore from the Victor Harbour side. It weathers to a reddish-pink colour on the surface and for a little distance down, but at depth shows the blue-grey tint due mainly to the presence of opalescent quartz. As one goes east this even-grained granite is seen to enclose masses of the porphyritic granite and to invade the latter in tortuous tongues. There has been a certain amount of contamination by the older rock, for at the contact the even-grained granite acquires sparingly phenocrysts of felspar and large blue quartz crystals, a feature which dies out with increasing distance from the contact.

The junction between the two granites is not sharp, but of a "swirling" nature, somewhat like that between the granite and diorite of Granite Island, showing that here, too, the time-interval between intrusions was small.

At Green Bay the even-grained granite is definitely succeeded by the porphyritic type, but it reappears on the coast past Commodore Point and continues for some little distance.

It is noteworthy that no inclusions of country rock have been found in this even-grained granite.

Red (potash) Aplite.—Past Commodore Point the even-grained granite is succeeded by a mass of brick-red coloured aplitic rock which fringes the coast for about 400 yards, round almost to Middleton Beach. This rock is readily distinguished by its characteristic weathering colour and by the close jointing by which the outcrop is intersected. The field relations of the mass could not be made out, but it is probably intrusive towards the even-grained granite. Landward its extension is not very great, and it is soon succeeded by other rocks. The rock is finer grained than the granites but distinctly coarser than the other aplites, and there is a notable absence of ferro-magnesian minerals.

Greisenised Soda Granophyre.—At the back, or landward, side of the red aplite and even-grained granite, and extending up to Middleton Beach, is an outcrop of fine-grained muscovitic rock which microscopical investigation has shown to be a pneumatolytically-altered soda granophyre. Its field relations with regard to the contiguous rocks could not be determined, and inland it soon disappears under a cover of sand.

Soda Aplite.—Probably very closely related to the soda granophyre is a fine-grained soda aplite which occurs as a dyke cutting the granite a little east of Green Bay. The dyke is only a few feet wide and runs seawards in a more or less meridional direction. Associated with it is a rim of biotite similar to those described below in connection with aplite pipes. The rock is of a cream colour, and towards the edges of the dyke has been contaminated by the granite, acquiring a little biotite and opalescent quartz.

Minor Potash Aplites, etc.—Other aplites, characterized by fineness of grain and by the presence of subordinate biotite, are found pretty abundantly at Port Elliot as veins or pipes cutting through the porphyritic and even-grained granites. As a rule the boundaries of the intrusions are quite sharp, but sometimes they are accompanied by a curious segregation rim of biotite. Fig. 3 shows diagrammatically such an occurrence. There is an aplitic pipe *(a)* with nests of quartz and tourmaline *(b)*; this is surrounded by a zone of the coarser granite *(c)* with less than the normal proportion of biotite, and varying in width from 1 in. up to 18 in. This zone is separated from the normal granite *(e)* by a narrow band or rim *(d)* 1 in. to $1\frac{1}{2}$ in. wide, very rich in biotite. Along this biotitic rim differential erosion has often produced a little depression or gutter.

The small nests of quartz and tourmaline are fairly common among the aplites, and appear occasionally in the granites, and even in the syenite of Rosetta Head. Megascopically one of these nests appears as a dense mat of tourmaline needles with a little interstitial felspar, the whole surrounded by a selvage of quartz. Viewed microscopically the tourmaline, strongly pleochroic from light brown to indigo blue, is seen to be replacing felspar, the replacement

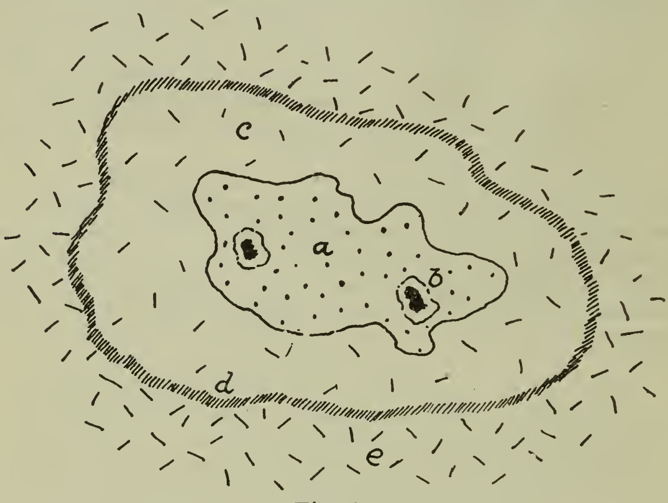

Fig. 3.

starting along cleavage planes, and the whole apparently represents an alteration of aplite by magmatic emanations.

Of the same general type, though on a larger scale, is a pipe about 4 ft. across, the outer rim being of quartz and biotite with some large felspars, forming a kind of pegmatite. Within this is a zone of quartz, and the centre is occupied by tourmaline.

Uralitic Dolerite.—The uralitic diabase described by Dr. Chewings is[7] from a small pipe cutting through the granites on the eastern side of Green Bay. The outcrop is visible only at low tide, and the author was never fortunate enough to find it uncovered.

(7) *Vide* Prof. Howchin.

IV. Petrography.

(1) porphyritic granite.

The type specimen was collected on Granite Island. The author is indebted to Mr. Rumbelow, of Encounter Bay, for a specimen from West Island, and this is identical in all respects with the type.

The minerals visible megascopically comprise *potash felspar* phenocrysts, rather tabular in habit, and usually showing irregular carlsbad twinning; *quartz*, bluish opalescent, the opalescence being occasionally interrupted and at times zonally disposed; *biotite* and small *felspar*, occasionally striated, in the interspaces, and at times a little *pyrites*.

Under the microscope are seen quartz, plagioclase, microcline, and biotite, with subordinate muscovite, apatite, and magnetite, and a little zircon and pyrites. The first three of these, and possibly biotite as well, occur in two generations. The rock texture is dominated by the larger crystals of microcline, quartz, and plagioclase, with an interstitial filling of the same minerals and biotite.

Microcline.—This mineral has been described in some detail by H. W. Gartrell,[8] who refers it to the anorthoclase group, but a re-examination of some of the optical and other physical properties points to the mineral being rather a microperthitic microcline. A section parallel to (010) gives an extinction of 6°, and shows streaks of another felspar, in roughly parallel orientation, with a R.I. higher than that of the host but lower than Canada Balsam. The D.R. of these streaks is slightly stronger than that of the host, and an extinction angle of 19° is found. The direction of the streaks makes an angle of 64° with the basal cleavage, which would make them parallel to (100). Sections of the phenocrysts cut normal to (010) show the usual microcline twinning, spindle-shaped rather than cross-hatched, and in addition have small discontinuous lenticular inclusions of plagioclase arranged roughly normal to the pinacoidal cleavage. There is no doubt then that there is a microperthitic intergrowth of albite with microcline.

Mr. L. A. Cotton, M.A., B.Sc., kindly made some rough measurements of the optic axial angle of the mineral, with the result that the approximate value of 76° was found for 2V. This is much closer to the value for microcline than to that for anorthoclase.

Gartrell's analysis of the felspar as given in his paper shows nothing unusual in the way of soda percentage for a

(8) *Loc. cit. sup.*

perthite, but it must be admitted that the lime is rather high,

	I.	II.	III.	IV.
SiO_2 ...	64·54	65·00	64·96	65·05
Al_2O_3 ...	19·34	19·50	18·91	19·19
Fe_2O_3 ...	tr.	·35	·43	·28
MnO ...	tr.	tr.	tr.	tr.
MgO ...	tr.	·05	—	—
CaO ...	1·24	·30	·32	·41
Na_2O ...	2·88	3·03	3·31	3·57
K_2O ...	11·84	12·36	12·09	11·19
H_2O ...	·58	·26	·18	·15
Total	100·42	100·85	100·20	99·84
Sp. gr.	2·562 (9)	2·568	—	2·564

I. Phenocryst from Port Victor granite. H. W. Gartrell, Trans. Roy. Soc. S. Austr., vol. xxvii., 1903, p. 257.

II. Perthitic felspar, Westfield, Mass, U.S A. W. H. Warren, Proc. Amer. Acad. of Arts and Sci., vol. 51, 1915, p. 139.

III. and IV. Perthitic felspars, Finland. Anal. Mäkinen. Quoted by W. H. Warren, *loc. cit.*

as is indicated by comparison of the analyses given above. Some of the lime would be accounted for by the inclusions of apatite and of andesine which are present, but even making allowance for these it is difficult to explain the figures.

The proportions of the various felspar molecules calculated from the analyses for the Victor Harbour and one of the Finland occurrences are:—

	I.		IV.
Or ...	65·7		67·2
Ab ...	22·9	34·3	32·8
An ...	11·4		

The felspar then is to be regarded as a microperthitic microcline.

The phenocrysts contain inclusions of biotite in good crystals up to about 2·5 mm.; this appears exactly of the same kind as that found elsewhere in the rock, but of smaller size and idiomorphic form. Occasionally the biotite is accompanied by muscovite either well crystallized or very ragged. Zoned plagioclase crystals up to 2 mm. in length and of the composition of andesine or oligoclase are also included. Quartz

(9) A re-determination gave this result. Gartrell's original figure was 2·582.

inclusions in ragged or rounded grains are irregularly distributed, at times forming a narrow rim or frame surrounding the inclusions of plagioclase or mica. A little apatite is also seen, in needles and short stout prisms.

All of these are primary inclusions, of earlier date than the felspar, but other apparent inclusions of quartz and sericitic muscovite are strung out in irregular lines and evidently fill cracks or solution cavities. A fairly constant characteristic of these felspar phenocrysts is the presence of a rim of variable width composed of quartz granules graphically intergrown with the felspar and optically continuous with each other over small areas, or at other times optically independent. The inner edge of the rim is as a rule straight. There are outgrowths of the felspar beyond the rim, the phenocrysts having as a result irregular boundaries against the other minerals of the rock. These outgrowths are usually notably free from perthitic intergrowths of albite. The whole appearance suggests that the felspar originally separated out from a fluid magma in idiomorphic crystals, and afterwards, under changed conditions, resumed growth, the additions consolidating during the crystallization of the ground-mass (see pl. i., fig. 1). It is this characteristic of the phenocrysts that produces the deceptive effect, megascopically, of rounding and resorption.

The microcline of the second generation is not in great amount, and is free from inclusions, and for the most part also from perthitic intergrowth, though traces of this are occasionally seen.

Quartz.—The quartz of the earlier generation is subidiomorphic at times, in crystals up to 1 cm. in length, and preserving under the microscope their hexagonal appearance, but with very ragged boundaries. Minute liquid and glass inclusions are extremely abundant everywhere throughout the crystals, occasionally aggregating into bands or strings and often containing fixed or mobile gas bubbles. In addition extremely slender dark rods, up to about ·01 mm. long, are very thickly distributed in places; these may be rutile. The quartz crystals show undulose extinction and are invariably traversed by irregular cracks which break up the area covered by any one section of quartz into a number of smaller areas, each in different orientation from its neighbours, as if fracturing had been in some way accompanied by rotation of the fragments. And yet strings of glass inclusions are often continuous over two adjacent areas. The cracks when cut diagonally polarize in bright colours.

A curious feature in connection with this irregular cracking is that in thin section the quartz when viewed in reflected light with the naked eye or under the microscope exhibits the opalescence in some of the irregular patches bounded by cracks, while other areas are dark. In transmitted light under the microscope the areas which showed opalescence exhibit a very faint but quite distinct yellowish tinge, while the other areas are quite colourless. No connection could be traced between the optical orientation of any fragment and the presence or absence of opalescence in it.

The quartz of the ground-mass is thoroughly allotiomorphic and is clear and free from cracks, but is not otherwise noteworthy.

Plagioclase. — This is in subidiomorphic crystals and irregular grains up to about 6 mm. in length, strongly zoned and twinned on the albite and pericline laws. Optical measurements were hard to get, but extinctions on a section parallel to (010) indicate a composition ranging between andesine (Ab_{60}) and oligoclase (Ab_{85}). In other crystals the outer margins are as acid as Ab_{90}. The composition does not vary continuously, but oscillates somewhat, in some crystals at all events. The felspar is spangled with secondary mica which develops mainly along cleavage planes. There are a few small grains of plagioclase in the ground mass, having the composition Ab_{90}, or in other words, the same as the outer zones of the larger crystals. The latter dovetail into the minerals of the ground-mass, and the inference is that, in the plagioclase as in the microcline, after the crystallization of the phenocrysts some of the felspar of the residual magma crystallized in optical continuity with the phenocrysts, while the rest went to form separate crystals.

Biotite.—Apart from the idiomorphic inclusions in microcline this mineral forms, with the second generation of quartz and felspar, a filling between the larger crystals. It varies considerably in size, the largest individuals being about 3 mm. in length, while the smallest are mere specks. The former may possibly belong to an earlier generation; they are very ragged and corroded and contain fairly abundant inclusions of apatite, ilmenite rods, and zircon.

Much of the smaller biotite is fairly idiomorphic, but quite irregular flakes are found intergrown with and wrapping round the quartz and felspar of the ground-mass; this biotite is much less marked by inclusions than the larger corroded material.

Other Minerals.—A little muscovite is intergrown with the biotite. Apatite in small stoutish prisms, zircon as tiny crystals in biotite surrounded by dense pleochroic haloes, ilmenite always included in biotite, and a little pyrites complete the mineral constitution.

A specimen of the granite from Granite Island was analysed, and the analysis is given below, along with that of another South Australian microcline granite, for comparison:—

	I.	II.
SiO_2	68·20	68·31
Al_2O_3 ...	15·99	15·21
Fe_2O_3 ...	0·89	0·53
FeO	2·58	3·73
MgO	0·80	0·65
CaO	2·61	1·99
Na_2O	2·85	3·14
K_2O	4·60	4·68
H_2O+ ...	0·64	0·44
H_2O- ...	0·21	0·08
CO_2	abs.	abs.
TiO_2	0·58	0·53
P_2O_5	0·14	0·29
MnO	0·04	0·04
BaO	0·04	abs.
ZrO_2	p.n.d.	—
FeS_2	0·11	0·09
Cl	—	0·10
Total ...	100·28	99·81
(10) Sp. gr. at 19° C	2·673	

I. Porphyritic granite from Granite Island. Anal. W. R. Browne.

II. Granite, Hundred of Moody, Co. Jervois, Eyre Pen. Anal. W. S. Chapman.(11)

An approximate mode calculated from the analysis gave the following weight-percentage composition:—

Quartz	28·9
Microcline	23·3
Plagioclase (Ab_{64})	29·8
Biotite	16·3
Ilmenite	1·2
Apatite	·3
Other minerals	·2

Certain assumptions had to be made in arriving at this result. All the MgO and FeO were allotted to biotite, and

(10) The standard of comparison is water at 4°C.

(11) Geol. Surv. of S. Austr., Bull. No. 3. Geology of the Co. of Jervois, by R. L. Jack, B.E., F.G.S., p. 14.

all the microcline was assumed to be perthitic and to have the composition found by Gartrell for the phenocrysts.

The mineral constitution and the chemical composition alike indicate that the rock belongs to the *Adamellite* division of the granite family.

(2) QUARTZ MICA DIORITE.

A number of specimens of this rock, chosen to illustrate the variation in characters, have been sectioned. No. 1 represents the quartz mica diorite proper, without any large crystals. It is a dense dark-blue rock, and under the microscope is seen to be holocrystalline, of fine variable grain size, and hypidiomorphic granular. A Rosiwal measurement gave the following percentage mineral constitution by weight:—

Quartz	36·1
Plagiolcase	41·7
Biotite	20·9
Ilmenite	1·3

One or two sections of potash felspar were also noticed, and a little sphene and apatite occur.

Plagioclase is in short idiomorphic prisms, averaging about ·4 mm., and is slightly dusted with alteration products. Some sections are zoned, and the composition appears to range from about Ab_{52} to Ab_{75}.

Biotite is quite fresh, with a strong, rather greenish-brown colour; it inclines to idiomorphism at times. Included in it there are commonly very tiny granules of sphene bunched together or in strings, and often clustering round the edges of the mica. The biotite appears to have crystallized partly before and partly after the felspar.

Quartz is granular and interstitial, wrapping round and sometimes including the felspar and other minerals. It is notably free from cracks and inclusions, in contrast to the opalescent quartz of the porphyritic granite.

Ilmenite is not very abundant. It is sometimes altered to secondary sphene. How far the sphene in the rock is primary is uncertain; a little does certainly occur in sub-idiomorphic sections, but much of the minutely granular material associated with the biotite is probably secondary.

Microlitic needles of apatite are fairly abundant, but strangely enough very little of it is included in the biotite. A certain amount of strain is indicated in the rock. The absence of zircon in the biotite is noteworthy, likewise the virtual absence of the potash felspar from the rock.

I am indebted to Mr. C. T. Tilley, B.Sc., for the following analysis of the rock:—

SiO_2	68·60
Al_2O_3	14·30
Fe_2O_3	0·79
FeO	4·70
MgO	1·24
CaO	2·88
Na_2O	3·40
K_2O	2·28
H_2O+	0·87
H_2O-	0·24
TiO_2	0·59
CO_2	abs.
P_2O_5	sl. tr.
Total	99·89

Sp. gr. at 20°C ... 2·716

The approximate mode, calculated from the analysis, is:—

Quartz	34·20
Plagioclase	43·67
Biotite	20·90
Ilmenite	1·23

In this calculation all the K_2O was taken to form biotite, potash felspar being practically absent from the rock. The agreement between the measured and calculated modes is very close.

No. 2 represents another portion of the rock-mass which is practically free from large crystals. Like the previous specimen it appears fairly evengrained megascopically. It differs from No. 1 only in being not quite so fine grained, and in the presence of potash felspar. This mineral is in relatively large allotriomorphic plates enwrapping all the other minerals, including even quartz at times. There are obscure traces of gridiron twinning, indicating microcline. The plagioclase prisms are about ·6 mm. long.

No. 3 is of somewhat different fabric from Nos. 1 and 2. It is perhaps in the average slightly finer than No. 1, and the grainsize for the individual grains is very variable. Plagioclase is in tiny subidiomorphic laths, but also occurs in larger more equidimensional sections. Quartz while mostly granular very often forms irregular micrographic intergrowths with felspar. Some of the felspar is microcline, but this is very subordinate. The plagioclase is altering zonally to carbonates.

The rock is noteworthy as containing a little hornblende intergrown with the biotite. Sphene and ilmenite are as in

No. 1, and there is a little pyrites. Apatite is in tiny needles and in stout prisms about ·25 mm. long. A few of the crystals are partially coloured, and pleochroic in blue and brown tints.

Occasional large crystals of microcline, opaline quartz, and plagioclase are scattered through the rock.

No. 4 is slightly coarser than the preceding type, but similar to it in fabric and mineral constitution, except for the absence of hornblende. The variation in grainsize is between wider limits, particularly in the plagioclase. Irregular patches of an opaque mineral with a dirty buff colour and chalky appearance in reflected light, often associated with ilmenite, may be leucoxene. Small grains of microcline are sparingly present, but more numerous than in No. 3.

In Nos. 5 and 6 a progressive increase in the grainsize of the body of the rock is shown, as well as in the proportion of larger crystals; these latter also increase in size, the microcline in No. 5 attaining a length of 4 cm. Apart from these larger crystals the rock is medium to fine grained. Biotite now occurs in relatively large flakes about 6 mm. in diameter. The ground-mass consists mainly of plagioclase, quartz, and biotite, with subordinate microcline. Apatite, ilmenite, and zircon are minor accessories, and appear to be confined principally to the larger flakes of biotite.

The rock might well be termed an *Adamellite porphyry* (pl. iii., fig. 1).

In slides 3 and 4 there is evidence of corrosion in the opalescent quartz; the contours are rounded and, as it were, mitred and surrounded with a ring of tiny quartz granules forming part of the ground-mass, but optically continuous with the large grain (pl. i., fig. 3). The plagioclase crystals, too, have been cracked and faulted, and the edges "nibbled" by the ground-mass. Pl. iii., fig. 1, represents well the rounded contours of a large microcline crystal in slide No. 6, evidently due to corrosion. Microscopic examination shows that this very crystal along part of its margin has been altered into plagioclase of about the same R.I. as quartz, and so probably oligoclase or andesine.

Apart from these superimposed characters the large crystals are similar in every respect to those of the porphyritic granite.

These circumstances, together with the fact noted above, that in the inclusions of diorite in the granite the proportion of large crystals increases towards the margin, indicate that these large crystals have been derived in some way from the magma of the porphyritic granite.

One is reminded, on examining the diorite and these transitional rocks, of the basic segregations described by

Harker and Marr as occurring in the Shap Fell granite,[12] but in the present instance the dark fine-grained rock, though of higher specific gravity, has actually a slightly higher percentage of silica than the main granite.

(3) EVEN-GRAINED GRANITE.

This rock is everywhere uniform in type. Microscopically it is of medium variable grainsize, and for the most part typically allotriomorphic granular, though a little graphic intergrowth is noticed. The mineral constitution is difficult to determine quantitatively, owing to the very uneven distribution of the minerals through the rock mass. The following results were obtained from measurements on three different slides: —

	%
Quartz	42·6
Microcline	42·7
Plagioclase	8·6
Biotite	6·1

There are also a few granules of sphene and apatite and some tiny zircons. A little muscovite is intergrown with the biotite, and a small amount of secondary pyrites fills cracks between quartz grains. The rock shows evidence of strain, slight granulation and wavy extinction being present. Alteration is fairly marked: the felspars are cloudy and the biotite is changing to chlorite.

Quartz is granular and is much cracked. It contains strings of tiny inclusions, many of which are glass-cavities in the form of negative crystals. A few liquid inclusions were also observed, but the peculiarities noted in the blue quartz of the normal granite are absent. Microcline is distinguished by its characteristic twinning; traces of cryptoperthitic intergrowth were detected. The mineral is very much kaolinized. The plagioclase is zoned, but owing to alteration the composition was hard to determine. It appears, however, to grade from oligoclase at the centre to albite (Ab_{95}) at the periphery. Alteration is very marked to calcite and sericite. The crystals often exhibit a highly altered kernel surrounded by a shell of clear fresh material. One felspar crystal consists of plagioclase surrounded by a broad continuous zone of fresh potash felspar. A single very tiny crystal of tourmaline was detected among some granulated quartz.

Primary iron ores are virtually absent, but a little secondary haematite is present. The biotite does not call for remark.

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(12) Q.J.G.S., vol. 47 (1891), pp. 280-282.

The order of crystallization is obscure. There are traces of graphic intergrowth of quartz with plagioclase and with microcline. Quartz is mostly wrapped round by both the felspars; occasionally plagioclase is idiomorphic against it but never microcline. The latter appears to have been the last mineral to cease crystallizing.

The chemical composition of the rock is given in column I. below:—

	I.	II.
SiO_2	75·48	75·57
Al_2O_3 ...	12·99	13·14
Fe_2O_3 ...	0·25	0·63
FeO	0·85	1·04
MgO	0·13	0·14
CaO	0·74	abs.
Na_2O	2·31	2·96
K_2O	6·06	6·06
H_2O+ ...	0·60	0·46
H_2O- ...	0·17	0·12
TiO_2	0·12	0·08
CO_2	—	abs.
P_2O_5	—	0·06
Other constit.	—	0·10
Total ...	99·70	100·36
Sp. gr. at 18° C	2·615	

I. Even-grained granite, Port Elliot. Anal. W. R. Browne.

II. Granite, Midgee, Hundred of Charleston, Eyre Pen. Anal. W. S. Chapman. Geol. Surv. S. Austr., Bull. 3, p. 14.

An approximate mode was calculated from this analysis, giving for the main constituents the following weight percentages:—

Quartz	36·8
Microcline	47·6
Plagioclase (Ab_{91})	8·8
Biotite	5·1
Ilmenite	·2
Kaolin	1·5

The discrepancy between this and the result of the Rosiwal measurement is due doubtless to the uneven distribution of the minerals through the rock.

It is interesting to note that this mode calculated from the analysis justifies the assumption of a sensibly constant composition for the microcline. The transfer to plagioclase of the albite and anorthite molecules included in the microcline would have the effect of altering the percentages to:—

Microcline	33·1
Plagioclase (Ab_{84})	23·2

These figures are obviously at variance with the Rosiwal result, and the composition of the plagioclase is less likely than that obtained by assuming Gartrell's figures for the microcline.

The rock is a strongly potassic biotite granite approaching aplite.

(4) ALBITE MICA SYENITE.

Although this rock does not outcrop anywhere else than at Rosetta Head, the relative proportions of the main constituents vary considerably from place to place, and there are likewise textural variations. Sometimes the rock is porphyritic and at other times phenocrysts are absent. For the most part mica is subordinate, but near the contact with the schists it increases in amount until it predominates over the felspar, and in places the syenite actually appears to merge gradually into the country rock.

Microscopically the typical rock is coarse grained and porphyritic and composed predominantly of albite. Sections parallel to (010) give extinctions of 19° from the basal cleavage, indicating a practically pure soda-felspar, and the phenocrysts and ground-mass felspars are apparently of identical composition. Very perfect twinning after albite and pericline laws is shown, in addition to simple twinning of very irregular type. A good deal of the felspar is of the variety known as chequer albite; in this the twin lamellae instead of being continuous are interrupted, the general effect being a kind of chequer pattern between crossed nicols when the lamellae are broad and the interruptions frequent, but often approaching the grating or spindle structure of the microcline twinning when the lamellae are long and thin. Chequer albite has been found by Flett[13] and Hughes[14] in soda rhyolites or quartz keratophyres, and the present writer has found it in similar rocks from Currabubula, New South Wales, but there does not seem to be any record of its occurrence in rocks similar to those now being described.[15] The chequer structure is apparently peculiar to the albite of very sodic rocks. In the present instance the structure appears to be due in part to a

(13) Geol. Surv. of Great Britain, Mem. "Geology of Newton Abbot," 1913, p. 60.

(14) Geol. Mag., 1917, p. 18.

(15) Except, of course, in the albitites of Cape Willoughby described by Tilley in Trans. Roy. Soc. S. Austr., 1919.

kind of interpenetration multiple twinning, and sometimes to an actual intimate parallel intergrowth of two multiple-twinned individuals.

While traces of biotite are occasionally visible in the slide, the original mineral has been almost entirely converted into a very pale green, faintly pleochroic chloritic mineral with a double refraction a shade stronger than that of quartz. It is uniaxial and positive. These optical characters do not agree with those of any of the usual rock-forming chlorites. The mineral is found both as inclusions in the phenocrysts and squeezed in between the felspar crystals.

Abundant minute red-brown pleochoric prisms of rutile are either enclosed in the chlorite or strung out and aggregated along the boundaries of felspars. Indeed this abundance of rutile is one of the characteristic features of the rock.

A few crystals of zircon with green pleochroic haloes are embedded in the chlorite, also a little apatite. Quartz is present very sparingly as irregular inclusions in the phenocrysts, but does not occur otherwise.

The rock mass has been subjected to considerable pressure, resulting in undulose extinction, bending of the chlorite, and in fracture and dislocation of the felspars, with considerable granulation, many patches of the rock being rendered quite microgranular. It is interesting to note how much more this essentially felspathic rock has suffered than the granites. It might be thought that the collapse of the rock took place as a result of the decrease in volume consequent on the change from biotite to chlorite, but that this has not been so is proved by the fact that the altered country rock, in which the biotite has been chloritized, is extremely compact and free from all traces of cataclasis.

A slide cut from a non-porphyritic specimen of the rock shows a much greater proportion of mica (chlorite), and among this there is some muscovite. The chlorite is sometimes so arranged as to give a rosette or fan-shaped effect. Quartz is more abundant than in the previous specimen; it is quite clear, is interstitially disposed, and though showing some undulose extinction is not granulated. Rutile is very abundant, though rather sporadically distributed. Apatite and zircon are distinctly more abundant than in the previous slide.

Fresh specimens of the rock were very hard to get, but one which was fairly fresh was analysed. This particular specimen was somewhat porphyritic and the ferro-magnesian constituents were subordinate. Microscopically chlorite was often seen to be associated with quartz in the little stringers or veins, sometimes evidently filling cracks in the felspar; in other cases the vein-filling was of chlorite alone. Here possibly the albite was of intratelluric crystallization, and had been dislocated during injection of the magma, and before the final consolidation of the rock. The chlorite was often crowded with rutile prisms to such an extent as to negative the supposition that these had been formed by the decomposition of a titaniferous biotite.

Although it is evident from the chloritization of the mica that this rock has been somewhat altered, still the effects of this alteration have been reduced to a minimum since ferromagnesian constituents are so subordinate, and the analysis is of interest and of some value:—

	I.	II.	III.
SiO_2 ...	64·60	66·13	66·09
Al_2O_3 ...	20·37	19·92	18·85
Fe_2O_3 ...	0·31	0·60	0·91
FeO ...	0·67	0·19	—
MgO ...	1·15	0·12	1·53
CaO ...	0·41	0·57	1·09
Na_2O ...	9·94	10·83	10·84
K_2O ...	0·16	1·02	0·48
H_2O+ ...	0·85	0·30	1·17
H_2O- ...	0·15	0·14	
TiO_2 ...	1·04	0·31	0·23
CO_2 ...	tr.	0·40	—
P_2O_5 ...	0·22	0·09	—
FeS_2 ...	abs.	0·05	—
ZrO_2 ...	0·03	—	—
BaO ...	abs.	—	—
Cl ...	—	0·03	—
Total ...	99·90	100·70	101·19

Sp. gr. at 23°C 2·635

I. Albite mica syenite, Rosetta Head. Anal. W. R. Browne.

II. Albitite, Sec. 40, Hundred of Roberts, Eyre Pen. Anal. W. S. Chapman. Geol. Surv. of S. Austr., Bull. 3, p. 16.

III. Albitite. Koswinsky Kamen. Quoted in Rosenbusch's "Elemente der Gesteinslehre," p. 263.

The analysis shows that the felspar is a pure albite, all of the lime belonging to apatite, and the small percentage of potash being quite probably contained in muscovite and in unaltered biotite. The approximate mode calculated from the analysis is:—

	%
Albite	84·1
Chlorite	10·7
Muscovite	1·6
Rutile	1·0
Quartz	2·0 (say)
Apatite	·5

By allotting to chlorite, as has been done here, all the oxides left over after satisfying the minerals of fixed constitution, the following chemical composition is deduced for that mineral:—

SiO_2	40·4
Al_2O_3	32·4
Fe_2O_3	3·0
FeO	6·2
MgO	10·8
H_2O	7·2

It may be that the SiO_2 percentage is unduly high owing to insufficient having been allowed for quartz in the rock, but even so the relative proportions of the other constituent oxides show the mineral to have a very unusual composition, MgO in particular being very low when compared with Al_2O_3.

The abundance of rutile in the rock is reflected in the relatively high percentage of TiO_2, a percentage which appears to be rather exceptional for such rocks.(16) The figures for this oxide make it abundantly clear that the rutile could not have been derived from the breaking down of biotite, a conclusion which is in accord with the microscopical evidence.

This syenite is of a rather rare type, judging by the small number of published analyses of similar rocks. Many of the recorded occurrences are associated with basic or ultrabasic rocks, and, apart from the Cape Willoughby rock recorded by C. E. Tilley, only three exceptions to this rule have so far come under the author's notice. The first of these is the soda granite of Croghan Kinshela, Co. Wexford, Ireland, described by Haughton,(17) which Harker(18) correlates

(16) The association of TiO_2 with sodic rocks has been noted and commented on by various writers, although Smyth (A.J.S., vol. 31, 1916, p. 37), following Washington, represents Ti as concentrating in subalkaline rather than alkaline magmas.

(17) Haughton: Q.J.G.S., vol. 12 (1865), p. 183.

(18) Anniv. Address to Geol. Soc. of London, Q.J.G.S., vol. 73, (1917), p. lxxxiii.

with the potash granites of south-eastern Ireland. The second is the rock recorded from Moolyella, Pilbarra Goldfield, Western Australia,[19] a tin-bearing albite pegmatite which cuts across a mass of granite. Mr. Gibb Maitland apparently assigns this albite rock to the pneumatolytic stage of the crystallization of the granite.

The third instance is recorded by Emmons and Calkins[20] as occurring in connection with a grano-diorite at Cable, in the Philipsburg Quadrangle, Montana. "The essential constituents are nearly pure albite and biotite; the accessories are zircon, rutile, and apatite; . . . chlorite is present in small amount." "A small exposure of pegmatite occurs; . . . It is essentially an aggregate of snow-white albite crystals . . . small polygonal interstices between which are filled with green chlorite. Quartz and potash felspar are absent. The accessories are zircon and rutile. . . "

This occurrence seems analogous to that of Rosetta Head. R. L. Jack[21] records albitite in the Hundreds of Roberts and Miltalie, Co. Jervois, Eyre Peninsula, the analysis of the former being given above, but there is nothing in his description of the occurrences to tell definitely whether they are associated or connected with the more potassic granites.

(5) RED (POTASH) APLITE.

The main outcrop of this rock occurs near Middleton Beach, and its field characters have already been described. A small dyke, to be presently described, is very similar both in appearance and in mineralogical characters, and may quite probably be genetically connected.

Microscopically the habit of the red aplite is fairly typically aplitic, the constituents being mostly allotriomorphic to subidiomorphic, and there has been a certain amount of strain, resulting in undulose extinction and in slight peripheral granulation. The minerals present are quartz and felspar, with a few flakes of muscovite and a little limonite after magnetite; ferro-magnesian constituents are absent.

The felspar comprises microcline and albite, both heavily kaolinized and stained with iron oxide, which gives the rock its red appearance. Microcline predominates, but owing to alteration the relative proportions of the two felspars are impossible of measurement.

Microcline occasionally shows a slight tendency to prismatic habit, and traces of microperthitic structure are seen.

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(19) Geol. Surv. of W. Austr., Bull. No. 15, pp. 12 and 25.

(20) U.S. Geol. Surv., Prof. Paper 78, p. 97.

(21) Jack: *Op. cit.*

Albite is slightly zoned, but its precise constitution could not be ascertained. Quartz and microcline are at times intergrown in rude graphic fashion.

The chemical composition of the rock, as determined by the author, is:—

SiO_2	76·65
Al_2O_3	12·98
Fe_2O_3	0·25
FeO	0·32
MgO	abs.
CaO	0·40
Na_2O	2·64
K_2O	6·18
H_2O+	0·29
H_2O-	0·17
TiO_2	0·11
Total	99·99

Sp. gr. at 27½°C ... 2·590

From this analysis an approximate mode was calculated:—

Quartz	35·34
Microcline	51·22
Albite	9·96
Kaolin	2·59
Magnetite	·46
Ilmenite	·30
Water	·09

or, distributing the kaolin proportionately between the felspars, neglecting the water and recalculating to 100:—

Quartz	35·40
Microcline	53·46
Albite	10·38
Magnetite	·46
Ilmenite	·30

In calculating this mode there was found to be insufficient lime available to satisfy the proportion required by Gartrell's analysis; this would indicate that the microcline is of different composition from that in the granite, and that the albite is practically if not absolutely a pure soda felspar. The same conclusion is indicated by the low specific gravity of the rock, which points to a strong preponderance of the potash felspar.

A Rosiwal measurement was made of the rock, but as it was found impossible to differentiate the two felspars owing to decomposition, the whole was measured as felspar and the relative proportions computed from the mode given above.

Quartz	36·9
Microcline	52·1
Albite	10·1
Muscovite	·2
Iron ore	·7

There is thus a satisfactory agreement between the calculated and measured constitutions.

(6) MINOR POTASH APLITES, ETC.

These are the rocks occurring as pipes and narrow veins through the granite. Most of the examples to be described were collected at Port Elliot.

Mineralogically the rocks exhibit a general similarity, consisting mainly of quartz and felspars, microcline predominating. There is usually subordinate biotite present, but one dyke (No. 1) cutting through the porphyritic and even-grained granites near the Victor Harbour end of Port Elliot is quite free from biotite and resembles very closely the red aplite. It differs in being a little finer grained and in having a larger proportion of albite among its felspar.

A partial analysis is as follows:—

SiO_2	76·54
Na_2O	3·02
K_2O	6·05

and as the albite is practically pure this would imply a probable approximate percentage composition by weight of:—

Quartz	36·0
Microcline	51·0
Albite	13·0

The specific gravity is 2·607, which reflects the increase in soda felspar as compared with the red aplite. It seems quite probable indeed that these two rock-types are closely connected genetically.

Some distance round from this dyke towards Middleton Beach there is another dyke (No. 2) which is interesting in that it contains very little albite and that it is characterized by the presence of a fair amount of micrographic fabric, in contrast to the allotriomorphic fabric of the other aplites. When intergrown with felspar (either microcline or albite) the quartz assumes the skeletal habit found in regular graphic granite, otherwise it occurs in small, rather angular but equidimensional grains to which the irregular grains of microcline (averaging about ·8 mm.) act as a kind of mosaic background. The rock is speckled with little flakes of biotite and granules of magnetite, and patches of secondary muscovite are developing from the felspar. The rock may be termed a granophyric potash aplite.

Specimen No. 3 is from a "pipe" in the porphyritic granite at Port Elliot, on the Victor Harbour side; with this pipe there is a quartz-tourmaline "nest."

Under the microscope the rock is seen to have a curiously uneven grain; the greater part has an average grainsize of about ·2 mm., but there are irregularly distributed patches, composed mostly of a few quartz grains surrounded by felspar, and in these patches the grainsize may reach 1·5 mm. The dominant felspar is potassic, but lacks the characteristic twinning of microcline; a good deal of albite is also present. Very subordinate biotite and muscovite, and a little magnetite and apatite form the remainder of the rock. Felspar is altering into muscovite in a manner which suggests some other process than mere surface weathering.

A pipe of biotite-bearing microcline aplite cuts through the coarser granite at Rosetta Head on its western side. It is comparable in grainsize with the coarser of the Port Elliot aplites, and is very poor in albite.

(7) SODA APLITE.

Contrasting with the strongly potassic aplites just described there are to be found at Port Elliot another series of very acid minor intrusions in which the predominant alkali is, or was originally, soda, this being expressed mineralogically by the almost complete absence of potash felspar.

The microscopic description of the soda aplite is as follows: —

The grainsize is about 1 mm. and fairly even, although some of the felspar attains a length of 2·5 mm. A Rosiwal measurement showed 32·5 per cent. by weight of quartz and 67·5 per cent. of albite, neglecting very small amounts of apatite and iron ore, mostly altered to haematite. Both of the main constituents are thoroughly allotriomorphic as a rule, showing the usual aplitic type of simultaneous crystallization, but in one part of the slide examined there is a tendency to columnar habit in the plagioclase, to which the quartz plays in part an interstitial rôle. No traces of granophyric intergrowth are visible. Quartz is fairly free from inclusions but is markedly strained. Albite is twinned according to the ordinary albite and occasionally to the carlsbad and pericline laws, but occurs for the greater part as the variety called chequer albite (pl. i., fig. 2). In composition it approaches a pure soda felspar. The mineral is somewhat kaolinized and spangled with sericitic mica. The presence of this secondary mineral in a soda felspar may be explained in three possible ways:—

(1) It may be formed from the soda felspar by the introduction of potash from without, as suggested by F. W. Clarke.[22]

(2) As most albites contain a small proportion of the orthoclase molecule in solid solution the sericite may represent the separation and alteration of this latent orthoclase.

(3) The sericite may really be a soda mica, and bear the same relation to albite as the ordinary potash sericite bears to orthoclase. No data, however, appear to be available as to whether some sericite may be sodic.

The chemical characters of the soda aplite are shown by No. 1 of the following analyses:—

	I.	II.	III.	IV.
SiO_2 ...	76·02	76·26	71·18	78·28
Al_2O_3 ...	14·60	12·40	14·89	12·00
Fe_2O_3 ...	0·27	1·64	2·11	—
FeO ...	0·08	2·60	1·21	1·19
MgO ...	0·04	tr.	0·14	0·37
CaO ...	0·34	0·28	0·82	0·29
Na_2O ...	7·08	6·27	6·85	6·89
K_2O ...	0·96	0·41	1·70	tr.
H_2O+ ...	0·34	0·12	0·64	0·61
H_2O- ...	0·15	0·02	0·24	
TiO_2 ...	0·07	0·50	0·48	0·34
Total	99·95	100·50	100·26	99·97
Sp. gr.	2·626	2·59 [23]	2·62	

I. Soda aplite, Port Elliot. Anal. W. R. Browne.

II. Quartz keratophyre, Mount Remarkable. Anal. E. O. Thiele. Trans. Roy. Soc. S. Austr., vol. xl., 1916, p. 583.

III. Soda aplite, St. David Head, Wales. Anal. A. V. Elsden. Q.J.G.S., vol. lxiv., 1908, p. 284.

IV. Aplite, James township, Ontario. Anal. N. L. Bowen. (Quoted by W. H. Collins in Memoir No. 33, Geol. Surv. of Canada, p. 76.)

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(22) Data of Geochemistry, Bull. U.S. Geol. Surv., No. 616, p. 593.

(23) Surely this figure is too low for an albitic rock.

Assuming the potash to be contained in the albite this gives the approximate mode:—

Quartz	28·7	
Albite (Ab_{98})	68·3	71·1
Kaolin	2·8	
Ilmenite	·2	

neglecting the small amounts of magnesia and hydrated iron oxides. The non-determination of P_2O_5 introduces no appreciable error.

The rock is then a true soda aplite. Its principal variation from the majority of similar rocks lies in its very small percentage of the iron oxides, and perhaps of titania also.

(8) GREISENISED SODA GRANOPHYRE.

As mentioned above, this rock outcrops at the north-east end of Port Elliot at the back of the red aplite, and only touches the coast at Middleton Beach.

The relative proportions of the constituents are found to vary from place to place in the mass, and two specimens have been selected and sectioned which illustrate this variation.

Specimen A, from the more southerly part of the outcrop, is of a pink colour, very fine grained, and shows well the sporadic distribution of muscovite, which occurs as little clumps or "books" irregularly scattered, and often associated with quartz which is somewhat coarser than usual.

Microscopically the minerals visible are quartz and albite in roughly equal proportions, with muscovite in very subordinate amount. The original fine granophyric fabric is still strikingly characteristic of the rock; generally the quartz, in irregular radiating vermicular stringers ramifies through the felspar, but occasionally the converse holds. The felspar, a pure albite, is very heavily kaolinized as a rule, and stained a brownish colour.

The occurrence of the mica is interesting; for the most part it is in irregular grains of medium size closely associated with medium-sized quartz grains. This coarser mica forms irregular patches and veins in the finer granophyric portions of the rock, and is occasionally in radiate or plumose aggregates. But the mineral is also seen to be replacing felspar: in some places the mica-replaced parts of a felspar grain appear as though in graphic intergrowth with the rest of it, and again where the felspar of a graphic quartz-felspar intergrowth has been replaced there is produced the effect of a quartz-muscovite intergrowth. But for the undoubted evidence of replacement by muscovite one might be tempted to call the rock a ternary eutectic of quartz, albite, and muscovite. The larger quartz grains associated with mica contain abundant minute glassy and liquid inclusions, with fixed and movable bubbles, whereas those of the granophyric intergrowths are almost if not entirely devoid of such inclusions.

It should be noted that the development of mica preceded that of kaolin. Both types of alteration are in some degree selective, as some of the felspars show very little alteration either to muscovite or kaolin even when almost surrounded by heavily kaolinized minerals. No reason can be assigned for this; the attacked and unattacked felspars appear to be of identical composition.

Specimen B from the Middleton Beach end of the outcrop is of a pinkish-grey colour and has the muscovite more evenly distributed than it is in A. Under the microscope the rock appears as a veritable confusion of muscovite, quartz, and subordinate albite, the grainsize being medium and very uneven. Granophyric fabric is of very much less account than in the previous specimen. Quartz and mica are for the most part in fairly large and very irregular grains up to 2 mm. in length at times. The former contains numerous glassy and liquid inclusions, and shows occasional traces of crystal outline, muscovite being then moulded on it. Some of the large quartz grains contain scattered small grains of felspar, recalling the quartz of certain rocks from Broken Hill which have come under the writer's notice, and which are reasonably supposed to have undergone silicification, in the course of which the original quartz grains have become so enlarged by accretion of silica as to enwrap crystals of other adjacent minerals.

The muscovite in the rock is at times very evidently eating into the albite in irregular fashion, and one large squarish section of mica appears to be pseudomorphous after a tabular felspar. The albite is not as a rule nearly so kaolinized as in Specimen A; it is in tabular to prismatic crystals up to 1 mm. long. Sometimes a crystal has been corroded until a mere skeleton is left, the relics preserving optical continuity while the deep embayments are filled with quartz or muscovite.

Besides these coarser-grained minerals the rock contains a good deal of finer-grained material, a confused aggregate of quartz, albite, and muscovite, with some granophyric intergrowth and a certain amount of replacement of the felspar.

There seems no reason to doubt that in the rocks just described a process of greisenisation has been taking place. The original rock was a granophyric soda aplite; in specimen A the alteration has just started, in B it has proceeded so far that granophyric fabric is almost obliterated and the rock is to all intents a greisen. The evidence for these conclusions may be summarized:—

(1) The corrosion and embayment of the felspars and their partial replacement by mica and quartz.

(2) The coarse-grained quartz mica aggregates, with traces of idiomorphism in the quartz, irregularly distributed through the fine-grained rock.

(3) The secondary enlargement of the quartz grains, and the presence of liquid inclusions, evidently not characteristic of the unaltered rock.

Kaolinisation and the development of mica have been quite independent, for mica is occasionally found replacing felspar which is free from kaolin, and indeed in specimen B there is much less kaolin visible than in specimen A. It is not improbable, indeed, that the kaolin was the result of the continuation of pneumatolytic processes into the hydrothermal stage; the fact that one part of the rock-mass is so very much more altered than another, although under similar weathering conditions, is all against kaolinisation by weathering.

With regard to the mechanics of greisenisation it appears as if partial solution of the original felspars must have been effected in places by the mineralizers, which thereafter filled the cavities, and from which quartz and muscovite crystallized. The substitution of these minerals for albite would require some accession of silica to the rock, as the amount required to make up the deficiency in volume (consequent on the change from albite to muscovite) would be more than that set free from the felspar.[24]

Partial analyses were made of the two specimens, with the following results:—

	A	B
SiO_2	78·25	78·60
Al_2O_3, etc. ...	n.d.	14·64
Na_2O	5·00	1·74
K_2O	0·90	3·21
H_2O	0·88	1·37
Sp. gr.	2·635	2·696

(24) Assuming Al_2O_3 to remain constant, and H_2O and K_2O in some combination to be supplied by the mineralizers, we may represent the reaction thus:—

$3(Na_2O.\ Al_2O_3.\ 6SiO_2)+K_2O+2H_2O=$
Albite (mol. vol. 601·8)
$K_2O.\ 3Al_2O_3.\ 6SiO_2.\ 2H_2O+12SiO_2+3Na_2O.$
Muscovite (282·2) (273·6)

There is thus a volume of 46·0 to be made up by SiO_2.

Assuming the deficiency from 100 per cent. in each case to be represented by kaolin, the mineral constitution is approximately:—

	A	B
Quartz	41·9	54·5
Albite	42·4	14·6
Muscovite	8·0	27·1
Kaolin	7·7	3·8

Now if, assuming the albite to be pure, one attempts to calculate the percentage composition of the original granophyre from the partial analyses given, by substituting albite for corresponding volumes of muscovite and quartz, and changing the kaolin to albite, the figures found in each case are very close, the mean of the two calculations being:—

SiO_2	76·1
Al_2O_3	14·9
Na_2O	9·0

All these calculations are, of course, only very approximate, but they do point to the conclusion that the griesenised rock was derived from a soda granophyre essentially similar in chemical composition to the soda aplite.

(9) URALITIC DOLERITE.

With one exception, to be presently referred to, the rocks from all the dykes examined bear a close resemblance to each other in general mineralogical characteristics. They are all fine grained, and the megascopic appearance varies in different specimens from that of a dense basalt to that of a fine-grained dolerite.

The principal constituents are felspar and uralite. Plagioclase is in fairly perfect laths and quite fresh; it is a labradorite about Ab_{40}. Augite has been entirely converted into amphibole, rather a pale-green colour for the most part, sometimes in plates dusted with abundant secondary magnetite, but very often in aggregates of needle-shaped crystals; a little tremolite is also seen. Dense mats of the amphibole occupy the spaces between the felspars and often project into the latter. Iron ore—ilmenite by its habit—is plentiful, and a little biotite is always present, as well as apatite in exceedingly fine needles. There is no indication that olivine ever formed part of the rock.

Occasionally, as in the dolerite from the meridional dyke through the schists at the back of Rosetta Head, relict ophitic fabric is well shown, the amphibole in large plates enclosing the felspar.

An analysis of the dolerite, for which I am indebted to Mr. H. Yates, B.Sc., is given in column I. below:—

	I.	II.
SiO_2	49·32	49·29
Al_2O_3	21·03	18·81
Fe_2O_3	1·79	3·57
FeO	8·31	7·78
MgO	2·31	3·28
CaO	10·91	9·25
Na_2O	2·97	3·07
K_2O	0·47	2·10
H_2O+	0·63	1·07
H_2O-	0·10	0·20
CO_2	abs.	tr.
TiO_2	1·96	2·17
P_2O_5	0·12	—
S	p.n.d.	—
Total	99·92	100·59
Sp. gr. at 15°C	2·992	

I. Uralitic dolerite, dyke at back of Rosetta Head. Anal. H. Yates.

II. Olivine diabase, west side of Blinman Mine. Anal. W. N. Benson. Trans. Roy. Soc. S. Austr., vol. xxxiii., 1909, p. 234.

Perhaps the most noteworthy feature of the analysis is the low magnesia. A careful check determination failed to increase the figures, so they may be accepted as correct.

On a rough estimate, based on the examination of a thin section, the rock contains between 60 and 70 per cent. of amphibole and less than 30 per cent. of plagioclase. This great predominance of amphibole shows that much of the lime and alumina of the analysis must be contained in this mineral, which, therefore, cannot be regarded as true actinolite. With the exception of the potash percentage the analysis of this rock corresponds very closely with that of the Blinman diabase.

The question naturally arises as to why these dolerites have been so completely uralitized, seeing that the granitic rocks, of earlier intrusion, have remained unaltered. It seems evident that no external agency was at work to produce the change, and one must conclude, following Duparc and Hornung,[25] that the uralitization has been of the nature of

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(25) Comptes Rendus, vol. 139, 1904, p. 223. Quoted by J. A. Thomson, W. Austr. Geol. Surv. Bull. 33, p. 132.

auto-metamorphism, the alteration of the pyroxene having taken place as a result of the activity of residual magmatic waters.

A curious rock is that forming the first dyke between Rosetta Head and King Point. Under the microscope it is seen to consist of numerous little sheaf-like bundles of amphibole (? actinolite) needles set in a clear and colourless microcrystalline matrix which high magnification reveals as a regular mosaic of interlocking quartz and plagioclase granules. The felspar is evidently pretty basic, its R.I. being distinctly greater than that of quartz, and it is apparently the predominant colourless mineral, although relative proportions could not be estimated. There is a fair sprinkling of ilmenite and a little pyrites. Dark-green pleochroic spots in the amphibole represent haloes round zircons.

The rock may be termed a dolerite hornfels; it appears to be a dyke rock which has been completely recrystallized, but if it belongs to the same suite as the other basic dykes the different course of metamorphism is difficult to understand. Most probably, however, this particular rock is older than the granite, and this suggestion is strengthened by the record of an axinite amphibolite from Rosetta Head by J. C. Moulden,[26] which, as he points out, has probably resulted from the contact metamorphism of a basic igneous rock by the granite. The present writer was not fortunate enough to encounter this axinite-bearing rock in the field.

V. Petrogeny.

(1) genetic relationships of the rocks.

There is every reason to believe that a close genetic relationship exists between all the different rock types. The field evidence points to it, and is to a certain extent supported by the mineralogical and chemical characters of the rocks.

A variation diagram (fig. 4) has been constructed to exhibit the chemical relations of the diorite, normal granite, and even-grained granite; in this specific gravities have been used as abscissae, and the continuity of the series is well shown. In particular the practically rectilinear nature of the curves for iron and magnesia (contained in biotite and the iron ores) and for soda emphasises the regular withdrawal of these constituents from the magma.

A regards the albite syenite, while there is no direct evidence that it is comagmatic with the other types, this is strongly suggested by its ultimate field association with the

(26) J. C. Moulden: *loc. cit.*

porphyritic granite. Further, Mr. Tilley has reported[27] the occurrence at Cape Willoughby, Kangaroo Island, of rutile-bearing albitites closely associated with potassic granites and connected with them by the common link of the opalescent quartz. As these Cape Willoughby rocks constitute another

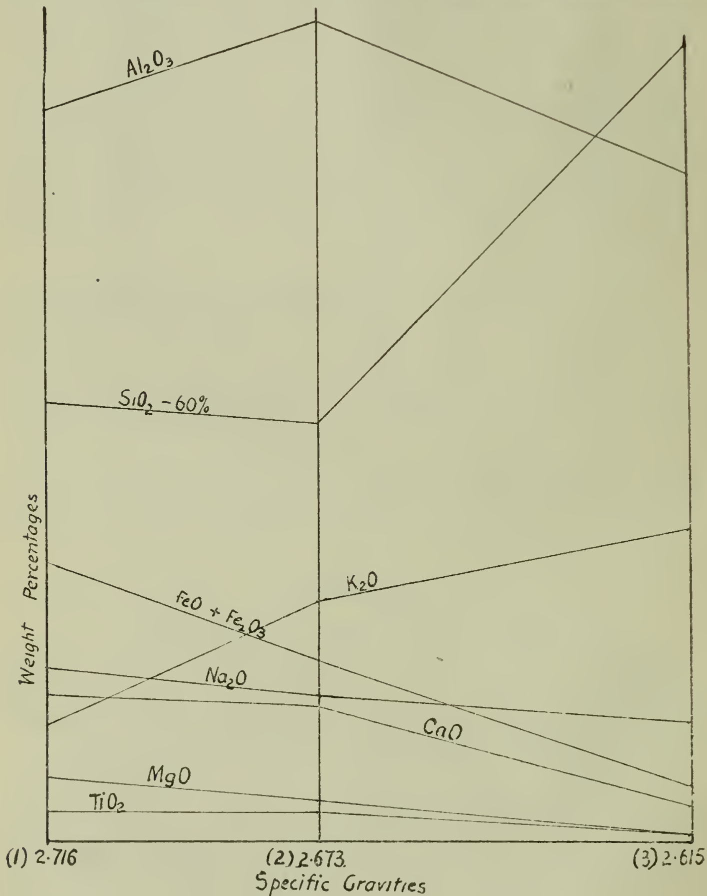

Fig. 4.

facies of the Encounter Bay magma, the connection of the Rosetta Head syenite with the granite magma is again indicated. As pointed out above, the syenite is to be considered as an end product of differentiation, the last member of the series which includes the diorite and the two granites.

[27] C. E. Tilley: *loc. cit.*

The red aplite is possibly to be regarded as a step in the differentiation of the granitic magma. It does not, however, fit very well into the variation diagram, and it differs from the other rocks (except the soda aplite) in containing no ferro-magnesian minerals. This fact rather negatives the idea of the rock being one of a differentiation series, of which the biotite-bearing syenite is an end member; it suggests, indeed, that the red aplite originated by some process distinct from that which operated to produce the diorite-granite-syenite series.

It is to be noted that the red aplite and the dolerite appear to stand in a complementary relationship towards the granite. A combination of the analyses of the two rocks in the proportions of 9 of aplite to 4 of dolerite gives a mean result very comparable on the whole with that of the porphyritic granite when we consider the rather peculiar composition of the dolerite: —

	Weighted mean of red aplite and dolerite.	Porphyritic granite.
SiO_2	68·24	68·20
Al_2O_3	15·46	15·99
Fe_2O_3	0·72	0·89
FeO	2·78	2·65
MgO	0·71	0·80
CaO	3·63	2·61
Na_2O	2·74	2·85
K_2O	4·42	4·60
TiO_2	0·68	0·58

Furthermore, the association of dolerites and quartz dolerites with soda aplites and granophyres has been noticed in different parts of the world, as for example at St. David Head in Wales,(28) in the Gowganda District of Ontario, Canada,(29) and elsewhere.

As can be seen by the list of analyses *(vide supra)* these soda aplites are quite comparable with that of Port Elliot, and it is here suggested that the red aplite, the soda aplite and granophyres, and the dolerites should be regarded as being closely related to each other and to the granite.

This suggestion of a connection between the dolerites and the aplites, both sodic and potassic, is not without support from other parts of South Australia. From various localities dykes of uralitic dolerite have been described cutting Cambrian

(28) J. V. Elsden: Q.J.G.S., vol. lxiv., 1908, p. 273.

(29) W. H. Collins: Geol. Surv. of Canada, Memoir 33, 1913.

rocks, all very similar in general characters and all presumably coeval. In two localities the presence of associated acid intrusives has been proved. In his paper on the Mount Remarkable area [30] Prof. Howchin mentions aplites and porphyritic acid dyke rocks in close relationship with the basic intrusives. In an appendix to the paper Thiele describes the porphyritic rock as a quartz keratophyre and the aplite as a microcline-bearing type. The former is very similar chemically to the Port Elliot soda aplite, while the latter, though not analysed or described in detail, is clearly potassic.

Through the courtesy of Prof. Howchin the present writer was able to examine microscopically a dyke rock from Blinman, evidently co-magmatic with the diabases and granophyric diabases described by Benson. [31] The rock is fine grained and pink coloured, non-porphyritic and much carbonated, but composed largely of albite, with a considerable proportion of interstitial quartz. It would be placed with the quartz keratophyres.

These instances seem to the writer to lend some weight to the supposition of a genetic relation between the dolerites and certain of the aplites of Encounter Bay.

(2) MINERALOGICAL VARIATIONS IN THE PRINCIPAL ROCK TYPES.

The following table indicates at a glance the variation of the principal constituents:—

	Quartz mica diorite.	Porphyritic granite.	Even-grained granite.	Albite mica syenite.
Quartz	34	29	37	2
Microcline ...	0	23	47	0
Plagioclase ...	44	30	9	85
Biotite	21	16	5	9 (chlorite)
Sp. gr. of rock	2·716	2·673	2·615	2·635

Considering the first three rocks, we find some notable features. There is very little variation in the quartz content, in spite of the range of SiO_2 percentage. Plagioclase and biotite, the minerals of highest specific gravity, decrease in amount towards the acid end of the series, while microcline, the lightest mineral, shows a very marked rise, plagioclase the while becoming more acid. All this is another way of expressing the fact that the order of commencement of crystallization for this particular magma has been one of decreasing specific gravity, and this is reflected in the decreasing specific gravity of the rocks.

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(30) Trans. Roy. Soc. S. Austr., vol. xl., 1916, p. 545.

(31) Trans. Roy. Soc. S. Austr., vol xxxiii., 1909, p. 226.

The constitution of the albite syenite shows how powerfully the presence of mineralizers has affected the order of precipitation of the minerals, holding albite in solution until microcline disappeared and free quartz was almost gone.

(3) DISCUSSION OF THE VARIATION DIAGRAM.

The foregoing observations have an important bearing on the construction of the variation diagram (fig. 4) and on the limitations of variation diagrams generally. The use of SiO_2 percentages as abscissae was obviously out of the question in the present instance, and the specific gravity of the rocks was indicated as the most characteristic and consistent reference-variable, as indeed it should be if the heavier minerals crystallized first. The regularity of the curves, particularly those for $FeO + Fe_2O_3$, MgO, and Na_2O, justifies the choice of abscissae.

[The experiment of making specific gravity variation diagrams for a number of recorded occurrences of related plutonic rocks was tried by the writer with a considerable amount of success, which is after all only natural, seeing that for the most part the order of crystallization of a magma, that is the order in which rocks are formed by fractionation, happens to be one of decreasing specific gravity.]

As the latest stages of crystallization were entirely controlled by mineralizers, and albite as a consequence was not precipitated till the very end, the order of decreasing specific gravity was destroyed and the end product (albite syenite) will not fit along with the other rocks into any diagram that can be constructed.

The present rock series illustrates the limitations of the usefulness of SiO_2 percentages as abscissae for a variation diagram. Their employment really presupposes that on the whole the sequence of crystallization under the given circumstances was that of lower silicates first with progressively higher silicates following, and ending with quartz, if the composition of the magma permitted. The ultimate product of such a sequence would be an aplite or even a pure quartz rock. Now while experience has shown this to be a common case it must be recognized that the rule is by no means universal. The order of crystallization of minerals from a magma is essentially one of increasing solubility under the conditions obtaining, and this is not necessarily or always that of decreasing SiO_2 percentage. For example, microcline usually follows quartz in granites, as in the present instance, and here the successive products of fractionation will be richer not merely in quartz, but also, to a greater degree, in microcline.

Again, it has been shown that after the granitic stage of a magma is reached differentiation may be prolonged so as to produce soda granites and syenites through the impoverishment of the magma in potash and silica,[32] and possibly through the concomitant concentration of mineralizers. Here, as there is an actual decrease in silica with advancing differentiation, the sequence could not be represented in its entirety on the ordinary variation diagram, and it really seems as if there is no convenient method, under these circumstances, of giving graphical expression to the complete differentiation-history of the magma.

(4) SHAPE AND NATURE OF THE INTRUSION.

Only very scanty data are obtainable as regards the formal relationships of the rock mass. It is to be remembered that the few outcrops available at the present day probably represent only a small marginal remnant of a once very extensive intrusion, and that the only place where the actual junction with the country rock may be observed is at Rosetta Head. It is therefore evident that there can be little certainty as to the original shape and the exact nature of the mass.

The boundary between granite and schist is interesting. From the photograph of Rosetta Head it will be seen that the junction, which has been sharply defined through differential erosion, makes an angle with the horizontal varying from about 13° to 45°, and that the bounding surface dips in towards the granite instead of off it, as is the usual case. The invaded schists dip about S. 10° W. at angles varying from 35° up to 60°. The local variations in direction and amount of dip are doubtless an effect of the intrusion. The evidence points to the series of rocks having been formed almost entirely by differentiation of a deep-seated or intratelluric magma and its subsequent eruption, in a partly crystallized condition, to a higher level in the lithosphere. The different rock types show genetic relationships towards each other; successive injections of magma at short intervals are indicated by "swirling" contacts, as between diorite and porphyritic granite, or between porphyritic and even-grained granites; while the presence of "rifted blocks" of schist gives evidence of the force with which the magma thrust itself up through the older rocks. The intrusion then, whatever its shape, is a multiple one, and the whole assemblage of rocks may be regarded as a plutonic complex in Harker's sense, the component members of which have

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[32] *Vide* Bowen: Jour. Geol., vol. 33, 1915, Supplement, p. 55, *et seq.*

been successively and more or less independently injected into their present positions from an underlying magma reservoir.

The intrusion is clearly transgressive, and it is difficult to know what term should be applied to it. It is not a true laccolite, inasmuch as it is not concordant; the term "chonolite" proposed by Daly, though rather comprehensive in its defined significance to be of much practical value, comes nearest to describing the form of the intrusion.

(5) MECHANICS OF DIFFERENTIATION.

To establish the sequence of events by which the assemblage of rocks was produced from the original magma is by no means easy, in view of the paucity of exposures and the possibility that some of the members of the series do not outcrop or have never been erupted from the intratelluric reservoir.

In the author's opinion the facts of intrusion, as we see them, can best be explained as due to two different types of differentiation: (1) fractionation with sinking of crystals, and (2) complementary differentiation, or the splitting of a portion of the original magma into an acid and a basic fraction. Differentiation *in situ* has also operated, but to a very minor extent.

(1) The possibility of some degree of differentiation by the sinking of crystals in a fluid magma has long been recognized by geologists, and the idea has been elaborated by Bowen,[33] who would assign to it a first place in the production of rock species. There are certain facts in connection with the Encounter Bay rocks which point to subsidence differentiation as a factor in their evolution. Attention has already been drawn to the linear relationship between the specific gravities and the variation in iron, magnesia, and soda which exists in the case of the quartz mica diorite and the two granites. Other facts which seem to be significant are:—

(1) The decrease in specific gravity from diorite to even-grained granite.

(2) The progressive decrease in biotite and increase in the felspars and quartz.

(3) The progressive acidity of the plagioclase.

(4) The very fine grain of the quartz mica diorite, increasing in the porphyritic varieties, and the increase in size and abundance of phenocrysts corresponding with the increasing grainsize of the ground-mass.

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[33] Supplement to Journ. Geol., vol. 33, 1915.

(5) The absence of microcline from the very fine-grained diorite and its advent and increase in the coarser varieties.

(6) The existence of the albite syenite which, with its unusually high soda content, its richness in TiO_2 and P_2O_5, and the intensity of its contact effects, is clearly marked out as an end product of differentiation.

These facts surely point to differentiation of a granitic magma by settling out of crystals as pictured by Bowen, and as observed by him in laboratory experiments. The first shower of crystals to reach the bottom of the reservoir would be those of least solubility, chiefly biotite, and plagioclase as basic as the temperature and the composition of the magma would permit. These crystals, owing to the short distance through which they had to fall, and the consequent small chance of growth by accretion of material, were of fine grain,[34] but as precipitation continued and crystals from higher levels sank the grainsize gradually increased.

Microcline was the last mineral to start crystallizing, and when it did commence, possibly owing to slow cooling in the upper parts of the magma, the centres of crystallization were few and the crystals grew relatively large.

In the upper parts of the magma, owing to the concentration of mineralizers, the freezing points of the minerals were lowered, and one can conceive of a temperature gradient existing, the temperature being higher at the bottom than at the top, and yet at the same time the bottom portion being much farther advanced than the top towards complete consolidation.

The mineralizers exercised a selective solvent power over the albite molecules in the magma, and to a great extent prevented them from being precipitated; consequently the proportion of potash in the rocks was increased, and instead of the usual sympathetic variation of the two alkalies in the variation diagram there is an actual antipathy. With increasing precipitation of minerals, the concentration of mineralizers became greater and greater, and as this concentration took place towards the top of the magma reservoir, in time there resulted a marked difference in the composition of the residual liquor in different parts of the magma. In the lower parts it was (as regards felspathic constituents) a mixture of albite and microcline molecules, but at the top almost if not quite entirely albitic.

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(34) *Cf.* Bowen, Amer. Jour. Sci., vol. 39, 1915, p. 177.

Before crystallization was completed the tranquillity of the intratelluric magma was violently disturbed by earth movements, and injection took place. In the course of these events portions of the solidified—or almost solidified—quartz mica diorite came to be engulfed in the partially crystallized granite, and so now the granite contains fragments, both small and great, of the diorite, including the two great masses on Granite Island; these fragments really play the part of "basic secretions" in the granite, though indeed the term is somewhat of a misnomer, seeing that the included rock has actually a greater percentage of SiO_2 and more free quartz than its host.[35]

The intercrustal magma must have been tapped near its base, seeing that we find the porphyritic granite invaded by the more acid and lighter even-grained granite.

These magma fractions then, having been injected into the secondary magma chamber (their present position), continued to crystallize under the new conditions. Hence in the granite we get the second generation of crystals forming a ground-mass or matrix to the first-formed phenocrysts. The residual liquid from this last crystallization was later squeezed out into cracks, forming the narrow aplitic dykes cutting the granites and diorite, so that these are the only products of *in situ* differentiation. The even-grained granite may have scarcely started to crystallize before injection (it has been noted above that the constitution of this rock is similar to that of the matrix of the porphyritic granite), and the new conditions caused it to solidify in even-grained fashion.

It is a far cry from this highly potassic rock to the highly sodic albite syenite, and possibly one or more of the intermediate stages are missing, but at all events the residual syenite magma, perhaps partially crystallized and highly charged with mineralizers, was finally forced upwards, rifting off blocks of schist and sending apophyses into the country rocks, at the same time impregnating these with magmatic solutions and producing marked alteration in them.

(2) A minor fraction became separated from the main magma and pursued a different course of differentiation, producing complementary types in the dolerites and the red aplite, as well as the soda aplites and soda granophyres by further differentiation of the dolerite sub-magma. The

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(35) An alternative reading of the evidence would place the porphyritic granite first in order of injection, carrying with it small included fragments of diorite, the main mass of semi-crystallized diorite being erupted through the granite very shortly afterwards. With "swirling" contacts it is difficult at times to tell which rock came first.

mechanism of complementary differentiation has never been satisfactorily explained, and it seems as if some sort of separation in the fluid magma must be postulated, perhaps by the formation of two immiscible fractions, or perhaps by sinking of earlier-formed crystals and their refusion at the base of a magma column with a very steep temperature gradient.[36] This might produce a basic fluid magma underneath and an acid one on top. Whatever the mechanism in the present instance, the separation was very complete, seeing that the lighter differentiates—the potash and soda aplites—are quite free from ferro-magnesian constituents.

(6) COMPARISONS WITH SIMILAR ROCKS ELSEWHERE IN THE STATE.

Rocks of very similar type to those described above are found in other parts of South Australia. The assemblage recently described by Mr. C. E. Tilley from Cape Willoughby, Kangaroo Island, are in many respects identical with the Encounter Bay rocks, and are unquestionably derived from the same magma, although the development of distinctive characteristics would show that they did not form part of the same original intrusion.

The igneous rocks—microcline-bearing granites and albitites—reported by Jack from Eyre Peninsula, analyses of which are quoted in this paper, are very similar chemically and mineralogically to the series under discussion, and Mr. Tilley informs me that in the Tate Museum of the University of Adelaide there are two specimens from Alford, near Kadina, one a granite and the other a porphyritic aplite, which are hardly distinguishable from the rocks of Encounter Bay and Cape Willoughby.

Again, there are at numerous localities dykes of epidiorite or uralitic dolerite similar to those of Rosetta Head and Port Elliot, some of which have been already referred to, and these are in some cases accompanied by intrusions of sodic, and in one case potassic, dyke rocks; the rock associations, as well as the chemical and mineralogical characteristics, are quite analogous to those of the Encounter Bav occurrence. Mention may also be made to the very similar rocks described by Mawson occurring as dykes at Broken Hill.

It is probable that further investigation will show that these two rock series, the granite-syenite and the dolerite-aplite series, are of much wider distribution in South Australia than is at present known, and if the suggestion connecting the dolerites with the granite magma is correct it appears

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(36) *Cf.* Iddings, Igneous Rocks, vol. i., p. 269.

that a large area of South Australia was, during the epoch of the Encounter Bay intrusions, underlain by a magma, differentiation of which was expressed both by plutonic rocks of granitic and syenite types, and by doleritic and aplitic dyke intrusions perhaps representing complementary differentiates. These dykes may well be satellitic to larger plutonic masses in every case, the latter being not always visible at the surface.

VI. Age of the Intrusions.

To the geological age of the Encounter Bay rocks only very wide limits can be assigned on the local evidence. After the close of the Cambrian this part of South Australia appears to have become a land mass, remaining as such during Palaeozoic times. There is no existing record of any further deposition of sediment until the Permo-Carboniferous glaciers passed over the region and the older rocks were mostly buried under morainic material and till. The igneous rocks are definitely intrusive into the Cambrian sediments, and by Permo-Carboniferous times had already been laid bare by denudation. Indeed, the old granitic range, of which the present outcrops form the northern remnant, may have formed the gathering ground for the glaciers.[37]

The intrusions then are to be assigned to the Palaeozoic, somewhere between the Cambrian and the Permo-Carboniferous.

It appears that at the close of the Cambrian, when the great basin had filled with sediment, tangential earth movements converted the geosyncline into a geanticline (or anticlinorium rather) and caused the beds to be to some extent metamorphosed, especially on the eastern side of the axis.

In his paper on the Cape Willoughby intrusion Tilley argues that it is to be assigned to a late period of this folding, and it is true that, if the injection of igneous magma was connected with earth movements at all, then it was probably a concomitant of these post-Cambrian disturbances, for there is no evidence of any subsequent Palaeozoic movements.

The records of other granitic intrusions in South Australia, which probably synchronized with those of Encounter Bay, do not help in fixing the age; they are just intrusive into Cambrian or pre-Cambrian rocks. But the occurrence of the dolerite dyke intrusions following the axis of folding of the Cambrian beds through the Mount Lofty and Flinders Ranges, and as far away as Broken Hill, would lend support to Mr. Tilley's contention.

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[37] Howchin: Trans. Roy. Soc. S. Austr., vol. xxxiv., 1910.

The internal evidence—that afforded by the rock masses themselves—appears somewhat conflicting. The intrusions are clearly and violently transgressive, and as such might well be connected with orogenic movements; but, on the other hand, the physical conditions were such that differentiation of the magma was able to proceed as far as the albite syenite stage, a state of things pointing to a prolonged period of profound tranquillity before intrusion.

In his presidential address to the Geological Society of London in 1917 Harker assigns the potash and soda granites of Leinster to a late phase of the Caledonian folding, but here the differentiation of the soda-rich rocks was effected by the tangential pressure, with the result that they were injected as entirely separate units distinct and away from the main granites.

At Encounter Bay, on the contrary, the sodic rocks are in the most intimate association with the normal granite.

In the absence then of decisive internal evidence it is best tentatively to consider the intrusions as having accompanied diastrophic movements which put an end to the Cambrian sedimentation.

In his paper on the "Basic Rocks of Blinman" Benson inclines to the view that the dolerites are Palaeozoic; the present investigation confirms that opinion of their age.

VII. Contact Metamorphism.

The metamorphism to be seen in the neighbourhood of the igneous rocks is partly anterior to and partly a result of the intrusions. About six or seven miles up the Inman River the sediments have plainly been altered and to some extent recrystallized, and this can only be attributed to metamorphic forces of a regional character. Owing to the overburden of glacial material it is difficult to trace zones of metamorphism continuously for any considerable distance inland from the contact, and as a great deal of time was not spent in examining the schists the author is not in a position to present a complete account of the metamorphism. The following notes of observations made and specimens collected will, however, indicate the interesting nature of the contact effects, and may serve as an introduction to more detailed work, should opportunity for further investigation arise at a future date.

The contact metamorphism is best studied in the neighbourhood of Rosetta Head, since nowhere else is a section exposed of the junction between the invading and invaded rocks. Still a certain amount of information can be gained from the included blocks of country rocks in the granite of

Granite Island and Port Elliot, and a few specimens of these are described below.

The rocks in the neighbourhood of the contact often exhibit well-marked schistosity. Whether this was developed as a result of magmatic pressure or by dynamic metamorphism before the intrusion is not quite clear. The micaceous quartzites some distance inland, although partially recrystallized, show no signs of schistosity; but this may be due to the quartzite being a "competent" rock, and successfully resisting the stresses of the regional metamorphism, which was able to convert the more aluminous sediments into schistose rocks.

On the whole it is probable that the schistosity as we see it now was produced originally by regional forces, and that the force of intrusion of the magma accentuated the effect to some extent. The inclusions of country rock in the granite comprise massive types, sometimes showing well-marked lamination, and distinctly schistose types as well, one in particular from Rosetta Head possessing strong schistosity at an angle of about 37° to the original bedding.

(1) MICACEOUS QUARTZITES AWAY FROM THE INTRUSIONS.

About two miles in from the coast at the back of Rosetta Head the prevailing rock is massive, micaceous looking, and almost black in colour, with uneven fracture and with no traces of schistosity. In thin section it is seen to be blasto-psammitic in structure and of fine but very uneven grainsize. Quartz and felspar together constitute about 85 per cent. of the rock, the former somewhat in excess, the remainder of the rock being mainly biotite, with subordinate muscovite and a little ilmenite, apatite, and zircon.

Irregular and angular grains of quartz and of kaolinized plagioclase (with a refraction exceeding that of Canada Balsam) up to ·6 mm. are set in a much finer-grained paste of quartz, felspar, and mica. While the larger quartz and felspar are clearly relict, there are traces of incipient alteration in some of the plagioclase, and a certain amount of recrystallization of the light-coloured minerals of the paste has occurred, the mica, too, being of course autogenic. The rock was originally a highly impure grit, and may be called a micaceous felspathic quartzite.

Another specimen, collected about one mile inland, shows very similar characters in thin section, though in hand specimen it is of a lighter-grey colour.

A third example, collected from half a mile along the east-west road running inland from just north of Rosetta Head, is likewise a dense dark-grey rock with little or no trace of schistosity, except that on a certain fracture flakes of muscovite are seen to flash against the dark background here and there, recalling the appearance of a dark micaceous shale broken along the lamination.

Under the microscope no traces of schistosity are to be seen. The rock consists for the most part of angular grains of quartz with much fine-grained biotite, a fair sprinkling of tiny muscovite crystals, grains of dusty plagioclase, and a little magnetite and apatite. The grainsize is very fine, that of quartz being not more than ·2 mm.

The only definitely autogenic minerals are the micas, and the structure is blastopsammitic.

(2) INCLUSIONS IN THE PORPHYRITIC GRANITE.

The metamorphism effected by the granite is not revealed in many places; at Rosetta Head the dominant alterations have evidently been due to the syenite, and it is only in the inclusions of country rock that one can see what transformations have been produced by the granite. A specimen from one of these inclusions on the east side of Granite Island is a fine-textured and fairly even-grained mosaic of quartz, felspar, and biotite, with a little residual apatite and iron ore. Some of the felspar is probably relict, but for the most part it is recrystallized, and a noteworthy feature is the presence of quite a considerable amount of clear untwinned orthoclase. This mineral has not been noted in any of the rocks away from the intrusions, and while in the present instance it may represent the recrystallization of an original constituent, it is more likely to have been introduced from the igneous magma, especially as it appears to bear an interstitial relationship to the other minerals of the rock.

A specimen obtained from another inclusion in the granite forming the breakwater at Granite Island shows faint traces of the original lamination in hand specimen. Microscopically it is composed of autogenic quartz and biotite (with a little muscovite) with a good deal of relict plagioclase and a little apatite and zircon. This rock, like the previous one, contains a certain amount of clear untwinned orthoclase, evidently autogenic.

There is a large dark-coloured mass of country rock embedded in the granite on the coast at Port Elliot near the dyke of soda aplite. It is, like the others, massive, and in its degree of metamorphism is only a stage farther advanced than the micaceous quartzites some distance inland.. The grainsize is fairly fine but very uneven, and the rock contains much angular relict quartz and plagioclase. Autogenic biotite and subordinate muscovite occur, and a fair sprinkling of iron ore with some apatite. A good deal of recrystallization has taken place in the paste, but no orthoclase could be detected.

It seems as though advancing metamorphism has tended to produce evenness of grainsize along with recrystallization in the rocks affected.

The absence of orthoclase in this rock may possibly be due to its having become embedded in the granite at a late stage in the cooling history of the latter, when little or no exchange of material was possible.

(3) CONTACT METAMORPHISM AT ROSETTA HEAD.

It is impossible wholly to differentiate the effects of the granite from those of the syenite, but in certain respects the special influence of the latter can be clearly discerned.

The approach to the igneous rock from the landward side is across the strike of the schists, and as the original sediments probably varied somewhat both in texture and in chemical composition the study of the progressive metamorphism is to some extent interfered with.

In some cases special metamorphic minerals have been produced, such as andalusite and cordierite, while the emanation of magmatic solutions, connected particularly with the syenite, has resulted in the introduction into the invaded rocks of such minerals as albite, rutile, apatite, and zircon, and in the alteration of biotite and chlorite.

The impregnation appears to have been selective, or rather the solutions have not spread out uniformly from the contact, but have perhaps followed the beds of greatest permeability, and consequently one finds occasionally among the impregnated rocks some which have simply been recrystallized without noticeable addition of material.

(a) Andalusite Mica Schists.—A specimen from near the contact on the western side of Rosetta Head is seen to be micaceous and to have a definite schistosity, very slightly waved, and roughened by knots.

In thin sections the minerals present comprise quartz, biotite, andalusite, chlorite, muscovite, and iron ore, with fairly plentiful little zircons showing pleochroic haloes, and sometimes coronae as well, embedded in the biotite and chlorite; felspar appears to be absent. Chlorite is associated and intergrown with biotite and evidently derived from it, but its distribution seems purely haphazard. The mineral has the peculiar characters of the chlorite in the albite syenite; its R.I. is a trifle high for ordinary chlorite, and it is uniaxial and positive. The colour is a very pale green with slight pleochroism. Birefringence is distinctly weaker than that of quartz and extinction from the basal cleavage is slightly oblique revealing multiple twinning parallel to the base. The characters are not those of any known variety of chlorite, nor yet of chloritoid, but they agree more closely with those of the former mineral.

The mode of occurrence of andalusite is noteworthy; it is in ovoid to irregular porphyroblasts up to 3 mm. in diameter and exhibits well the sieve structure of Bécke and Grubenmann, being crowded with inclusions chiefly of quartz and iron ore. These are arranged along definite lines, generally curved, in the host, but the directions apparently do not bear any definite or constant relationship to the cleavage planes or to the schistosity of the rock, to which, indeed, they are indifferently parallel and perpendicular. The appearance in places reminds one of helicitic relict texture, but it is plain that the two things have nothing in common. The phenomenon may possibly be attributed to some deorientating force possessed by the growing andalusite and exerted against the minerals which remained undigested in the process of formation of the andalusite itself, a process which occurred subsequently to the schistose recrystallization of the rock and as a result of the igneous intrusion.

The andalusite in its growth has made room for itself partly by mechanical and partly by chemical means, the schistose laminae being sometimes pushed out, and at other times cut across and corroded. Both effects are well seen in the microphotograph (pl. ii., fig. 2). There is no reason to belive that rotation of the andalusite under pressure has occurred. Indeed, the evidence is all against this.

It has been noted that, whereas tiny inclusions of iron ore (? ilmenite) are quite a feature of the andalusite, they are by no means so abundant elsewhere in the rock, which suggests that they represent the iron rejected from the biotite used up in forming the andalusite.

In another schist from close to the syenite contact the development of andalusite with sieve structure, of a very similar type to that just described, has very plainly followed the former lamination of the rock, and is possibly due to the presence of strongly aluminous layers at intervals in the original sediment. Though the schistosity is here at 40° to the bedding planes it is not distorted in the neighbourhood of the andalusite, and likewise there is no sinuous arrangement of inclusions. There is a tendency for the development of little knots or segregations of sericite in parts of the slide, which in shape and general arrangement are very similar to the andalusite.

Biotite is slightly bleached and tiny zircon inclusions are fairly numerous. Some chlorite in crystals of quite distinctive blade-like habit is found, generally associated with the andalusite and sericite. It appears to be of quite different origin from the ordinary biotite of the rock.

(b) Cordierite Mica Schist.—There is a considerable development of knotted schists at intervals to the west of Rosetta Head. The knots are often very abundant, and may be upwards of half an inch in diameter. The schists, too, may be corrugated, and the transition from smooth to knotted or corrugated schists is often quite sharp. Some of the knotted varieties are, as shown above, andalusite-bearing, but in a specimen collected about half-way round towards King Point the knots prove to be cordierite. On the weathered face they show up of a brownish-yellow colour in roughly elliptical sections, with slight traces of an orientation parallel to the schistosity. The knots are very numerous, occupying about half the surface on a face cut perpendicular to the schistosity.

In thin section the ground fabric of the rock is seen to be of the usual type; there is well-marked schistosity indicated by parallel layers of biotite separated by finely granular quartz. The knots are really individuals and aggregates of medium to large xenoblasts of cordierite, the aggregates comprising anything up to half a dozen intergrown or interlocking grains, and measuring up to about 12 mm. in greatest length. The external boundaries of the minerals are as a rule indistinct, being frayed out into the ground fabric and indented by biotite. Sometimes the schistosity folds round the cordierite, and in one case it is much dented by the porphyroblast; here the enfolding biotite is thickly studded with pleochroic haloes and has an unusual concentration of iron ore.

The grains of cordierite are crammed with inclusions, most of them colourless, and so extremely tiny that their identification is generally impossible. They seem to be mostly quartz, but zircon is recognized by the characteristic yellow pleochroic haloes; in addition there are inclusions of muscovite, biotite (often bleached), and iron ore, and these larger grains occasionally carry the schistosity direction through the porphyroblast. The cordierite is stained yellow in places, but strangely enough shows no trace of the very usual alteration to pinite.

As regards the ground fabric, in addition to biotite and quartz it contains muscovite and chlorite, both of which are in crystals larger than the biotite. They are mostly found round about the cordierite, and sometimes associated with the little veinlets of quartz containing small prisms of apatite. Granules and tiny crystals of iron ore are fairly plentiful, but are most abundant in the cordierite, suggesting their derivation by the dissociation of biotite. The rock is also characterized by quite an unsually large proportion of zircon inclusions in biotite, each surrounded by a halo. There is often local concentration of these along schistosity directions without any apparent reason.

Andalusite and cordierite are the only two of the heavier metamorphic minerals found by the author in the schists. Prof. Howchin [38] has noted the occurrence of garnetiferous sands at Rosetta Head and Port Elliot, which are probably derived from the metamorphic rocks of the vicinity.

(c) Cliff Section at Rosetta Head.—A number of specimens were obtained showing the variations to be observed along the track from Victor Harbour to the old jetty at Rosetta Head. As the track cuts across the strike of the rocks there are slight variations of composition and texture.

No. 1 was obtained about 100 yards past the old barn situated where the coastline bends round to the east, or roughly about 1,200 yards from the contact. It is a very compact rock of a grey colour with a micaceous sheen. Slight schistosity is visible and the laminae are curved, possibly due to the intrusion of a vein of quartz and biotite. Microscopically the rock is an exceedingly fine-textured aggregate, mainly of quartz and biotite with subordinate iron ore. Many of the grains are not greater than ·01 mm. in diameter, so that the identification of the colourless constituents is very difficult and the presence or absence of felspar could not be determined. A slightly coarse layer in the rock does show plagioclase with a higher refractive index than Canada Balsam. The rock is distinctly schistose.

No. 2 is likewise somewhat schistose, of a dull-grey colour, very compact, and with a hardness of 5. A sprinkle of brownish mica flakes serves to reveal the schistosity. In thin section the rock is very fine grained, averaging about ·08 mm. Schistosity is distinct, and the following minerals were identified:—Quartz, chlorite, biotite, albite, rutile, and a little iron ore.

Chlorite is a very pale green, almost colourless, with a faint pleochroism. Rutile is fairly plentiful in little prisms and granules. Biotite flakes up to ·5 mm. in length give a pseudoporphyritic character to the rock; they are somewhat bleached.

The rock might be termed a very fine schistose hornfels.

No. 3, about 480 yards distant from the contact, shows very different characters from Nos. 1 and 2. It has a kind of pepper-and-salt colour, due to the presence of biotite and chlorite, and a micaceous lustre, and is much roughened by knots.

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[38] Geology of South Australia, p. 45.

Under the microscope this rock is seen to have a coarser grain than the others, and a strongly marked feature is its crystallization schistosity, produced by folia of biotite separated by quartz granules; the biotite is rather greenish and bleached looking, and there is local development of muscovite. There is a sprinkling of iron ore, and little zircons occur in places. Felspar could not be detected. The knots are found to be irregular rounded patches of very fine sericite, resembling very closely in shape and general appearance the andalusite of some of the other knotted schists. At the edges the patches fray out into the ground fabric of the rock, little tongues of sericite dovetailing in with the biotite (pl. ii., fig. 1). Round the knots the schistosity becomes curved, and strings of inclusions, mostly of quartz and iron ore, run through the sericite, usually in curved lines, and continuing the schistosity just as in the andalusite. Where biotite is included it has been altered to chlorite. Iron ore is far more abundant in the sericite areas than elsewhere in the rock.

In the immediate neighbourhood of the knots there are occasional crystals of chlorite; these are set in all directions, and often contain inclusions of the other minerals as well as of zircon. Muscovite occurs in similar circumstances.

The distribution of the sericite knots in the rock is quite irregular, as far as could be made out.

Except that the knots disappear, the rocks maintain their general characters for some distance along the track. No. 4 shows a ground fabric a little finer than that of No. 3, but otherwise identical. The rock is slightly porphyroblastic, a few crystals of chlorite cutting across the schistosity and containing numerous inclusions. One section cut parallel to the vertical axis shows boundaries sharp parallel to (001) but frayed out at the ends. Basal twinning is shown. The mineral has rather a high refractive index for chlorite, and resembles chloritoid in many characters, but differs from it in being of a very light-green colour, in having maximum absorption parallel to the base, and in being uniaxial (pl. i., fig. 5).

At the old tunnel, driven into the cliff about 150 to 200 yards from the contact, the rock (No. 5) is black and perfectly massive, with very irregular fracture. It is seen under the microscope to be a fine-textured mosaic of quartz and biotite with some plagioclase, and a little apatite and zircon. The rock has been entirely recrystallized, and resembles some of the inclusions in the granite of Granite Island and Port Elliot. There are no traces of lamination or schistosity.

There is a hiatus in the cliff section owing to a deep depression having been carved out of the schists by the Permo-Carboniferous glaciers, this trough being now filled with glacial *débris.*

(d) Impregnation near the Syenite Contact.—Close to the contact the country rock is again seen, and the most intense metamorphic effects of the syenite are to be observed near the old jetty. The syenite itself, as well as the country rock, becomes very micaceous, and the increase in this silvery-grey-looking mica is so great at times that it is hard to tell where the actual contact is. Tongues of non-porphyritic syenite are thrust into the schists, whose folia are curved and contorted, while veins of quartz and veinlets of quartz and mica are also sent out into the invaded rocks. In places the schistosity is largely destroyed, and a very compact, somewhat dull, light-grey rock is developed, streaked with what appear to be tiny parallel veinlets of mica. The rock is really a kind of hornfels.

In regard to the inclusions in the syenite it is noted that whereas the smaller masses of schist have been changed in colour from black to grey, in the larger masses this alteration has only been marginal. The change in colour, as will be seen presently, indicates a change in composition due to transfer of material, and apparently this can be effected without any appreciable loss in the sharpness of the boundaries of the xenolith.

Microscopically the altered rocks vary a good deal in texture and in the relative abundance of the constituent minerals, but they are all characteristically composed of a fine-grained mosaic aggregate of quartz, albite, and chlorite, producing a tpyical hornfels structure, fine and even in grain (pl. i., fig. 6).

Veins of chlorite or of quartz and chlorite, with rarely a little albite and an occasional little apatite prism, traverse the hornfels, often with parallel arrangement. These have sometimes forced open a space for themselves and appear as true veins, or the quartz and chlorite may be found as medium-sized grains poikilitically enclosing the other constituents of the rock.

Some of the rocks show more or less frequent flakes of pale-brown biotite intergrown with or passing into chlorite.

In addition to the minerals already mentioned all the rocks are characterized by quite an unusual development of rutile in very tiny crystals, generally simple, but rarely showing geniculate twins.

In some of the slides traversed by quartz-chlorite veinlets there are strings of rutile running parallel to the veins;

apart from this the mineral is well distributed through the rock as a rule, and included in all the other constituents, both of the hornfels proper and of the quartz-chlorite veins. Zircon, too is fairly abundant, and in some cases apatite. The former shows up well in biotite and chlorite by reason of the haloes and coronae which envelop it. One effect of the zircon on its host is to cause the part of it covered by the halo to have a slightly weaker birefringence than the rest.

As regards chlorite, that in the veinlets is identical with what is found in the albite syenite, and in addition to the bladed forms appears as broader somewhat irregular grains, while the fine-grained material of the hornfels proper is very pale, almost colourless, and often crystallized, vertical sections giving lath-like shapes. The derivation of this chlorite from biotite is proved by the occurrence of occasional crystals of biotite of exactly the same habit, which is in striking contrast with the entirely irregular forms characterizing the micaceous quartzites, and resembles most the biotite of the strongly schistose rocks.

From the prevalence of albite and rutile in all these rocks it is evident that there has been an important transfer of material from the syenite magma, especially of soda and titania, producing a rutile-bearing albitic hornfels as a result of metasomatic metamorphism. It seems as if one must postulate two stages of alteration to account for all the effects produced. The albite syenite was first injected, with accompanying veins and veinlets, the country rock being impregnated with albite, and to a less degree, with rutile, zircon, and apatite. Subsequently circulating solutions, still magmatic in character, attacked the biotite of both igneous rock and schists, converting it into chlorite.

The presence of chlorite in the knotted schists closely associated with the porphyroblasts suggests that the circulating solutions had probably something to do with the production of the minerals forming the "knots," while the peculiar features mentioned in connection with the sericite aggregates suggest that these may possibly represent an intermediate stage in the production of the andalusite.

VIII. Summary.

(1) A group of igneous rocks at Encounter Bay is described, comprising two related series: *(a)* A plutonic series consisting of quartz mica diorite, porphyritic granite, even-grained granite, and albite mica syenite; and *(b)* a series of minor intrusions consisting of uralitic dolerites, potash aplite, and soda aplite and granophyre.

(2) The genetic relationships of the rocks are discussed, and the conclusion is drawn that the first series was derived by fractionation and sinking of crystals in an intercrustal magma with subsequent intrusion at a higher level, while the second series may have resulted from complementary differentiation of a separate portion of the original magma.

(3) The pneumatolytic phase of the intrusion is manifested in:—

(a) Quartz tourmaline nests in granites, aplites, etc.

(b) The greisenisation of the soda granophyres.

(c) The impregnation of the country rock in the neighbourhood of the albite syenite.

(4) From comparison with similar occurrences elsewhere in the State it is considered probable that a magma underlay much of South Australia, as well as the Barrier region of New South Wales, in paulo-post-Cambrian times, intrusion of which was expressed either by granites and allied rocks or by dyke intrusions of both basic and acid types.

(5) The age of the intrusions is discussed, and Tilley's view of their connection with the folding of the Cambrian rocks is upheld.

(6) The contact metamorphism produced by the intrusions is dealt with and a number of rock types are described.

IX. Acknowledgements.

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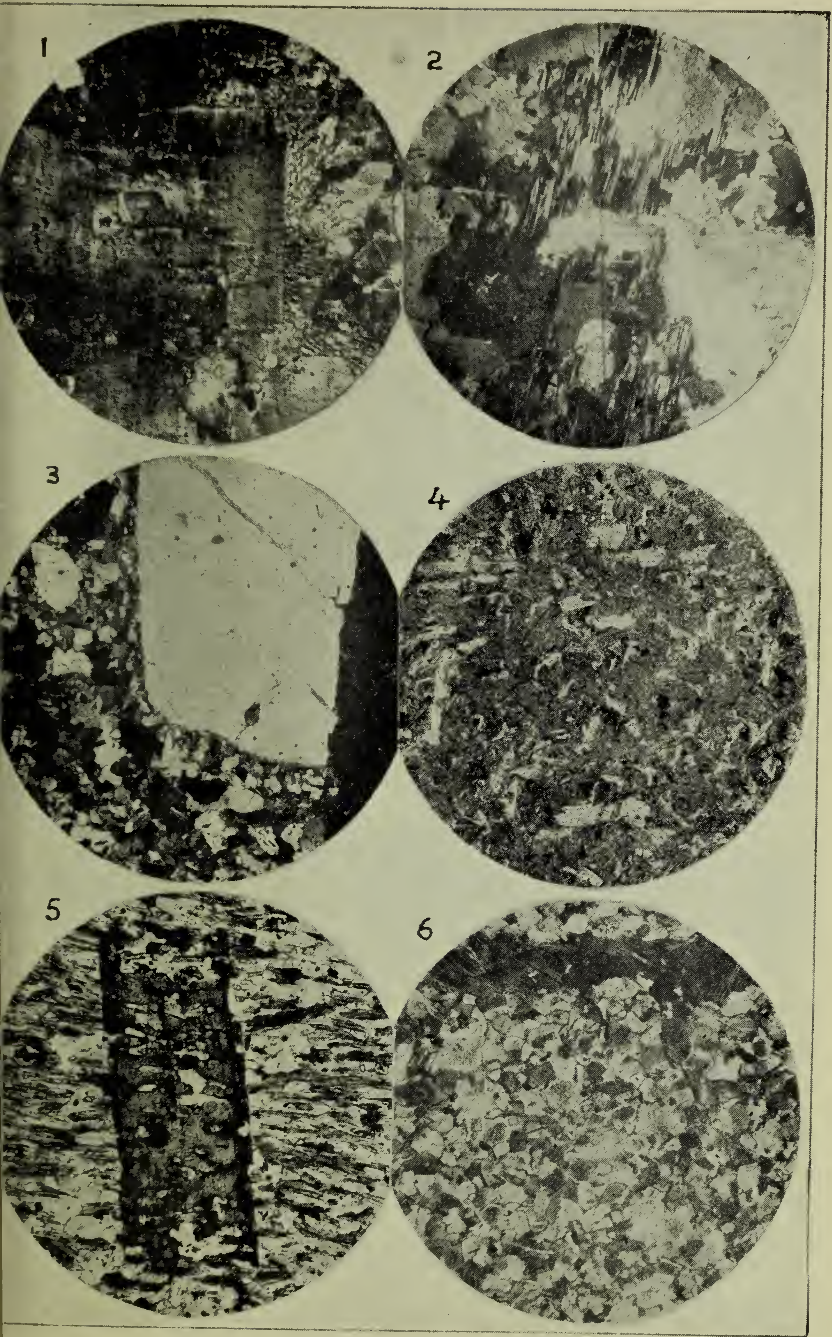
The microphotographs were made by Mr. H. G. Gooch, of the Geology Department of Sydney University, as were also the excellent series of specially large rock slides on which the petrological investigations were carried out.

Geology Department,
University of Sydney.



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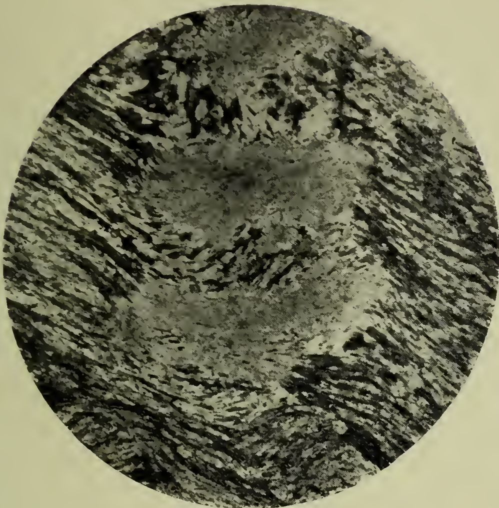

Fig. 1.

Fig. 2.

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Fig. 1.

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Fig. 1.

Fig. 2.

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EXPLANATION OF PLATES.

Plate I.

Fig. 1. Microcline from porphyritic granite, with rim of quartz granules in graphic intergrowth with the felspar (×16½).

,, 2. Chequer albite from soda aplite, Port Elliot (×23).

,, 3. Quartz in adamellite porphyry showing "nibbled" outline, surrounded by a ring of optically continuous quartz granules (×16½).

,, 4. Uralitic dolerite from dyke on landward side of Rosetta Head. Ordinary light (×15).

,, 5. Mica schist with porphyroblast of chlorite cutting across the schistosity, Cliff section, Rosetta Head. Note quartz inclusions carrying schistosity through the chlorite. Ordinary light (×33).

,, 6. Albitic hornfels from near contact of albite syenite, Rosetta Head. Portion of a chlorite veinlet is visible (×44).

Plate II.

Fig. 1. Mica schist with "knots" of sericite, cliff section, Rosetta Head. Ordinary light (×16½).

,, 2. Andalusite porphyroblast in mica schist, Rosetta Head. Note the biotite folia partly pushed aside and partly cut across by the andalusite. Ordinary light (×11).

Plate III.

Fig. 1. Adamellite porphyry from Granite Island, showing a simply-twinned, well-rounded phenocryst of microcline.

,, 2. Boulder of porphyritic granite on Granite Island showing the characteristic weathering.

Plate IV.

Fig. 1. Contorted schists at contact with albite syenite, Rosetta Head.

,, 2. Rosetta Head from King Point. The seaward side of the headland is of granite and syenite; the sloping ground at the back is composed of schists, which also form the outcrops close to the sea level in the foreground and middle distance. The low cliffs are of Permo-Carboniferous glacial deposits.

New Australian Lepidoptera.

By Oswald B. Lower, F.E.S., F.Z.S., etc.

[Read April 8, 1920.]

TORTRICIDAE.

Mictoneura eurypelta, n. sp.

♂, 14 mm. Head, palpi, antennae, and thorax dull ochreous, palpi infuscated above, except base. Abdomen greyish-ochreous. Legs dull ochreous. Forewings elongate, costa gently arched, termen hardly oblique; ochreous-grey, suffusedly irrorated with pale fuscous; a large well-marked, fuscous, triangular patch on costa at one-third, its apex obtuse, reaching about one-third across wing; two fine fuscous dots on costa, between base and patch; a row of fine fuscous dots along costa, from middle to apex, continued along termen to tornus; cilia dull ochreous. Hindwings and cilia grey.

Known at once by the triangular costal patch.

Hab.—Cairns district, North Queensland; two specimens received from Mr. F. P. Dodd, taken in October.

Argyroploce drymoptila, n. sp.

♂, 16 mm. Head, palpi, antennae, and thorax fuscous, mixed with darker fuscous. Abdomen fuscous. Legs whitish-grey, banded with fuscous, posterior pair fuscous. Forewings elongate, moderate, costa gently arched, termen faintly sinuate beneath apex; fuscous; costa shortly strigulated with oblique darker fuscous marks, arranged in pairs, interspaces dull ochreous; all veins more or less outlined with dark fuscous, interspaces more or less filled in with dull whitish; an obscure, dull-ochreous, roundish blotch on middle of dorsum, more or less continued to tornus, its upper edge reaching about one-third across wing; cilia grey-whitish, becoming fuscous in middle, and with a whitish subapical line. Hindwings with termen rather strongly sinuate in middle; white or grey-whitish, apical half pale fuscous; sometimes dorsum with a few fuscous scales; cilia pale fuscous.

Hab.—Cairns district, North Queensland; three specimens, in October, received from Mr. F. P. Dodd.

OECOPHORIDAE.

Heliocausta charodes, n. sp.

♂, 24-26 mm. Head, palpi, antennae, and thorax ochreous-grey, palpi somewhat pinkish tinged. Abdomen yellow-ochreous. Legs whitish, anterior pair tinged with carmine. Forewings elongate, costa gently arched, termen obliquely rounded; ochreous-grey, somewhat pinkish-tinged; costal edge carmine throughout; a reddish-fuscous dot on fold in middle; a second obliquely above and before; a third, much larger, at posterior end of cell; an indistinct row of fine reddish-fuscous dots from beneath costa at three-quarters, thence curved round and parallel to termen and ending on tornus; some indistinct fuscous dots along termen; cilia ochreous-white, basal half pink. Hindwings orange-yellow, darker around margins; cilia pale ochreous, darker at apex.

In the neighbourhood of *phylacopis*, Meyr.

Hab.—Warra, South Queensland; three specimens, in October, received from Mrs. F. H. Hobler.

EULECHRIA XIPHOPEPLA, n. sp.

♀, 26 mm. Head, palpi, thorax, and antennae dull greyish-white. Abdomen greyish-ochreous. Legs greyish-fuscous. Forewings elongate, costa gently arched, termen obliquely rounded; dull greyish-fuscous, sometimes more or less obscurely irrorated with whitish; a moderately broad whitish longitudinal subcostal streak from base to costa at five-sixths, in one specimen the streak is costal on basal portion; a well-marked fuscous dot on lower edge of streak at one-third; a similar spot at posterior end of cell; veins towards termen sometimes more or less outlined with whitish; cilia greyish. Hindwings light fuscous; cilia fuscous.

A somewhat dull species, but the white longitudinal streak is characteristic.

Hab.—Semaphore, South Australia; three specimens, probably in October.

EULECHRIA PLAGIOSPILA, n. sp.

♂, 16 mm. Head, palpi, and thorax ochreous-white, palpi ringed with fuscous, thorax fuscous tinged anteriorly, patagia more ochreous. Antennae fuscous, annulated with white, ciliations 1. Abdomen ochreous, segmental margins silvery-grey. Legs greyish-ochreous, tibiae ringed with fuscous, tarsi sometimes banded with fuscous. Forewings elongate, moderate, costa gently arched, termen obliquely rounded; ochreous-whitish, with dark-fuscous markings; a small quadrate costal spot, just before base; a small elongate dorsal spot, near base; a flattened spot on costa at about one-quarter, with a darker dot on lower edge; a small darker dot immediately below and beyond, just above dorsum; a similar flattened spot on costa at about three-quarters, with two similar dark-fuscous dots placed as before; a curved mark, somewhat dot-like, near apex, reaching to just above tornus; cilia dull ochreous, mixed with fuscous. Hindwings fuscous; cilia fuscous, becoming ochreous-grey around tornus.

Neatly marked and distinct.

Hab.—Sydney and Hornsby, New South Wales; three specimens in October.

EULECHRIA CERATOCHROA, n. sp.

♂, 26 mm. Head and thorax pale greyish-fuscous. Antennae and palpi pale greyish, antennal ciliations $1\frac{1}{2}$, palpi tinted with pale fuscous internally, terminal joint paler. Abdomen and legs pale greyish-fuscous, three lower segments of abdomen with greyish-ochreous segmental bands. Forewings elongate, costa moderately arched, termen obliquely rounded; pale greyish-fuscous, sometimes minutely irrorated with fuscous on posterior half; a small fuscous dot in middle of wing at one-third from base; a second on fold below and beyond; a third at posterior end of cell, more conspicuous than others; a row of fine fuscous dots from beneath costa at about middle, thence continued parallel to costa near apex and along termen to tornus; cilia greyish, with a paler basal line throughout. Hindwings pale greyish-fuscous; cilia grey-whitish with a fuscous median line.

Not unlike a large specimen of *Philobota pulverea*, Meyr. The form of the posterior line is unusual.

Hab.—Gisborne, Victoria; three specimens in February.

EULECHRIA RHODOLOMA, n. sp.

♂ and ♀, 25 mm. Head, palpi, antennae, and thorax grey, basal joint of palpi with a suffused fuscous subapical band. Abdomen fuscous, whitish-grey beneath. Legs greyish, anterior and middle tarsi banded with fuscous. Forewings elongate, costa moderately arched, termen gently rounded, oblique; grey, with a few scattered fuscous dots; costal edge pink throughout; a fuscous dot on fold in middle; a second obliquely above and before, and a third at posterior end of cell; a row of fine fuscous, more or less confluent dots, from beneath costa at about three-quarters, curved around and parallel to termen and ending above tornus; a row of fuscous dots along termen; cilia grey, faintly pinkish tinged. Hindwings and cilia light fuscous, cilia with a paler greyish basal line.

Reminds one of species of *Machimia*, especially *sobriella*, Wlk.

Hab.—Cairns, North Queensland; three specimens in October. I possess also a specimen from Toowoomba, Queensland, sent by Mr. Walter Barnard.

EULECHRIA NIPHOBOLA, n. sp.

♂ and ♀, 24-26 mm. Head, palpi, and thorax ashy-grey-fuscous, second joint of palpi whitish with a blackish sub-basal ring. Antennae greyish, imperfectly spotted with whitish, ciliations nearly 3. Abdomen greyish. Legs greyish-fuscous, posterior pair greyish-ochreous. Forewings elongate, costa arched, termen obliquely rounded; ashy-grey-whitish, all veins more or less outlined with darker fuscous; a well-marked, narrow, longitudinal white streak in middle of wing, containing a fuscous dot at each extremity (really one at each end of cell); a crenulate fuscous line just before termen, from near apex to tornus; cilia ashy-grey, somewhat sprinkled with fuscous. Hindwings grey-whitish, sprinkled with fuscous towards apex; cilia grey-whitish, terminal half sprinkled with fuscous. A winter species; not unlike some forms of *Guestia*.

Hab.—Broken Hill, New South Wales; nine specimens in July.

TRACHYPEPLA DASYLOPHA, n. sp.

♂, 24 mm. Head, palpi, and thorax whitish, collar dark fuscous, lower half of basal joint of palpi dark fuscous externally, terminal joint with fuscous basal and apical bands. Antennae fuscous. Abdomen dull orange, segmental margins whitish, two basal segments wholly whitish. Legs greyish, anterior and middle pair infuscated. Forewings elongate, moderate, costa moderately arched, termen obliquely rounded; whitish, more or less wholly suffused with light fuscous, except on an elongate patch reaching from base to about middle of dorsum, and with an acute projection on upper edge near base, indicating first tuft of scales; second tuft at posterior extremity of patch, third and fourth obliquely above; upper edge of patch edged with darker fuscous; a black dot just above posterior end of patch, edged posteriorly with a spot of white; a suffused patch of dark fuscous on costa at about two-thirds; a short, narrow, inwardly oblique black mark just below this, with a line of whitish beneath; a curved series of fuscous dots, from costa to tornus, sometimes nearly absent; cilia ochreous-grey, with a fuscous subterminal line. Hindwings greyish, fuscous tinged; cilia greyish-fuscous, with an ochreous basal line.

Not unlike some species of *Eulechria* in general appearance. The whitish head and thorax, together with the orange abdomen, are prominent characteristics.

Hab.—Cairns and Warra, Southern Queensland; four specimens in November and December.

Oenochroa endochlora, Meyr.

I have bred this species freely from pupae found under the bark of *Eucalyptus* and *Angophora* in February and March, at Wayville, South Australia.

Oenochroa iobaphes, Meyr.

Bred under similar circumstances as above, in March, at Wayville, South Australia.

Oenochroa dinosema, Meyr.

The same remarks apply to this species.

Philobota gypsomera, n. sp.

♂, 16 mm. Head, palpi, and thorax white, lower two-thirds of palpi tinged with fuscous. Antennae greyish, ciliations 1. Abdomen dull ochreous. Legs ochreous-white, anterior and middle pair more or less infuscated. Forewings elongate, costa gently arched, apex pointed, termen oblique; pale whitish-ochreous; veins more or less outlined with pale fuscous, coalescing beneath costa so as to form a more or less longitudinal streak from base to apex, leaving anterior two-thirds of costa whitish; a small dot in middle of wing at one-third from base; a second at posterior end of cell; cilia ochreous-white. Hindwings and cilia pale ochreous-white.

Hab.—Hobart, Tasmania; two specimens in March.

Philobota (?) capnochroa, n. sp.

♂, 24 mm. Head and thorax fuscous. Antennae ochreous-fuscous, antennal ciliations 1, palpi ochreous-whitish, basal joint with sub-basal and subapical fuscous bands. Abdomen ochreous. Legs dark fuscous, posterior pair ochreous. Forewings elongate, rather broad, costa hardly arched, termen oblique; dark fuscous; costal edge narrowly ochreous, from near base to near apex; a few obscure scattered blackish dots in disc; an obscure curved series of fine black dots from beneath costa at three-quarters to near tornus; cilia dark fuscous, mixed with blackish. Hindwings fuscous; cilia fuscous, becoming ochreous around termen and tornus.

Doubtfully referable to *Philobota*, perhaps a *Compsotropha;* the antennal ciliations would appear to place it in the latter genus, but I can see no sign of a pecten. Fresher specimens may decide the question.

Hab.—Parkside, South Australia; two specimens in March.

PHILOBOTA PARASEMA, n. sp.

♂, 20-22 mm. Head, thorax, palpi, and antennae dull greyish-fuscous, antennal ciliations $1\frac{1}{2}$, palpi externally fuscous with a whitish subapical spot on basal joint. Abdomen silvery-grey. Legs grey, posterior pair grey-whitish. Forewings elongate, costa gently arched, apex hardly pointed, termen oblique; pale fuscous-grey, with fuscous markings; costal edge slenderly whitish from near base to near apex; some scattered fuscous marks in middle of wing, some of which coalesce to form an obscure mark on fold at one-third from base, and another, larger, at posterior end of cell; a curved row of small dots, from costa at termination of whitish streak, obliquely outwards to beneath apex, thence direct to tornus; cilia greyish, with some fuscous scales. Hindwings and cilia whitish-grey.

Hab.—Highbury, South Australia; three specimens in October.

PHILOBOTA DIPHRACTA, n. sp.

♂, 20 mm. Head, palpi, and antennae ochreous-whitish, basal joint of palpi strongly infuscated, antennal ciliations 1. Thorax fuscous, posterior half ochreous-white. Abdomen ochreous-white, segmental margins pale fuscous, anal tuft ochreous-white. Legs ochreous-white, posterior pair slightly infuscated. Forewings elongate, costa gently arched, termen faintly sinuate beneath apex, thence obliquely rounded; ochreous-white, with light-fuscous markings; a small, somewhat quadrate spot on costa at base; a transverse fascia from costa just beyond one-third to dorsum at about one-third, edges irregular, posterior edge indented above middle; a similar fascia, but somewhat broader, from costa near apex to tornus, broadest at apex, where it contains a few spots of ground-colour on costa; a small dot in disc, just before anterior edge of second fascia; an elongate streak on middle of termen; cilia ochreous-white. Hindwings pale ochreous-whitish, terminal half faintly tinged with fuscous; cilia ochreous-whitish.

Hab.—Cairns district, North Queensland; two specimens in October.

PHILOBOTA PICRAULA, n. sp.

♂ and ♀, 20-22 mm. Head, palpi, and thorax pale whitish-ochreous, basal joint of palpi externally fuscous. Antennae and legs whitish-ochreous, antennal ciliations 1, posterior legs mixed with pale fuscous. Abdomen greyish-ochreous. Forewings elongate, rather narrow, costa gently arched, apex pointed, termen oblique; pale ochreous-whitish; a narrow longitudinal subcostal streak from base to apex, gradually dilated to apex; cilia ochreous-whitish. Hindwings pale greyish-fuscous, slightly darker around margins, cilia pale greyish-ochreous, with a faint fuscous sub-basal line.

Allied to *physaula*, Meyr., but easily recognized by the distinct ochreous tinge and more pointed forewings, besides the single stripe running to apex.

Hab.—Belair, South Australia; four specimens in November.

EUPHILTRA ORTHOZONA, n. sp.

♀, 14-16 mm. Head white. Thorax reddish-fuscous, with three white spots posteriorly, two lateral, one central. Palpi white. Antennae fuscous. Abdomen ochreous. Legs ochreous, anterior and middle pair mixed with fuscous. Forewings elongate, moderate, costa gently arched, termen oblique; white, with deep reddish-fuscous markings; a moderately broad transverse fascia from costa at one-third to middle of dorsum, edges irregular, anterior curved outwards to costa where it is continued as a fine line to base; a similar fascia, somewhat curved inwards from costa at three-quarters to tornus, edges hardly irregular; a suffused patch below middle of wing, connecting the two fasciae below middle and leaving a small spot of ground-colour on dorsum; area along apex and termen similarly suffused, with indications of a short narrow white line along middle of termen; a somewhat obscure linear black mark touching anterior edge of second fascia in middle; cilia reddish-fuscous, median third white, becoming blackish at tornus. Hindwings ochreous-fuscous, paler towards base; cilia fuscous, with a lighter basal line.

Near *eroticella*, Meyr., but broader winged and different coloured hindwings.

Hab.—Warra, South Queensland; three specimens in October and November.

CHEZALA OCHROBAPTA, n. sp.

♂, 28-32 mm. Head, palpi, antennae, thorax, legs, and abdomen pale whitish-ochreous, second joint of palpi fuscous externally. Forewings elongate, costa gently arched, termen oblique, hardly rounded; pale whitish-ochreous, without markings; cilia pale whitish-ochreous. Hindwings light ochreous; cilia as in forewings, but basal half ochreous.

Hab. — Duaringa, Queensland; three specimens in January.

CAESYRA LEPTADELPHA, n. sp.

♂, 10 mm. Head, palpi, antennae, and thorax pale ochreous. Abdomen and legs whitish-ochreous. Forewings elongate, costa gently arched, termen obliquely rounded; pale whitish-ochreous; a dull purplish-reddish band, occupying posterior third of wing, anterior edge nearly straight, finely edged with fuscous; cilia dull fuscous-reddish. Hindwings and cilia grey-whitish.

Hab.—Cairns district, North Queensland; three specimens in October.

CHRYSONEMA ADELOSEMA, n. sp.

♂, 16 mm. Head, palpi, antennae, thorax, abdomen, and legs pale ochreous, anterior edge of thorax and patagia fuscous, antennal ciliations nearly 1, both joints of palpi infuscated externally, anterior and middle legs infuscated. Forewings elongate, moderate, costa hardly arched, termen obliquely rounded; pale ochreous-whitish, with some scattered minute fuscous scales; costal edge slenderly fuscous throughout; an inwardly oblique irregular fuscous mark on costa at three-quarters, below which is a well-marked fuscous spot; a fuscous spot in middle of disc at one-third and another just below and beyond; veins towards terminal half of wings somewhat outlined with fuscous and appearing to form a curved line near termen; cilia ochreous-grey, with a few fuscous scales. Hindwings greyish, tinged with fuscous; cilia ochreous-grey with a fuscous median line.

Near *maculifera*, Low.

Hab.—Cairns district, North Queensland; two specimens in October.

MACHAERITIS ENCRITA, n. sp.

♀, 10 mm. Head, palpi, antennae, and thorax shining white, thorax tinged with ochreous posteriorly. Abdomen silvery-white, beneath white. Legs white. Forewings elongate, apex pointed; white, faintly tinged with ochreous; markings ochreous-fuscous; a narrow transverse fascia close to base; a moderately broad fascia, from just before middle of costa to about middle of dorsum, edges tolerably straight, anterior edge margined with dark fuscous; sometimes lower half of fascia mixed with fuscous; a second similar fascia from costa at two-thirds to dorsum before tornus, posterior edge rather irregular, anterior edge nearly straight; a short subapical streak; cilia fuscous, becoming darker at apex and tornus. Hindwings lanceolate; pale fuscous; cilia pale fuscous, lighter at base.

Hab.—Parkside, South Australia; two specimens in January.

GELECHIADAE.

CROCANTHES THERMOBAPTA, n. sp.

♂ and ♀, 12-14 mm. Head ochreous-white. Antennae, palpi, and thorax ochreous-white, strongly mixed with orange.

Abdomen yellow. Legs ochreous-orange, posterior pair paler. Forewings elongate, costa nearly straight, termen slightly sinuate, oblique; pale yellow, strongly suffused and streaked with orange; a very broad dull purplish-fuscous oblique fascia, from middle of costa to middle of dorsum, anterior edge limited by a fine fuscous, nearly straight line, posterior edge dentate, lowest dentation continued for a short distance along fold; a fine fuscous line along termen; cilia yellow, becoming fuscous at apex. Hindwings and cilia pale yellowish-orange.

Between *zonodesma*, Low., and *halurga*, Meyr.

Hab.—Mackay, Queensland; nine specimens in October and November.

Chelaria baliodes, n. sp.

♂, 16 mm. Head and thorax cinereous-grey. Palpi grey-whitish, terminal joint with three fuscous rings. Antennae grey, spotted with fuscous. Abdomen greyish-ochreous. Legs fuscous, suffusedly banded with fuscous. Forewings elongate, costa gently arched, termen obliquely rounded; ashy-grey-whitish more or less mixed throughout with small fuscous blotches; about nine small fuscous spots on costa throughout; first basal, becoming obliquely fascia-like to base of dorsum; third very distinct, continued obliquely inwards to fold, more or less broken beneath costa, broadest on lower two-thirds; two or three short blackish dashes between this and middle of termen; one or two similar dashes on fold beneath; a fine row of fuscous dots near and parallel to termen; cilia cinereous-grey, with a median row of fuscous dots throughout. Hindwings greyish, becoming fuscous-tinged posteriorly; cilia whitish.

Hab.—Warra, South Queensland; five specimens in September and October, also a single abraded specimen from Broken Hill, New South Wales, in October.

Gelechia plinthodes, n. sp.

♂, 12 mm. Head, palpi, and thorax dull reddish-fuscous, terminal joint of palpi, with two fuscous rings. Antennae fuscous, basal joint darker. Abdomen fuscous, mixed with whitish laterally, and with ochreous beneath. Legs fuscous, banded with whitish, posterior pair ochreous. Forewings elongate, moderate, costa hardly arched, termen oblique; dull reddish-fuscous, somewhat finely irrorated with fuscous; costal edge finely blackish from base to three-quarters; a fine black transverse mark near base, reaching half across wing; two well-defined black dots in middle of wing at one-third from base, transversely placed; indications of a small similar dot between these and sub-basal mark; a fine black dot at posterior end of cell; costa from three-quarters to apex more reddish; a series of irregular fuscous dots along termen and apical sixth of costa; cilia ochreous, with a dark fuscous median line. Hindwings and cilia grey-whitish, cilia somewhat ochreous-tinged at base.

Allied to *dictyomorpha*, Low.; best distinguished from that species by the well-marked dots and clearer colouring of forewings.

Hab.—Broken Hill, New South Wales; two specimens in August.

DORYCNOPA TRIPHERA, n. sp.

♂ and ♀, 14-16 mm. Head and palpi ochreous-white, basal joint of palpi with two fuscous rings, terminal joint with one, median. Thorax, antennae, abdomen, and legs fuscous, thorax sometimes mixed with whitish, abdominal tuft ochreous, legs banded with ochreous-white. Forewings elongate, narrow; dark fuscous, mixed with blackish; markings dull ochreous; a moderately broad outwardly oblique fascia, anteriorly edged with fuscous, from just beneath costa at one-fifth to dorsum at about one-quarter continued along dorsum to middle; three or four apical spots, sometimes confluent into two; a small reddish-ochreous or ferruginous patch, beyond posterior end of cell, edged above and below with a small spot of ochreous-white; a sharply defined black dot in middle of patch, sometimes edged with whitish; a black, white-edged dot on upper edge of dorsal streak, at about one-quarter from base of wing; a similar dot in middle of wing, resting on anterior edge of ferruginous patch; cilia grey-whitish, with some scattered black scales. Hindwings with apex pointed, produced; greyish-white; cilia greyish-white, with an ochreous basal line.

Hab.—Largs Bay, South Australia; seven specimens in March.

XYLORYCTIDAE.

XYLORYCTA SPODOPASTA, n. sp.

♀, 22 mm. Head, thorax, palpi, and antennae ashy-grey-whitish, palpi dark fuscous exteriorly, antennae obscurely annulated with white. Abdomen fuscous, segmental margins silvery-grey. Legs cinerous-grey, posterior pair greyish-white. Forewings elongate, costa gently arched, termen obliquely rounded; slaty-grey, with some fine blackish irroration; veins more or less outlined with black, interspaces dull whitish; cilia greyish-fuscous, darker on basal half. Hindwings light fuscous, lighter on basal half; cilia white, with a fuscous sub-basal line.

A neatly-marked insect. In one specimen there appears to be a faint whitish anterior band on thorax.

Hab.—Broken Hill, New South Wales; three specimens in March.

MICROSTOLA, n. g.

Head smooth. Antennae dentate, thickened, ciliations one-half. Labial palpi short (imperfect). Abdomen moderate. Posterior tibiae smooth. Forewings with vein one furcate towards base, two from about middle, three and four stalked, five approximated towards three at base, seven and eight stalked, nine out of seven from about one-quarter, eleven from well before middle. Hindwings slightly broader than forewings, three and four stalked, seven and eight stalked, five absent, eight free.

Mr. Meyrick, who suggested the above generic name, has referred it to the *Xyloryctidae*. It has peculiar neural characters, and as I possess but one male, further specimens may have the hindwings normal.

MICROSTOLA AMMOSCIA, n. sp.

♂ and ♀, 15-18 mm. Head, palpi, antennae, thorax, legs, and abdomen pale ochreous-whitish, antennal ciliations of male one-half. Forewings elongate, costa gently arched, termen gently and obliquely rounded; pale ochreous-whitish, slightly infuscated towards termen; a dark fuscous dot in middle of wing at one-third from base; two similar dots, transversely placed, at posterior end of cell; veins towards termen faintly outlined with fuscous; cilia greyish-ochreous, with a fuscous basal line. Hindwings pale greyish-ochreous, infuscated at apex and along termen; cilia as in forewings. An obscure-looking insect.

Hab.—Kuranda, near Cairns, North Queensland; four specimens from Mr. F. P. Dodd.

AGRIOPHARA LEPTOSEMELA, Low.

Several specimens bred during February and March. The pupae were enclosed in a loose cocoon beneath the bark of *Eucalyptus* at Wayville, South Australia.

AGRIOPHARA CINEROSA, Rosen.

Bred under similar circumstances to above. Not very common.

TINEIDAE.

NARYCIA STICTOPTERA, n. sp.

♂, 25 mm. Head whitish. Thorax whitish, mixed with fuscous. Palpi and antennae grey. Abdomen grey-whitish. Legs whitish, mixed with fuscous. Forewings elongate, moderate, costa slightly arched, termen obliquely rounded; 7 and 8 stalked; white, suffusedly irrorated throughout with small round fuscous dots, arranged in transverse rows, these coalesce to form 3 more or less transverse fasciae; first indistinct, from costa at one-sixth to dorsum at one-quarter; second, curved outwards, from costa at about one-quarter to dorsum in middle, interrupted in middle, lower two-thirds more distinct; third from costa in middle to tornus, sometimes not traceable; cilia dull fuscous, spotted with whitish. Hindwings and cilia pale whitish-grey.

Allied to *euryptera*, Meyr., but narrow winged.

Hab.—Toowoomba and Warra, South Queensland; four specimens sent by Mrs. F. H. Hobler.

ELACHISTIDAE.

Trachydora leucodela, n. sp.

♂, 12 mm. Head, palpi, antennae, and thorax greyish-white, apex of basal joint of palpi mixed with fuscous, antennae infuscated. Abdomen fuscous above, white beneath. Legs white or whitish. Forewings elongate-lanceolate; dark fuscous; a well-marked elongate white streak, from near base to one-third costa, not touching costa at termination; a fine whitish streak beneath this, from base to second tuft of scales; scale-tufts blackish; first just above dorsum in middle, second immediately above and beyond, third larger, just above tornus; fourth, similar, obliquely beyond, on middle of termen, surmounted on costa by a small flattened mark; fifth small, at about two-thirds from base, obliquely above third; a fine whitish line between second and fourth; a fine fuscous line along termen, preceded on upper portion by a whitish line; cilia dark fuscous, with a whitish subapical patch.

Hab.—Parkside, South Australia; three specimens on trunks of *Eucalyptus* in December.

Trachydora pauxilla, n. sp.

♂ and ♀, 8-10 mm. Head, palpi, and thorax greyish-white, basal joint of palpi with suffused subapical ring, patagia fuscous. Abdomen greyish - fuscous above, grey - whitish beneath. Legs whitish. Forewings elongate-lanceolate; dark fuscous; markings white; an oblique costal streak from base to one-quarter; a similar, but shorter one beyond, from costa at about two-fifths; a rather broad dorsal streak, from base to one-third, thence curved upwards and reaching termination of second costal streak; a moderately thick streak, from apex along termen and continued along fold and almost reaching dorsal streak, attenuated on terminal half; a small costal spot at five-sixths; a fine line from costa from between this and second costal streak, somewhat metallic and reaching to tornus, sometimes interrupted in middle; tufts small, rather obscure, whitish-metallic; a fine black line along termen; cilia fuscous, with a distinct white line at base. Hindwings and cilia greyish-fuscous.

Probably allied to *oxyzona*, Meyr., but quite distinct by the white dorsal stripe. It is the smallest species yet discovered, and is extremely active when disturbed.

Hab.—Parkside, South Australia; several specimens on trunks of *Eucalyptus* in November and December.

LIMNOECIA TRIXANTHA, n. sp.

♂, 10 mm. Head and thorax fuscous. Palpi and antennae ochreous. Abdomen fuscous. Legs ochreous-white, posterior pair strongly infuscated. Forewings elongate, pointed; coppery-fuscous; a large triangular yellow blotch, resting on dorsum and reaching nearly to costa; a similar, but smaller spot on dorsum just before tornus, reaching half across wing; a small yellow spot from costa at about three-quarters, its apex nearly touching previous spot, but slightly beyond; cilia fuscous. Hindwings and cilia fuscous.

Distinct by the yellow triangular blotches.

Hab.—Cairns district, North Queensland; three specimens in October received from Mr. F. P. Dodd.

Certain Diophantine Problems.

By J. R. Wilton, M.A., D.Sc.,

Professor of Mathematics in the University of Adelaide.

[Read April 8, 1920.]

A rapid and obvious way of obtaining the solution in positive integers(1) of the equation

$$x^2+y^2=z^2$$

is to put

$$x+iy=(p+iq)^2.$$

Equating real and imaginary parts we have

$$x=p^2-q^2,\ y=2pq,\ \text{and}\ z=p^2+q^2.$$

More generally, if

$$x^2+y^2=z_1z_2{}^2\ldots z_n^n$$

we put

$$z_r=p_r{}^2+q_r{}^2,$$

$$x+iy=(p_1+iq_1)\,(p_2+iq_2)^2\ \ldots\ (p_n+iq_n)^n$$

and equate real and imaginary parts.

The solution of

$$x^2+y^2=(a^2+b^2)z^n$$

is obtained by putting

$$x+iy=(a+ib)\,(p+iq)^n,$$

or, when $n=2$, by means of the identity

$$(ax+by)^2+(bx-ay)^2=(a^2+b^2)\,(p^2+q^2).$$

Exactly similar solutions may be obtained for the equation

$$(x-ay)^2+by^2=z_1z_2{}^2\ \ldots\ z_n^n.$$

Put

$$x-ay+iy\sqrt{b}=\Pi\,(p_r+iq_r\sqrt{b})^r$$

and equate real and imaginary parts. (In this case it is possible to obtain integer solutions if a and b are rational). And similarly the right-hand side may be multiplied by c^2+bd^2.

A solution of the equation

$$x_1{}^2+x_2{}^2+\ldots+x_n{}^2=u^2$$

is readily derived from the trigonometric solution

$$x_r=\sin\,\theta_1\sin\,\theta_2\ \ldots\ \sin\,\theta_{r-1}\cos\,\theta_r$$

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(1) Every letter used will denote an integer (not necessarily positive), except that i, as usual, denotes $\sqrt{-1}$.

(in which $\theta_n=0$) by putting $\tan \frac{1}{2}\theta_r = q_r/p_r$. We thus obtain

$$x_1 = 2^{n-1} p_1 q_1 p_2 q_2 \ . \ . \ . \ p_{n-1} q_{n-1}$$
$$x_2 = 2^{n-2} p_1 q_1 p_2 q_2 \ . \ . \ . \ p_{n-2} q_{n-2} (p_{n-1}^2 - q_{n-1}^2)$$
$$x_3 = 2^{n-3} p_1 q_1 p_2 q_2 \ . \ . \ . \ p_{n-3} q_{n-3} (p_{n-2}^2 - q_{n-2}^2)(p_{n-1}^2 + q_{n-1}^2)$$
$$\cdot$$
$$\cdot$$
$$\cdot$$
$$x_n = (p_1^2 - q_1^2)(p_2^2 + q_2^2)(p_3^2 + q_3^2) \ . \ . \ . \ (p_{n-1}^2 + q_{n-1}^2)$$
$$u = (p_1^2 + q_1^2)(p_2^2 + q_2^2) \ . \ . \ . \ (p_{n-1}^2 + q_{n-1}^2)$$

A particular case when $n=3$ is

$$5^4 + 6^4 = 65^2 - 48^2.$$

An evident solution of

$$x^2 + y^2 = z^2 + w^2,$$

is

$$x = pr - qs, \qquad z = ps - qr,$$
$$y = qr + ps, \qquad w = qs + pr.$$

And a similar solution of

$$x_1^2 + x_2^2 + x_3^2 + x_4^2 = y_1^2 + y_2^2 + y_3^2 + y_4^2,$$

derived from Euler's expression of the product of two sums each of four squares as the sum of four squares, is

$$x_1 = pp' + qq' + rr' + ss', \quad y_1 = pp' + qq' + rr' - ss',$$
$$x_2 = qr' - q'r + ps' - p's, \quad y_2 = -qr' + q'r + ps' + p's,$$
$$x_3 = rp' - r'p + qs' - q's, \quad y_3 = -rp' + r'p + qs' + q's,$$
$$x_4 = pq' - p'q + rs' - r's, \quad y_4 = -pq' + p'q + rs' + r's.$$

When we pass to equations of degree higher than the second, there are very few cases which admit an easy solution: perhaps the simplest is the equation

$$x^3 + y^3 + z^3 - 3xyz = w^n.$$

If $\omega^3 = 1$, $\omega + \omega^2 = -1$, a solution is obtained by putting

$$w = p(r^2 - rs + s^2),$$
$$x + y + z = p^n,$$
$$x + \omega y + \omega^2 z = (r + \omega s)^n.$$

In particular if $n=2$,

$$x = p(3p + 2r + 2s) + r^2, \ y = p(3p + 2r + 2s) + 2rs,$$
$$z = p(3p + 2r + 2s) + s^2, \ w = 3p(r^2 - rs + s^2) + r^3 + s^3,$$

satisfy the equation

$$x^3 + y^3 + z^3 - 3xyz = w^2.$$

And when $n=3$,

$$x = q + r^3 + s^3, \quad y = q + 3r^2 s, \quad z = q + 3rs^2,$$
$$w = 3p(r^2 - rs + s^2) + r^3 + s^3,$$

where $\quad q = 3p\{3p^2 + 3p(r+s) + (r+s)^2\}$,

satisfy

$$x^3 + y^3 + z^3 - 3xyz = w^3.$$

An interesting particular case is

$$23^3 + 24^3 + 25^3 - 3.23.24.25 = 6^3.$$

The general solution of the equation

$$x^3 + y^3 = z^2$$

may be obtained by a similar method. The two factors $x + y$ and $(x+y)^2 - 3xy$ of $x^3 + y^3$ can, if x and y are prime to one another, have no common factor but 3: hence we have either

$$x + y = m^2,$$

or

$$x + y = 3m^2.$$

In the first case we put

$$x + \omega y = (p + \omega q)^2,$$

i.e.,

$$x = p^2 - q^2, \quad y = 2pq - q^2.$$

We thus have

$$m^2 = (p+q)^2 - 3q^2,$$

the solution of which is

$$p = 3r^2 - 2rs + s^2, \quad q = 2rs, \quad m = 3r^2 - s^2.$$

This type of solution of

$$x^3 + y^3 = z^2$$

is therefore

$$x = (r-s)(3r-s)(3r^2+s^2),$$
$$y = 4rs(3r^2 - 3rs + s^2),$$
$$z = |3r^2 - s^2|(9r^4 - 18r^3s + 18r^2s^2 - 6rs^3 + s^4).$$

Particular cases are

$$8^3 - 7^3 = 13^2, \qquad 56^3 + 65^3 = 671^2,$$
$$105^3 - 104^3 = 181^2, \quad 57^3 + 112^3 = 1261^2.$$

Taking now the second case, in which

$$x + y = 3m^2,$$

we may put

$$x + \omega y = (2+\omega)(p + \omega q)^2;$$

whence

$$x = 2p^2 - 2pq - q^2, \quad y = p^2 + 2pq - 2q^2,$$

and therefore

$$m^2 = p^2 - q^2,$$

so that

$$p = r^2 + s^2, \; q = r^2 - s^2, \; m = 2rs,$$

and the second type of solution of

$$x^3 + y^3 = z^2$$

is

$$x = -r^4 + 6r^2s^2 + 3s^4,$$
$$y = r^4 + 6r^2s^2 - 3s^4,$$
$$z = 6rs\,(r^4 + 3s^4).$$

Particular cases are

$$1^3 + 2^3 = 3^2, \; 11^3 + 37^3 = 228^2, \; 71^3 - 23^3 = 3^2 . 14^4.$$

The solution of

$$x^3 + y^3 = 2z^2$$

is required below. The only case which leads to a solution is

$$x + y = 6m^2,$$
$$x + \omega y = (2+\omega)(p + \omega q)^2,$$

i.e.,

$$x = 2p^2 - 2pq - q^2, \quad y = p^2 + 2pq - 2q^2,$$
$$p^2 - q^2 = 2m^2.$$

Whence $\quad p = r^2 + 2s^2, \;\; q = r^2 - 2s^2, \;\; m = 2rs;$

$$x = -r^4 + 12r^2s^2 + 12s^4,$$
$$y = r^4 + 12r^2s^2 - 12s^4,$$
$$z = 6rs\,(r^4 + 12s^4);$$

e.g., $\quad 23^3 + 1^3 = 2.78^2, \;\; 239^3 - 143^3 = 2.2316^2.$

(A form of solution of $x^3 + y^3 = az^2$ is obvious: we write $6as^2$, $3a^2s^4$ instead of $12s^2$, $12s^4$ in the above result.)

The last result enables us to solve the equation

$$x^2 + y^3 = z^4.$$

If x, y, z are prime to one another, $z^2 - x$ and $z^2 + x$ have at most a common factor 2. If they are both odd we put

$$z^2 + x = p^3, \;\; z^2 - x = q^3,$$
$$x = \tfrac{1}{2}(p^3 - q^3), \;\; y = pq, \;\; p^3 + q^3 = 2z^2.$$

Substituting for p, q, and z the values which satisfy the last equation, we obtain

$$x = |12r^4 - s^4|\,(144r^8 + 408r^4s^4 + s^8),$$
$$y = (12r^4 + 12r^2s^2 - s^4)\,(-12r^4 + 12r^2s^2 + s^4),$$
$$z = 6rs\,(12r^4 + s^4);$$

e.g., $\quad 6083^2 + 23^3 = 78^4, \;\; 433^2 + 143^3 = 42^4.$

The case in which $z^2 + x$ and $z^2 - x$ are both even appears not to lead to a solution.

The equation

$$x^2 + y^4 = z^3$$

also admits of solution.

We put $\quad x + iy^2 = (p - iq^2)^3$, and therefore

$$x = p^3 - 3pq^4, \;\; y^2 = q^2\,(q^4 - 3p^2),$$

whence $y = qm$, provided that

$$m^2 + 3p^2 = q^4.$$

Put $\quad m + ip\sqrt{3} = (r + is\sqrt{3})^4,$

and therefore $\quad p = 4r^3s - 12rs^3,$

$$m = r^4 - 18r^2s^2 + 9s^4,$$
$$q = r^2 + 3s^2.$$

Whence

$$x = 4rs\,|r^2 - 3s^2|\,(3r^8 + 20r^6s^2 + 258r^4s^4 + 180r^2s^6 + 243s^8),$$
$$y = (r^2 + 3s^2)\,(r^4 - 18r^2s^2 + 9s^4),$$
$$z = r^8 + 28r^6s^2 - 42r^4s^4 + 252r^2s^6 + 81s^8.$$

Putting $r = s$ we find $88^2 + 4^4 = 20^3$. This, however, is not a satisfactory solution, as it is derived from $11^2 + 2^2 = 5^3$ by multiplying through by 2^6. The solution obtained by putting $r = 2s$ is

$$57112^2 + 329^4 = 2465^3.$$

Various solutions of the equation

$$x^3 + y^3 + z^3 = w^3$$

have been given. The following appears to be rather more general than any I have seen:—

Let $(p^2 - pq + q^2)(x + y) = (r^2 - rs + s^2)(w - z)$,

$(u + \omega v)(r + \omega s)(x + \omega y) = (u + \omega^2 v)(p + \omega^2 q)(w - \omega^2 z)$.

From these equations, observing that

$$x + y + \omega(x + \omega y) + \omega^2(x + \omega^2 y) = 0,$$

we obtain the solution,

$x = (r^2 - rs + s^2)[u^2(2pr - qs - qr - ps) + 2uv(2qs - qr - ps - pr) + v^2(2qr + 2ps - pr - qs)] + (u^2 - uv + v^2)(p^2 - pq + q^2)^2$,

$y = (r^2 - rs + s^2)[u^2(pr + qs - 2qr - 2ps) + 2uv(qs + qr + ps - 2pr) + v^2(qr + ps + pr - 2qs)] - (u^2 - uv + v^2)(p^2 - pq + q^2)^2$,

$z = (p^2 - pq + q^2)[u^2(-pr - qs + 2qr + 2ps) + 2uv(-qs - qr - ps + 2pr) + v^2(-qr - ps - pr + 2qs)] + (u^2 - uv + v^2)(r^2 - rs + s^2)^2$,

$w = (p^2 - pq + q^2)[u^2(2pr - qs - qr - ps) + 2uv(2qs - qr - ps - pr) + v^2(2qr + 2ps - pr - qs)] + (u^2 - uv + v^2)(r^2 - rs + s^2)^2$.

Particular cases are

$3^3 + 4^3 + 5^3 = 6^3$, $1^3 + 6^3 + 8^3 = 3^6$, $20^3 + 54^3 + 79^3 = 87^3$,
$34^3 + 39^3 + 65^3 = 72^3$, $86^3 + 95^3 + 97^3 = 134^3$,
$9^3 + 10^3 = 1^3 + 12^3$, $26^3 + 36^3 = 17^3 + 39^3$.

Vocabularies of Four South Australian Languages—Adelaide, Narrunga, Kukata, and Narrinyeri—with Special Reference to their Speech Sounds.

By J. M. Black.

[Read April 8, 1920.]

These small collections of words were made during a visit to Point Pearce Aboriginal Mission Station, on northern Yorke Peninsula, in October, 1919. Founded in the year 1867 for "the civilization and evangelization of the aborigines on Yorke Peninsula," the mission was managed for half a century by local trustees, but four years ago it was placed under Government control. The first missionary and superintendent was the Rev. W. J. Kühn (1867-1880), and the present superintendent is Mr. F. Garnett, who has held office since 1909, and who kindly gave me every assistance in my work. The natives at the mission number about 230, but of these only some 25 are full-blooded; the remainder are half-castes and quadroons.

As in former papers on the same subject, the alphabet used is that of the International Phonetic Association, with a few modifications.

[a] is the *a* in Scottish "man" or German "Mann"; when long (which is rare) it is the English *a* in "father." Before any of the reflexed consonants [*r*, *l*, *n*], etc., it approaches the English *u* in "nut" or "fur" [ə], as [ma*r*a] hand, almost [mə*r*a]; [ba*l*a, ba*r*la] woman, almost [bə*l*a, bə*r*la].

[e] is the close French *é* in "répéter" [repete], or the first element in the "ey" of "they" [δeĭ, δe : ĭ].

[ϵ] is the open English *e* in "bed" [bϵd]; when long, like *e* in "there" [δϵ : ə].

[i] is the short, open sound heard in "pity" [piti]; when long [i :], it sounds as in "marine."

[ɔ] is the English *o* in "not"; when long it is almost like *a* in all" [ɔ :l], but with a slight tendency towards [o :]. Both sounds are somewhat rare.

[ə] is the obscure sound heard in "wanderer" [ˈwɔndərə]. I have not used it much in this paper, because, although one may hear [wɔηgənə] or [baηgərə] in rapid enunciation, yet, if the native is pressed to pronounce clearly, one hears [wɔηgana] and [baηgara].

[u] when short = *oo* in "foot"; when long = *oo* in "boot."

[œ] is the French *eu* or German *ö*, as heard in "peur, Köpfe" [pœ:r, kœpfə].

[ai] and [au] are near English *i* in "fire" and *ow* in "how," but the first element of the diphthong is distinctly heard and always bears the stress. The second element is almost consonantal, so that it might be more correct to write [aj, aw]. As [kawi], the term for "water" in some Tindo languages, corresponds to [kabi] in others, it seems to me preferable to write [kawi] rather than [kauwi], as has usually been done in the past.

A long vowel is indicated by the sign [:] placed after it.

[j]=English *y* in "young"; [dj] must not be confused with English *j*.

[*ŋ*]=*ng* in "singer."

[*θ*]=*th* in "thin."

[*δ*]=*th* in "other."

[r] is the rolled or trilled *r*, as heard in Scottish or Irish speech, or English of the concert room.

[*r*] is the Somersetshire (reflexed or inverted) *r*, and is a marked peculiarity of Australian native speech. When dealing with this sound in a previous paper (these Trans., xli., 2), I called this the "cacuminal or Somersetshire *r*," and stated that it was also found in the Sanscritic and Dravidian languages of India. I should have said the Dravidian languages only. The matter is explained by the following note received from Mr. David Jones, M.A., English secretary of the International Phonetic Association:—"A couple of points strike me in connection with what you say about *r* on page 2. The retroflexed fricative (Somersetshire) *r* (ɹ) occurs in Norwegian to my certain knowledge; I have heard it from Norwegians. I am almost certain it also occurs in Swedish, but cannot at the moment remember hearing it. As for Indian languages, the famous retroflex (cacuminal, cerebral) *r* of Northern India is quite a different sound. The tongue starts from retroflex position and is then shot forwards and downwards, so that the under-side of it hits against the teeth-ridge and makes a strong flap. The action is like that of flipping with the finger against the thumb. It is the flap which is the characteristic element of the sound. In Southern (Dravidian) India the true Somersetshire *r* is found. A variety of it occurs in Tamil; it is often described as something intermediate between *r* and *l*. It is the final sound in the word 'Tamil' [təmi*r*]. Ordinary rolled *r* also occurs in this language, as in the Northern Indian languages."

These two forms of *r* (the trilled and the reflexed) were noticed by some of the early writers on Australian languages, although only one expressed the difference in type. Teichelmann and Schürmann, in dealing with the Adelaide language (1840), say:—"*r* sometimes sounds as *r* in English, sometimes rather softer, as in birri (nail of fingers or toes), marra (hand), gurltendi (to cough), &c." This "softer" sound is, of course, the Somersetshire *r*, and the two first words are written in my vocabulary [bi*r*i, ma*r*a]. Schürmann, in the introduction to his "Vocabulary of the Parnkalla language" (1844), says both sounds occur in that dialect (spoken near Port Lincoln), and points out that they distinguish the meaning of otherwise similar words, *e.g.*, yurra, "man"—yurra, "earth" (the latter written yura in the vocabulary); wirra, "scrub"—wirra, "air, rain"; karra, "high"—karra, "grass" (the latter written kara in the vocabulary). In our system these words would be written [jura—ju*r*a; wira—wi*r*a; kara, ka*r*a]. It will be noticed that there is the same difference in Narrunga between [wiri] club, and [wi*r*i] shoulder, between [wara] language, and [wa*r*a] sea-beach, and between [mara] leaf, and [ma*r*a] hand.

The distinction is also observed by G. F. Moore, Advocate-General of Western Australia, in his "Descriptive Vocabulary of the language in common use amongst the aborigines of Western Australia" (London, 1842). This work is based on a vocabulary compiled by Capt. G. Grey (afterwards Governor of South Australia) in 1838, and deals with the language of the natives living about the Swan River. Moore writes the word [ma*r*a] hand "marh-ra," and adds: "The first *r* is to be aspirated. This is an attempt to explain in letters a sound which hearing and practice alone can enable anyone to understand and acquire." To show how closely allied the Swan River language is to our own dialects spoken from Adelaide to the Great Bight, it is only necessary to quote the following words from Moore's work: "marh-ra, hand; buyu, smoke; dta, mouth; dtallang, tongue; gabbi, water; kalla, fire; katta, head; kardo, husband or wife; mandigara, girl; mel, eye; wangon, speaking; warru, female kangaroo."

[*l*]. I believe this to be a peculiar sound, not hitherto recognized as single, and common to many of, perhaps all the languages of the Tindo family (the group which stretches along the coasts from Adelaide to Perth, and from the Great Bight northwards into Central Australia). The word for "fire" in the Adelaide dialect is given by Teichelmann and Schürman as "gadla" or "garla," and was at first heard by me as [ka*r*la, kə*r*la] or even [k*r*la], with a syllabic [*r*]. In Narrunga the same word was heard at first as [kadla], with a faint *d*, or as [kalla]; McEntire, in Taplin's Folklore, p. 63, quotes it as "kudla." In the Baroota dialect (these Trans.,

xli., 12) I transcribed it [kaδla]. In the same way the word for "house" is heard as [wə*r*li], [wa*r*li], or [wadli], and is spelt "wodli, wurli," by other observers, and the word for "man" sounds as [je*r*li], [jadli], or [ja*r*dli]. Such varied transcriptions seem to indicate, in these and many other words, that there is something wrong about the hearing and the method of representation, and this belief was strengthened when I found that Mrs. Newchurch rejected such pronunciations as [ka*r*la, kadla] or [kaδla] as incorrect. The sound in question appears to be a simple one—an *l* formed by pressing the slightly reflexed point of the tongue against the front part of the palate. The tongue is not so much reflexed as for [*r*], nor is it pushed so far back on the palate, but in both cases the preceding vowel is indistinct in quality, owing to the peculiarly elevated position of the tongue, so that one feels in doubt whether it should be represented by [a], [ə], [ɔ], or even [ɛ]. I therefore write these words [ka*l*a, wa*l*i]. In Wirrung I heard the word for "fire" as [kala] or [kɔla], with a very open vowel, but the *l* appeared fairly normal or only slightly reflexed. Whether [*l*] was originally [*r*l] is an open question, but very likely it was. The sound is quite distinct from Spanish *ll*, Welsh voiceless *ll*, or the thick, backward Russian *l*, although nearest to the last-named.

Then there are many words in which [*r*] is more or less heard before a palatal [*n*], [*t*], or [*d*], such as [ma*r*nguri] or [ma*n*guri, ma*ŋ*guri], three; [ma*r*na] or [ma*n*a], big; [ka*r*tu] or [ka*t*u], wife. It is quite possible that here also we are dealing with simple reflexed-palatal sounds bearing the same relation to [n] and [t] that [*l*] does to [l] and [*r*] to [r]. There is this difference, however, that this strong, reflexed-palatal [*t*] or [*d*], or a very similar sound, occurs at the beginning of some words, a position in which I have never heard [*r*] or [*l*]. Of course a reflexed-palatal sound such as [*r*] or [*l*] affects a following [n], [t], or [d] so that they become reflexed-palatal also. The same changes occur in other languages which possess the [*r*] sound. Paul Passy, in his "Changements phonétiques," p. 179, when discussing assimilation of consonants, writes [ba*n*] for the Swedish [ba*r*n], Barn, "child." In the Swedish text given in the "Principles of the International Phonetic Association," p. 25, Nordan, "the north wind," is transcribed [no:*d*an], with the statement that [*d*] is an inverted (reflexed) [d]. In the "Exposé des principes" of the same association, p. 19, is a Norwegian text, where it is stated that [*r*t, *r*d, *r*n, *r*l, *r*s] may be reduced to [*t*, *d*, *n*, *l*, *s*], and in the text occur the words [træ:*r*nə], træerne, "the trees"; [ˈvakkə*r*t], vakkert, "beautiful"; [ko:*r*nə], korne, "corn." These words might therefore, according to the above, be also transcribed [træ:*n*ə, vakkə*t*, ko:*n*ə]. The above examples go to prove that the same difficulty about the phonetic transcription of certain sounds exists wherever the reflexed or inverted [*r*] is found. I question, however, whether the Somersetshire "hurn" for "run," or the American "purty" for "pretty," would be correctly represented by [hə:*n*] and [pə:*t*i]. Either [hə*r*n] and [pə*r*ti], or [h*r*n] and [p*r*ti], with a syllabic [r], would appear preferable.

The following remarks by Teichelmann and Schürmann show the difficulties they encountered in dealing with the question: "*r* is changed with *l* or *d;* as kurlana, kullana (recent); garla, gadla (fire); murla, mulla (dry); *r* is omitted before *n*, as marnkutye, mankutye (three); marngandi, mangandi (to request); nurnti, nunti (away); *r* before *t* is changed into *t*, as ngartendi, ngattendi (to ask)."

[*v*] is the bilabial *v*, the ordinary sound of German *w (was, ewig)*, and of the Spanish *b* and *v* between vowels *(cabo, ave)*. It is rare in Australian languages, but was distinctly heard (only in the middle of words), and is perhaps a variant of [w] or [b].

The stressed or accented syllable is indicated by the sign ['] placed *before* it, but as the great majority of native words are accented on the first syllable, the accent mark is omitted whenever such is the case. Thus the words [pa*r*kana] and [gamidi] are accented like the English words "perjury" and "company." Where there are four syllables, as in [bindjanidja], [ŋariŋjɛri], and [jɛrabula], the main stress is still on the first syllable and there is a slight secondary stress on the third syllable, as in the English "tantalizing." Why certain words, such as [tan'danja, ka'rawi, pu'lɔmbi, ba'lardu] are accented on the second syllable, is a question whose solution would require a more thorough knowledge of native languages than we possess.

Letters and words in the phonetic alphabet occurring in the ordinary text are placed within square brackets.

Voiced and voiceless consonants.—The sounds of *p* and *b* are alike to the native, and it is the same with *t* and *d*, *k* and *g*. He pronounces [kaka, kaga] or [gaga], "head," indifferently; so also [tidna] or [didna] for "foot," and [papa] or [baba] for dog. It is impossible to imagine the Australian aboriginal taking an interest in his own language or reducing it to writing and using it for literary purposes (as has been done by one or two of the North American tribes), but, if such a thing were done, it is probable that only the voiceless consonants *(p, t,* and *k)* would be used, at least at the beginning of words; otherwise much confusion would occur.

One hears from the same individual such varying forms as [ka*r*nada] and [ga*r*nara] for "north wind," [jalkata] and [jɛlgada] for "three," [kɔ:*r*ni] and [kwɔ:*r*ni] for "man." Especially in unaccented syllables is there much licence: [maŋ'kata] and [maŋkara] for "girl." These divergencies are not surprising when we remember that the natives are without letters or any standard of "correct" speech.

The Adelaide Language.

An interesting and intelligent personality is Mrs. Amelia Taylor, who claims to be the last survivor of the Adelaide tribe. Born near Adelaide, and probably between 60 and 70 years of age, she now occupies a cottage at Point Pearce. Her native name is [i*v*ariti], meaning "a gentle, misty rain." Mr. M. Moorhouse, who was appointed Protector of Aborigines in 1839, estimated the number of natives near Adelaide in 1851 to be 220. Bishop Short, in giving evidence before a Parliamentary Select Committee on the aborigines, in 1860, said:—"The Adelaide tribe is gone. They used to come down to Hindmarsh to bury. I remember 300 natives assembling in the heart of what is called Norwood now." Dr. Wyatt, who was Protector of Aborigines from 1837 to 1839, gave evidence:—"With regard to the Adelaide tribe, it has nearly died out. . . . The Adelaide tribe varied from 150 to 300 at one time, including the children—that is to say, the tribe called the Adelaide tribe was a group of smaller tribes of which the Adelaide tribe was the centre." Thus it appears that in 24 years—from 1836 to 1860—the Adelaide tribe became almost extinct.

In 1840 the Revs. C. G. Teichelmann and C. W. Schürmann, two Lutheran missionaries, published "Outlines of a Grammar, Vocabulary, and Phraseology of the aboriginal language of South Australia spoken by the natives in and for some distance around Adelaide." In the following vocabulary, obtained from Mrs. Taylor, any notes taken from the above work are indicated by the initials "T. and S."

The Adelaide Public Library contains a pamphlet entitled "A Vocabulary of the language of the aborigines of the Adelaide district and other friendly tribes of the Province of South Australia, by William Williams, of the Colonial Store Department. Adelaide, 1839." This little work is mentioned in Mr. T. Gill's Bibliography of South Australia (1885), but has not, as far as I know, been noticed in any linguistic publication. It is interesting, because it is almost certainly the first attempt to describe any native language of this State, and precedes Teichelmann and Schürmann's larger and more complete work by one year. The spelling is somewhat primitive, *e.g.*, cur-la, "fire," [ka*l*a]; hunkey, "female," [aŋki]; my-ie, "biscuit," [mai] or [maji], really meaning "vegetable food." Some of the proper names are interesting: Turn-darn-yung-gah, "land on the banks of the Torrens," is [tan′danjaŋka] "at Adelaide"; Ton-darn-ya-par-rey, "River Torrens," is [tan′danja pa*r*i] "Adelaide River," and is evidently another native name for the Torrens, because T. and S. call it Karrauwirraparri, *i.e.*, the "Redgum forest-river." War-rey par-rey, "the creek that runs from the hills into Holdfast Bay" (*i.e.*, Sturt River), is the Warriparri [wari pa*r*i] of T. and S. It means the "wind river," or "river of the west wind." Wee-tun-gar, "the Reedbeds," is the Witongga [wi:toŋga] of T. and S., from [wi:to] a reed. The word still exists in the same locality as "Wetunga," the name of Captain S. A. White's estate, at Fulham.

buljuna (puljuna), black, of dark complexion.

bu*l*atji, two. (T. and S., purlaitye.) This word may be placed before the dual (at least this was done by Amelia), so that a double dual was produced: bu*l*atji kadlii*l*a, two dogs; bu*l*atji tappu*l*a, two flies; bu*l*atji miju*l*a, two men; bu*l*atji ŋaŋkii*l*a, two women. Uraidla is properly [ju*r*ii*l*a], "two ears," from [ju*r*i] ear, as Mount Lofty and the next hill to the north resemble, when seen from the plains, two ears rising from the head of an animal. T. and S. give the dual suffix as "-la, -rla, -dla."

di:kanti (dikanti), sitting, living (T. and S., tikkandi); wa inna di:kanti? where do you live? ŋaiji dikanti tan′danjaŋka, I live at Adelaide.

i*v*ariti, misty rain; the native name of my informant. A similar name is mentioned by Mrs. Daisy Bates, these Trans., xlii., 161.

jaka, here; jaka manja, here is rain. T. and S. say: "yakka, int. expressing aversion, as, yakka manya."

jalaka, given as "yesterday." T. and S. translate it "at present, now, to-day."

jaŋara, wife.

jaŋadli, by and by; soon.

jɛ*l*ina, husband (T. and S., yerlina).

ka′*v*aiji waŋkadli, let us come and talk.

kadli, dog; kadlii*l*a, two dogs; kadlina, dogs.

kaiŋka wira, North Adelaide, and given as meaning "gum scrub." T. and S. give "karra wirra" for the same locality, with the meaning "forest of gum trees."

ka*l*a, fire (T. and S., gadla).

kantara, basket made of reeds for carrying the baby.

kapi, tobacco (T. and S., kappi).
kawi, water (T. and S., kauwe).
kunta (gunta), beating, thrashing (T. and S., kundandi, to strike, beat, kill).
mabu, wild cat (T. and S., mabo).
manja, rain (T. and S., manya, cold, rain).
ma*n*kudji, three (T. and S., marnkutye).
maηkata, girl (T. and S., mangkarra).
maηkiti, finger.
ma*r*a, hand (T. and S., marra, finger, hand).
miju (meju), man (T. and S., meyu); miju'aηki, man and wife; miju puljuna, blackfellow.
mi:na, eye (T. and S., mena, eye).
mutjata, rug made of skins sewn with kangaroo sinews.
na:, you (nom. pl.).
nanto, kangaroo.
ninna, those (nom.).
nintu, by-thee (causative case); nintu ηaitju kadli kunta, you beat my dog.
niηku, thy; niηku kadli, thy (your) dog.
noko, suffix meaning "from" (T. and S., nangko, nungko, unungko); tan'danjanoko, from Adelaide.
ηadlu, we (nom. case); ηadlu bu*r*idji ηanta'anti, we are all ill.
ηaiji, I (nom. case); ηaiji ηanta'anti, I am ill.
ηaitju, my (T. & S., ngaityo); ηaitju jaηara, my wife.
ηantu, by-whom; ηantu kadli ηaitju pa*l*ta? who struck my dog? lit., by-whom dog mine struck?
ηattu, by-me (causative case); ηattu pa*l*ta niηku kadli, I struck your dog; ηattu ninna nakki, I see you; jaηadli attu inna nakko:ta, I will see you later, lit., by-me thee will-be-seeing. [attu] and [inna] are reduced forms of [ηattu] and [ninna], often used in the middle of a sentence.
ηaηki, often pronounced aηki, woman (T. and S., ngangki, female, generally).
ηaηki, pa*r*i, River Onkaparinga. This name—the women's river"—was derived by Amelia from the fact that near the stream was a place of refuge for women and children during tribal wars. Teichelmann gives the name as "ngangki parri." Our appellation represents the native name with the locative suffix [ηaηki'pa*r*iηka], "at the women's river."
ηanpu, given as "Port Adelaide."
ηarkato, give; kawi ηarkato, give (me) water.
pa, he she (nom. case); pa ηanta'anti, he or she is ill.
padna (badna), they (T. and S., parna).

padni, see pa*r*ni.
pa*l*ta, to strike (T. and S., pallta).
pa*l*u, by him or her (causative case; T. and S., padlo): pa*l*u gunta kadli, he beat the dog (lit., by-him beating dog).
pa*r*i, river (T. and S., parri).
pa*r*kana, white (T. and S., perkanna).
pa*r*'natatja, name of Amelia's father. She did not know its meaning, but it is probably a relationship name, and connected with (perhaps an inversion of) "ngarpatyata," given by T. and S. as meaning "son-in-law."
pa*r*ni ka'*v*aiji, come here (T. and S., parni kauwai); ηaiji pa*r*ni:ta jaηadli, I will come by and by; nundi padni, go away; adlati ninna pa*r*ni padnita? when will you come? pa*r*ni and padni are perhaps only variants of the same word expressing movement.
pata'wilja, Glenelg (T. and S., pattawilya). Teichelmann and Schürmann do not explain this name (Amelia also could give no explanation), but in their vocabulary patta is given as "a species of gumtree" and wilya as "foliage; young branches; brushwood." The name Patawalonga, now applied to the river which enters the sea at Glenelg, appears to be [patawilja] with the locative suffix [-ηka], *i.e.*, [pata'wiljàηka], meaning "at Glenelg."
pindjadu ka*l*a, make a fire!
pinti, binti (T. and S., pindi, "the grave or habitation of souls before birth and after death"); pinti'meju, white man (T. and S., pindi meyu, European); bintiju wa*l*i, white man's house.
puljuna, black (T. and S., pulyonna); kadli buljuna, black dog.
pu:lti, country towards the Semaphore; evidently the same as Teichelmann's "yertabulti, Port Adelaide." "Yerta" [jε*r*ta] means "land" and "bulti," in T. and S., means "asleep."
tan'danja, site of Adelaide south of the Torrens (T. and S., tandanya, site of South Adelaide).
taη'kaira, given by Amelia as her mother's name. She did not know its meaning, but there can be little doubt that it is the same word as "tangkaiira," given by T. and S. as "a species of fungus."
tappu, fly (T. and S., tappo); tappudna, flies.
tidna, foot (T. and S., tidna).
tinjara, boy (T. and S., tinyara).
wa, where?

waδaηko, whence (T. and S., wādangko); waδaηko inna? where do you come from?
wakaku, child (T. and S., wakwakko).
wa*l*i, house (T. and S., wodli).
wa*r*aηku, sick, ill (T. and S., wārrangko).
wara, language (T. and S., warra).

NARRUNGA.

This is the language spoken by the tribe ['naruηa], which inhabited northern Yorke Peninsula. Like all the coastal languages east of the two gulfs, it is very closelv allied to the Adelaide speech; in fact, the coastal tribes from Cape Jervis to north of Port Augusta can have had no difficulty in understanding each other. Mrs. Sarah Newchurch was a most intelligent assistant, and Harry Richards, native name ['waηwia], *i.e.*, "fifth son," also gave me a number of words. He is an old, full-blooded native, and blind. He claims to be the last representative of the Wallaroo blacks.

adje, mother.
adjɛli, father.
aηki, woman (= ηaηki).
baitja, snake (in general).
baka, tobacco, also black snake.
ba*l*a (almost ba*r*la), woman (used contemptuously).
ba*l*u (almost ba*r*lu), by him or her (causative case).
ba*l*udja (ba*l*idja), died; ηaηki ba*l*udja, the woman is dead; ηaitju jɛ*l*i ba*l*idja, my husband is dead.
bamani, come or go (imperative).
bamatja (bamadja), going, coming; nini wanti bamadja? where are you going?; bamatjai, I am going (also ηai bamatja); ηadjɛli ba*r*ni bamaniη, my father is coming here; mu:ntanu bamaninu, you are going to Moonta.
ba*n*da (ba*r*nta), stone; ba*n*da wa*l*i (stone house).
ba*n*dala, back (of body).
baηgara, country. This is the "pangkarra" of the Adelaide tribe, which T. & S. describe as "the district belonging to an individual, which he inherits from his father."
bapi, father.
ba*l*u (ba*r*lu), by him, her (causative).
ba*r*na, iguana.
ba*r*nu, his or her; ba*r*nu adje, his or her mother.
ba*r*nugu, their; ba*r*nugu adje, their mother.
bi:ku, forehead; bi:ku buti, eye-brows.
bilta, opossum; bilta balta, opossum rug.
bindara (bin'di*r*ja), white man, European (=gudnju).

bindi'nanto (lit., white man's kangaroo), horse; also bindara nantu.
bindjanidia, making; ka*l*a ŋattu bindjanidja, I am making a fire; ka*l*a bindjaru! make a fire!; buju bindjaru! make a smoke! These imperatives are in the singular; if addressed to several persons the phrase would be: ka*l*a (buju) bindjanidja!
bidia, eldest son in a family. Mrs. Newchurch gave me the following words, which are often applied as names to the children, and retained by them through life: bidia, first son; gadidu, first daughter; waria, second son; waridu, second daughter; munaija, third son; munadu, third daughter; mi*l*aija, fourth son; mi*l*adu, fourth daughter; waŋwia, fifth son; waŋudu, fifth daughter. T. and S. give "munaitya" as the name of the 4th son, and "munato" of the 4th daughter; "midlaitya" and "midlato" as the 5th son and daughter in the Adelaide language.
biŋku, given as "rat" and said to = wara. T. and S. give "pingko" in the Adelaide language as "a small animal with a white tail which burrows in the earth"—probably a bandicoot.
bi*r*a, moon.
budjaka, stumpy-tailed lizard (= ma*r*awa*ti*).
budna, chest (of body).
buju, smoke.
bu*l*ai, two; bu*l*ai nippu, two blackfellows.
bu*l*i, star.
bundunja, deaf adder.
buŋgwidja, striking, hitting.
bu*r*ka, grey head, old man.
burkiana, the country around Point Pearce Mission Station, so-called from the number of "oil-bushes").
burko, the oil-bush *(Geijera parviflora)*.
*d*a*v*ara (*d*a:bara), mouth.
*d*a*l*pa (*t*a*l*pa), lip.
*d*a*l*ti, ear; *d*a*l*ti danpa, deaf.
*d*amuli, grandfather (mother's father).
*d*a*r*tu (*t*a*r*tu), hill.
didnŋi, elbow.
di:ja, teeth, set of teeth, a single tooth being ŋurku.
dintu, sun (= tindo).
diŋjara, young man.
dudnja, sweetheart.
gamidi, grandmother (mother's mother).
ga*r*dinja, fine, handsome; ga*r*dinja maŋgara, a fine girl.

ga*r*tu (ka*r*tu, ga*t*u), wife.
gawana, uncle (father's or mother's brother).
gidja, little, small; appears always to follow the noun: gu:ŋa gidja, a little child; ŋaŋki gidja, a small woman.
gudnju, white man.
gu:ŋa (guŋanja), child.
gurana, good; gurana nipu, a good blackfellow.
jagana, sister or first cousin.
ja*l*i (jɛ*l*i), man; ŋaitju jɛ*l*i, my husband; ja*l*i, gidja, a little man.
ja*l*ku, leg.
jambini, widower.
ja*r*ta (jɛ*r*ta), land, soil.
jɛrabula, four; jɛrabula ja*l*i, four men; jɛrabula ŋari ja*l*i, five men.
jœŋka, beard.
juko (ju:ku), boat.
juŋa, brother or first cousin.
juŋgwidja, giving; baka juŋgo, give (me) tobacco.
kadli (gadli), dog; gadli gidja, a little dog.
kaka (gaga), head; kaka wi:lja (gaga wilja), hair of the head; gaga buno, hat.
ka*l*a, fire.
ka*r*nada (ga*r*nara), hot wind, north wind.
kwi:ja, fish.
maiji (maji), vegetable food.
mailku'wa*t*a, cheek. In the Adelaide language "malta-worta" (T. and S., p. 18).
maku, cloud.
malabi, grandfather (father's father).
mandiku, net made of strips of opossum skin for carrying the baby.
manja, rain.
manjatu, cold.
maŋgadi, grandmother (father's mother).
maŋgara, girl, young woman; maŋga maŋgaridi, the Seven Sisters (Pleiades); maŋgaridi was said to mean "the maids." The same name occurs in the Adelaide language as "mankamankarranna s.pl. (girls) the Pleiades" (T. and S., p. 19).
maŋguri, three; maŋguri ja*l*i, three men.
maŋgwidja, carrying off; nippu maŋgwidja ba*r*la, the blackfellow carried off (another blackfellow's) wife.
mara, leaf.
maruga, widow.
mata, knee.

ma*r*a, hand; ma*r*a bi*r*i, finger nail.
ma*r*a'wa*t*i, the stumpy-tailed lizard.
ma*r*nguri, three (also maŋguri).
ma*r*na (ma*r*ni, mœ*r*na, ma*n*a), much, big; ma*r*na wa*l*ta, very hot; ma*r*na gu:ŋanja, a big child: ma*r*na gadli, a big dog.
mi:na (mina), eye; mina buti, eye-lashes.
mi:naku (minagu), blind.
mudla, nose.
mulari, very well; all right.
murgadja, crying, weeping.
mu*r*u, sand; mu*r*u *d*a*r*tu, sandhill.
muŋari, the little island between Point Pearce and Wardang Island (native name of the latter, waralti). When crossing to Wardang Island the blacks waded out to [muŋari] and swam the rest of the distance. Mrs. Newchurch's grandfather and grandmother told her that while the swimmers were in the water the old men sat along the shore and sang an incantation to keep the sharks away. No one was allowed to move until the party landed on the island. When ready to return they made a signal across the water and the singing began again. The object of these visits was to get fish and penguins' eggs.
nagudja (nagwidja), seeing; baitja ŋattu nagudja, I see a snake; baitja naguru, look at the snake.
nanto, kangaroo.
naruŋa, the tribe formerly inhabiting the northern part of Yorke Peninsula; naruŋa wara, their language.
ne, yes (pronounced with a short, close [e]; in fact equivalent to the French *né);* ne, ŋai wɔŋgani, yes, I am speaking.
nini, thou; nini wɔŋgani, you are speaking; nini wa*r*ana, you are ill; nini tikadja, you are sitting down.
nintu, by thee (causative); nintu buŋgwidja gadli, you are striking the dog.
niŋku (niŋgu), thy; niŋku adje, thy mother; niŋgu ga*t*u, thy wife.
nippu (nipu), blackfellow.
ŋaβara, aunt (father's or mother's sister).
ŋadje (ŋaitje, ŋaite = ŋaitju adje), my mother. Or perhaps this word and ŋadjɛli are merely different forms of adje and adjɛli, like ŋaŋki and aŋki, a woman.
ŋadjɛli (ŋaitjali = ŋaitju adjɛli), my father.
ŋadlu, we.
ŋai (ŋaj, ŋaiji), I (nom. case); ŋai bamatja mu:ntan, I am going to Moonta; ŋai tikadja, I am sitting down.

ηaitju (ηaitu), my; ηaitju ηuβa, my husband.
ηalugu, our.
ηamaitja, mother.
ηami (ηammi), woman's breast; mother, mamma. Used by young children for "mother," as bapi for "father," the words adje and adjɛli being substituted as they grow older.
ηantu, "hand and arm up to the shoulder."
ηari, solitary, one.
ηarigu, one; ηarigu ja*l*i, one man, a soltary man.
ηarka (narka), a crowd; ηarka nippu, a crowd of blacks; ηarka wa*l*i, a lot of wurlies, a camp.
ηattu, by me (causative case); gadli ηıttu buηwidja, I beat the dog.
ηo:βa (ηuβa), husband.
ηu:njidja, laughing; ηu:nji mana iηja, you make me laugh.
ηunta, away; ηunta bamani, go away.
ηurku, a tooth.
pa*r*ni (ba*r*ni, pə*r*ni), here; pa*r*ni bamani, come here!
pa*r*u, meat, game.
pukara, south wind.
tadni (dadni), sea; tadni waldu'nindjana ("the rushing through of the sea"), native name of Point Pearce.
talinja, tongue.
tidna (didna), foot.
tikadja, sitting down; digani, sit down! (speaking to one person); digadja, sit down! (to several people).
tindo (dintu), sun; dintu ga*r*idja, the sun is rising; dintu digadja, the sun is setting.
tu:gudja, small; tu:gudja guηanja, a small child. This word seems to be an intensive form of gidja.
wadiwe, name of the beach near Point Pearce.
wadna, boomerang.
wajaga, shooting star.
wa'laηgwidja, covering; gaka wa'laηgwidja, I cover (my) head.
wa*l*i, house, wurlie.
wa*l*ina, bad; wa*l*ina ja*l*i, a bad man.
wa*l*ta, hot.
wa*l*tu, neck.
wandidja, lying down.
wanti, where? which way?
wara, language; also rat.
waralti, Wardang (or Wauraltee) Island. The name was given by Mrs. Newchurch as meaning "Rat Island," but if [wara] is synonymous with [biηku] it

probably means "Bandicoot Island." This is the interpretation in R. Cockburn's Nomenclature of South Australia, p. 140.
wari, west wind.
wa*r*a, sea beach.
wa*r*ana, sick, ill; ηaji wa*r*ana, I am ill.
wa*r*nku, brown snake.
wa*r*no (wa*n*o), chin.
wa*r*tu (wa*t*u), wombat.
widna, fishing net made of reeds bound with sinews of kangaroo's tail.
winta, spear.
wira (wirra), scrub.
wiri, club, waddy.
wi*r*i, shoulder.
witata, shark.
wɔηgana, speaking; ηai wɔηgani, I am speaking; ηai wɔηgadja, I am speaking Narrunga.

Kukata.

Kukata (Kookkata, with accent on the first syllable) is the name of a tribe inhabiting the country north of Lake Gairdner. Their language is very near the Wirrung or Wîrongu, spoken further south, and already dealt with in two papers by Mrs. Bates and myself respectively (these Trans., xlii., 153; xli., 3), but differs entirely as regards several words which are shared with more northern dialects. Stanley Davis, a young native from Mount Eba Station, supplied the following vocabulary:—

bagali, grandfather (see [bɔgali] in the list of relationship in Mrs. Bates' paper, these Trans. xlii., 162-3).
drini, big; drini baba, a big dog.
gudjuda, one; ku:ba gudjuda, one blackfellow.
gutara, two; ηa*r*na gutara, two trees.
jalkata (jɛlgada), three.
kabi, water.
kabu*l*i (kabu*r*li), grandmother.
kada (kata), head; kada uru, hair of the head; tjindo kata'rara, the sun is rising. This is evidently the same word as the Wîrongu word kɔgarara, meaning "east."
kadidi, teeth.
kalta, stumpy-tailed lizard.
kama*r*u, uncle (mother's brother).
kaηga*r*u, elder sister.
kaηgu, house, camp.

ku : ba, white man.
ku*d*a, brother.
kuga, meat.
kuka*t*a (kuka*r*ta), one of the inland tribes living north of the Gawler Ranges.
kundali, aunt (father's sister).
ku*r*u, eye; a Central Australian word, given as "coo-roo" in Willshire's Vocab., p. 44.
maj (maij), vegetable food.
mama, father.
ma*r*a, hand; ma*r*a bi*r*i, finger nail.
ma*r*lu, kangaroo. This is another Central Australian word, used by the natives round Lake Amadeus (Willshire).
miηa, ant.
mukadi, boot.
mu*l*a, nose.
mu : na, hat.
mu : ra, camp.
nanto, kangaroo; horse.
nira, to you; nira ηaila buju ju : a, I give you tobacco.
nja : ni, sheep.
njimi, lip; njimi gutara, two lips.
nju : ra, by thee (causative case); nju : ra ηaigu papa pumanda, you beat my dog.
njurguda, bad.
ηaigu, my; ηaigu mama, my father.
ηaila, by me (causative case); ηaila woηga kukata, I am speaking Kukata; ηaila papa pumanda, I hit the dog; ηaila bi'ɛndula, I am shivering; ηaila gudu nantu jaηganduga, I am going after the horses.
ηandlu, by whom (causative case); ηandlu papa pumanda? who hit the dog?
ηanja, to me; buju ηanja ju : a, give me tobacco.
ηa*r*na, tree; ηa*r*na tadi, scrub.
padu, blackfellow; padu murka, a crowd of natives.
pala (bala), good.
papa (baba), a dog.
puju (buju), tobacco; smoke.
pu*l*ka, an old man. Evidently the same as bu*r*ka, with the same meaning, in the Adelaide and Narrunga languages.
*t*a :, mouth.
*t*a : li, tongue.
*t*a : njimi, the lips.
tjina, foot.
tjindo, sun; tjindo kata'rara, the sun is rising.

waru, fire. Given as the word for "fire" (warroo) by W. W. Willshire in his vocabulary of the language spoken near Lake Amadeus (1891), p. 44.

waru'jɛlta, cold (probably "fire-less").

wi:a, mother.

Narrinyeri.

Frank Blackmoor, a member of this well-known riverine tribe, and who was living at Point Pearce at the time of my visit, gave me the following list of words, which approaches nearer to Taplin's "standard Narrinyeri" than the vocabulary published in a former volume of these Transactions (xli., 8-12): —

ka'lallin, hot, being hot; ka'lallin'ap, I am hot; ka'lallin'and, you are hot; ka'lallin'atj, he is hot; ka'lallin'ar, they are hot.

ka:r, they, by them (nom. and caus. cases); shortened to ar when following an intransitive verb, as in the above example.

ka'rawi, big; ka'rawi kɔ:rni, a big man.

kɛ:li, dog; kɛ:lɛŋg, two dogs; kɛ:lar, dogs.

ki:li, by him (causative case); ki:li an taminjuan ŋa'rakki, he is shooting a duck. The word an, "it," is in apposition to ŋa'rakki, as the natives say in English, "he shoot um duck."

ki'riŋkari, white man. The origin of this word is fully explained by Taplin, Manners S.A. Aborigines, p. 37.

kɔ:rni, man; kɔ:rnɛŋg, two men; kɔ:rnar, men.

ku:li, head; ku:li an wi:əlan, (my) head aches.

minj'indian taminjuil? what have you shot? The first part of this sentence sounds like one word, but is evidently composed of three words: minj or minji, what; indi, by you (causative case); an, it (accusative case).

mɔruwal'appa ŋɔpinal, I am going out walking. The first part of this phrase can be decomposed into the "moru el ap" of Taplin's grammar, meaning "I will go down," lit., "down will I"; the second part represents Taplin's "ngoppun," walking, apparently with the verbal suffix al (el), meaning "will," repeated.

mu:ara (muwara) windjɛri, foot; muwara windjɛrɛŋg, two feet.

muru'lappi, small; muru'lappi kɔrni, a small man.

ni'nɛ:paδar, three; ni'nɛ:paδar kɛ:lar, three dogs.

ŋaniŋi, pigface *(Mesembryanthemum)*.

ŋariŋjɛri, the Narrinyeri or Ngarringyeri language.

ŋa'rakki, teal, duck.

pereŋo:ki, River Murray. Taplin gives the name as "Murrundi." The word ŋo:ki means water; what pere means I do not know. It may be the same as the Adelaide [pari] "river."

pi:li, eye.

piŋgjali, emu.

pɔ:ti, horse.

pu'lɔmbi, ear.

raŋgu'mi:lan, barking; ke:li raŋgu'mi:lan, the dog barks; ke:lar raŋgu'mi:lan, the dogs bark.

tœ:ji, hair of the head.

tœ:ni, hand.

tœ:ri, tooth.

walkandi, north.

wi:rin, being ill, sick; wi:rin ap, I am ill; wi:rin and, thou art ill; wi:rin atj, he is ill; wi:rin aŋan, we are ill; wi:rin aŋun, you are ill; wi:rin ar, they are ill. The verbal adjective and the pronoun, or pronominal suffix, are pronounced as one word, and might very well be written as such: wi:rinap, etc., as was done with ka'lallin.

Essential Oil from the Fruits of *Callitris verrucosa.*

By H. H. Finlayson.
(Communicated by Professor Rennie.)

[Read May 13, 1920.]

The tree yielding the fruits was found in fairly dense scrub about nine miles south-east of Tailem Bend, and its striking appearance at once attracted attention. The pines in the neighbourhood, although numerous, seem to be all either *C. robusta* or *C. calcarata*, and their foliage is a very dark green, and their fruits, which are relatively sparsely distributed over the tree, are large and fairly smooth of surface; the pine in question, on the other hand, was about 15 ft. high, and the foliage, which was covered with a peculiar bloom, appeared almost white; the fruits were small, very numerous, and covered with wart-like protuberances from which, by simple pressure between the fingers, oil could be expelled in considerable amount.

An examination of the cones by Miss Collins, of the Botanical Department, University of Adelaide, revealed a close correspondence with those of *C. verrucosa*, a common species in New South Wales, and the identification of the tree as *C. verrucosa* has been confirmed by Mr. Maiden, Curator of Botanic Gardens, Sydney, as a result of an examination of samples of both foliage and fruits which were submitted to him. Since, however, the oil-content of the fruits was obviously very much higher than the ·44 per cent. which is the yield obtained by Baker and Smith from the cones of this species, it was resolved to steam-distill a small quantity, to determine the yield and to examine the oil in some detail.

The fruits were picked from the one tree on August 29, 1919, in warm weather, and were steam-distilled seven days later, the steaming being continued for twelve hours, during which time 9 l. of distillate were collected. (The material was not completely exhausted of volatile matter, but the quantity coming over was sufficiently small to be neglected.)

After standing for twenty-four hours the oil was run off from the milky aqueous layer and the latter redistilled, about 200 cc. being collected; the small quantity of oil was separated from this second distillate, combined with the main bulk, and the whole then dried over anhydrous Na_2So_4 and filtered. 3,950 g. of fruits gave 98·3 g. of oil of a pale yellow colour and with a strong turpentine-like smell.

The ester value obtained by two hours' boiling with $\frac{1}{2}$N alcoholic potash was 8·5, corresponding to 2·9 per cent. of bomyl or geranyl acetates, and after acetylation this figure rose to 12·14, indicating the presence of about 1 per cent. of free alcohols calculated as $C_{10}H_{18}O$.

Determinations of density and specific rotation gave the values:—

$$D^{12}_{12} = 8674 \text{ and } [\alpha]_{D13} = -19{\cdot}3°.$$

These values are at variance with those attributed to the fruit oil of *C. verrucosa* by Baker and Smith, as the following comparisons show:—

Found.	Baker and Smith (Pines of Australia, p. 106).
$D^{12}_{12} = {\cdot}8674$	[1]$D^{22} = {\cdot}8608$
$[\alpha]_{D13} = -19{\cdot}3°$	$[\alpha]_D = +{\cdot}3°$
Esters = 2·9 %	Esters = 1 78 %
Alcohols = 1 %	Alcohols = (?)
Yield = 2·49 %	Yield = ·44 %

A careful fractionation of 82 g. of the oil under 18 mm. pressure gave the following results:—

	53-55°	55-60°	60-70°	70-80°	80-90°	90-100°	100-135°	Residue
1.	62·3 g.	10·4 g.	2·2 g.	—	—	—	5·3 g.	—

	53-55°	55-60°	60-80°	80-110°	100-130°	Residue
2.	66·3 g.	6·8 g.	1·6 g.	1·1 g.	3·4 g.	—
3.	69·8 g.	3·2 g.	1·6 g.	1·1 g.	3·4 g.	Slight resinous residue

Fraction 1, 53°-55° C., constituting 85 per cent. of the total oil, had $D^{19}_{19} = {\cdot}8574$ and $[\alpha]_{D19} = -27{\cdot}44°$, and these constants, together with the boiling point, left little doubt that pinene was the chief constituent of the oil; to confirm this the nitrosochloride and nitrol-benzylamide were prepared.

10 g. of the fraction with 10 g. of amyl nitrite were cooled to $-5°$ and 3 cc. of concentrated hydrochloric acid slowly dropped in with continual stirring; separation of the nitrosochloride began after the first few drops had been added and the addition occupied one-quarter hour.

The freezing mixture and reaction product were allowed slowly to attain the atmospheric temperature (two hours), and the precipitate was then filtered at the pump and thoroughly washed with alcohol until snow white; after solution in chloroform and precipitation with methyl alcohol, the compound melted sharply at 103° C.

(1) Corresponding to the corrected value $D^{12} = {\cdot}8672$.

The yield was poor, 20 g. of the fraction giving only 3·8 g. of nitrosochloride.

The benzylamide was prepared by digesting 3·7 g. of the nitrosochloride with 4 g. of benzylamide in 30 cc. of spirit for one hour on the water bath, the greater part of the spirit being then distilled off and the residue poured into water; the precipitated oil slowly solidified, and when crystallization was complete it was recrystallized from somewhat dilute alcohol; it then melted at 122°-123° C. To the extent of 85-90 per cent., therefore, the oil consists of pinene, the laero variety predominating.

The remaining fractions were too small for systematic examination, but fraction 2 also seemed to consist largely of pinene; limonene, if not absent, was present in very small quantity only.

Fraction 5 contained large amounts of esters, and an attempt was made to characterize the alcohols present after saponification, but without success; geronial was almost certainly absent, and although the smell of borneol was prominent a specimen of that substance could not be isolated.

In conclusion, I have to thank Miss Collins for the preliminary botanical exmination of the fruits, and Mr. Maiden for the final identification of the tree as *C. verrucosa*.

Chemical Department, University of Adelaide.

Studies in Comparative Physiology.

1.—Observations on the Physiology of the Fly's Intestine.

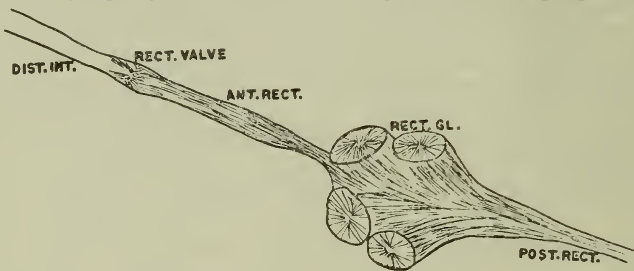
By T. Brailsford Robertson, Ph.D., D.Sc.
(From the Department of Physiology and Biochemistry, University of Adelaide).

[Read May 13, 1920.]

Introduction.

The intestine of an insect represents a rhythmically contracting, automatic structure in which the contractile elements are striated muscle fibres (1). In the vertebrates those organs which display similar automaticity and rhythmicity are, with the exception of the heart, smooth-muscle organs. The insect intestine, therefore, affords an opportunity of ascertaining whether the characteristic reactions of smooth and striated muscle to various chemical agents are correlated primarily with their cytological structure or rather with the nature of their functional activity. The single exception afforded by the heart to the rule which prevails in the vertebrata, that automatically contractile organs are provided with smooth muscle, is too isolated and unique to afford a basis for generalization. The functions performed by the heart are peculiar and not paralleled by those performed by any other tissue. We are not surprised to find the striated muscle of the heart differing in many features of its behaviour from the striated skeletal muscles, the more especially since cytological details of its structure also differentiate it from the other striated muscles in the body. In the intestine of the insect, however, we have an organ performing a strictly analogous function to that which is performed by the intestine of a vertebrate. In the one case the fibres are of the striated, in the other of the smooth type. We are led to inquire whether, in their reactions to muscle stimulants or depressants, the striated muscles of the insect intestine resemble the *structurally* similar striated muscles of the vertebrate, or whether they do not, on the contrary, resemble the *functionally* similar smooth muscles of the vertebrates. The experiments herein described were undertaken with a view to throwing some preliminary light upon this question.

As I have pointed out in a previous communication to this Society (2, 3), if the last abdominal segment of a fly be grasped with forceps and gently torn away from the others a considerable length of intestine may, with a little practice, be withdrawn from the abdomen with very little stretching or injury. It is perhaps unnecessary to explain that the fly is killed, by compression of the thorax, before this operation is performed. If the traction which is exerted is too strong the intestine breaks, generally just below or just above the junction of the Malpighian tubes. It is difficult to withdraw any of the proximal intestine (proximal, that is, to the point of entry of the Malpighian tubes) without injurious traction and stretching or tearing of the intestine. It is preferable to draw out the entire rectum and a portion of the distal intestine and then separate this from the intestine which still remains in the abdomen by incision with a sharp scalpel. A camera lucida drawing of such a preparation is reproduced in the accompanying figure. The various parts of the preparation



are named in accordance with the nomenclature adopted by Hewitt (4). The greater part of the distal intestine is not represented in the figure. The boundary between the proximal and distal intestine is marked by the insertion of the Malpighian tubes. In the preparations used in these experiments the proximal intestine was never employed, although the Malpighian tubes were occasionally included.

Two species of flies were used in nearly all of the experiments. They were the common Australian "blow fly," *Calliphora oceanicoe*, and the "blue bottle," *Lucilia sericata*.[1] In one or two experiments the grey-striped "flesh fly," *Sarcophaga aurifrons*, was employed. The relative length of the different sections of the intestine and rectum varies greatly in different species, but in the two species employed in nearly all of the experiments the proportional lengths of the different sections of the lower alimentary canal are very similar. The anterior rectum is somewhat longer in *Lucilia sericata* than in *Calliphora oceanicoe*, and the Malpighian tubes, which

(1) I am indebted to Mr. A. M. Lea for his kindness in identifying these flies for me.

are not repesented in the figure, appear to be much shorter. The distal intestine in both species is five or six times the length of the rectum. No differences in physiological behaviour were noted in the different species employed.

Experimental Results.

Effects of Sodium and Calcium Salts.

In my previous communication I pointed out that if the preparation just described be laid upon a glass slide and wetted with saline solution (m/8 NaCl) waves of peristalsis may be seen passing along the intestine in the aboral direction. Powerful contractions of the rectum and rectal glands are usually evident, and may persist for some hours. If the preparation be touched at about its middle with the point of a camel hair brush soaked in pure m/8 calcium chloride solution, the peristalsis instantly ceases in the area so treated, but the conduction of excitation is not inhibited. The wave of peristalsis disappears on entering the treated region, reappearing below it at the moment when it would have appeared had the wave been normally propagated. Potassium chloride, in like concentration, suppresses both contraction and conduction.

In the present experiments I at first employed physiological saline (m/8 NaCl) made up in tap-water, assuming that the calcium and other salts present in the tap water would provide a solution approximating more nearly to a "physiologically balanced" mixture than pure sodium chloride. To my surprise little or no movement was exhibited by the preparations immersed in these solutions. Peristalsis of the distal intestine was almost invariably absent, and a few twitches of the rectal glands and incoordinate contractions of individual fibres in the posterior rectum usually comprised all of the movement observed. On placing a crystal of sodium chloride in the drop of water containing the preparation, violent contractions of the rectum and rectal glands took place. It was inferred that the calcium chloride present in Adelaide tap water was possibly sufficient to inhibit contractions, and that its effect could be overcome by increasing the relative proportion of sodium chloride, or, in other words, decreasing the $\frac{Ca}{Na}$ ratio to a favourable magnitude. I was subsequently informed by Dr. W. A. Hargreaves that the Adelaide tap water contains about 0·058 grammes of calcium per litre, corresponding, in a m/8 solution of sodium chloride, to only one molecule of calcium salt per 200 of sodium. Direct experiment showed that a much higher proportion, about 1 to 12·5 of calcium to sodium, is required to inhibit the movements of the intestine in the manner and degree in which they were inhibited by tap water. It must be assumed, therefore, that some other constituent of the tap water, possibly magnesium, added its effect to that of the calcium and was similarly antagonized by sodium.

A number of experiments were next performed in which m/8 sodium chloride in distilled water was used as the bathing fluid. In this good contractions of the rectum and rectal glands were always observed, excepting in the case of nearly moribund flies which were just about to discharge larvae or had already done so. Peristalsis of the intestine, however, was almost invariably absent. Experiments were then performed in which varying proportions of calcium chloride were added to the sodium chloride solution, namely, one, two, three, or four molecules of calcium chloride per fifty molecules of sodium chloride. The remarkable result was then obtained that an increase in the proportion of calcium favoured intestinal while actually inhibiting rectal contractions. Thus while the proportion of 50 mols. NaCl to 1 mol. $CaCl_2$ generally permits simultaneous contraction of the intestine and of the various segments of the rectum, the proportion of 50 mols. NaCl to 4 mols. $CaCl_2$ either immobilises the entire preparation or, more usually, induces powerful peristalsis of the distal intestine while absolutely inhibiting the contractions of the rectum and rectal glands. The following protocol of a typical experiment illustrates this fact, a + indicating contraction and – absence of contraction. The period of exposure to each solution was five minutes. The preceding solution was always drained off from the preparation by means of filter paper, taking care not to actually touch the preparation, before the new solution was applied:—

Table 1.

Experiment No. 32.

Solution.	Post. Rect.	Rect. Gl.	Ant. Rect. and Valve.	Dist. Int.
NaCl	+	+	–	–
50 NaCl+1 $CaCl_2$ ...	+	–	–	+
NaCl	+	+	–	–
50 NaCl+1 $CaCl_2$ ...	–	–	–	+
NaCl	+	+	–	–
50 NaCl+1 $CaCl_2$ ...	–	–	–	+
NaCl	+	+	–	–
50 NaCl+1 $CaCl_2$ ...	–	–	–	+

The optimal ratio of $\frac{Ca}{Na}$ for the maintenance of intestinal and rectal contractions, respectively, varied considerably in different preparations. In the instance cited, the proportion of 1 mol. of calcium to 50 of sodium sufficed to entirely inhibit rectal contractions while constituting an optimum proportion for the maintenance of intestinal peristalsis. In such cases a further increase of calcium, for example to the proportion of 4 mols. of calcium chloride to 50 of sodium chloride, led also to the inhibition of the intestine, and the entire preparation was immobilized. In other instances the optimal proportion of calcium for intestinal peristalsis was much higher, even as high as 4 to 50. In every case, however, without any exception, the optimal concentration of calcium for intestinal contractions was far above the optimum for rectal contractions, and generally sufficient to inhibit them altogether. Conversely, a proportion low enough to be optimal for the rectum and rectal glands was always below the optimum for the intestine, and generally so low as to inhibit contractions of the intestine altogether; in fact, in the great majority of instances, pure sodium chloride solution appeared to very nearly represent the optimum for the rectal contractions.

We have in the fly's intestine, therefore, a clear-cut instance of a phenomenon to which attention has but rarely been drawn, namely, the existence of a definite *optimum* ratio of calcium to sodium above or below which the muscular movements are inhibited. It has long been recognized that a reduction of the $\frac{Ca}{Na}$ ratio increases the irritability of skeletal muscles in the vertebrata, but it has been supposed that this increase of irritability is merely the greater, the greater the reduction of the ratio. In the auricles and sinus of the heart the irritability is sufficient to permit rhythmic contractions even in the presence of the calcium salts in blood or in Ringer's or Locke's solutions, but the isolated ventricular strip requires a reduction of the $\frac{Ca}{Na}$ ratio below the level obtaining in the blood before spontaneous rhythm is possible. Differences in the "threshold value" of the $\frac{Ca}{Na}$ ratio in different parts of the same muscular organ have therefore been recognized. Below this threshold, differing in different muscular tissues, spontaneous rhythm is possible; above this threshold it is not. But the existence of a lower as well as an upper threshold of the ratio, between which lies an optimum, has, so far as I am aware, only been hitherto observed by Bancroft, in the galvanotropic response of *Paramoecium* (5). It is possible that such a double threshold exists in other muscular tissues than the fly's intestine, but the example which this tissue affords is of so striking a nature as to immediately compel attention, while the absence of comment upon such phenomena in other muscular tissues bears witness either to their rarity or to the technical difficulty of making them evident.

Magnesium chloride has a still more strongly inhibitory action upon rectal and intestinal movements than calcium chloride, and, so far as I have been able to observe its action, is wholly inhibitory and never stimulatory, thus agreeing with its action upon the mammalian intestine, as established by Meltzer and Auer (6). The contrast between the action of magnesium chloride and that of calcium chloride is displayed in the following protocol:—

TABLE 2.

EXPERIMENT No. 51.

Solution.	Post. Rect.	Rect. Gl.	Ant. Rect. and Valve.	Dist. Int.
NaCl	+	+	+	−
50 NaCl+1 $MgCl_2$ ...	+	−	−	−
NaCl	+	+	+	−
50 NaCl+1 $CaCl_2$ ...	−	−	−	+
50 NaCl+1 $MgCl_2$ ...	+	−	−	−

A phenomenon which appears to be so unique invites an alternative explanation. It might be imagined, for example, that the contractions of the rectum inhibit those of the intestines and *vice versa*. This, indeed, was the explanation which first occurred to the author, but it is negatived by the fact that preparations are repeatedly obtained, especially when immersed in the mixture 50NaCl to $1CaCl_2$, in which active contraction of both the rectal and intestinal segments are simultaneously and synchronously occurring. In such preparations the rectal contractions can be inhibited by raising the proportion of calcium to sodium to a point which still permits active peristalsis of the intestine, while the intestinal contractions may be inhibited and the rectal contractions left unimpaired by immersing the preparation in pure sodium chloride solution.

As will be seen from succeeding experiments, the effects of various drugs upon the intestine combine to support the view that there exists in the fly's intestine (including the rectum) a gradient of $\frac{Ca}{Na}$ thresholds, increasing from below upwards, analogous to the gradients of metabolic activity, conduction and rhythmic activity which have been shown by Alvarez and his co-workers to exist in the mammalian intestine (7, 8, 9), and the question necessarily suggests itself whether this is not, after all, the fundamental gradient of which the others are the indirect expression. Certainly this view would explain the remarkable effect of the reduction of the $\frac{Ca}{Na}$ ratio by saline cathartics in increasing the contractions of the colon, with evacuation of its contents, while the upper intestine remains unaffected or is actually inhibited (6, 7).

Effects of Drugs which paralyse or stimulate Nervous Tissues.

Curari paralyses the nerve-endings of striated skeletal muscles in the vertebrates, but it leaves the nerve-endings in the heart unaffected. The muscles of different species are, however, differently affected by curari, and certain species—for example, fishes and the tortoise—are almost immune to its effects (10). The muscles of worms are totally unaffected by curari (11). In these experiments it was found that curari, even in such high dosage as 1 : 1000 solution, either in m/8 NaCl or in a mixture of 50 mols. m/8 NaCl to 1 mol. m/8 $CaCl_2$, leaves the movements, both of the intestine and of the rectum, totally unaffected.

Atropine, on the contrary, while leaving the nerve-terminations in the striated muscles of the vertebrates unaffected, nevertheless paralyses the nerve-terminals in a variety of smooth-muscle organs. The movements of the mammalian intestine are, however, unaffected by atropine (12), and in these experiments atropine sulphate in 1 : 1000 solution was similarly found to be devoid of effect.[2]

Nicotine first stimulates and then paralyses the peripheral ganglia of the autonomic nervous system of the vertebrates. In these experiments it exerted only a long-delayed toxic action. Solutions containing 1 : 1000 of the free base caused a gradual and progressive diminution of the frequency and amplitude of contractions, but the intestine (or rectum) was not brought to a standstill even after half an hour of exposure to this solution. Washing with fresh saline solution immediately restored the original vigour of the contractions.

Codeine, on the contrary, which has little or no effect upon striated muscles or their nerve supply in vertebrates, brings about almost instant cessation of all movements in the fly's intestine. This corresponds to the usual action of small dosages upon the unstriated muscle of the mammalian intestine. The following protocol of a typical experiment illustrates this effect, a double plus sign being used to denote exceptionally vigorous

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(2) A solution is stated to be devoid of effect when no change in rhythm or frequency is observed after fifteen minutes. During longer periods spontaneous changes of rhythm or amplitude may occur which do not allow us to differentiate between the effects of drugs and spontaneous deterioration of the tissue due to prolonged exposure to abnormal conditions.

contractions. The solvent for the drugs employed was m/8 NaCl:—

TABLE 3.

EXPERIMENT No. 20.

Solution.	Post. Rect.	Rect. Gl.	Ant. Rect. and Valve.	Dist. Int.
NaCl	++	++	++	−
Curari 1:1000	++	++	++	−
Codeine phosphate 1:1000	−	−	−	−
NaCl	+	−	+	−

Pilocarpine, which stimulates the motor nerve-endings in various smooth-muscle organs, and particularly the intestine of the vertebrate, immobilises the fly's intestine, but not nearly so quickly as codeine. The contractions in preparations immersed in 1:1000 solutions of pilocarpine in m/8 NaCl or 50 m/8 NaCl + 1 m/8 $CoCl_2$ slowly diminish in frequency and amplitude, but may still persist after ten minutes. No trace of stimulation could ever be observed.

Chloretone, which is a general anaesthetic, causes immediate cessation of movement when applied in 1:1000 solution. More dilute solutions, 1:4000, cause a slow decrease in amplitude and frequency, but decided contractions may still persist after six or eight minutes of exposure to the solution.

In reviewing these results it is evident that the striated muscle fibres of the fly's intestine differ in their reaction to nerve excitants and depressants from both the striated and the unstriated fibres which occur in the majority of mammalian tissues. The most striking reaction is the instant immobolisation by codeine, in which respect of its behaviour the striated muscle of the fly's intestine approaches more closely to the smooth muscle of the mammalian intestine than to any other mammalian muscle tissue.

Effects of Drugs which affect Muscle Tissue or Myoneural Junctions.

Veratrine, which paralyses the relaxation of vertebrate striated muscle, and hence induces sustained contracture, promptly, in 1:2000 solution, immobilises the fly's intestine. It cannot be said, however, that the intestine is immobilised in a condition of sustained contraction. No definite changes of muscular tone were observed. Great increase of muscular tone does occur when the fly's intestine is treated with adrenaline. In such cases the increase in tone is evidenced by shortening and coiling up of the intestine. No such changes are evidenced after teatment by veratrine. It must be recollected, however, that veratrine, besides its action upon vertebrate striated muscle, also paralyses nerve fibres. It is possible that its action upon the fly's intestine, therefore, is due to paralysis of nervous conduction rather than to direct action upon the muscle fibres.

Of the drugs which affect myoneural junctions, adrenaline, as is well known, stimulates the junctions of the postganglionic fibres of the autonomic system. Where sympathetic stimulation causes muscular contractions or increase of tone, adrenaline will give rise to like effects, as in the blood vessels and the heart, the muscularis mucosoe and the spleen (13, 14). Where sympathetic stimulation causes loss of tone and inhibition of contractions adrenaline elicits similar responses, as in the muscles of the bronchi and the external muscular coats of the intestine. Ergotoxine stimulates certain motor myoneural junctions, particularly those of the blood vessels, heart, and uterus. It has little action upon the mammalian intestine. Ergotinine is the anhydride of ergotoxine, and has comparatively little action upon mammalian myoneural junctions. Ergamine acts directly upon the muscle cells themselves, causing loss of tone in some (blood vessels) and increase of tone in others (uterus and bronchi), while it gives rise to energetic peristalsis of the mammalian intestine ("peristaltic rush"). Digitaline stimulates the inhibitory myoneural junctions in the heart and also stimulates (increases the tone of) the muscle cells themselves.

In their effects upon the fly's intestine these drugs fall into two groups which are sharply opposed to one another. The first, represented by adrenaline, inhibits rectal and stimulates intestinal contractions; the second, comprising ergotinine, ergotoxine, ergamine, and digitaline, inhibits both rectal and intestinal contractions.

The action of adrenaline upon this preparation is most characteristic and invariable. It exactly reproduces the effect of increasing the $\frac{Ca}{Na}$ ratio; in other words, the preparation subjected to the action of adrenaline behaves as if the $\frac{Ca}{Na}$ thresholds had been lowered. A mixture in which the $\frac{Ca}{Na}$ ratio had formerly been insufficiently high to permit intestinal peristalsis now not only facilitates peristalsis but also inhibits rectal contractions. This action of adrenaline is illustrated by the following protocols, which are typical of many experiments. In each case the solvent for the adrenaline was the saline solution employed for comparison :—

TABLE 4.

EXPERIMENT No. 12.

Solution.	Post. Rect.	Rect. Gl.	Ant. Rect. and Valve.	Dist. Int.
NaCl	+	+	+	+
Adrenaline 1 : 1000 ...	+	+	+	++
NaCl	+	+	+	–
Adrenaline 1 : 1000 ...	+	+	+	++
NaCl	+	+	+	–
Adrenaline 1 : 1000 ...	+	+	+	+++
Ergotinine 1 : 1000 ...	–	–	–	–
Adrenaline 1 : 1000 ...	+	+	+	+
NaCl	+	+	+	–
Ergotinine 1 : 1000 ...	–	–	–	–

TABLE 5.

EXPERIMENT No. 42.

Solution.	Post. Rect.	Rect. Gl.	Ant. Rect. and Valve.	Dist. Int.
50 $NaCl$+1 $CaCl_2$ ...	+	–	–	+
Adrenaline 1 : 10000 ...	–	–	+	++
50 $NaCl$+1 $CaCl_2$ ...	+	–	–	–
Adrenaline 1 : 10000 ...	–	–	–	++
Adrenaline 1 : 1000 ...	–	–	–	–
50 $NaCl$+1 $CaCl_2$ ...	–	–	–	+

The adrenaline employed in these experiments was the free base prepared from suprarenal glands by the method of Abel (15). The dosage required to elicit these effects is high compared with the dosages required to elicit responses in mammalian tissue, nevertheless the effects are definite. The optimum dosage varies in different preparations, just as the $\frac{Ca}{Na}$ optima vary. In some preparations 1 : 1000 adrenaline is requisite to elicit intestinal peristalsis; in others this is an excessive concentration, and leads to total immobilisation of the intestine. If a preparation which has been thus immobilised, however, be returned to the solution originally bathing it and employed as solvent for the adrenaline, stimulation is observed of such a pronounced character as to indicate an after-effect, or possibly the effect of adrenaline imbibed by the tissue and subsequently diluted by the adrenaline—free solution. Adrenaline was, in fact, found to be a very useful means of stimulating sluggish preparations to prolonged activity. If the bathing solution was favourable to rectal contractions, *e.g.*, pure NaCl, this after-stimulation extended to the rectum and rectal glands as well as to the intestine. Previously immobile preparations, by several brief exposures to adrenaline followed by a return to NaCl solution, could be converted into preparations which were notably active in every part, displaying simultaneously intestinal peristalsis, rectal contractions, and powerful and rapid contractions of the rectal glands.

The second group of substances—ergotinine, ergamine, ergotoxine (Burroughs, Wellcome), and digitaline (Merck)—all alike produced complete inhibition of intestinal and rectal movements in concentrations of 1 : 1000. In more dilute solutions (1 : 10000) intestinal peristalsis was inhibited immediately, and at a much later period the rectal contractions were also inhibited. In a number of instances, however, very dilute ergotoxine or ergamine (1 : 100000) definitely stimulated the contractions of the rectum and rectal glands, either increasing their amplitude or initiating them when they were otherwise absent; in other words, the action of these drugs was in every way the opposite of that of adrenaline. Their action resembled the effect of *reducing* the $\frac{Ca}{Na}$ ratio, or, in other words, of raising the $\frac{Ca}{Na}$ thresholds of the tissue.

Pituitrine, in dosages of one or one-tenth mil. Parke Davis "O" pituitrine per 20 cc. of solvent produced a dual effect, as, indeed, it usually does in mammalian tissues. The first effect was definite stimulation, especially of the rectum and rectal glands, this being followed, usually within a minute, by complete immobilisation of the preparation. This diphasic action of pituitrine, which is characteristic of its action upon mammalian blood pressure (fall followed by a rise), is attributed by the majority of authors to an admixture of two or more principles of diverse action. It should be noted that the secondary inhibition could not have been due to the admixture of chloretone contained in this solution, since a like concentration of chloretone, without pituitrine, failed to exert a like effect.

Discussion.

In general, it may be stated from the foregoing results that the fly's intestine is comparatively indifferent to those agencies which, in the vertebrate, act primarily upon nervous tissues or upon striated skeletal muscles. On the other hand, those agencies which, in the vertebrate, act powerfully upon the myoneural junctions of smooth muscle, or upon smooth-muscle fibres themselves, also exert characteristic actions upon the muscle of the fly's intestine. The muscle fibres of the fly's intestine, therefore, react to these drugs in a manner corresponding to their function rather than to their structure. The effects of these drugs may be classified in relation to the $\frac{Ca}{Na}$ gradient which has been shown to exist in this preparation, and a relation, hitherto unobserved, has been shown to exist between the $\frac{Ca}{Na}$ thresholds of these muscular tissues and the effects of adrenaline, ergamine, and so forth upon them. Whether this relationship has more general application, or is limited to the tissues employed in these experiments, is a question which awaits further investigation.

Conclusions.

1. There exists, in the fly's intestine, a gradient of $\frac{Ca}{Na}$ thresholds, above and below which contractions or peristalsis cannot occur, and between which lies an optimum ratio. The threshold and optimal ratios increase from below upwards, being least in the posterior rectum and highest in the distal intestine.

2. Curari and atropine in 1 : 1000 solutions are devoid of effect upon the contractions of the excised fly's intestine. Nicotine and pilocarpine exert long-delayed inhibitory action. Codeine and chloretone in 1 : 1000 solutions immobilise the preparation immediately.

3. Veratrine immobilises the fly's intestine, but without evidence of prolonged contracture or increase of tone.

4. Adrenaline stimulates the preparation in such a way as to suggest that the $\frac{Ca}{Na}$ thresholds have been lowered.

5. Ergotoxine, ergotinine, ergamine, and digitaline inhibit the preparation. In very dilute solutions they may stimulate the rectal movements. Their effect is such as to suggest that the $\frac{Ca}{Na}$ thresholds have been raised.

6. Pituitrine exerts a dual action, the initial effect being stimulation, the later effect inhibition.

7. In its reactions to the above-mentioned drugs the muscle of the fly's intestine resembles its functional similar (the vertebrate smooth-muscle fibre) rather than its structural similar (the vertebrate striated muscle fibre).

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A Contribution to the Orchidaceous Flora of Papua (British New Guinea).

By R. S. Rogers, M.A., M.D. and C. T. White, F.L.S.

[Read June 10, 1920.]

Plates V. to VIII.

During July and August, 1918, one of us (C. T. W.), through the kind invitation of H. E. the Hon. J. H. P. Murray, spent five weeks botanizing in the territory of Papua. Owing to the pressure of other matters the work of identifying and describing the material gathered has been somewhat delayed, but is now nearing completion and the examination of several families has been kindly undertaken by various specialists in England and Australia. Only a few orchids were collected; as a general rule this family is very strongly represented in Papuan collections, but the trip undertaken was of a very hurried nature and the localities visited did not seem particularly rich in orchids; as the area, however, from which the material was obtained has not to our knowledge been previously collected over, most of the specimens represent what appear to us previously undescribed forms. All were gathered in the mountainous country between Dilava and Mafula at an elevation of 3 to 4,000 ft. and about sixty miles inland from Yule Island on the Southern coast.

Physurus bicalcaratus, n. sp.

Pl. v.

Planta ± 34 cm. alta; foliis prope a basi, 3 vel 4, ellipticis vel oblongo-ellipticis, acuminatus, integris, glabris, 3-4 nervosis, lamina 3 cm.-9·5 cm. longa et 1·5-3·3 cm. lata, petiolis (cum vaginis) 2·3 cm.-3 cm. longis basi vaginiformibus dilatatis; caule fere glabro leviter pubescenti, bracteis circiter 2 acuminatis pilosis; spica ± 14 cm. alta, floribus circiter 12 sessilibus remotis, rhache bracteis et floribus extus hispidulis; ovario subgracili, ± mm. longo, tortissimo; sepalo dorsali anguste cucullato, erecto, 3-nervoso, ± 7 mm. longo; sepalis lateralibus liberis, labello obliqui suppositis, falco-lanceolatis, 3-nervosis, ± 8 mm. longis; petalis lateralibus sepalo dorsali aequantibus et cum eo in galeam conniventibus, apicibus cohaerentibus, membranaceis, lineari-falcatis, 1-nervosis; labello inferne, sessile, a basi columnae breviter adnato, ab apice calcaris ad extremam laminam $\pm$ 7 mm. longo, calcari conico in mediano bifido inter sepalos laterales exserto, in inferioribus duo-trientibus ventricoso et erecto ad columnam deinde abrupte contracto lamina terminali ovali vel obovata integra et recurva, laciniis lateralibus parvis et erectis; columna (rostello excepto) $\pm$ 2·5 mm. longa; rostello profunde bipartito, erecto, circa (cum glandula) 2 mm. longo, membranaceo; stigmate prope a basi columnae, cavo, erecto, cum alis subgrandibus lunatis. *Habitat*—Deva Deva (C. T. White, No. 605).

Root a creeping rhizome. Leaves near the base, 3 or 4, elliptical or oblong-elliptical, acuminate, entire, glabrous, 3-4 main parallel nerves with many subsidiary ones and transverse reticulations; lamina 3 to 9·5 cm. long and 1·5 to 3·3 cm. wide; petioles 2·3 to 3 cm. long with dilated scarious sheathing bases. Stem almost glabrous, slightly pubescent, with 2 acute hairy bracts. Total height of plant about 34 cm. Spike $\pm$ 14 cm. of about a dozen sessile distant flowers, each subtended by an acuminate ovate-lanceolate bract which is usually shorter than the ovary. Rhachis, bracts, and outside of the flowers beset by minute glandular hairs.

Ovay sessile, rather slender, hairy, much twisted, $\pm$ 11 mm. long. Dorsal sepal narrow-cucullate, erect, 3-nerved, $\pm$ 7 mm. long, tip rather obtuse. Lateral sepals free, inserted obliquely below the labellum, falco-lanceolate, 3-nerved, total length (from lowest point of insertion) about 8 mm. Lateral petals same length as dorsal sepal and connivent with it to form a hood, membranous, 1 nerved, connate at the extreme tips, narrower in the lower than upper half, linear-falcate, much narrower than the sepals. Labellum inferior, shortly adnate to the base of the column, sessile, $\pm$ 7 mm. (including the spur) when fully extended; spur conical, short, bifid antero-posteriorly, exserted between the lateral sepals; lower two-thirds ventricose, erect against column, suddenly contracted into a short neck then dilated into an entire oval or obovate membranous recurved terminal lobe; lateral lobes small erect; lamina glabrous throughout, traversed by several prominent longitudinal nerves.

Column proper short $\pm$ 2·5 mm. long, or including rostellum and gland $\pm$ 4·5 mm.; anther posterior erect; rostellum erect, membranous, deeply bipartite, gland oval or elliptical (the division of the rostellum is only evident after removal of the gland); stigma situated on lower face of column near the base, erect with rather large crescentic wings.

A species, *P. chinensis*, Rolfe, has been recorded (under the name of *P. Henryi)* from New Guinea by Schlechter, and

Hayata in his "Icones Plantarum Formosanarum" (iv., 99) figures what he believes to be Rolfe's plant. His illustrations appear to be identical with the specimens from Deva Deva, but in the absence of measurements of the Formosan Orchid it is impossible to say whether Hayata's interpretation is correct, as he acknowledges that he has not seen the type and has been guided entirely by the original description. Rolfe's measurements (as shown below) indicate a plant with flowers only about half the size of those of the orchid under review and (unless there has been a printer's error) one with a remarkably short scape. He does not, moreover, refer to the coherent tips of the petals (constantly present in Mr. White's specimens) an unusual little feature which is not likely to have escaped the notice of this acute observer had it occurred in his type. There are other points which certainly raise doubts as to the identity of the Deva Deva specimens with Mr. Rolfe's species and for this reason it is deemed advisable to describe it under a new name, leaving the adjustment to be made later should this become necessary.

TABLE OF COMPARATIVE MEASUREMENTS.

	P. CHINENSIS.	P. BICALCARATUS.
Leaves	3·3-10 cm. long and 1·3-4·5 cm. wide ...	3-9·5 cm. long and 1·5-3·3 cm. wide
Petioles	1·3-2·5 cm. long	2·3-3 cm. long
Scape	2-4·5 cm. long	$\pm$ 34 cm. long
Bracts	6-10 mm. long	10-25 mm. long
Sepals and petals	4 mm. long	Dorsal sepal and lat. petals = $\pm$ 7 mm. long; lat. sepals (from lowest point of insertion) = 8 mm. long
Spur	3 mm. long	Average length, about 3 mm.

The genus *Physurus* comprises about 74 recorded species, the vast majority of which are natives of the New. World, only 10 being found in Asia and in certain of the islands lying to the south and east of that continent. These islands include Japan, Formosa, Java, Sumatra, and New Guinea. The flowers are inconspicuous, but some of the plants are prized for their beautiful leaves, resembling in this respect the genus *Anoectochilus*, to which, indeed, *Physurus* is closely related.

GOODYERA HISPIDULA, n. sp.

Pl. vi.

Foliis circa sex, petiolatis, ovato-ellipticis, acuminatis; lamina 9-13 cm. longa, 3-5 cm.-5·5 cm. lata (maxine diametro), longitudiner nervosa, transverse reticulata; petiolis (cum vaginis) ± 5 cm., basi vaginiformibus dilatatis; caula . . . ; spica ± 24 cm. longa, mediocriter dense floriferi; floribus sessilibus; bracteis subulatis ± 15 mm. longis flores superantibus; rhache ovario et floribus extus hispidulis; ovario gracili ± 11 mm.; flore ± 7·5 mm.; sepalis lateralibus liberis, late falcatis, 3-5 nervosis, ±7·5 mm.; sepalo dorsali ± 7·5 mm., anguste cucullato, basi leviter contracto, 3-nervoso; petalis lateralibus ± 6·5 mm., spathulo-falcatis, 1-nervosis, cum sepalo dorsali in galeam cohaerentibus; labello sessile, inferne, ad basin ventricoso, ovato, apice in processus ligulatum producto, in toto ± 6·5 mm. longo, margine membranacea indivisa, lamina longitudiner multi-nervosa in ventriculo pilosa, extus glabro; columna (excepto rostello) ± 4 mm. longa, rostello (cum glandulâ) erecto, circa ± 2 mm., anthera erecta postica, testa angustata stigmate in altitudine aequali, pollinia 2 sectilia, caudicula aliquanto longa, stigmate prominente quadrato-ovato. *Habitat*—Dilava (C. T. White, No. 603).

Leaves about 6, on definite petioles with dilated sheathing scarious bases, ovate-elliptical, accuminate, with marked longitudinal veins and much intermediate reticulation; lamina 9-13 cm. long and 3·5-5·5 cm. broad in widest part, petioles ± 5 cm. Stem incomplete in specimen under examination. Spike ± 24 cm. (± 9½ inches) long, moderately dense. Flowers sessile, each subtended by a characteristic narrow subulate bract about 15 mm. long exceeding in length the summit of the flower; axis of spike, bracts, ovary, and outside of flowers densely beset with short glandular hairs. Ovary rather slender ± 11 mm.; flower ± 7·5 mm.

Lateral sepals ± 7·5 mm., free, broadly falcate with rather blunt tips, 3-5-nerved; dorsal sepal of equal length, narrowly cucullate, erect, slightly contracted at base, 3-nerved, partly connate with lateral petals to form a hood. Lateral petals rather shorter and more membranous than the other segments, not hairy, narrower at base than in upper half, spathulo-falcate, 1-nerved. Labellum sessile, inferior, not adnate to column, with ventricose base projecting between lateral sepals, ovate with ligulate apical projection 2·5 mm. long, total length ± 6·5 mm.; margins entire membranous slightly crenulate; lamina hairy in the concave portion of upper surface, multi-nerved.

Column (excluding rostellum) about 4 mm. long, rostellum and gland slightly exceeding 2 mm., vertical; anther posticous, anther-case narrow reaching to about level of upper border of stigma; pollen sectile, pollinia 2, large, lying at back of and extending below the stigma in a posterior sac formed by a membranous connection between the margins of stigma and the anther, connected by the rather long caudicle to a large elliptical gland on apex of the rostellum; stigma rather prominent, quadrate-ovate.

This plant approaches very closely *Goodyera longibracteata*, Hayata, with which species it may ultimately be deemed identical (*vide* "Icones Plantarum Formosanarum" iv., 114, t. 61, a...h) but in the Formosan species the numerous prominent longitudinal nerves in the labellum do not appear to be present. In the bud the apical projection of the labellum in the Papuan plant is closely approximated to the front of the rostellum and rostellar gland, which it exactly covers and protects.

DENDROCHILUM MURRAYI, n. sp.

Pl. vii.

Pseudobulbi subfusiformes, subangusti, monophylli, ± 7·5 cm. longi, 12·5 mm. lati. Folia apicalia, lineari-lanceolata, petiolata; lamina glabra, nervo solo medio valdior prominenti, 5-nervosa, ± 20-27 cm. longa, 15-35 mm. lata; petioli ± 5 cm. longi. Scapi erecti, terminales, graciles, foliis longiores; racemus 6-9 cm. longus, laxiflorus. Bracteae oblongo-ovatae, glumaceae, valde multinervosae, basibus contractae, fere reflexae, ± 8 mm. longae. Pedicelli ovaria aequantes. Flores mediocres. Sepala lateralia libera, patentia, lanceolata, 3-nervosa, ± 7 mm. longa, 1·6 mm. lata; sepalum dorsale erectum, 3-nervosum, sepalis lateralibus paulo breviore angustioreque, circiter 6·5 mm. longum. Petala lateralia patentia, 3-nervosa, sepalis breviora et angustiora, ± 5·75 mm. longa, ± 1 mm. lata. Labellum sessile, trilobum, ± 4 mm. longum, hypochilium rectilineare; lobi laterales parvi, recurvi, anguste triangulares; lobus intermedius ovato-rhomboideus, apice acutus, margine integro; in basi laminae 3 carinae crassae elevatae. Columna subgracilis, ± 2·75 longa, apice incurvata galeata; stelidia conspicua, sub-falcata, acuminata, prope medium gynostemii, galea breviora; rostellum triangulare, apice obtusum; stigma grande, prominente, ovale, erectum in superiore parte columnae. *Habitat*—Deva Deva (C. T. White, No. 606), August, 1918.

Pseudobulbs rather narrow, somewhat fusiform, ± 7·5 cm. long, 12·5 mm. wide, monophyllous. Leaf linear-lanceolate, petiolate; lamina glabrous with prominent midrib, 5-

nerved, $\pm$ 20-27 cm. long by 15-35 mm. wide; petiole $\pm$ 5 cm. long. Scapes erect, terminal, slender, exceeding the leaf in height; raceme 6-9 cm. long, loosely-flowered. Bracts oblong-ovate, glumaceous, prominently multi-nerved, contracted at the base, generally reflexed, $\pm$ 8 mm. long. Pedicels equaling in length the ovary. Flowers medium-sized.

Lateral sepals free, lanceolate, spreading, 3-nerved, $\pm$ 7 mm. long, 1·6 mm. wide; dorsal sepal erect, 3-nerved, rather shorter and narrower than the lateral sepals, about 6·5 mm. long. Lateral petals spreading, 3-nerved, shorter and narrower than the sepals, $\pm$ 5·75 mm. long, $\pm$ 1 mm. wide.

Labellum sessile, hypochilium rectilinear, $\pm$ 4 mm. long; lateral lobes small, recurved, narrowly triangular; middle lobe ovate-rhomboid, acute at the tip with entire margin; 3 raised longitudinal lines on the base of the lamina.

Colunm rather long and slender, $\pm$ 2·75 mm. long, upper extremity incurved and hooded; stelidia well marked, somewhat falcate, acuminate, near the middle of column on either side of stigma, shorter than the hood; rostellum triangular with blunt apex; stigma large, prominent, oval, erect in upper part of the column.

This Papuan plant finds its place in the subgenus *Platyclinis* of *Dendrochilum*, Bl. Specifically it comes rather close to *D. gracile* (Hook. f.), J. J. Smith, and *D. linearifolium*, Hook. f. Both of these species have, however, very much smaller flowers and in the latter the stilidium is linear and arises from a restricted area at the very base of the column and the plant is provided with a relatively much shorter and rather blunt leaf.

Named in honour of the Hon. John Hubert Plunkett Murray, Lieutenant-Governor of Papua.

The history of this genus is interesting. It was founded by Blume in 1825. In 1843, Nees and Meyen described from an imperfect seeding specimen without flowers, a new genus *Acoridium*, which they regarded as non-orchidaceous and placed in the Order Philydraceae. It was transferred almost immediately by Endlicher to the Burmanniaceae, and later on was again removed to the Cyperaceae, in which order it remained for many years with the somewhat doubtful approval of Bentham. In 1884 Bentham split Blume's genus into *Dendrochilum* and *Platyclinis*, the former having a lateral and the latter an apical inflorescence (*i.e.*, in regard to their origin from the pseudobulb). In the Genera Plantarum, *Platyclinis* appears among the Epidendreae under the subtribe Liparieae and *Dendrochilum* is placed under Dendrobicae. Much more recently flowering specimens of *Acoridium* were discovered, and though they were relegated to their true order, their identity with Nees and Meyen's imperfect specimen was not at first recognized. Ultimately, however, this was established by Rolfe, who also showed that *Acoridium* was identical with Bentham's genus *Platyclinis*. But inasmuch as the former name had precedence over the latter by more than 40 years, *Platyclinis* became reduced to a synonym of *Acoridium*. About 1907 J. J. Smith reconstructed the genus *Dendrochilum* so as to include within it all orchids hitherto placed under *Platyclinis* and *Acoridium*. These two genera are now reduced to the rank of subgenera or sections. This arrangement appears to have received the approval of botanists generally and has been adopted by Ames, and also by Pfitzer and Kränzlin in their monograph of the Coelogyninae (Das Pflanzenreich).

SPATHOGLOTTIS PAPUANA, Bail., var. PUBERIFLORA, var. nov.

Flowers, ovary and pedicel beset with minute setaceous hairs; pedicel ± 15 mm.; unimpregnated ovary almost cylindrical, about same length as pedicel. Segments of perianth subequal in length and almost similar, the paired petals being very slightly longer than the other segments.

Lateral sepals free, ovate-elliptical, ± 17 mm. long by ± 10 mm. broad, with one dark central vein and several lighter parallel veins on either side. Dorsal sepal ovate, cucullate, accuminate, ± 17 mm. long × 10 mm. broad; dark central nerve with several parallel nerves on either side. Lateral petals ovate-elliptical with dark central nerve and several parallel nerves on either side, ± 18 mm. long × 10 mm. broad. Labellum sessile, 3-lobed, ± 14 mm. long; middle lobe with an obcordate veined tip about 7 mm. wide, passing backwards by a narrow isthmus to its junction with the lateral lobes and there dilating into a trapeziform expansion; the lamina with a rather small conical callus about the middle of the isthmus, another very large bilobed somewhat pyramidal callus arising in the posterior dilated portion of the isthmus, the surface behind the large callus pubescent and traversed by 2 parallel longitudinal lines; the lateral lobes erect or slightly incurved, oblong with entire margins, each about 7 mm. long.

Column semi-terete, slightly incurved, gradually expanding laterally from below upwards, ± 12 mm. long; anther lid-like, terminal on anterior surface of the apex; stigma transverse, oblong, rather shallow, situated immediately below anther; rostellum widely triangular with a rather blunt apex, situated on upper margin of stigma, inclined forward, not very prominent.

The new variety departs from type by the presence of innumerable short setaceous hairs on stem, bracts, pedicels, and outer-surface of flowers, the type being quite glabrous; also by the pubescent condition of the posterior portion of upper-surface of the labellum.

In the bud, the face of the anther fits exactly into the cleft in the tip of the labellum while the expanded lobes on either side of this cleft embrace the apex of the column; the base of the column is at the same time clasped by the lateral lobes of the labellum.

Habitat—Mafulu (C. T. White, No. 445).

Habenaria ramosa, n. sp.

Pl. viii.

Planta robusta; caule excedenti 120 cm. alta; foliis circa novem, vaginantibus, alternatis, lanceolatis, 7·5 cm. longis; bracteis non-nullis, acutis, amplectantibus, prope a spica; spica circa 30 cm.; ovario gracili, torto, calcari longiore; sepalis lateralibus deflexis, circa 11 mm. longis, oblique ovato-lanceolatis; sepalo dorsali erecto, acuminato, anguste cucullato, circa 10 mm. longo; petalis lateralibus profunde bipartitis, partitione postica basi lata alioquin anguste lineari circa 9 mm. longa, antica longiore ramosissima; labello tripartito, lacinia intermedia anguste lineari integra circa 12 mm. longa, laciniis lateralibus aequalibus aut paulo longioribus ramosissimus; columna breve, staminodiis verucosis, processubus stigmaticis oblongo-lanceolatis, carnosis, antherae canalibus porrectis longioribus; caudiculis longissimis circa 2·5 to 3 mm., pellucidis; glandulis nudis; calcari circa 20 mm. longa.

Habitat—Dilava (C. T. White, No. 680).

A robust plant upwards of 120 cm. (4 feet) in height. Leaves about 9, sheathing, alternate, lanceolate, 7·5-23·3 cm. (3-10 inches) long; bracts several near the spike, acute, clasping, also an acute bract subtending each flower. Ovary very slender, twisted, exceeding the spur in length. Lateral sepals deflexed on either side of the spur, $\pm$ 11 mm. long, obliquely ovate-lanceolate; dorsal sepal erect, acuminate, rather narrowly cucullate, $\pm$ 10 mm. long. Lateral petals erect, deeply bipartite, posterior division rather wide at the extreme base, otherwise narrow-linear, $\pm$ 9 mm. long; anterior division longer, markedly ramiferous. Labellum deeply tripartite; middle lobe narrow-linear entire, $\pm$ 12 mm. long; lateral lobes at least as long, markedly ramiferous; spur about 20 mm. long, linear, with wide funnel-shaped orifice and bulbous extremity, pendent.

Column short, with a warty, elliptical staminode on each side; anther-tubes horizontal not quite as long as caudicles but at least as the narrow rostellum lying between them; stigmatic processes fleshy, oblong-lanceolate, extending forward on either side of the orifice to the spur; pollinia composed of numerous packets of sectile pollen; caudicles extremely long ± 2·5-3 mm., transparent, passing downwards and forwards, guarded below by the anther-tubes beyond which their tips project; glands approximate and quite exposed.

This species falls under Kränzlin's Section "Medusaeformes" and approaches *H. ternatea*, Reich. f., the habitat of which is given as the Sunda Islands; in the Island of Ternate.

CRYPTOSTYLIS ERYTHROGLOSSA, Hayata.

Root a creeping rhizome. Plant glabrous, stem slender. Leaves 2 (one broken off in specimen), petiolate, elliptic-ovate, acuminate, 11 cm. long by 4 cm. in its widest part (without the petiole); petiole slender, ± 5 cm. Bracts clasping, narrow acuminate; 15-30 mm. long.

Flowers inverted, green white and red, rather large, ± 40 mm. diameter. Lateral sepals green, spreading linear, acute, ± 15 mm.; dorsal sepal green, linear, spreading, same width as lateral sepals, length not determined (owing to damage to specimen). Lateral petals green, spreading, filiform, much shorter and narrower than sepals, ± 8 mm. Labellum ovate-lanceolate, ± 15 mm. long and ± 5 mm. broad in widest part, white with reddish base, spotted, multi-nerved, margins entire, acute; base sessile, obtuse, clasping the anther, and slightly saccate (?).

Column very short, anther erect shortly acuminate. The Formosan plant differs from the Papuan in that the labellum is entirely red.

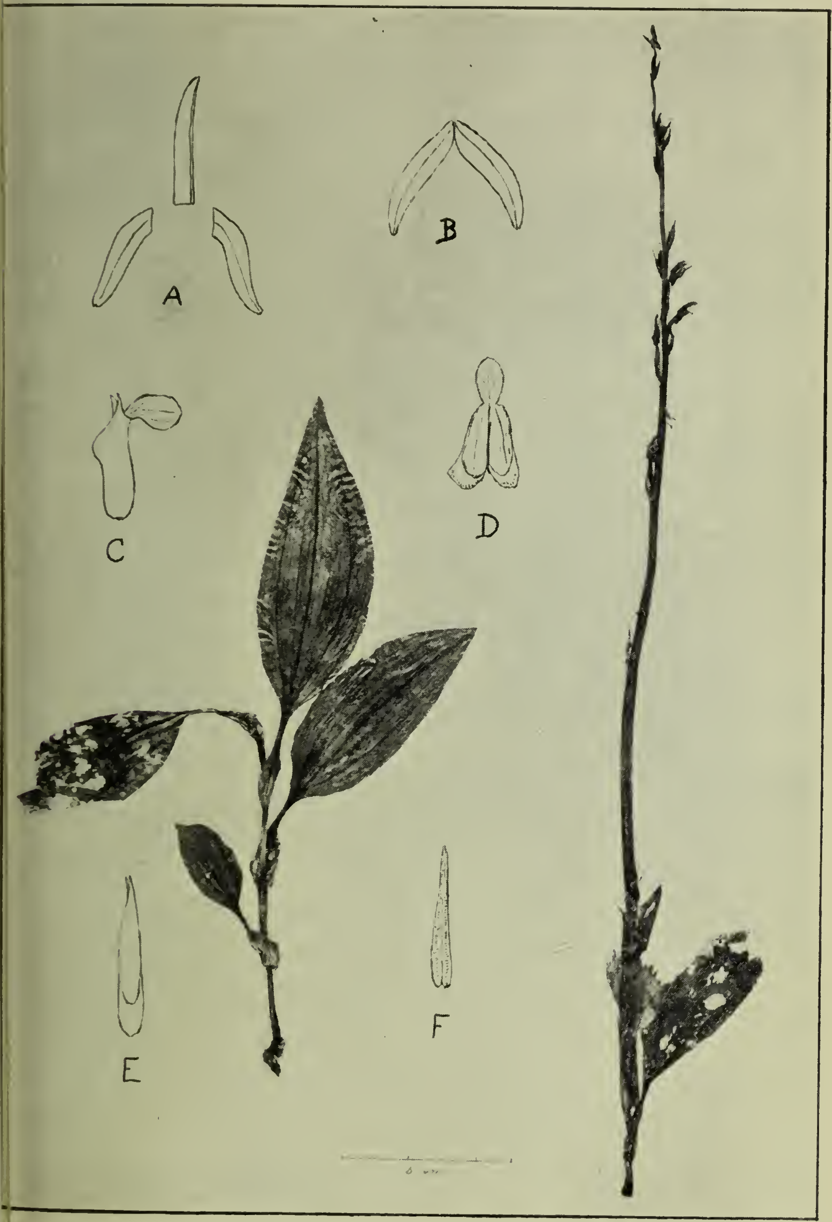
Habitat—Deva Deva (C. T. White, No. 658).

DESCRIPTION OF PLATES.

PLATE V.

Physurus bicalcaratus, n. sp.

A. Sepals. B. Lateral petals. Note the connate apices. C. Labellum, a side view. D. Labellum opened out, so as to show double spur. E. Column. F. Pollinia. (A-F enlarged.) The plant (natural size) is shown on the right of the plate, and leaves with their dilated scarious sheathing bases on the left.

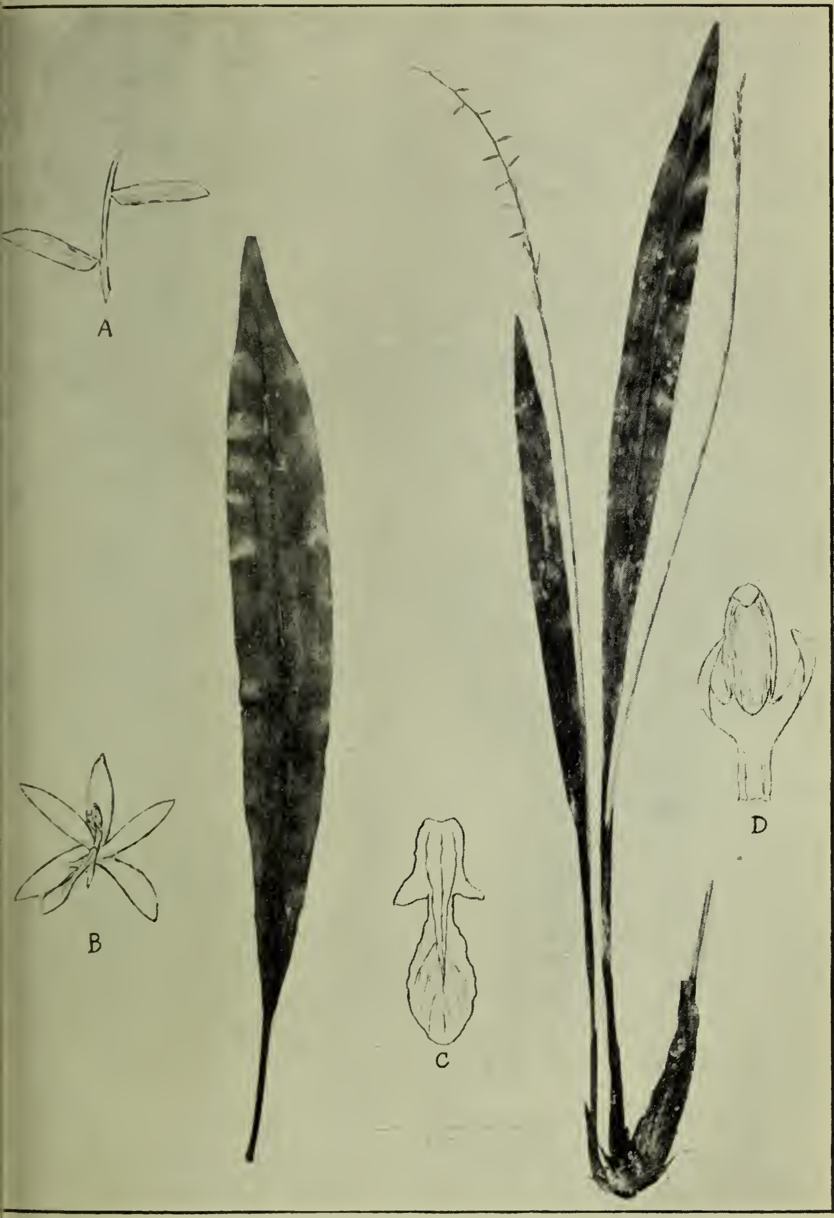


Physurus bicalcaratus.

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

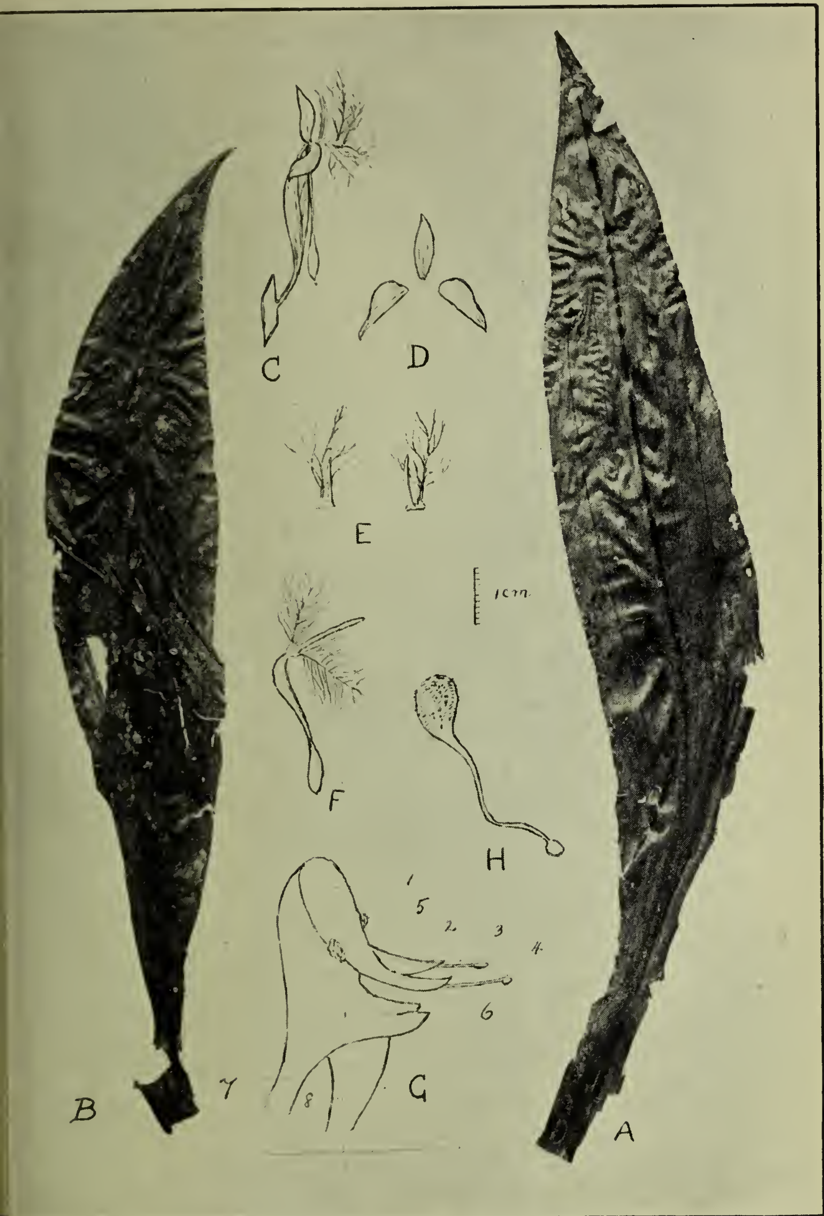
Goodyera hispidula.

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



Dendrochilum Murrayi.

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



Habenaria ramosa.

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

PLATE VI.

Goodyera hispidula, n. sp.

A. Perianth segments separated out. B. Column. C. Pollinia. (A-C enlarged.) The upper part of the plant (reduced to nearly half natural size) is shown on the right of the plate, and two leaves (nearly natural size) to the left of this.

PLATE VII.

Dendrochilum Murrayi, n. sp.

A. Portion of the scape and two bracts. B. Flower. C. Labellum (the apex is shown too blunt in the drawing). D. Column. (A-D enlarged.) The plant (much reduced) is shown on the right of the plate, and a leaf on the left.

PLATE VIII.

Habenaria ramosa, n. sp.

A. Leaf (upper surface); B. Leaf (lower surface); both reduced according to the 5 cm. measure at base of plate. C. Flower. D. Sepals. E. Lateral petals. F. Labellum (spread out to show the 3 segments) and spur. (C-F reduced according to the 1 cm. measure alongside.) G. Column (much enlarged): 1, anther; 2, anther-tube; 3, caudicle; 4, gland; 5, staminode; 6, stigmatic process; 7, ovary; 8, upper part of spur. H. Pollinium, caudicle, and gland (much enlarged).

A Revision of the Australian Noctuidae.

By A. Jefferis Turner, M.D., F.E.S.

[Read June 10, 1920.]

It would be difficult to over-estimate the debt which we owe to Sir George Hampson's great work, the Catalogue of the Lepidoptera Phalaenae. By it the study of the Noctuidae as a whole has been for the first time placed on a scientific basis, for previous attempts were only concerned with the fauna of restricted areas. It has been a task of enormous magnitude; already it has included some 8,500 species, and the large subfamilies of the Noctuinae and Hypeninae have not yet been included. The work must have been exceedingly difficult, for not only are the species so numerous, but they are also in the great majority very uniform in structure, so that generic and even subfamily distinctions are hard to find, and still more difficult to apply with consistency. While the general accuracy of Sir Geo. Hampson's work is freely acknowledged, there cannot fail to be some instances of errors of observation in a work of this magnitude, some of them the inevitable consequence of poorness of material. For instance, abdominal and thoracic crests are easily liable to denudation. There must also be instances in which differences of opinion as to the validity of characters regarded as generic by the author may lead to divergence of judgment.

My attempt at a revision of the Australian species is, of course, based on Hampson's work, which will always remain as an indispensable foundation for any study of this family; and I shall therefore assume that the student has it before him, and shall not consider it necessary to give references to it nor to repeat the synonymy, localities, etc., that may be found there. Where additional information is forthcoming it will be stated. Where I differ from him as to matters of fact or judgment, this will be indicated by the classification I have adopted, and where I think it advisable these differences will be discussed. In some respects my task has been comparatively easy, for I have only some 500 species to deal with, of most of which I have been able to examine sufficient material, and nearly all have been already diagnosed in Hampson's work. On the other hand, an opportunity of examining exotic material would no doubt have modified some of my conclusions. I shall deal with the subfamilies to the end of the

Acontianae, leaving the Catocalinae and Plusianae to be considered at a future date, in conjunction with the Noctuinae and Hypeninae.

The only subfamily not represented in Australia is the Mominae. Of those here dealt with I can give not only a census of the known species, but also a rough estimate of the percentage that they bear to the whole known fauna:—

	No.	Per cent.		No.	Per cent.
Agaristinae ...	37	15·5	Erastrianae ...	120	10
Agrotinae ...	48	4	Eutelianae ...	9	5
Melanchrinae ...	45	4·5	Stictopterinae	9	8
Cucullianae ...	7	1	Sarrothripinae	53	16
Acronyctinae ...	146	6	Acontianae ...	35	11

The total number of 509 species represents about 7 per cent. of the world fauna. The Agaristinae and Sarrothripinae are very largely represented in Australia; the Erastrianae and Acontianae are well represented; the other groups only to a moderate or small extent. The groups which predominate in the Palaearctic regions, and in the temperate zone, are less developed here; while those of the Oriental region have spread across the tropics into the northern part of our continent in relatively large numbers.

The normal neuration of the forewings is as follows:—The second anal is weakly developed and sometimes (but by no means always) does not anastomose with the first anal owing to obsolescence, 2 arises from about $\frac{2}{3}$, 3, 4, and 5 from near lower angle of cell, 6 from upper angle or from slightly below, an areole is present from which 8, 9 are always stalked, 7 connate with them or closely approximated, rarely short-stalked, 10 separate, 11 from about middle of cell. In the hindwings 2 arises from about $\frac{2}{3}$, 3 and 4 are approximated or connate from lower angle of cell, 6, 7 connate from upper angle, 8 anastomoses with cell near base. In both wings the second branch of the cubital (usually known as 1 c.) is absent. In the hindwings vein 5 is in the Agaristinae, Agrotinae, Melanchrinae, Cucullianae, and Acronyctinae normally from the middle of the cell, and very weakly developed; in the other subfamilies it is from near the lower angle, and more or less strong.

In the forewing the slight variations in the origin of 6 and 7 do not appear of generic value. Rarely, as in *Aiteta*, 6 arises from the areole. The separation of 10 is more constant, and should it become connate with 8, 9 this may usually be depended on as a generic character; this is in fact the first step towards the obsolescence of the areole. In the forewing 3 and 4 are very rarely stalked, but this occurs less rarely in the hindwing; 6 and 7 of the hindwing are rarely stalked; in some groups the anastomosis of 8 with the cell may occur as far as its middle.

Vein 5 of the hindwings is the second branch of the median, and in the pupal wing is supplied from the median trachea. During the maturation of the wing the median trachea disappears, and as a consequence vein 5 either atrophies in its original position, or is captured by a branch of the cubital trachea, and in its origin becomes deflected towards the lower angle of the cell. According to which alternative occurs we may primarily divide the Noctuidae into Trifinae and Quadrifinae, but the distinction is not absolute. In some Acronyctinae vein 5 arises from much below the middle, but is always weak, and in the Erastrianae many intermediate positions occur, together with a varying degree of development of the vein. It is in fact impossible to separate the subfamilies adopted by Hampson by absolute distinctions, or only by distinctions of relatively trivial importance, such as the spining of the tibiae, the hairiness of the eyes, the rough scaling of the forewings, etc.—characters which in other families occur in nearly related genera. I have, however, adopted Hampson's subfamilies, as they appear on the whole to represent natural groups, and no better classification presents itself; but I think they should be regarded rather as sections or tribes not sharply defined. Some of the generic characters admitted by Hampson are not in my judgment to be trusted, for instance the scaling of the thorax, and some of the finer distinctions in the shape of the frons and of the thoracic crests. I have endeavoured to apply all generic characters with consistency; fine distinction may be sometimes admissable, but they must be real, not imaginary. I must confess that I find some of Hampson's characters inappreciable, and I would rather retain large genera than break them up by characters which fail in practice.

The secondary sexual characters of the male are seldom of generic value in the Noctuidae, being often extraordinarily different in closely related species. I have therefore not considered it necessary to describe them, more especially as they have been given by Hampson with much fulness and accuracy. Species marked with a † I have not been able to examine.

Subfam. AGARISTINAE.

These are usually regarded as a distinct family, the Agaristidae. They are, however, simply day-flying Noctuidae, separable from that family by no structural character. Sir George Hampson indeed finds such a character in the antennae, which are "more or less distinctly dilated towards extremity." Antennae so dilated, and hooked also at the apex, are certainly prsent in such genera as *Burgena*, *Comocrus*, *Phalaenoides*, *Agarista*, and others. But in *Cruria*, which is closely allied to these genera, and has the antennae similarly hooked, it needs an effort of the imagination to discover any dilatation. Again in *Argyrolepidia*, which Hampson includes in the Agaristidae, the antennae are no more dilated than in *Idalima*, which he excludes from the family. If Hampson's criterion were correct the species *tetrapleura*, which he makes a *Phalaenoides*, would have to be excluded also, for its antennae are filiform. The antennal differences, where real, are of no more than generic value, and to make them a basis of family distinction is an artificial device, which widely separates genera, which are naturally very closely allied. Hence it is that the Australian species are found in Hampson's work partly in the third and partly in the ninth volume.

I am unable even to define the group as a subfamily, although it is certainly a natural group, and should be treated as such. The alternative would drive us to place *Eutrichopidia*, with its hairy eyes, in the Melanchrinae, and *Cruria*, with its spiny tibiae, in the Agrotinae, which would be altogether unnatural.

1.	Abdomen stout, with dense lateral tufts of long hair from apical segments ...	10. *Hecatesia*
	Abdomen normal, without long lateral tufts	2.
2.	Forewing with 8, 9, 10 stalked from areole	3.
	Forewing with 10 arising separately from areole	5.
3.	Posterior tibiae hairy on dorsum	2. *Comocrus*
	Posterior tibiae smooth-scaled	4.
4.	Posterior tibiae spiny	3. *Cruria*
	Posterior tibiae without spines	1. *Burgena*
5.	Eyes hairy	4. *Eutrichopidia*
	Eyes not hairy	6.
6.	Abdomen with dorsal crests on 3 or 4 segments	7.
	Abdomen not crested, or on first segment only	8.
7.	Frons with truncate conical prominence with raised rim at apex	9. *Periopta*
	Frons with bluntly pointed conical prominence	8. *Argyrolepidia*
8.	Frons with truncate conical prominence with raised rim at apex	9.
	Frons not so formed	13.
9.	Posterior tibiae hairy on dorsum	10.
	Posterior tibiae smooth	11.

10. Palpi short (less than 2), terminal joint hairy	7. *Periscepta*
Palpi moderately long (over 2), terminal joint smooth	5. *Phalaenoides*
11. Abdomen with basal dorsal crest	12. *Radinocera*
Abdomen without basal crest	12.
12. Antennae thickened beyond middle and hooked at apex	6. *Agarista*
Antennae filiform and not hooked	11. *Idalima*
13. Frons rounded and covered with long rough hairs	13. *Agaristodes*
Frons with long acute flattened corneous process	14.
14. Eyes small, abdomen hairy	14. *Apina*
Eyes normal, abdomen smooth	15. *Ipanica*

1. Gen. BURGENA, Wlk.

Antennae $\frac{4}{5}$, dilated beyond middle, slightly hooked at apex. Frons rounded, only slightly projecting. Palpi rather long, ascending; second joint densely rough-haired; terminal joint long, smooth. Abdomen smooth, not crested. Tibiae smooth. Forewings with 8, 9, 10 stalked from areole, 7 connate or short-stalked. Hindwings normal.

varia, Wlk.

2. Gen. COMOCRUS, Jord.

Antennae $\frac{1}{2}$, dilated beyond middle, hooked at apex. Frons with truncate conical prominence with raised rim at apex. Palpi rather long, ascending; second joint with long and dense rough hairs; terminal joint long, smooth. Abdomen not crested, clothed with dense, short, loose hairs. Tibiae with long rough hairs on dorsum. Forewings with 8, 9, 10 stalked from areole. Hindwings normal.

behri, Angas.

3. Gen. CRURIA, Jord.

Antennae $\frac{1}{2}$ or less, not dilated, slightly hooked at apex. Frons with truncate conical prominence with raised rim at apex. Palpi rather long, ascending; second joint with long dense rough hairs; terminal joint rather long, smooth. Abdomen smooth, not crested. Tibiae smooth-scaled; posterior pair with spines on ventral surface. Forewings with 8, 9, 10 stalked from areole. Hindwings normal.

donovani, Bdv. *neptioides*, Butl. *darwiniensis*, Butl. *platyxantha*, Meyr. *synopla*, Turn.: Trans. Roy. Soc. S. Austr., 1903, p. 1. *epicharita*, Turn.: Ann. Q'land Mus., x., p. 59 (1911).

CRURIA STHENOZONA, n. sp. (σθενοζωνος, strongly girdled).

♂, ♀, 32-35 mm. Resembles *C. synopla*, but markings of forewings white without ochreous tinge; a slender line across thorax behind middle, extended into forewings beneath cell to about middle; hindwings with very broad ochreous-whitish median fascia, nearly half breadth of wing, not dislocated at costal extremity towards tornus.

This is the northern representative of *synopla*, just as *darwiniensis* is that of *donovani*.

Hab.—Northern Queensland: Atherton, in May; Evelyn Scrub, near Herberton, in October and January; three specimens.

4. Gen. EUTRICHOPIDIA, Hmps.

Eyes hairy. Antennae about $\frac{1}{2}$; very slightly dilated beyond middle; hooked at apex. Frons with truncate conical prominence with raised rim at apex. Palpi rather long, ascending; second joint with long dense rough hairs; terminal joint long, smooth. Abdomen slightly hairy, not crested. Posterior tibiae smooth. Neuration normal.

latina, Don.

5. Gen. PHALAENOIDES, Lew.

Antennae about $\frac{1}{2}$; slightly dilated beyond middle and hooked at apex. Frons with a truncate conical prominence with raised rim at apex. Palpi rather long, ascending; second joint with long dense rough hairs; terminal joint long, smooth. Abdomen moderately hairy. Posterior tibiae with long rough hairs on dorsum. Neuration normal.

glycinae, Lew. *tristifica*, Hb.

PHALAENOIDES THORACOPHORA, n. sp.

(θωρακοφορος, wearing a breastplate).

♀, 50 mm. Head yellow, apex of frontal process and an interrupted bar between antennae blackish. Palpi yellow; upper and lower edge of second joint blackish; terminal joint wholly blackish. Antennae blackish. Thorax [partly abraded] yellow with blackish spots; pectus yellow. Abdomen fuscous; terminal segment and tuft yellow. Legs blackish; tibiae and femora partly whitish beneath; those of posterior pair wholly whitish beneath. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; blackish with bluish and purple reflections; a narrow whitish-grey sub-basal fascia; median area whitish-grey, bounded anteriorly by a line from $\frac{1}{6}$ costa to $\frac{1}{4}$ dorsum, posteriorly by a line from $\frac{3}{5}$ costa nearly to tornus, containing a blackish line along costa, a large oval antemedian spot, an incomplete fascia from beneath midcosta, expanding on dorsum and continued to tornus; veins on posterior area grey; cilia blackish. Hindwings with termen rounded, somewhat irregular; blackish; a large basal white blotch not extending to margins nor extreme base; cilia blackish, towards tornus apices white. Underside blackish; forewings with a long oblique oval blotch from beneath costa beyond middle nearly to tornus; hindwings with basal white blotch extending to dorsum.

This species is very unlike its Australian congeners, but comes nearest to *P. basiplaga*, Roths., from New Guinea. It shows a general resemblance to the Pyralid *Vitessa glaucoptera*, Hmps. Type in National Museum, Melbourne.

Hab.—Northern Queensland: Claudie River, in March; one specimen, taken by Mr. J. A. Kershaw. Type in National Museum, Melbourne.

6. Gen. Agarista, Leach.

Antennae less than $\frac{1}{2}$; dilated beyond middle and hooked at apex. Frons with a truncate conical prominence with raised rim at apex. Palpi rather long, ascending; second joint with long dense rough hairs; terminal joint long, smooth. Abdomen hairy, not crested. Middle and posterior tibiae smooth. Neuration normal.

Distinguished from *Idalima* by the structure of the antennae.

agricola, Don.

7. Gen. Periscepta, nov. (περισκεπτος, conspicuous).

Antennae $\frac{1}{2}$; filiform. Frons with a truncate conical prominence with raised rim at apex. Palpi short (less than 2), porrect; second joint hairy; terminal joint very short, hairy. Abdomen hairy, not crested. Posterior tibiae hairy on dorsum. Neuration normal.

Distinguished from *Phalaenoides* by the different antennae and palpi.

polysticta, Butl.

8. Gen. Argyrolepidia, Hmps.

Antennae $\frac{2}{3}$; filiform. Frons with a bluntly pointed conical prominence. Palpi rather long, ascending; second joint thickened with rather short, loosely appressed hairs; terminal joint long, smooth. Abdomen slightly hairy, with loose hairy crests on dorsum of basal segments. Posterior tibiae smooth or with a few loose hairs on dorsum. Neuration normal.

This description applies to the Australian species. I am unable to examine the type species as to the presence of abdominal crests, but these are inconspicuous and very easily denuded.

fracta, Roths. *coeruleotincta*, Luc. *centralis*, Roths.

†*econia*, Hmps. I have not seen this species and cannot say whether it is referable here. *subaspersa*, Wlk. In the event of these species not being congeneric with *Argyrolepidia*, the name *Coenotoca*, Turn., must be adopted.

9. Gen. Periopta, nov. (περιοπτος, conspicuous).

Antennae $\frac{1}{2}$ to $\frac{2}{3}$; filiform. Frons with truncate conical prominence with raised rim at apex. Palpi moderate, ascending; second joint with rather short, loosely appressed hairs; terminal joint long, smooth. Abdomen smooth, with dorsal crests more or less developed. Posterior tibiae with long hairs on dorsum. Neuration normal.

ardescens, Butl. (Type). *diversa*. Wlk.

10. Gen. Hecatesia, Bdv.

Antennae $\frac{3}{4}$; very slightly dilated *(thyridion)* or clubbed *(fenestrata)* before apex. Frons with short truncate conical prominence, with raised rim at apex concealed by long hairs. Palpi moderate or rather long, porrect or slightly ascending; terminal joint long, smooth *(thyridion)* or hairy *(fenestrata)*. Abdomen very stout, smooth, with small dorsal tufts of hair on three basal segments, and with lateral tufts of hair on apical segments. Posterior tibiae with long hairs on dorsum. Forewings in female with 10 short-stalked or connate, 8, 9 from areole(1); in male with a large ribbed hyaline subcostal area curved round a strong chitinous costal projection, and neuration much distorted. Hindwings normal.

thyridion, Feist. *fenestrata*, Bdv. † *exultans*, Wlk.

The exact affinities of this curious genus are doubtful.

11. Gen. Idalima, Turn.

Antennae about $\frac{1}{2}$, rarely longer *(metasticta)* or shorter *(tetrapleura)*; filiform. Frons with truncate conical prominence with raised rim at apex. Palpi moderate or rather long, ascending; second joint densely hairy beneath; terminal joint moderate or long, smooth. Abdomen smooth, not crested. Posterior tibiae smooth. Neuration normal.

tetrapleura, Meyr. † *hemiphragma*, Low. *affinis*, Bdv. *leonora*, Dbld. *metasticta*, Hmps. *aethrias*, Turn.: Trans. Roy. Soc. S. Austr., 1908, p. 55; of this *cyanobasis*, Hmps., is a synonym.

12. Gen. Radinocera, Hmps.

Antennae slightly over $\frac{1}{2}$; filiform. Frons with a truncate conical prominence with raised rim at apex. Palpi ascending, in male moderate, in female rather long; second joint with rather long dense loosely appressed hairs; terminal joint in male very short, in female long, smooth. Abdomen smooth, with a fan-shaped crest of scales on first segment only. Posterior tibiae smooth. Neuration normal.

maculosa, Roths. † *placodes*, Low. † *vagata*, Wlk.

(1) I have only one female *(fenestrata)* for examination.

13. Gen. Agaristodes, Hmps.

Eyes small. Antennae $\frac{1}{2}$; in male bipectinate to apex, in female biserrate. Frons rounded, densely covered with long hairs. Palpi moderate, porrect; second and terminal joint covered with long dense rough hairs. Abdomen hairy, not crested, apical segments with three lateral tufts of short hair in male, two in female. Femora with dense long hairs. Posterior tibiae smooth, with a few loose hairs on dorsum. Neuration normal.

feisthameli, H.-Sch.

Hab.—New South Wales: Adaminaby (3,500 ft.), in October; one specimen. Previously recorded only from Tasmania.

14. Gen. Apina, Wlk.

Eyes small, narrowed antero-posteriorly, posteriorly flattened. Antennae $\frac{1}{2}$; in male bipectinate to apex, in female filiform. Frons with a long acute flattened corneous process, quadrangular and emarginate at apex. Palpi moderate, porrect; second and terminal joints with long loose spreading hairs. Abdomen hairy, not crested. Femora densely hairy. Posterior tibiae with long loose spreading hairs on dorsum. Neuration normal.

callisto, Wlk.

15. Gen. Ipanica, Hmps.

Eyes normal. Antennae over $\frac{1}{2}$; in male slightly serrate and minutely ciliated, in female filiform. Frons with a long acute flattened, corneous process, rounded-rectangular at apex. Palpi rather long, porrect; second joint with dense appressed hairs; terminal joint long, smooth. Abdomen smooth, not crested. Femora hairy. Posterior tibiae with long loose hairs on dorsum. Neuration normal.

cornigera, Butl.

Subfam. AGROTINAE.

1.	Fore tibiae with claws or spines	2.
	Fore tibiae without claws or spines	9.
2.	Fore tibiae with terminal claws only ...	3.
	Fore tibiae with spines, with or without claws	5.
3.	Fore tibiae with a single claw	11. *Propatria*
	Fore tibiae with two claws	4.
4.	Fore tibiae shorter than first tarsal joint	1. *Timora*
	Fore tibiae longer than first tarsal joint	3. *Neocleptria*
5.	Fore tibiae with a few spines towards apex only	6.
	Fore tibiae with numerous spines not confined to apical portion	7.
6.	Fore tibiae shorter than first tarsal joint	2. *Canthylidia*
	Fore tibiae longer than first tarsal joint	4. *Heliothis*

7.	Fore tibiae shorter than first tarsal joint	8.
	Fore tibiae longer than first tarsal joint	10. *Graphiphora*
8.	Frons prominent, rounded, with a small central depression with raised rim ...	8. *Euxoa*
	Frons not prominent, and without central depression	9. *Agrotis*
9.	Abdomen crested	7. *Buciara*
	Abdomen not crested	10.
10.	Palpi with terminal joint very small ...	11.
	Palpi with terminal joint moderate or rather long	12.
11.	Posterior tibiae densely hairy on dorsum	5. *Astonycha*
	Posterior tibiae with only a few loose hairs on dorsum	6. *Adisura*
12.	Thorax with rounded anterior and small posterior crests	12. *Proteuxoa*
	Thorax without crests	13. *Androdes*

1. Gen. Timora, Wlk.

Frons rounded, projecting. Palpi rather short (1); second joint with short loosely appressed hairs; terminal joint short, stout, obtuse. Thorax and abdomen without crests. Anterior tibiae shorter than first tarsal joint, broad, with a terminal pair of strong claws, the inner larger, and no spines. Middle and posterior tibiae with a few spines; posterior tibiae hairy on dorsum. Forewings with 10 arising from apex of areole, which is narrow, connate with 8, 9, 7 also connate with 8, 9 or short-stalked, 6 from well below angle of cell. Hindwings normal.

So far as the Australian species is concerned its generic position rests on the structure of the anterior tibiae, and a well-defined neurational character, the three (rarely reduced to two) veins arising connate from the apex of the areole. I cannot say whether the latter character is present in the other species referred to this genus.

alarioides, Butl.

2. Gen. Canthylidia, Butl.

Frons rounded, projecting. Palpi moderate, porrect or obliquely ascending; second joint loosely rough-haired beneath; terminal joint short. Thorax and abdomen without crests. Anterior tibiae shorter than first tarsal joint, broad, with a terminal pair of strong claws, the inner larger, and one or two small spines on inner side. Middle and posterior tibiae with a few spines; posterior tibiae hairy on dorsum. Forewings with 6 from well below angle of cell. Hindwings normal.

A characteristically Australian genus of some size. The male gland and brands mentioned by Hampson are present in *pallida*, but not in other species. Hampson identifies it with *Melicleptria*, Hb., represented by a solitary European species which I am not able to examine.

† *cistella*, Swin. *eurhythma*, Turn.: Proc. Roy. Soc. Q'land, 1915, p. 21. *eodora*, Meyr. *cladota*, Swin. † *mesoleuca*, Low.: Proc. Linn. Soc. N.S. Wales, 1901, p. 640. *neurias*, Meyr. *rhodopolia*, Turn.: Ann. Q'land Mus., x., p. 61 (1911). † *cramboides*, Gn. *osmida*, Swin. *ionola*, Swin. *pallida*, Butl. *ferruginosa*, Turn.: *l.c.*, p. 61 (1911), *canusina*, Swin. *aleurota*, Low.: Proc. Linn. Soc. N.S. Wales, 1901, p. 641. *moribunda*, Gn. † *aberrans*, Butl. *melibaphes*, Hmps.

Canthylidia epigrapha, n. sp. (*επιγραφος*, inscribed).

♀, 25 mm. Head, palpi, thorax, and abdomen pale brownish-ochreous. Antennae pale fuscous. Legs whitish-ochreous. Forewings triangular, costa slightly arched, apex round-pointed, termen slightly bowed, scarcely oblique; whitish-ochreous with patchy brownish-ochreous irroration; a minute blackish dot representing orbicular; reniform fairly large, blackish, somewhat quadrate; claviform obsolete; a suffused blackish interrupted subterminal line; a terminal series of blackish dots on veins; cilia whitish-ochreous. Hindwings with termen sinuate; whitish-ochreous; a broad, suffused, fuscous, terminal band; cilia whitish-ochreous. Underside similar but forewings with general fuscous irroration, hindwings with terminal band narrower.

Allied to *C. cistella*, Swin.

Hab.—Northern Territory: Port Darwin; one specimen, received from Mr. G. F. Hill.

3. Gen. Neocleptria, Hmps.

Frons rounded, projecting. Palpi moderately long, porrect; second joint loosely rough-haired beneath; terminal joint short. Thorax and abdomen without crests. Anterior tibiae longer than first tarsal joint, with a terminal pair of claws, and no spines. Middle and posterior tibiae with many spines; posterior tibiae hairy on dorsum. Neuration normal.

Differs from *Heliothis* in the absence of spines on anterior tibiae.

punctifera, Wlk.

4. Gen. Heliothis, Ochs.

Frons rounded, projecting. Palpi moderately long, porrect; second joint loosely rough-haired beneath; terminal joint short. Thorax and abdomen without crests. Anterior tibiae longer than first tarsal joint, with a terminal pair of claws, and spines on sides. Middle and posterior tibiae with many spines; posterior tibiae hairy on dorsum. Neuration normal.

I follow Mr. Meyrick (Trans. N. Z'd. Inst., 1911, p. 90) in adopting Ochsenheimer's name for this genus with *dipsacea*, Lin., as the type.

aresca, Turn.: Ann. Q'land Mus., x., p. 60 (1911). *obsoleta*, Fab. *assulta*, Gn.

HELIOTHIS HYPERCHROA, n. sp. (ὑπερχροος, highly coloured).

♂, ♀, 28-35 mm. Head and thorax crimson. Palpi whitish-ochreous, sometimes almost wholly suffused with crimson. Antennae pale grey, towards base crimson; ciliations in male $\frac{1}{2}$. Abdomen whitish-ochreous, basal dorsal crest crimson; tuft with some crimson suffusion. Legs whitish-ochreous, mostly suffused with crimson. Forewings crimson, with darker transverse crimson lines more or less marked; orbicular obsolete or faintly indicated; reniform small, fuscous, with paler centre; a subterminal series of whitish dots on veins; cilia crimson. Hindwings ochreous-whitish; a broad terminal fuscous band, sometimes edged anteriorly and posteriorly by crimson; cilia ochreous-whitish, bases sometimes crimson. Underside whitish-ochreous with broad terminal bands partly crimson, partly fuscous.

Though this may be merely a local mountain form of *C. obsoleta*, it is a brilliant insect, quite distinct from *C. rubrescens*, Wlk., which is a dark Brisbane form of *obsoleta*, scarcely reddish.

Hab.—Queensland: Stanthorpe; New South Wales: Lawson (Blue Mountains); Tasmania.

5. Gen. ASTONYCHA, nov. (ἀστονυχος, clawless).

Frons rounded, projecting. Eyes large, round, glabrous, without cilia. Tongue strong. Palpi moderate (over 1), slightly ascending; second joint long, rather shortly rough-scaled; terminal joint very short. Antennae in male simple, minutely ciliated. Thorax and abdomen not crested. Anterior tibiae without spines or claws; middle tibiae with two spines on inner side shortly before apex; posterior tibiae with two spines on inner side before apex, and densely hairy. Neuration normal.

Allied to the *Heliothis* group, though without tibial claws. The number of tibial spines may not be constant.

ASTONYCHA LITARGA, n. sp. (λιταργος, nimble).

♂, 32 mm. Head, palpi, thorax, and abdomen ochreous-whitish. Antennae pale grey; ciliations in male $\frac{1}{3}$. Legs ochreous-whitish; anterior pair, except coxae, fuscous. Forewings triangular, costa straight to near apex, apex round-pointed, termen straight, oblique, slightly wavy; ochreous-whitish with some subcostal fuscous irroration; markings pale fuscous; a basal patch margined by a darker line from $\frac{1}{4}$ costa to near middle of dorsum; orbicular and reniform represented by subquadrate spots before and beyond middle; a broad terminal band margined by a darker line from near $\frac{3}{4}$ costa obliquely outwards, forming a sharp apical curve, thence sinuate to $\frac{2}{3}$ dorsum; cilia ochreous-whitish. Hindwings with termen slightly rounded, wavy; whitish; a large central terminal pale-fuscous blotch; cilia whitish. Underside whitish; markings of forewings faintly indicated.

Hab.—Queensland: Rosewood, in April; one specimen, taken flying at dusk.

6. Gen. Adisura, Moore.

Frons rounded, projecting. Palpi moderate, obliquely ascending; second joint thickened, with short, loosely appressed hairs; terminal joint short, obtuse. Thorax and abdomen without crests. Anterior tibiae without spines. Middle and posterior tibiae with a few spines; posterior tibiae smooth, with a few loose hairs on dorsum. Neuration normal.

dulcis, Moore.

7. Gen. Buciara, Wlk.

Frons not projecting. Palpi long, ascending; second joint with dense long rough hairs beneath; terminal joint long, smooth, porrect. Thorax with rounded anterior and strong posterior crest; patagia long, projecting. Abdomen with dorsal crests on second and third segments. Anterior tibiae without spines. Posterior tibiae with one or two spines and with long hairs on dorsum. Forewings with small tufts of scales near base and before tornus. Neuration normal.

bipartita, Wlk.

8. Gen. Euxoa, Hb.

Frons rounded, projecting, at its apex a minute circular depression with raised edges. Palpi rather long, ascending; second joint shortly rough-haired beneath; terminal joint moderate or rather long, smooth. Thorax with a rounded anterior and small posterior crest. Abdomen without crests. Anterior tibiae shorter than first tarsal joint, broad, with numerous strong spines on sides and apex. Middle and posterior tibiae with numerous spines; posterior tibiae smooth, with some long hairs towards base of dorsum. Neuration normal.

Closely allied to *Agrotis*, from which it differs only in the structure of the frons.

radians, Gn. *porphyricollis*, Gn.; of this *transversa*, Wlk.: Char. Undesc. Lep., p. 70, is a synonym. † *repanda*, Wlk. † *interjectionis*, Gn.

9. Gen. Agrotis, Ochs.

Frons not projecting. Palpi rather long, ascending; second joint shortly rough-haired beneath; terminal joint moderate, smooth. Thorax with a rounded anterior and small posterior crests. Abdomen not crested. Anterior tibiae shorter than first tarsal joint, broad, with numerous strong spines on sides and apex. Middle and posterior tibiae with numerous spines; posterior tibiae smooth with long hairs on basal part of dorsum. Neuration normal.

poliotis, Hmps. *ypsilon*, Roths. *infusa*, Bdv.; slightly variable; I have no doubt that *spina*, Gn., is a synonym, though Hampson places the two in different genera.

10. Gen. Graphiphora, Ochs.

Frons not, or only slightly, projecting. Palpi moderately long, ascending; second joint thickened, with rather smoothly appressed hairs, especially towards apex, which is expanded; terminal joint moderate, smooth, often porrect. Thorax with rounded anterior crest. Abdomen with long hairs at base of dorsum but without crests. Anterior tibiae longer than first tarsal joint, not expanded at apex, with a series of fine spines on inner edge, and one or two on outer edge near apex. Middle and posterior tibiae with numerous spines; posterior tibiae smooth, hairy on dorsum except towards apex. Neuration normal.

Differs from *Agrotis* in the anterior tibiae and palpi. A large cosmopolitan genus.

compta, Wlk.

11. Gen. Propatria, Hmps.

Frons rounded-conical, projecting, at its apex a shallow circular depression with raised edge. Palpi rather long; second joint obliquely ascending, densely rough-haired beneath; terminal joint porrect, rather long, smooth. Thorax with rounded anterior crest. Abdomen not crested. Anterior tibiae longer than first tarsal joint, with a single strong anterior apical claw, without spines. Middle and posterior tibiae with one or two spines towards apex; posterior tibiae hairy on dorsum. Neuration normal.

neuroides, Swin. *mundoides*, Low.: Trans. Roy. Soc. S. Austr., 1893, p. 152.

12. Gen. PROTEUXOA, Hmps.

Frons rounded, slightly projecting. Palpi rather long, ascending; second joint shortly rough-haired beneath; terminal joint moderate or long, smooth, sometimes porrect. Thorax with rounded anterior and small posterior crest. Abdomen without crests. Anterior tibiae without spines. Posterior tibiae with one or two spines, and with long hairs on dorsum. Neuration normal.

I can see no sufficient reason for distinguishing *Ectopatria*, Hmps., from this genus.

† *mniodes*, Low.: Proc. Linn. Soc. N.S. Wales, 1901, p. 642. *amaurodes*, Low.: *l.c.*, p. 642. *paurogramma*, Low.: *l.c.*, p. 643. † *spilonota*, Low.: *l.c.*, p. 641. *subrufescens*, Wlk. *aspera*, Wlk. *umbrosa*, Hmps. *loxosema*, Turn.: Trans. Roy. Soc. S. Austr., 1908, p. 55. *spodias*, Turn.: *l.c.*, p. 56.

13. Gen. ANDRODES, nov. (ἀνδρωδης, masculine),

Frons not projecting. Palpi moderate, ascending; second joint thickened, with loosely appressed scales; terminal joint short, smooth, obtuse. Thorax and abdomen without crests. Anterior tibiae without spines. Posterior tibiae with a few spines; in male densely hairy, in female hairy on dorsum. Wings of male wholly or partly covered with modified scales on underside. Neuration normal.

The two following species with their spineless anterior tibiae are quite out of place in the genus *Agrotis*. They are more nearly allied to *Proteuxoa*.

tibiata, Gn.; type. *hypochalchis*, Turn.

Subfam. MELANCHRINAE.

(*Polianae*, Hmps.)

I am unable to accept Hampson's name for this group and many of his generic distinctions. For a discussion of the points involved I would refer the student to a paper by Mr. E. Meyrick, F.R.S., in the Transactions of the New Zealand Institute, 1912, p. 88.

1. Thorax and abdomen without crests ...	2.
Thorax and abdomen with crests	4.
2. Frons projecting, a large apical depression with raised edges containing a central, truncate, corneous process	1. *Metopiora*
Frons not so formed	3.
3. Posterior tibiae smooth	3. *Meliana*
Posterior tibiae hairy on dorsum	4. *Leucania*
4. Abdomen with small crest on basal segment only	5.
Abdomen with more than one crest	7.

5. Tongue short and weakly developed ...	2. *Brithys*
Tongue strong	6.
6. Abdomen with lateral tufts of hair, more developed in male	5. *Dasygaster*
Abdomen without lateral tufts	6. *Sideridis*
7. Thorax with sharp, ridge-like anterior crest	7. *Tiracola*
Thorax with rounded anterior crest ...	8. *Melanchra*

1. Gen. Metopiora, Meyr.

Tongue short and weakly developed. Frons projecting, with a large circular apical depression with raised rim containing a central circular truncate corneous process. Palpi short, ascending; second joint with short loosely appressed hairs; terminal joint small, slender. Thorax and abdomen without crests. Posterior tibiae hairy on dorsum. Neuration normal.

sanguinata, Luc.

2. Gen. Brithys, Hb.

Tongue short and weakly developed. Frons rounded, very slightly projecting. Palpi short, obliquely ascending; second joint densely rough-haired; terminal joint minute, concealed. Thorax with small posterior crest. Abdomen with small crest on basal segment. Posterior tibiae hairy on dorsum. Neuration normal.

crini, Fab.

3. Gen. Meliana, Curt.

Frons not projecting. Palpi moderate, obliquely ascending; second joint with loosely appressed hairs; terminal joint short. Thorax and abdomen not crested. Posterior tibiae smooth. Neuration normal.

Type, *flammea*, Curt. Hampson describes the frons as showing a rounded prominence, which is not the case in the Australian species. However this may be, the smooth posterior tibiae should be made the distinction between this genus and *Leucania*.

lewinii, Butl. *scotti*, Butl. *microsticta*, Turn.: Proc. Linn. Soc. N.S. Wales, 1909, p. 341.

4. Gen. Leucania, Ochs.

Frons not projecting. Palpi moderate, porrect or obliquely ascending; second joint with loosely appressed hairs; terminal joint small. Thorax and abdomen without crests. Posterior tibiae hairy on dorsum. Neuration normal.

cruegeri, Butl. *melanopasta*, Turn.

5. Gen. Dasygaster, Gn.

Frons not projecting. Palpi rather long, ascending; second joint densely rough-haired beneath; terminal joint moderate or rather long, smooth. Thorax with rounded anterior and small or moderate posterior crests. Abdomen with small crest on basal segment; in male covered with woolly hair; with lateral tufts, longer in male. Posterior tibiae hairy. Neuration normal.

eugrapha, Hmps. *ligniplena*, Wlk. † *nephelistis*, Hmps. *hollandiae*, Gn. *epundoides*, Gn. *reversa*, Moore.

Dasygaster epipolia, n. sp. (ἐπιπολιος, grizzled).

♀, 46 mm. Head, palpi, and thorax whitish, densely irrorated with dark fuscous. Antennae fuscous, near base whitish. Abdomen grey. Legs whitish, irrorated with fuscous. Forewings elongate, costa very slightly arched, apex rounded-rectangular, termen slightly bowed, slightly oblique, crenulate; whitish, densely irrorated with fuscous; markings fuscous, nearly obsolete; some longitudinal streaks on and between veins; reniform indistinctly outlined; a terminal series of interneural dots; cilia fuscous with indistinct basal, median, and terminal whitish lines. Hindwings with termen sinuate and crenulate; fuscous; cilia whitish with a sub-basal fuscous line. Underside of forewings fuscous; of hindwings whitish with fuscous irroration, round discal spot, and terminal band.

The male may have more developed markings. The species may be recognized by the large size, and elongate and uniformly grey forewings. Type in Coll. Goldfinch.

Hab.—New South Wales: Mount Kosciusko (5,000 ft.), in January; one specimen.

6. Gen. Sideridis, Hb.

Frons not projecting. Palpi rather long, ascending; second joint with loosely appressed hairs or slightly rough; terminal joint moderate or rather long, sometimes porrect. Thorax with rounded anterior and small posterior crest. Abdomen with small crest on basal segment; slightly or densely hairy. Posterior tibiae densely hairy, or at least hairy on dorsum. Neuration normal.

A cosmopolitan genus for which Mr. Meyrick prefers the name *Aletia*, Hb. It is the genus most developed in Australia, and presents slight differences in the palpi and in the hairiness of the abdomen and legs. The basal abdominal crest is often concealed and difficult of observation.

eboriosa, Gn. † *costalis*, Wlk. *obusta*, Gn. *diatrecta*, Butl. † *uda*, Gn. *abdominalis*, Wlk. *dasycnema*, Turn.:

Mem. Nat. Mus., Melb., iv., p. 21 (1912). *leucosta*, Low. *leucosphenia*, B-Bak. *Hab.*—Northern Queensland: Ingham; one specimen, in Coll. Goldfinch. *rhodopsara*, Turn.: Ann. Q'land Mus., x., p. 62 (1911). *ciliata*, Wlk.; of this *adjuncta*, Wlk.: Char. Undesc. Lep., p. 68, is a synonym (*nec* Hmps., v., p. 489). *exarans*, Luc.: Proc. Linn. Soc. N.S. Wales, 1893, p. 141; of this *orthomita*, Turn.: Trans. Roy. Soc. S. Austr., 1908, p. 56, is a synonym. *decisissima*, Wlk.; of this *aureola*, Luc.: Proc. Linn. Soc. N.S. Wales, 1889, p. 1097, is a synonym. *porphyrodes*, Turn.: Ann. Q'land Mus., x., p. 63 (1911). *acontosema*, Turn. *yu*, Gn. *venalba*, Moore. *dentosa*, Turn.: *l.c.*, p. 62 (1911). *loreyi*, Dup. *polysticha*, Turn. *xanthosticha*, Turn.: *l.c.*, p. 64 (1911). *unipuncta*, Haw. *subsignata*, Moore. *obumbrata*, Luc. *irregularis*, Wlk. *ewingii*, Westw. This species is the type of *Persectania*, Hmps., a genus recognized both by Sir George Hampson and Mr. Meyrick, as distinguished by the frons forming a slight rounded prominence with a corneous plate below it. Having rubbed off the palpi and frontal scales from examples of *ewingii*, *loreyi*, and *abdominalis*, I can find no difference between them.

SIDERIDIS VIBICOSA, n. sp. (*vibicosus*, full of small scars).

♂, 35 mm. Head whitish with a few fuscous scales. Palpi $1\frac{1}{2}$, second joint with loosely appressed scales, terminal joint short; ochreous-whitish, outer surface of second joint partly suffused with grey, with slight fuscous irroration. Antennae grey, paler towards base. Thorax whitish-grey irrorated with fuscous. Abdomen pale grey. Legs pale grey with some fuscous irroration; anterior coxae densely hairy, with purple-grey irroration. Forewings with costa slightly arched, apex rounded-rectangular, termen straight to near tornus, not oblique; whitish-grey suffused and irrorated with dark grey; paler towards base and costa; absence of irroration leaves a pale discal spot at $\frac{3}{5}$, and a large number of pale transverse strigulae in posterior part of disc; cilia dark grey with a pale basal line. Hindwings with termen wavy; whitish, towards margins suffused with grey; cilia grey with whitish basal line, towards tornus wholly whitish.

Although very inconspicuously coloured the numerous strigulae on forewings distinguish this from any Australian species.

Hab. — Queensland: Brisbane, in September; one specimen.

7. Gen. TIRACOLA, Moore.

Frons not projecting. Palpi moderately long, ascending; second joint with loosely appressed hairs beneath;

terminal joint short, smooth, porrect. Thorax with a sharp, ridge-like anterior and a small posterior crest. Abdomen with small crests on first two segments. Posterior tibiae hairy on dorsum. Neuration normal.

plagiata, Wlk.

8. Gen. Melanchra, Hb.

Frons not projecting. Palpi moderate, ascending; second joint shortly rough-haired beneath; terminal joint moderate, smooth. Thorax with rounded anterior and small posterior crests. Abdomen with several crests on basal segments. Posterior tibiae hairy on dorsum. Neuration normal.

Another large cosmopolitan genus.

consanguis, Gn. † *dictyota*, Low. *xanthocosma*, Turn.

Subfam. CUCULLIANAE.

This group is very scantily represented in Australia.

1. Frons with a strong, conical, pointed prominence	1. *Gyroprora*
Frons not projecting	2.
2. Tegulae forming a sharp dorsal ridge ...	2. *Neumichtis*
Tegulae not so formed	3. *Eumichtis*

1. Gen. Gyroprora, Turn.: Ann. Q'land Mus., x., p. 64 (1911).

Frons with a strong, obtusely pointed, corneous, conical prominence. Antennae of male bipectinated to apex. Palpi moderately long, porrect; second joint shortly rough-haired beneath; terminal joint moderate, smooth. Thorax and abdomen without crests. Posterior tibiae densely hairy. Neuration normal.

Probably allied to the European *Aporophyla*, Gn.

ochrias, Turn.: *l.c.*, p. 64 (1911).

2. Gen. Neumichtis, Hmps.

Frons not projecting. Palpi rather long, ascending; second joint rough-haired beneath; terminal joint moderate, smooth. Thorax with a sharp, ridge-like, anterior crest formed by tegulae and a small bifid posterior crest. Abdomen with a series of dorsal crests. Posterior tibiae hairy on dorsum. Neuration of forewings normal. Hindwings with 5 weakly developed from below middle of cell ($\frac{1}{3}$).

trijuncta, Wlk.

Neumichtis archephanes, n. sp.

(ἀρχεφανης, of chiefly appearance).

♀, 48 mm. Head, palpi, and thorax dark fuscous, densely irrorated with white. Antennae dark fuscous. Abdomen grey mixed with whitish, crests fuscous. Legs fuscous with whitish irroration. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen bowed, oblique, crenulate; fuscous-grey; markings white edged with blackish; a dentate sub-basal line from costa near base to fold; a crenulate, outwardly oblique line from $\frac{1}{5}$ costa to $\frac{2}{5}$ dorsum; orbicular and reniform very distinct, the former large, 8-shaped, the latter still larger, kidney-shaped; claviform obsolete; a postmedian fascia, its inner edge angled outwards beneath costa and on vein 2, outer edge less distinct, veins crossing it partly blackish, a fine dentate subterminal line, bent outwards and more sharply dentate between veins 3 and 4; triangular blackish terminal dots between veins; cilia grey with some whitish irroration, and finely barred with white opposite veins. Hindwings with termen gently rounded, irregularly waved; fuscous with darker lines on veins; costa whitish; a blackish terminal line obsolete towards tornus; cilia grey, bases whitish, apices white. Underside of forewings fuscous with two dark lines before termen; of hindwings whitish irrorated with fuscous, with large fuscous discal lunule and terminal band.

Nearly allied to *trijuncta*, Wlk., but considerably larger, the antemedian line crenulate, more oblique, running to mid-dorsum, projections on postmedian line bluntly rounded.

Hab.—New South Wales: Mount Kosciusko (5,000 ft.), in January; one specimen.

3. Gen. Eumichtis, Hb.

Frons not projecting. Palpi rather long, ascending; second joint densely rough-haired beneath; terminal joint moderate, smooth. Thorax with a rounded anterior and bifid posterior crest. Abdomen with a series of dorsal crests. Posterior tibiae hairy on dorsum. Neuration of forewings normal. Hindwings with 5 from below middle of cell ($\frac{1}{3}$).

sepultrix, Gn. *saliaris*, Gn. *mesophaea*, Hmps. † *extima*, Wlk.

Subfam. ACRONYCTINAE.

This is a most difficult group, and I cannot expect that the following revision will be found completely satisfactory. The length of the cell and the point of origin of vein 5 in the hindwings sometimes furnish good generic characters. The last is expressed numerically; for instance, $\frac{1}{3}$ connotes that 5 arises from $\frac{1}{3}$ of the distance between the lower and upper angle of the cell reckoning from the former. I include here the genus *Amyna*.

1. Abdomen with one or more dorsal crests ... 2.
   Abdomen without crests ... ... 23.

2.	Abdomen with three or more dorsal crests	3.
	Abdomen with basal crest only, or (rarely) a crest also on second segment	12.
3.	Hindwings with 8 anastomosing with cell at $\frac{1}{3}$	1. *Magusa*
	Hindwings with 8 anastomosing with cell before $\frac{1}{4}$	4.
4.	Hindwings with cell $\frac{3}{5}$	2. *Cosmodes*
	Hindwings with cell $\frac{1}{2}$ or less	5.
5.	Forewing with subapical dorsal tuft	6.
	Forewing without dorsal tuft	8.
6.	Forewing with areole absent	3. *Musothyma*
	Forewing with areole present	7.
7.	Palpi moderate, porrect	4. *Eriopus*
	Palpi long, appressed to frons, exceeding vertex	5. *Data*
8.	Thorax with anterior crest	9.
	Thorax without anterior crest	11.
9.	Frons with rounded prominence	8. *Cycloprora*
	Frons without prominence	10.
10.	Forewings with 8, 9, 10 stalked from areole	6. *Pansemna*
	Forewings with 10 arising separately from areole	7. *Euplexia*
11.	Palpi with first and second joints triangularly dilated	12. *Calogramma*
	Palpi not so formed	13. *Prodenia*
12.	Thorax crested	13.
	Thorax not crested	21.
13.	Frons projecting	14.
	Frons not projecting	19.
14.	Frontal prominence with circular apical depression	15.
	Frontal prominence without apical depression	17.
15.	Frontal depression minute	16.
	Frontal depression large and containing an acute corneous process	15. *Thegalea*
16.	Hindwings with 8 anastomosing with cell at $\frac{1}{4}$	9. *Molvena*
	Hindwings with 8 anastomosing before $\frac{1}{6}$	10. *Thalatha*
17.	Hindwings with 5 from much below midddle ($\frac{1}{4}$)	16. *Hypoperigea*
	Hindwings with 5 from middle of cell	18.
18.	Frontal prominence pointed	44. *Leucogonia*
	Frontal prominence rounded	45. *Metaxanthia*
19.	Hindwings with discocellulars angled	14. *Spodoptera*
	Hindwings with discocellulars not angled	20.
20.	Palpi with third joint porrect	17. *Namangana*
	Palpi with third joint erect	19. *Phaeopyra*
21.	Abdomen with short lateral tufts of hair	11. *Acronycta*
	Abdomen smooth	22.
22.	Palpi smooth	26. *Chasmina*
	Palpi rough anteriorly	42. *Amyna*
23.	Thorax crested	24.
	Thorax without, or with only very small rudimentary crests	34.

24. Frons not projecting	25.	
Frons projecting	29.	
25. Thorax with anterior crest	26.	
Thorax without anterior crest	28.	
26. Anterior thoracic crest triangular, acute	23.	*Lophocalama*
Anterior thoracic crest rounded	27.	
27. Palpi with terminal joint porrect	18.	*Luperina*
Palpi with terminal joint erect	20.	*Phaeomorpha*
28. Abdomen with dense lateral tufts	24.	*Peripyra*
Abdomen without lateral tufts	28.	
28. Patagia elongate	43.	*Zalissa*
Patagia not elongate	25.	*Diplonephra*
29. Posterior tibiae smooth	30.	
Posterior tibiae hairy on dorsum	32.	
30. Frons with minute apical depression ...	28.	*Paromphale*
Frons without apical depression	31.	
31. Frons acutely projecting at lower edge ...	29.	*Eccleta*
Frons rounded	30.	*Aucha*
32. Tongue weak or absent, neuration normal	33.	
Tongue strongly developed, forewings without areole	33.	*Prometopus*
33. Frons with apical depression	31.	*Eremochroa*
Frons without apical depression	32.	*Micropia*
34. Frons projecting	35.	
Frons not projecting	39.	
35. Tongue weakly developed	35.	*Azenia*
Tongue strongly developed	36.	
36. Frons with a large apical depression, in its centre a corneous process	37.	
Frons not so formed	36.	*Dinoprora*
37. Anterior tibiae with an apical claw ...	34.	*Calophasidia*
Anterior tibiae without claw	38.	
38. Posterior tibiae smooth	36.	*Aegle*
Posterior tibiae hairy on dorsum	37.	*Omphaletis*
39. Tongue weak or absent	40.	
Tongue strongly developed	41.	
40. Palpi slender, male antennae not pectinate	21.	*Sesamia*
Palpi thickened with loose hairs, male antennae pectinate to apex	22.	*Bathytricha*
41. Posterior tibiae smooth	39.	*Radinogoës*
Posterior tibiae hairy on dorsum	42.	
42. Hindwings with 5 from well below middle	43.	
Hindwings with 5 from middle of cell ...	41.	*Caradrina*
43. Palpi with second joint dilated towards apex	40.	*Leucocosmia*
Palpi with second joint not dilated	27.	*Callyna*

1. Gen. Magusa, Wlk.

Frons not projecting. Palpi long, ascending, exceeding vertex; second joint with appressed hairs; terminal joint long. Thorax with rounded anterior and small bifid posterior crests. Abdomen with four or five dorsal crests. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell about $\frac{1}{3}$; 8 anastomosing with cell at $\frac{1}{3}$.

olivaria, Hmps. *Hab.*—Northern Queensland: Cairns. *tenebrosa*, Moore.

2. Gen. Cosmodes, Gn.

Frons not projecting. Palpi moderate, ascending; second joint with loosely appressed hairs; terminal joint short. Thorax with large anterior and posterior crests. Abdomen with a large dorsal crest on third segment and minute crests on first two segments. Posterior tibiae hairy on dorsum. Forewings with small tornal projection. Neuration normal. Hindwings with cell $\frac{3}{5}$.

elegans, Don.

3. Gen. Musothyma, Meyr.

Frons with slight rounded projection. Palpi long, slender, obliquely ascending; second joint rough-scaled; terminal joint rather long. Thorax with small posterior crest. Abdomen with dorsal crests on first three segments, that on third segment large. Posterior tibiae smooth. Forewings with a dorsal tuft before tornus; areole minute or absent, 7 and 10 arising separately from cell. Hindwings with discocellulars angled, 5 from below middle ($\frac{1}{3}$), 8 anastomosing with cell at $\frac{1}{4}$.

cyanastis, Meyr.

4. Gen. Eriopus, Treit.

Frons not projecting. Palpi moderate, obliquely ascending, not appressed to frons; second joint rough-haired beneath and also above towards apex; terminal joint moderate, porrect. Thorax with a small posterior crest. Abdomen with large crests on three basal segments. Posterior tibiae densely hairy. Forewings with a small dorsal scale-tuft before tornus. Neuration normal. Hindwings with cell $\frac{2}{5}$; 5 from below middle ($\frac{1}{3}$).

ferruginea, Hmps. (my example has no abdominal crests, but they may have been denuded). *rivularis*, Wlk. *maillardi*, Gn.

5. Gen. Data, Wlk.

Frons not projecting. Palpi long, ascending, appressed to frons, exceeding vertex; second joint with loosely appressed hairs; terminal joint long, erect. Thorax with rounded anterior and bifid posterior crests. Abdomen with dorsal crests on three or four basal segments. Posterior tibiae densely hairy. Forewings with small dorsal scale-tuft before tornus. Neuration normal. Hindwings with cell $\frac{2}{5}$; 5 from slightly below middle.

thalpophiloides, Wlk.

6. Gen. Pansemna, nov. (*πανσεμνος*, very stately).

Frons not projecting. Palpi very long, ascending, appressed to frons, much exceeding vertex; second joint slightly roughened; terminal joint very long (⅔ of second joint). Thorax with anterior and posterior crests. Abdomen with dorsal crests on three or four basal segments. Posterior tibiae hairy. Forewings with 8, 9, 10 stalked from areole. Hindwings with 5 from below middle (⅓).

Clearly defined by the long-stalking of vein 10 of forewings.

beryllodes, Turn.

7. Gen. EUPLEXIA, Stph.

Frons not projecting. Palpi moderate, ascending; second joint rough-haired; terminal joint moderate. Thorax with rounded or bifid anterior and bifid posterior crests. Abdomen with dorsal crests on three or four basal segments. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with 5 from below middle.

A large cosmopolitan genus, for which the name *Euplexia* may be conveniently adopted for the present, though no doubt it will be ultimately superseded. To it I refer the Australian species which Hampson places under *Trachea* (except *smaragdistis*, which is a *Phaeopyra)* and *Perigea*. There are slight specific differences in the form of the thoracic crests and in the length of the palpi, but any attempts to base generic definitions on these will, I think, break down in practice.

† *iorrhoa*, Meyr. † *trichroma*, Meyr. *bryochlora*, Meyr. *consummata*, Wlk. *prolifera*, Wlk. *adamantina*, Turn. † *signata*, Low. *polycmeta*, Turn. *callisina*, Turn. *leucostigma*, Turn. † *callichroa*, Low. † *melanops*, Low. *dolorosa*, Wlk. *aroana*, B-Bak. *capensis*, Gn. *euarmosta*, Turn.: Ann. Q'land Mus., x., p. 65 (1911). *asbolodes*, Turn.: *ib.*, p. 66.

EUPLEXIA DOCIMA, n. sp. (δοκιμος, excellent).

♂, 34 mm. Head white; face with a transverse median black bar. Palpi black; apex and inner surface of second joint white; terminal joint white. Antennae dark fuscous, towards base white. Thorax white; bases of tegulae, outer edges of patagia, a transverse median bar, and base of posterior crest black. Abdomen whitish with median dorsal and lateral series of blackish dots; tuft whitish, at base blackish. Legs whitish; tibiae and tarsi annulated with blackish. Forewings elongate-triangular, costa slightly arched, apex rounded-rectangular, termen bowed, moderately oblique; white with black markings; a basal line; a subbasal line from costa, outwardly oblique, bent sharply inwards below middle to near base of dorsum; closely following this a leaden-grey fascia mixed with brownish towards costa, with a strong posterior projection above middle; a line from $\frac{1}{4}$ costa obliquely outwards to fold, where it runs into claviform; a subcostal spot at $\frac{1}{3}$ representing orbicular; seven costal spots, the first connected with a subcostal spot posterior to it, the fifth and sixth connected with a short transverse streak; five dorsal spots, above the fourth a short oblique streak bifurcating above, and preceded by a leaden-grey suffusion; a thin crescentic line with concavity outwards representing reniform; a blotch containing some leaden-grey and white scales posterior to this; three angular submarginal spots preceded by a slight grey suffusion; cilia white, sharply barred with black. Hindwings with termen rounded; fuscous; dorsal area suffused with white; a darker postmedian line; cilia fuscous with several white bars.

Hab.—New South Wales: Sydney (Hornsby), in March; one specimen in Coll. Lyell.

8. Gen. Cycloprora, nov. (κυκλοπρωρος, with rounded prow).

Frons with rounded or somewhat conical prominence. Palpi moderate, ascending, appressed to frons; second joint slightly roughened anteriorly; terminal joint short. Thorax with rounded anterior and small posterior crests. Abdomen with a small dorsal crest on basal segment and minute crests on second and third segments. Posterior tibiae hairy on dorsum. Neuration normal.

nodyna, Turn.

9. Gen. Molvena, Wlk.

Frons with truncate conical prominence, at its apex a small circular depression. Palpi short, porrect; second joint smooth; terminal joint minute. Thorax with a small posterior crest. Abdomen with a small dorsal crest on basal segment. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell $\frac{1}{2}$; 8 anastomosing with cell at $\frac{1}{4}$. Allied to *Thalatha*.

guttalis, Wlk.

Molvena hieroglyphica, n. sp.

♂, 23 mm. Head white; lower margin of face and apex of frontal process blackish. Palpi blackish, apices white. Antennae fuscous. Thorax white; a median spot on tegulae and outer edge of patagia towards base blackish. Abdomen grey; basal crest and apical segments fuscous; tuft ochreous-whitish. Legs dark fuscous mixed with whitish. Forewings rather broadly triangular, costa gently arched, apex rect-angular, termen bowed, only slightly oblique; white with sharply defined black markings; a short median bar from base; a transverse bar from costa at $\frac{1}{6}$ nearly touching the preceding; a bar from costa before middle narrowing in cell, and bent forward in a right angle to posterior end of cell, a costal dot at $\frac{2}{3}$; a triangular mark on mid-dorsum; an oblique quadrangular elongate bar from tornus; an irregular blotch at apex; cilia white, on markings blackish. Hindwings with termen rounded; white; an apical fuscous blotch; cilia white, on apex fuscous.

Hab.—Northern Queensland: Claudie River, in December; one specimen, taken by Mr. J. A. Kershaw. Type in National Museum, Melbourne.

10. Gen. Thalatha, Wlk.

Frons with rounded prominence, at its apex a small circular depression. Palpi rather short, obliquely ascending; second joint with appressed hairs; terminal joint short. Thorax with a posterior crest. Abdomen with a small dorsal crest on basal segment. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell $\frac{1}{2}$; 8 anastomosing with cell before $\frac{1}{6}$.

Hampson describes the thorax as without crests, but one is present in the Australian species.

psorallina, Low.

11. Gen. Acronycta, Ochs.

Tongue strong. Frons not projecting. Palpi long, ascending, exceeding vertex; second joint roughened anteriorly; terminal joint moderate or long. Thorax not crested. Abdomen with small dorsal crests on two basal segments, and lateral tufts on apical segments. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell over $\frac{1}{2}$.

fasciata, Moore. Hampson refers this to *Craniphora*, but it has only two abdominal crests, and that on second segment is minute. It agrees with *Acronycta*, except that the terminal joint of the palpi is unusually long (over $\frac{1}{2}$).

Acronycta phaeocosma, n. sp.

(φαιοκοσμος, with dusky ornament).

♂, ♀, 40 mm. Head and thorax dark fuscous, irrorated with whitish. Palpi whitish; second joint dark fuscous, except at base and apex; terminal joint short ($\frac{1}{5}$). Antennae fuscous; in male simple. Abdomen fuscous mixed with whitish; legs fuscous, mixed with whitish; anterior and middle tibiae with two dark fuscous rings; tarsi whitish, annulated with dark fuscous. Forewings with costa gently arched, apex rounded-rectangular, termen bowed, scarcely oblique; dark fuscous more or less irrorated with whitish, markings dark fuscous; a triangular basal spot; a dark suffusion on base of dorsum and several indistinct dark spots on basal part of costa; an indistinctly double finely-waved line from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum; beyond this a whitish fascia containing a small orbicular, outlined with dark fuscous and with a central dot; an angular median line twice dentate outwards, triangularly thickened towards margins and between dentations; reniform rather large, slenderly outlined, with a fine central line, its posterior margin nearly straight, connected by a line with dorsum at $\frac{2}{3}$; a finely dentate double posterior line from $\frac{2}{3}$ costa, at first curved outwards, then inwards, towards dorsum, obscured by dark suffusion; a fine streak from median line along vein 2 nearly to termen; a whitish dentate subterminal line followed by some wedge-shaped spots; some small terminal dots; cilia whitish with dark-fuscous bars. Hindwings grey; a faintly darker postmedian line. Underside grey-whitish; both wings with dark-fuscous spot on costa before middle and postmedian line.

Allied to *A. fasciata*, but much darker, without basal streak on forewing, and terminal joint of palpi shorter.

Hab. — Queensland: Montville, Blackall Range (1,500 ft.), in March; two specimens.

12. Gen. Calogramma, Gn.

Frons not projecting. Palpi rather short, ascending; basal and second joints somewhat rough-haired, triangularly dilated; terminal joint short. Thorax with a small bifid posterior crest. Abdomen with dorsal crests on three basal segments. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell $\frac{1}{2}$; discocellulars angled, 5 from below angle.

festiva, Don.

13. Gen. Prodenia, Gn.

Frons not projecting. Palpi moderate, ascending, appressed to frons; second joint with loosely appressed hairs, slightly roughened anteriorly; terminal joint short. Thorax with small anterior and bifid posterior crest. Abdomen with dorsal crests on three basal segments. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell $\frac{1}{2}$; discocellulars angled, 5 from below angle.

litura, Fab.

14. Gen. Spodoptera, Gn.

Frons not projecting. Palpi moderate or rather long, appressed to frons; second joint smooth-scaled, slightly roughened anteriorly; terminal joint rather short. Thorax with a small posterior crest. Abdomen with a dorsal crest on basal segment. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell $\frac{1}{2}$; discocellulars angled, 5 from below angle.

Laphygma is not tenable as a distinct genus; in *exigua* 3 and 4 of hindwings are usually stalked, but this is inconstant. No reliance can be placed on the less broadly hairy anterior tibiae, for there are intermediates in other species; still less in the slightly narrower forewings.

umbraculata, Wlk. *mauritia*, Bdv. *leucophlebia*, Hmps. The distribution of this species is curious, but it is certainly endemic in Australia. I have three examples, one from Melville Island, Northern Territory, and two from Brisbane. *exempta*, Wlk. *exigua*, Hb.

15. Gen. Thegalea, nov. (θηγαλεος, sharp).

Frons prominent, conical, with a large circular apical depression with raised edges, in its centre an acute corneous process. Palpi rather long, slender, porrect; second joint shortly rough-scaled; terminal joint rather long. Thorax with a small posterior crest. Abdomen with a small dorsal crest on basal segment. Posterior tibiae smooth. Forewings normal. Hindwings with 5 from shortly above lower angle of cell ($\frac{1}{6}$).

haemmorhanta, Turn.

16. Gen. Hypoperigea, Hmps.

Frons with rounded prominence. Palpi moderate, ascending; second joint rough-haired; terminal joint moderately short. Thorax with a small posterior crest. Abdomen with a dorsal crest on basal segment, and sometimes a small crest on second segment. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell $\frac{1}{2}$; 5 from well below middle ($\frac{1}{4}$).

tonsa, Gn. This species varies in the development of reddish scales on forewings; they may be absent.

17. Gen. Namangana, Stgr.

Frons not projecting. Palpi moderate or rather long, ascending; second joint rough-haired; terminal joint short or rather long, porrect. Thorax with rounded anterior and small posterior crests. Abdomen with dorsal crest on basal segment. Posterior tibiae hairy. Neuration normal.

† *minor*, Butl. † *albirena*, Hmps.

NAMANGANA DELOGRAPHA, n. sp.

(δηλογραφος, clearly engraved).

♂, 36 mm. Head and thorax ochreous-whitish, irrorated with dark fuscous. Palpi rather long (2); ochreous-whitish irrorated with dark fuscous. Antennae whitish finely barred with fuscous; in male simple, minutely ciliated, with slightly longer bristles. Abdomen whitish, irrorated with grey. Legs fuscous irrorated, and tibiae and tarsi annulated with ochreous-whitish. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen slightly bowed, slightly oblique; fuscous irrorated with whitish so as to appear grey, and with some pale-ochreous scales, especially on fold, and on a median streak posterior to reniform; markings whitish partly outlined with fuscous; sub-basal line indicated by costal and subcostal spots; antemedian at $\frac{1}{4}$, transverse, interrupted; orbicular circular with a dark central dot; reniform 8-shaped with two included dark dots, incomplete beneath; several white dots on terminal third of costa; postmedian slender, sinuate; subterminal slender, indented in middle; a terminal series of blackish lunules preceded by whitish; cilia fuscous, apices barred with ochreous-whitish. Hindwings with termen rounded; white; a few fuscous scales on veins; cilia white with an interrupted fuscous line before middle. Underside whitish with fuscous irroration towards costa and termen; forewings on male with long whitish hairs on under-surface of cell.

A distinct and neatly-marked species. The palpi are long for this genus, but some other species approach it in this respect. Type in Coll. Goldfinch.

Hab.—New South Wales: Bourke; one male from the late Mr. Helms' collection. Western Australia: Dowerin; one female from Mr. L. J. Newman.

18. Gen. LUPERINA, Bdv.

Frons not projecting. Palpi long, obliquely ascending; second joint with rough hairs anteriorly and also posteriorly at apex; terminal joint long, porrect. Thorax with rounded anterior and small posterior crest. Abdomen without crests. Posterior tibiae hairy. Neuration normal.

Allied to *Namangana*, from which it differs in the absence of basal abdominal crest, but agrees in the structure of the palpi. The European *L. testacea*, Schiff., which is nearly allied to the type, has the tongue rather short and weak, and the thorax clothed with hairs. In these respects it differs from the following species, but they are hardly sufficient for generic distinction.

horologa, Meyr.

19. Gen. PHAEOPYRA, Hmps.

Frons not projecting. Palpi long, ascending; second joint roughened anteriorly; terminal joint moderate. Thorax with rounded anterior and bifid posterior crests. Abdomen with a dorsal crest on basal segment. Posterior tibiae hairy on dorsum. Neuration normal.

chloëropis, Turn. *smaragdistis*, Hmps.

20. Gen. PHAEOMORPHA, nov.

(φαιομορφος, of dusky appearance).

Frons not projecting. Palpi moderately long, ascending, appressed to frons; second joint with appressed scales; terminal joint moderate. Thorax with rounded anterior and dense posterior crest. Abdomen not crested. Posterior tibiae hairy. Neuration normal.

Near *Phaeopyra*, from which it differs in the absence of basal abdominal crest.

PHAEOMORPHA ACINETA, n. sp. (ἀκινητος, sluggish).

♂, ♀, 35-40 mm. Head whitish, irrorated with dark fuscous, back of crown whitish-ochreous. Palpi ochreous-whitish, irrorated with dark fuscous. Antennae fuscous; in male with short ciliations ($\frac{1}{3}$) and longer bristles ($\frac{2}{3}$). Thorax, anterior half pale-brownish, posterior half grey. Abdomen dark grey. Legs fuscous; anterior and middle tibiae with median and apical whitish-ochreous rings; tarsi reddish-tinged with dark-fuscous annulations. Forewings with costa nearly straight, apex rounded-rectangular, termen straight, not oblique, rounded towards tornus; grey with grey-whitish suffusion, markings fuscous; a line from costa near base to fold; a number of short strigulae on costa; claviform represented by a fuscous mark; orbicular faintly indicated; reniform better marked, narrow, with a central line, preceded and followed by a dark dot; a very fine postmedian line, at first finely dentate, then bent inwards in a curve to $\frac{3}{4}$ dorsum; an indistinct pale subterminal line; a terminal series of dark pale-edged dots; cilia dark grey with whitish points. Hindwings fuscous becoming grey towards base; cilia white with a sub-basal fuscous line not extending to tornus. Underside of forewings fuscous; of hindwings whitish with broad blackish terminal band.

Hab.—Queensland: Montville, Blackall Range (1,500 ft.), in March; two specimens.

21. Gen. SESAMIA, Gn.

Frons not projecting. Tongue very weak or absent. Palpi moderate or short, slender, ascending; second joint shortly rough-haired; terminal joint short. Thorax covered with long loose hairs, not crested. Abdomen without crests. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell over $\frac{1}{2}$; 5 from slightly below middle ($\frac{2}{5}$).

exanimis, Meyr. *brunnea*, Hmps. † *albicostata*, Low.

22. Gen. Bathytricha, nov. (*βαθυτριχος*, with thick hair).

Frons not projecting, covered with rough hairs. Antennae of male bipectinated to apex. Tongue absent. Palpi moderate, obliquely ascending; second joint shortly rough-haired above and beneath; terminal joint long. Thorax densely hairy, without crests. Abdomen not crested. Posterior tibiae hairy. Forewings normal. Hindwings with cell $\frac{1}{2}$; 5 from slightly below middle ($\frac{2}{5}$).

truncata, Wlk. This cannot be referred to *Phragmatiphila*, Hmps., better known as *Nonagria*, although it is allied, because it has no frontal projection. I have not seen the type of that genus, but in *typhae* the tongue appears sufficiently strongly developed.

23. Gen. Lophocalama, Hmps.

I have not been able to examine this genus, but it seems sufficiently distinct. The tongue is fully developed; thorax with a triangular anterior and double posterior crest; abdomen without crest.

† *neuritis*, Hmps.

24. Gen. Peripyra, Hmps.

Frons not projecting. Palpi moderate, ascending; second joint rough-scaled anteriorly, and with a small posterior terminal tuft; terminal joint rather long. Thorax with a small undivided posterior crest. Abdomen hairy, without crests, but with dense lateral tufts of hair. Posterior tibiae hairy. Neuration normal.

Allied to the New Zealand *Bityla* and the European *Amphipyra*, though the abdomen is less flattened; but this is in any case an unsatisfactory character. It agrees with them in the lateral abdominal tufts, but differs in the small, acute, posterior, thoracic crest.

sanguinipuncta, Gn.

[Hampson refers † *atronitens*, Wlk., to the genus *Amphipyra*, but as the Australian locality requires confirmation, I have omitted it.]

25. Gen. DIPLONEPHRA, nov.

(διπλονεφρος, with doubled kidneys).

Frons not projecting. Palpi short, porrect; second joint rough-scaled; terminal joint very short. Thorax with a dense posterior crest. Abdomen hairy but without crests. Posterior tibiae hairy on dorsum. Neuration normal.

ditata, Luc.

26. Gen. CHASMINA, Wlk.

Frons not projecting. Palpi moderate, ascending, appressed to frons; second joint smooth; terminal joint moderate. Thorax not crested. Abdomen smooth, with dorsal crest on basal segment, or sometimes *(pulchra)* on first two segments. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell from about $\frac{1}{2}$; 5 from below middle ($\frac{1}{3}$ or $\frac{1}{4}$).

tibialis, Fab. *tenuilinea*, Hmps. *pulchra*, Wlk.

27. Gen. CALLYNA, Gn.

Frons not projecting. Palpi rather long, ascending, appressed to frons; second joint smooth; terminal joint rather long. Thorax and abdomen without crests. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with 5 from below middle ($\frac{1}{3}$). Allied to *Chasmina*.

leuconota, Low. *monoleuca*, Wlk. *leucosticha*, Turn.: Ann. Q'land Mus., x., p. 69 (1911).

28. Gen. PAROMPHALE, Hmps.

Frons forming a truncate conical prominence with a minute depression at apex. Palpi moderately long, obliquely ascending; second joint with loosely appressed scales; terminal joint short. Thorax with a small posterior crest. Abdomen without crests. Posterior tibiae smooth. Forewings normal. Hindwings with cell over $\frac{1}{2}$; 3 and 4 sometimes short-stalked, 8 anastomosing with cell at $\frac{1}{4}$.

caeca, Swin. *pinodes*, Turn. This is referable here, though Hampson places it in the genus *Scotostena* among the Erastrianae.

29. Gen. ECCLETA, Turn.

Frons with an acute projection at lower edge. Palpi long, ascending, appressed to frons, exceeding vertex; second joint with loosely appressed scales; terminal joint long. Thorax with a posterior crest. Abdomen without crests. Posterior tibiae smooth with a few hairs on dorsum opposite median spurs and at apex. Forewings normal. Hindwings with cell $\frac{1}{2}$.

xuthophanes, Turn.

30. Gen. Aucha, Wlk.

Frons forming a rounded projection. Palpi rather long, ascending, appressed to frons, exceeding vertex; second joint smooth; terminal joint rather long. Thorax with a smooth-scaled posterior crest. Abdomen not crested. Posterior tibiae smooth with a few hairs on dorsum opposite median spurs and at apex. Forewings normal. Hindwings with cell $\frac{1}{2}$; 8 anastomosing with cell at $\frac{1}{4}$.

triphaenoides, Wlk. *vesta*, Swin.

31. Gen. Eremochroa, Meyr.

Frons forming a truncate conical prominence, at its apex a small circular depression with raised edges. Tongue absent. Antennae of male bipectinated to apex. Palpi rather long, porrect; second joint with loose hairs above and beneath; terminal joint hairy, rather short. Thorax with a posterior crest. Abdomen without crests. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell over $\frac{1}{2}$; 5 from slightly above middle.

† *psammias*, Meyr. † *thermidora*, Hmps. *macropa*, Low. † *paradesma*, Low. *alphitias*, Meyr.

32. Gen. Micropia, Hmps.

I have not examined this genus. Like *Eremochroa* it has the tongue aborted, but the frons forms a rounded prominence, and the tibiae are smooth.

† *rhodocentra*, Low.

33. Gen. Prometopus, Gn.

Frons with a strong truncate conical projection. Palpi long, obliquely ascending; second joint with loose spreading hairs above and beneath; terminal joint long, porrect. Thorax with a posterior crest. Abdomen not crested. Posterior tibiae hairy on dorsum. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with cell over $\frac{1}{2}$; 5 from below middle ($\frac{1}{3}$).

The following species stands alone in the Australian fauna. The other two Australian species referred to this genus by Hampson have the areole normally developed.

inassueta, Gn.

34. Gen. Calophasidia, Hmps.

I have not examined this genus. It is sufficiently distinguished by the hook on anterior tibiae.

† *lucala*, Swin. † *radiata*, Swin. † *dentifera*, Hmps.

35. Gen. AZENIA, Grote.

Allied to *Aegle*, but differing in the weak obsolescent tongue.

† *tusa*, Swin. † *pura*, Swin.

36. Gen. AEGLE, Hb.

Frons projecting with a large apical depression with raised edges, from its centre an acute, vertically-flattened, bilobed, corneous process. Palpi short, ascending; second joint rough-scaled anteriorly; terminal joint short. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings normal. Hindwings with cell $\frac{3}{5}$; 5 from slightly below middle ($\frac{2}{5}$).

hedychroa, Turn.

37. Gen. OMPHALETIS, Hmps.

Frons projecting, containing a large apical depression with raised edges, in the centre of this a pointed or truncate corneous process. Palpi moderate, obliquely ascending; middle joint slightly roughened; terminal joint short. Thorax without crests or sometimes with a rudimentary double posterior crest. Abdomen not crested. Posterior tibiae hairy on dorsum. Neuration normal.

florescens, Wlk. *heliosema*, Low. *nuna*, Gn. *melodora*, Low. *metaneura*, Hmps. † *sarcomorpha*, Low. † *petrodora*, Low.

38. Gen. DINOPRORA, nov. (*δινοπρωρος*, with rounded prow).

Frons forming a strong rounded prominence. Palpi moderate, obliquely ascending; second joint slightly roughened; terminal joint short. Thorax and abdomen not crested. Posterior tibiae hairy on dorsum. Neuration normal.

endesma, Low.; type. *xerampelina*, Turn. *plinthina*, Turn.

39. Gen. RADINOGOËS, Butl.

Frons not projecting. Palpi moderate, ascending; second joint smooth; terminal joint short. Thorax and abdomen not crested. Posterior tibiae smooth. Forewings normal. Hindwings with cell over $\frac{1}{2}$.

Distinguished by the smooth palpi and posterior tibiae. I should have adopted the name *Proxenus*, H-Sch., if Hampson had not figured the type with hairy posterior tibiae.

tenuis, Butl.

40. Gen. LEUCOCOSMIA, Butl.

Frons not projecting, in male a cleft corneous ridge on vertex covered with scales. Palpi rather long, ascending, appressed to frons, reaching vertex; second joint smooth, but rough on anterior edge, strongly dilated anteriorly towards apex; terminal joint short. Thorax not crested. Abdomen hairy, more so in male, without crests. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell over $\frac{1}{2}$; 5 from well below middle ($\frac{1}{3}$).

Apart from the peculiar male characters this genus is sufficiently distinguished by the palpi combined with the origin of vein 5 of hindwings.

reclusa, Wlk.

41. Gen. Caradrina, Ochs.

Frons not projecting. Palpi moderate, ascending; second joint slightly roughened anteriorly; terminal joint short. Thorax not crested, or with very slight rudiments only of crests. Abdomen without crests. Posterior tibiae hairy on dorsum. Neuration normal.

As thus defined this is undoubtedly a very large and cosmopolitan genus, but I do not see any safe way of dividing it. Hampson for some unexplained reason has dropped the name *Caradrina*, and substituted for it *Athetis*, Hb., characterized by the presence of an anterior thoracic crest. Of this I can find no trace in the two Australian species *obtusa* and *maculatra*, though a rudiment of it may be found in some extra-Australian species, to which they appear allied. The great majority of those given beneath he ascribes to *Ariathisa*, Wlk., characterized by small paired posterior thoracic crests. These are sometimes present in a rudimentary form, but if I had to rely on them for a criterion I should have to exclude many species from the genus, and concerning others I should be in doubt. I conclude that they cannot be depended on for generic definition.

obtusa, Hmps. *maculatra*, Low. *passalota*, Turn. *exundans*, Gn. † *ochroleuca*, Low. *pelosticta*, Low. † *cornuta*, Low. † *euchroa*, Low. † *angasi*, Feld. *amathodes*, Turn. *tortisigna*, Wlk.; of this *chrysospila*, Low., is a synonym. † *paragypsa*, Low. † *gypsina*, Low. *paratorna*, Low. † *chionopasta*, Hmps. *cyanoloma*, Low. *callimera*, Low. † *etoniana*, Low. *hydraecioides*, Gn. *marginalis*, Wlk. *microspila*, Low. † *atmoscopa*, Low. *confinis*, Wlk.; of this I think *basisticha*, Turn., and *nycteris*, Turn., are synonyms. *poliocrossa*, Turn. *porphyrescens*, Low. *bistrigula*, Wlk. *capularis*, Gn. *atra*, Gn. † *microdes*, Low. † *atrisquamata*, Low. *cryphaea*, Turn. † *heterogama*, Low. *monochroa*, Low. † *adelphodes*, Low. *leucosticta*, Turn. † *interferens*, Wlk. *flexirena*, Wlk. † *adelopa*, Hmps. *acallis*, Turn. *melanographa*, Turn. *ophiosema*, Turn.:

Ann. Q'land Mus., x., p. 66 (1911). *ebenodes*, Turn.: *ib.*, p. 67. *celaenica*, Turn.: *ib.*, p. 68. *ochropepla*, Turn.: *ib.*, p. 68. *spilocrossa*, Turn.: Proc. Roy. Soc. Q'land, 1915, p. 22.

CARADRINA AUSTERA, n. sp. (ἀυστηρος, stern).

♀, 38-42 mm. Head fuscous. Palpi whitish, external surface of second joint, except apex, dark fuscous. Antennae fuscous. Thorax fuscous; tegulae pale grey [this character is probably inconstant]. Abdomen grey. Legs fuscous-grey; tibiae and tarsi annulated with whitish. Forewings elongate-triangular, costa nearly straight, apex rounded, termen scarcely oblique, rounded beneath; dark grey with some fuscous admixture, but without any brownish tinge; a double dentate sub-basal line from costa to fold, dark fuscous; a double dentate blackish line very distinct from $\frac{1}{4}$ costa to mid-dorsum, angled outwards on fold, inwards beneath fold, thence oblique; a fine blackish streak on fold crossing this line; orbicular very small, circular, pale, slenderly outlined with blackish; reniform K-shaped, open above and beneath, produced at outer inferior angle, brownish-tinged, outlined with blackish, sometimes outer half whitish; a fine dentate blackish line from midcosta curved outwards and then inwards beneath reniform, angled inwards on fold, outwards beneath fold, ending on $\frac{3}{4}$ dorsum; a dark-fuscous shade from costa before apex to tornus, sharply defined and dentate posteriorly, ill-defined, and giving off several short longitudinal blackish streaks anteriorly; a very slender interrupted blackish terminal line; cilia grey with a pale basal line. Hindwings with termen wavy; grey, towards base whitish; cilia whitish, at apex grey, and with a grey sub-basal line not reaching tornus. Underside of forewings grey with a fuscous dot on end of cell; of hindwings whitish with fuscous dot on end of cell, subcostal irroration, and apical blotch.

Hab.—Queensland: Brisbane, in April and May; two specimens.

42. Gen. AMYNA, Gn.

Frons not projecting. Palpi moderate or rather long; upturned; second joint thickened with loosely appressed scales, rather rough anteriorly; terminal joint long. Thorax not crested. Abdomen with dorsal crests on two basal segments. Posterior tibiae with median and apical hair-tufts on dorsum. Forewings normal. Hindwings with 5 from below middle ($\frac{1}{3}$).

apicalis, Wlk. *natalis*, Wlk. *octo*, Gn. † *spilonota*, Low. *punctum*, Fab. Northern Territory: Port Darwin; Northern Queensland: Atherton, Townsville.

43. Gen. Zalissa, Wlk.

Frons not projecting. Palpi rather short, obliquely ascending; second joint rough-scaled; terminal joint short. Thorax with a small posterior crest. Abdomen not crested. Posterior tibiae hairy. Forewings normal. Hindwings with branched median vein present in cell; otherwise normal.

catocalina, Wlk.

44. Gen. Leucogonia, Hmps.

Frons with a short conical prominence. Palpi long, porrect; second joint shortly rough-haired; terminal joint long. Thorax with a small posterior crest. Abdomen hairy, with a small dorsal crest on basal segment. Posterior tibiae hairy on dorsum. Neuration normal.

ekeikei, B-Bak. The name selected by Mr. Bethune-Baker for this fine species grieves me.

45. Gen. Metaxanthia, Hmps.

Frons with rounded prominence. Palpi moderate, porrect or slightly ascending; second joint triangularly dilated with loose hairs towards apex; terminal joint very short, concealed. Thorax with a small posterior crest. Abdomen with a dorsal crest on basal segment. Posterior tibiae slightly hairy on dorsum. Neuration normal.

cosmopis, Low.

Subfam. ERASTRIANAE.

Sir George Hampson has felt some difficulty in distinguishing this subfamily from the Acronyctinae, for he remarks that some genera have the typical trifid neuration of the latter, and makes the abortion of the anterior prolegs of the larvae the essential distinction. As in the majority of cases the larvae are unknown this distinction is not only inapplicable in practice, but it is at present impossible to test its validity. Doubtful cases must therefore be decided by considerations of apparent affinity, and I have therefore included here *Micrapatetis* and *Xenospeustis*. The Erastrianae seem to be an intermediate and transitional group, and probably their distinction from the Noctuinae will be equally difficult.

1.	Forewings without areole	2.	
	Forewings with areole present	19.	
2.	Forewings with 7, 8, 9, 10, 11 stalked ...	1.	*Araeoptera*
	Forewings with these veins not all stalked	3.	
3.	Forewings with 7, 8, 9, 10 stalked	4.	
	Forewings with these veins not all stalked	10.	
4.	Forewings with 3 and 4 stalked	3.	*Pseudocraspedia*
	Forewings with 3 and 4 separate	5.	

5. Hindwings with 8 anastomosing with cell to near middle ... ... 7. *Micrapatetis*
Hindwings with 8 not anastomosing beyond ¼ ... ... 6.
6. Abdomen with dorsal series of crests ... 7.
Abdomen with only one or no crest ... ... 8.
7. Palpi porrect, hairy above and beneath 4. *Peperita*
Palpi upturned, appressed to frons ... ... 10. *Cophanta*
8. Abdomen with basal crest ... ... 9. *Himerois*
Abdomen without crests ... ... 9.
9. Frons with rounded prominence ... ... 11. *Narangodes*
Frons without prominence, palpi slender 12. *Enispa*
10. Forewings with 8, 9, 10 stalked, 7 separate 11.
Forewings with 10 separate, 7, 8, 9 stalked, or 7, 8 stalked, 9 absent ... ... 17.
11. Abdomen with dorsal crest on basal segment ... ... 12.
Abdomen without crests ... ... 14.
12. Thorax with a posterior crest ... ... 15. *Pyripnoa*
Thorax not crested ... ... 13.
13. Frons with a rounded prominence ... ... 16. *Euthytoma*
Frons not projecting ... ... 17. *Ozarba*
14. Hindwings with 6 and 7 stalked ... ... 2. *Trissernis*
Hindwings with 6 and 7 not stalked ... 15.
15. Thorax with a posterior crest ... ... 18. *Haplopseustis*
Thorax not crested ... ... 16.
16. Palpi obliquely porrect, second joint with subapical tuft of hairs on upper surface 13. *Catoblemma*
Palpi upturned, appressed to frons ... 14. *Eublemma*
17. Forewings with 9 absent ... ... 5. *Decticryptis*
Forewings with 9 present ... ... 18.
18. Hindwings with 8 anastomosing with cell to near middle ... ... 8. *Xenopseustis*
Hindwings with 8 anastomosing near base only ... ... 6. *Holocryptis*
19. Forewings with 10 connate or stalked from areole ... ... 20.
Forewings with 10 arising separately from areole ... ... 23.
20. Frons with a pointed prominence ... ... 22. *Trogatha*
Frons not projecting ... ... 21.
21. Abdomen with dorsal crest on basal segment ... ... 19. *Metasada*
Abdomen without crests ... ... 22.
22. Hindwings with cell not over ⅓ ... ... 20. *Carmara*
Hindwings with cell about ½ ... ... 25. *Callipyris*
23. Frons not projecting ... ... 24.
Frons prominent ... ... 33.
24. Abdomen not crested ... ... 25.
Abdomen with one or more dorsal crests 29.
25. Palpi with an apical tuft on posterior surface of second joint ... ... 26.
Palpi without apical tuft on second joint 28.
26. Posterior tibiae smooth ... ... 27.
Posterior tibiae hairy on dorsum ... ... 26. *Corgatha*
27. Hindwings with cell ⅓ ... ... 21. *Cerynea*
Hindwings with cell ½ ... ... 27. *Hyposada*

28. Hindwings with cell $\frac{1}{3}$ ... ... 29. *Oruza*
Hindwings with cell $\frac{1}{2}$ ... ... 31. *Eucolastra*
Hindwings with cell $\frac{2}{3}$ ... ... 32. *Mimasura*
29. Abdomen with dorsal crest on basal segment only ... ... 30.
Abdomen with dorsal crests on other than basal segment ... ... 31.
30. Palpi with a small posterior apical tuft on second joint ... ... 28. *Hypobleta*
Palpi without apical tuft on second joint 33. *Eustrotia*
31. Thorax not crested ... ... 30. *Lophoruza*
Thorax with a posterior crest ... ... 32.
32. Hindwings with 3 and 4 stalked ... ... 34. *Maliattha*
Hindwings with 3 and 4 not stalked ... 35. *Lithacodia*
33. Frons with a transverse apical groove ... 36. *Uncula*
Frons without apical depression ... ... 34.
34. Hindwings with 6 and 7 stalked ... ... 37. *Habrophyes*
Hindwings with 6 and 7 connate ... ... 35.
35. Thorax not crested ... ... 36.
Thorax with a posterior crest ... ... 39. *Tarache*
36. Hindwings with 8 anastomosing with cell to $\frac{1}{2}$ ... ... 23. *Diplothecta*
Hindwings with 8 anastomosing with cell near base only ... ... 37.
37. Palpi with terminal joint very short ... 24. *Sophta*
Palpi with terminal joint long ... ... 38. *Epopsima*

1. Gen. Araeoptera, Hmps.

Frons not projecting. Palpi moderate or long, upturned; second joint thickened with rough scales; terminal joint moderate or long. Thorax not crested. Abdomen without crests, or with minute crests on apical segments *(canescens)*. Posterior tibiae smooth. Forewings without areole, 3 and 4 stalked, 7, 8, 9, 10, 11 stalked. Hindwings with 3 and 4 stalked, 5 from slightly below middle ($\frac{2}{5}$), 6 and 7 stalked, 8 anastomosing with cell to $\frac{1}{4}$.

micraeola, Meyr. *epiphracta*, Turn. *pleurotypa*, Turn. *canescens*, Wlk.

Araeoptera microclyta, n. sp.

(*μικροκλυτος*, splendidly small).

♂, 10 mm. Head whitish; face with fine fuscous transverse lines. Palpi long, terminal joint long ($\frac{2}{3}$); whitish, outer surface of second joint fuscous, terminal joint with a slender subapical fuscous ring. Antennae whitish, annulated with fuscous. Thorax whitish, with fuscous irroration. Abdomen whitish, on dorsum mixed with brown and irrorated with fuscous. Legs fuscous, annulated with whitish; posterior pair wholly whitish. Forewings rather narrow, costa gently arched, apex rounded, termen obliquely rounded; whitish, markings fuscous mixed with brown; a spot on base of costa;

a sub-basal fascia, followed by an inwardly oblique interrupted transverse line; brown spots on costa at $\frac{1}{4}$, middle, and $\frac{3}{4}$; from middle costal spot a broad fuscous transverse fascia including a whitish spot on dorsum, its posterior edge angled outwards in middle; from third spot an outwardly curved line ending in a fuscous spot on dorsum before tornus; a well-defined slender whitish line defines this posteriorly, strongly dentate above tornus; apical area mostly fuscous; a terminal series of fuscous dots separated by brown dots; cilia fuscous with whitish spots. Hindwings with termen nearly straight; as forewings but with fascia before middle leaving median area whitish, subterminal whitish line broader.

Very like *A. micraeola*, Meyr., but darker and readily distinguished by the longer terminal joint of palpi; in *micraeola* this is less than $\frac{1}{2}$.

Hab.—Northern Queensland: Kuranda, near Cairns, in October; one specimen received from Mr. F. P. Dodd.

2. Gen. Trissernis, Meyr.

Frons not projecting. Palpi moderate, porrect or ascending; second joint more or less roughened anteriorly; terminal joint short. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings without areole, 8, 9, 10 stalked. Hindwings with 5 from slightly below middle ($\frac{2}{5}$), 6 and 7 stalked, 8 anastomosing with cell to $\frac{1}{4}$.

prasinoscia, Meyr. *ochrochlora*, Turn. Best distinguished from the preceding by the palpi, which are porrect rather than ascending, and with the second joint less roughened.

3. Gen. Pseudocraspedia, Hmps.

Frons not projecting. Palpi slender, ascending; second joint slightly roughened anteriorly; terminal joint short. Thorax not crested. Abdomen with a series of small dorsal crests. Posterior tibiae smooth. Forewings without areole, 3 and 4 stalked, 7, 8, 9, 10 stalked. Hindwings with 5 from slightly below middle ($\frac{2}{5}$), 6 and 7 stalked, 8 anastomosing with cell to $\frac{1}{4}$.

punctata, Hmps. *Hab.*—Northern Queensland: Townsville.

4. Gen. Peperita, Hmps.

Frons not projecting. Palpi moderately long, porrect; second joint hairy above and beneath; terminal joint minute. Thorax not crested. Abdomen with dorsal series of crests. Posterior tibiae hairy. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with 5 from slightly below middle ($\frac{2}{5}$).

molybdopasta, Turn.

5. Gen. Decticryptis, Hmps.

Frons not projecting. Palpi very short, slender, porrect; second joint smooth; terminal joint porrect. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings without areole, 7 and 8 stalked, 8 and 9 coincident. Hindwings with 3 and 4 stalked, 5 from well below middle ($\frac{1}{4}$).

deleta, Moore. *Hab.*—Northern Queensland: Kuranda, near Cairns (F. P. Dodd).

6. Gen. Holocryptis, Meyr.

Frons with rounded prominence. Palpi rather short, slender, obliquely ascending; second joint smooth; terminal joint moderate. Thorax not crested. Abdomen with small dorsal crests on third, fourth, and fifth segments. Posterior tibiae smooth. Forewings without areole, 7, 8, 9 stalked. Hindwings with 3 and 4 stalked, 5 from well below middle ($\frac{1}{3}$), 6 and 7 stalked.

phasianura, Luc.

7. Gen. Micrapatetis, Meyr.

Frons with small rounded prominence. Palpi moderate, ascending; second joint thickened with rough scales; terminal joint short. Thorax with a small posterior crest. Abdomen without crests. Posterior tibiae smooth. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with 3 and 4 short-stalked, 5 from slightly below middle ($\frac{2}{5}$), 6 and 7 stalked, 8 anastomosing with cell to near middle.

tripartita, Butl. *orthozona*, Meyr. The two sexes are alike. *leucozona*, Turn. *glycychroa*, Turn. † *purpurascens*, Hmps. † *albiviata*, Hmps.

Micrapatetis icela, n. sp. (εἴκελος, similar).

♀, 16 mm. Head ochreous. Palpi fuscous, apices ochreous. Antennae fuscous. Thorax dark fuscous with an anterior ochreous spot in tegulae, apices of patagia and a posterior spot whitish-ochreous. Abdomen fuscous. Legs fuscous; posterior pair whitish-ochreous. Forewings triangular, costa moderately arched, apex round-pointed, termen slightly bowed, slightly oblique; whitish-ochreous, markings dark fuscous; a basal costal streak attenuating to a point at $\frac{1}{3}$; a postmedian fascia, its anterior edge convex, wavy, from midcosta to $\frac{3}{5}$ dorsum, its posterior edge concave, wavy, from $\frac{3}{4}$ costa to $\frac{4}{5}$ dorsum; a moderate terminal fascia, angled and shortly produced inwards above middle; cilia dark fuscous. Hindwings with termen slightly sinuate; fuscous; cilia fuscous.

Closely allied to the two preceding species, but certainly distinct. The costal streak is twice as long, the fascia narrower, postmedian, and curved slightly outwards towards dorsum. It appears to be a native of the interior.

Hab.—Queensland: Adavale, in April; one specimen.

8. Gen. Xenopseustis, Meyr.

I have not examined this genus, but it is probably allied to the preceding.

† *poecilastis*, Meyr.

9. Gen. Himerois, Turn.

Frons with slight rounded prominence. Palpi moderate or rather short, upturned; second joint with appressed hairs; terminal joint moderate or rather long. Thorax not crested. Abdomen with a smooth dorsal crest on basal segment. Posterior tibiae smooth. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with 3 and 4 short-stalked, 5 from slightly below middle ($\frac{2}{5}$), 6 and 7 stalked.

thiochroa, Turn.

Himerois periphaea, n. sp. (περιφαιος, dusky-edged).

♂, 14 mm. Head, palpi, thorax, and abdomen yellow. Antennae pale fuscous; ciliations in male minute. Legs ochreous with some fuscous irroration. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen slightly bowed, slightly oblique; yellow; a moderate dark-fuscous terminal fascia, broadest in middle, its edge irregularly denticulate; cilia dark fuscous. Hindwings with termen slightly sinuate; fuscous; cilia fuscous.

Hab.—Northern Territory: Port Darwin, in October; two specimens, received from Mr. F. P. Dodd.

10. Gen. Cophanta, Wlk.

Frons not projecting. Palpi moderate, upturned, appressed to frons; second joint much thickened, with appressed hairs; terminal joint moderate. Thorax with a posterior crest. Abdomen with dorsal crests, those on third and fourth segments large. Posterior tibiae smooth. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with 3 and 4 connate or short-stalked, 5 from slightly below middle ($\frac{2}{5}$), 6 and 7 stalked.

funestalis, Wlk.

11. Gen. Narangodes, Hmps.

Frons with rounded prominence. Palpi rather short, upturned; second joint rough-scaled anteriorly; terminal

joint very short. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with 3 and 4 connate or stalked, 5 from slightly below middle ($\frac{2}{5}$), 6 and 7 stalked.
nigridiscata, Swin.

12. Gen. Enispa, Wlk.

Frons not projecting. Palpi moderate or rather short, porrect or obliquely ascending, slender; terminal joint minute. Thorax and abdomen not crested. Posterior tibiae smooth or slightly hairy. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with 5 from much below middle ($\frac{1}{4}$), 8 anastomosing with cell near base or to $\frac{1}{4}$.
prolecta, Turn. *plutonis*, Luc. *niveiceps*, Turn. *violacea*, Luc. This differs from the Ceylon species *oblatoria*, Wlk., in the semilunar discal mark on forewings and absence of pale dentate lines.

13. Gen. Catoblemma, Hmps.

Frons not projecting, but with a small anterior tuft of scales. Palpi long, obliquely porrect; second joint thickened with appressed scales and with a subapical tuft of hairs on upper surface. Thorax and abdomen without crests. Posterior tibiae with long hairs on dorsum. Forewings without areole, 8, 9, 10 stalked. Hindwings with 5 from much below middle ($\frac{1}{5}$).
Allied to *Eublemma*, but with different palpi.
aplecta, Turn. *dubia*, Butl. *digona*, Hmps.

Catoblemma adiaphora, n. sp. (ἀδιαφορος, indifferent).

♀, 12 mm. Head white. Palpi in female 3; pale fuscous. Antennae whitish. Thorax whitish-grey; tegulae white. Abdomen whitish-grey. Legs whitish. Forewings triangular, costa straight, apex acute, slightly produced, termen bowed, oblique; whitish-grey; antemedian line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, outwardly curved, blackish, forming the inner edge of a large quadrangular blackish blotch, which extends to mid-dorsum and to above middle of disc; an incomplete blackish discal ring above middle; postmedian line from $\frac{2}{3}$ costa, at first outwardly oblique, then transverse in disc, bent inwards beneath cell, then downwards to $\frac{3}{4}$ dorsum, very slender and pale grey, but blackish towards costa; a slight fuscous subapical costal suffusion; cilia whitish-grey. Hindwings with termen rounded; whitish-grey; cilia whitish-grey.
Hab.—Northern Territory: Port Darwin, in November; one specimen, received from Mr. F. P. Dodd.

Catoblemma anaemacta, n. sp. (ἀναιμακτος, bloodless, pale).

♀, 18-24 mm. Head, thorax, and abdomen whitish. Palpi 3; whitish. Antennae whitish. Legs whitish; anterior pair with some pale-fuscous irroration. Forewings triangular, costa nearly straight, but slightly sinuate towards base and before apex, apex tolerably acute, termen bowed, moderately oblique; whitish, with sometimes a few fuscous scales near costa; lines very pale grey; antemedian very faint or obsolete, from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, angled outwards on fold, inwards on vein 1; discal spot obsolete; postmedian faint, double, or only the outer line developed, from $\frac{2}{3}$ costa obliquely outwards, curved outwards in disc, slightly angled inwards on fold, ending on $\frac{3}{4}$ dorsum; a subterminal line of fuscous dots ending in a short subapical oblique streak more or less developed; cilia whitish. Hindwings with termen rounded; whitish; cilia whitish.

Hab.—Northern Territory: Port Darwin, in December. Victoria: Murtoa, in February. Two specimens. This is a widely distributed species, which may not be uncommon when its habits are known.

Catoblemma acrosticha, n. sp.
(ἀκροστιχος, with apical streak).

♂, 18 mm. Head whitish. Palpi in male 2; pale fuscous. Antennae whitish; in male serrate, ciliations minute ($\frac{1}{5}$). Thorax whitish; tegulae ochreous-whitish. Abdomen and legs ochreous-whitish. Forewings triangular, costa straight, apex pointed, not produced, termen bowed, oblique; ochreous-whitish, towards costa whitish irrorated with fuscous; lines and discal spot obsolete; a short, oblique, blackish, subapical costal streak, giving rise to a short subterminal line of a few minute blackish dots; cilia ochreous-whitish. Hindwings rounded; ochreous-whitish; cilia ochreous-whitish.

This might be taken for one of the *dubia* group, but differs in the extremely short male antennal ciliations.

Hab.—Queensland: Gayndah; one specimen, received from Dr. Hamilton Kenny.

Catoblemma porphyris, n. sp. (πορφυρις, purple).

♂, ♀, 17-23 mm. Head and thorax rosy-purple mixed with whitish. Palpi long, male 3, female 4; rosy-purple. Antennae whitish-ochreous; ciliations in male $1\frac{1}{2}$. Abdomen whitish. Legs whitish mixed with rosy-purple; posterior pair wholly whitish. Forewings elongate-triangular, costa straight, apex acute, slightly produced, termen bowed, moderatedly oblique; rosy-purple; a darker postmedian discal spot scarcely indicated; a fine, short, inwardly-oblique, blackish streak from costa just before apex, sometimes giving rise to a line of fuscous dots parallel to termen; cilia whitish-ochreous tinged except at tornus with rosy-purple, apices whitish. Hindwings with termen rounded; ochreous-brown, paler towards base; cilia as forewings. Allied to *Catoblemma dubia*.

Hab.—Northern Territory: Port Darwin; five specimens, received from Mr. G. F. Hill, with the note, "Larvae predaceous on large *Lecanium* on *Acacia*."

14. Gen. Eublemma, Hb.

Frons not projecting, without anterior tuft. Palpi moderate, upturned, more or less appressed to frons; second joint thickened with scales, rough anteriorly; terminal joint short or moderate. Thorax and abdomen without crests. Posterior tibiae smooth or hairy on dorsum. Forewings without areole, 8, 9, 10 stalked. Hindwings with 3 and 4 connate or stalked, 5 from well below middle ($\frac{1}{3}$ to $\frac{1}{4}$), 8 anastomosing with cell near base or to $\frac{1}{4}$.

A large genus with some variation in structure.

pectorora, Luc. *flavipars*, Hmps. *Hab.*—Northern Queensland: Cairns, Townsville. *dimidialis*, Fab. † *brunnea*, Hmps. *paurograpta*, Butl. † *pulvinariae*, Olliff. *glaucochroa*, Turn.: Proc. Linn. Soc. N.S. Wales, 1902, p. 116. *silicula*, Swin. *anachoresis*, Wlgrn. *cochylioides*, Gn. *roseana*, Moore. *parva*, Hb. *rivula*, Moore. *leucodesma*, Low. *loxostropha*, Turn. *rufipuncta*, Turn. *sphragidota*, Turn. *curvata*, Luc. *abrupta*, Wlk. *versicolor*, Wlk. *loxotoma*, Turn. *ragusana*, Freyer. *rubra*, Hmps. *vestalis*, Butl. *innocens*, Butl. *extorris*, Warr: Seitz Macrolep. d. Erde. *Hab.*—Northern Territory: Port Darwin.

Eublemma iophaënna, n. sp. (*ιοφαεννος*, violet-shining).

♂, 15 mm. Head and palpi ochreous. Antennae fuscous; ciliations in male long ($2\frac{1}{2}$). Thorax fuscous. Abdomen and legs pale ochreous. Forewings triangular, costa nearly straight, apex round-pointed, termen bowed, slightly oblique; fuscous mixed with whitish scales showing violet reflections in oblique light; an indistinct slender pale sub-basal line; a similar line, more distinct, at $\frac{1}{4}$; antemedian pale slender slightly outwardly curved from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; two blackish discal dots at and before middle; a pale median fascia, becoming whitish towards costa; postmedian line similarly whitish towards costa, defined anteriorly by a slender fuscous line from costa beyond middle, outwardly oblique, then bent downwards and obscurely denticulate, bent inwards below cell, angled inwards on fold and vein 1, ending on mid-dorsum, towards dorsum preceded by an ochreous shade; a fine pale imperfectly-developed line closely following post-median; subterminal whitish, angled inwards above middle and on fold; a fine whitish submarginal line; cilia ochreous-whitish, suffused with fuscous opposite apex, mid-termen, and tornus. Hindwing with termen rounded; whitish-ochreous, apical half suffused almost wholly with fuscous; cilia whitish-ochreous.

Not near any other species so far as I know.

Hab.—Northern Queensland: Herberton, in February; one specimen, received from Mr. F. P. Dodd.

15. Gen. Pyripnoa, nov. (πυριπνοος, fiery).

Frons not projecting. Palpi moderate, upturned, appressed to frons; second joint rough anteriorly, terminal joint rather long. Thorax with a posterior crest. Abdomen with a rough crest on basal segment. Posterior tibiae smooth with dorsal tufts of hair on middle and at apex. Forewings without areole, 8, 9, 10 stalked. Hindwings with 5 from well below middle ($\frac{1}{4}$), 8 anastomosing with cell near base only.

Near *Ozarba*, differing in the posterior thoracic crest, and the shorter anastomosis of 8 of forewings.

pyraspis, Meyr.; type. *plumbipicta*, Hmps. *camptozona*, Turn.

16. Gen. Euthytoma, nov. (εὐθυτομος, straightly divided).

Frons with rounded prominence. Palpi moderate, upturned; second joint thickened with rough scales; terminal joint moderate. Thorax not crested. Abdomen with a small dorsal crest on basal and sometimes also on second segment. Posterior tibiae smooth with a small median dorsal tuft of hairs. Forewings without areole, 8, 9, 10 stalked. Hindwings with cell over $\frac{1}{2}$; 5 from near lower angle ($\frac{1}{4}$).

Allied to *Eustrotia* and *Ozarba*. The loss of the areole is perhaps due to the separation of 7 from connection with 8, 9; 7 approaches the stalk of these veins rather nearly, in *Ozarba* they are more separate.

opella, Swin.

17. Gen. Ozarba, Wlk.

Frons not projecting. Palpi moderate, upturned, appressed to frons; second joint rough anteriorly; terminal joint long. Thorax not crested. Abdomen with a smooth crest on basal segment. Posterior tibiae smooth, with dorsal tufts of hair on middle and at apex. Forewings without areole, 8, 9, 10 stalked. Hindwings with 5 from below middle ($\frac{1}{3}$), 8 anastomosing with cell to $\frac{1}{3}$.

punctigera, Wlk. *chrysaspis*, Meyr. † *hemiplaca*, Meyr.

18. Gen. Haplopseustis, Meyr.: Trans. Ent. Soc., 1902, p. 34.

Acuissa, Turn.: Trans. Roy. Soc. S. Austr., 1902, p. 180.

Antennae bipectinate to apex in both sexes. Frons not projecting. Tongue present, weakly developed. Palpi moderate, ascending; second joint long, much thickened, with loosely appressed scales; terminal joint very short. Thorax with a large hairy posterior crest. Abdomen not crested. Posterior tibiae nearly smooth. Forewings without areole, 8, 9, 10 stalked. Hindwings with 5 from well above angle ($\frac{1}{3}$), 8 anastomosing with cell at $\frac{1}{4}$.

The presence of a tongue and the basal anastomosis of 8 with the cell in the hindwings definitely place this genus in the Noctuidae, as was done by Mr. Meyrick, although the bipectination of antennae in both sexes gives it a deceptive resemblance to the Liparidae.

erythrias, Meyr.: Trans. Ent. Soc., 1902, p. 34; of this *pyrrhias*, Turn. (Trans. Roy. Soc. S. Austr., 1902, p. 180), is a synonym.

19. Gen. Metasada, Hmps.

Unfortunately I have no example of this genus to examine.

† *polycesta*, Turn.

20. Gen. Carmara, Wlk.

Frons not projecting, but with an anterior tuft of scales. Palpi rather long, obliquely porrect; second joint long, thickened with loosely appressed hairs, expanded at apex, with a small apical tuft on upper surface; terminal joint minute. Thorax and abdomen without crests. Posterior tibiae slightly hairy. Forewings with 10 connate or stalked with 8, 9 from areole. Hindwings with cell very short ($\frac{1}{3}$), 3 and 4 stalked, 5 from well below middle ($\frac{1}{4}$).

subcervina, Wlk.

21. Gen. Cerynea, Wlk.

Frons not projecting. Palpi long, ascending; second joint thickened with rough scales and with a posterior subapical tuft of hairs; terminal joint long. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings normal.

Hindwings with cell $\frac{1}{3}$; 3 and 4 short-stalked, 5 from much below middle ($\frac{1}{4}$).

trogobasis, Hmps.

22. Gen. TROGATHA, Hmps.

Frons with a bluntly-pointed prominence. Palpi rather long, obliquely ascending; second joint long, smooth, with a small apical tuft on upper-surface; terminal joint minute. Thorax and abdomen without crests. Posterior tibiae somewhat hairy. Forewings with 8, 9, 10 stalked from areole. Hindwings with 5 from well below middle ($\frac{1}{4}$).

A development of *Sophta.*

poecilota, Turn.

23. Gen. DIPLOTHECTA, nov. (διπλοθηκτος, twice sharpened).

Frons with a conical projection. Palpi long, porrect; second joint very long, thickened with rough scales above and beneath, greatly expanded towards apex; terminal joint moderate, stout, obtuse, slightly depressed. Antennae of male simple, minutely ciliated, with a longer bristle on each segment. Thorax and abdomen not crested. Forewings with 2 from $\frac{2}{3}$, 3, 4, 5 equidistant from near angle, areole present but small, 7, 8, 9 stalked from areole. Hindwings with 2 from $\frac{3}{4}$, 3, 4, 5 equidistant from near angle, 6, 7, connate, 8 anastomosing with cell from $\frac{1}{4}$ to middle.

Allied to *Sophta*, Wlk., with which it agrees in the conical frons, shape of forewings, and small areole; but differs in the longer, porrect, much-dilated palpi, and in the long anastomosis of vein 8 of hindwings.

DIPLOTHECTA DIGONIA, n. sp. (διγωνιος, twice angled).

♂, 30 mm. Head whitish-ochreous. Palpi grey with a few dark-fuscous scales. Antennae grey. Thorax and abdomen ochreous-grey, with a few dark-fuscous scales. Legs greyish-ochreous. Forewings with costa strongly arched, apex acute, termen strongly angled on vein 4; grey sparsely irrorated with fuscous; two transverse lines whitish, edged with fuscous or brown; first from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, slightly outwardly-curved, wavy; second from $\frac{3}{4}$ costa to $\frac{2}{3}$ dorsum, angled outwards beneath costa, thence nearly straight; a pale-brownish, transverse, median, discal mark containing two fuscous dots; a line of minute white dots from costa near apex to tornus; a submarginal series of fuscous dots; an interrupted terminal fuscous line; cilia purple-fuscous, bases and apices whitish. Hindwings with termen wavy, slightly angled on vein 4; as forewings but without first line.

Hab.—Northern Queensland: Cairns; one specimen. Type in Coll. Lyell.

24. Gen. Sophta, Wlk.

Frons with strong rounded prominence. Palpi rather long, obliquely ascending; second joint long, thickened with appressed scales, expanded at apex; terminal joint minute. Thorax and abdomen without crests. Posterior tibiae slightly hairy. Forewings normal. Hindwings with 5 from well below middle ($\frac{1}{4}$).

concavata, Wlk.

25. Gen. Callipyris, Meyr.

Frons not projecting but with an anterior tuft of scales. Palpi long, obliquely porrect; second joint long, with long hairs on upper-surface forming an apical tuft; terminal joint short. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings with 8, 9, 10 stalked from areole. Hindwings with 5 from slightly below middle ($\frac{2}{5}$).

A development from *Corgatha*, differing in the neuration of the forewings.

drosera, Meyr.

26. Gen. Corgatha, Wlk.

Frons not projecting but with an anterior tuft of scales. Palpi long, obliquely porrect; second joint long, with long hairs on upper-surface forming an apical tuft; terminal joint short. Thorax and abdomen without crests. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with 5 from below middle (usually $\frac{1}{3}$, sometimes $\frac{2}{5}$).

anthina, Turn. *omopis*, Meyr. *loxomita*, Turn. *minuta*, B-Bak. *dichionistis*, Turn. † *daphoena*, Hmps. *figuralis*, Wlk. † *straminea*, Butl.

Corgatha miltophyres, n. sp.

(*μιλτοφυρης*, vermilion-smeared).

♂, 23 mm. Head grey. Palpi $1\frac{1}{4}$; fuscous irrorated with white. Antennae grey; in male simple, ciliations minute. Thorax purple-red; tegulae fuscous-brown; patagia purple, bases fuscous-brown. Abdomen ochreous-whitish, basal half of dorsum purple-red. Legs fuscous, irrorated with white; posterior pair more white, the tarsi annulated with purple-red. Forewings triangular, costa straight but bent before apex, apex acute, slightly produced, termen angled on vein 4, slightly concave above angle, straight below; dorsal quadrant so far as postmedian line deep red with purple iridescence; costa so far as antemedian line grey, mixed with white towards edge; antemedian line from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, nearly straight, but slightly angled outwards above middle, grey; a narrow white transverse discal mark extending to costa; median space before this fuscous-red; postmedian line indistinct towards costa, finely crenulate, incurved below middle, ending on $\frac{3}{4}$ dorsum, preceded by a broadly suffused interrupted ochreous line, which is interrupted in middle by a white spot; a fine whitish crenulate subterminal line defined anteriorly by reddish-brown; terminal area purple-white with terminal and wavy submarginal lines reddish-fuscous; posterior veins ochreous-streaked; cilia yellow, on tornus purple-white. Hindwings with termen straight, apex and tornus rounded; as forewings but whitish towards costa.

Hab.—Queensland: Montville (1,500 ft.), near Nambour, in October; one specimen.

27. Gen. Hyposada, Hmps.

Frons not projecting. Palpi moderate, ascending; second joint rough-scaled, with a minute posterior apical tuft; terminal joint minute. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings normal. Hindwings with cell slightly over $\frac{1}{3}$; 3 and 4 short-stalked, 5 from well below middle ($\frac{1}{3}$).

hydrocampata, Gn.

28. Gen. Hypobleta, Turn.

Frons not projecting. Palpi moderate, slender, ascending; second joint slightly roughened, with a small posterior apical tuft of hairs; terminal joint short. Thorax not crested. Abdomen with a small dorsal crest on basal segment. Posterior tibiae smooth. Forewings normal. Hindwings with cell $\frac{1}{3}$; 3 and 4 short-stalked, 5 from well below middle ($\frac{1}{3}$).

Nearly allied to the preceding genus.

cymaea, Turn.

29. Gen. Oruza, Wlk.

Frons not projecting. Palpi moderate or rather long, upturned; second joint thickened with appressed scales; terminal joint short or moderate. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings normal. Hindwings with cell about $\frac{1}{3}$; 3 and 4 connate or short-stalked, 5 from well below middle ($\frac{1}{4}$ to $\frac{1}{3}$).

semilux, Wlk. *crocodeta*, Turn. *cariosa*, Luc.

30. Gen. Lophoruza, Hmps.

I have no examples of this genus for examination.

† *addescens*, Swin. † *xylonota*, Low.

31. Gen. Eucolastra, Butl.

Frons not projecting. Palpi rather long, upturned, appressed to frons; second joint nearly smooth; terminal joint long. Thorax and abdomen without crests. Posterior tibiae smooth, with a median dorsal tuft of hairs. Forewings normal. Hindwings with cell about $\frac{1}{2}$; 5 from near lower angle ($\frac{1}{5}$).

fasciata, Butl. † *eurynipha*, Turn. † *phaeozona*, Hmps. † *thermozona*, Hmps.

32. Gen. Mimasura, Hmps.

Frons with small rounded prominence. Palpi moderate, ascending; second joint shortly rough-haired; terminal joint short. Thorax and abdomen not crested. Posterior tibiae smooth. Forewings normal, areole rather large. Hindwings with cell $\frac{2}{3}$; 5 from much below middle ($\frac{1}{4}$), 8 anastomosing with cell to $\frac{1}{4}$.

This diagnosis is taken from the Australian species. Hampson describes the terminal joint of palpi as long, and figures it as such in one species, but as short in two species.

albiceris, Turn.

33. Gen. Eustrotia, Hb.

Frons not projecting. Palpi moderate, oblique, or ascending; second joint thickened with appressed scales; terminal joint short or moderate. Thorax not crested. Abdomen with a dorsal crest on basal segment. Posterior tibiae smooth or slightly hairy on dorsum. Forewings normal. Hindwings with cell $\frac{1}{2}$ or more; 5 from near lower angle ($\frac{1}{5}$ or $\frac{1}{4}$).

crystallodes, Meyr.: Trans. Ent. Soc., 1902, p. 42; of this *argotypa*, Turn., is a synonym. *rhaptina*, Turn. *amorpha*, Butl. *ritsemae*, Snel.; of this *thermozona*, Hmps., is a synonym. † *macrosema*, Low. † *euchrysa*, Low.

34. Gen. Maliattha, Wlk.

Frons not projecting. Palpi moderate, upturned; second joint thickened with appressed scales, slightly roughened anteriorly; terminal joint moderate. Thorax with a small posterior crest. Abdomen with dorsal crests on first, third, and fourth segments. Posterior tibiae with median and apical tufts of hair on dorsum. Forewings normal. Hindwings with cell over $\frac{1}{2}$; 3 and 4 stalked, 5 from near lower angle ($\frac{1}{8}$).

I separate this from *Lithacodia*, not only by the stalking of 3 and 4 of hindwings, which by itself might not be sufficient, but also by the much smaller thoracic crest, the longer, more upturned, smoother palpi, with longer terminal joint, and the closer approximation of 5 of hindwings to angle.

ferrugina, Turn. *signifera*, Wlk.

35. Gen. Lithacodia, Hb.

Frons not projecting. Palpi moderate, obliquely ascending; second joint thickened with rough hairs; terminal joint short. Thorax with a large posterior crest. Abdomen with dorsal crest on third segment, and sometimes on first, fourth, and fifth segments. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with cell $\frac{1}{2}$ or more; 5 from below middle ($\frac{1}{6}$ to $\frac{1}{3}$).

bryistis, Turn. *clandestina*, Turn.

36. Gen. Uncula, Swin.

This genus is unknown to me.

† *lunata*, Low.

37. Gen. Habrophyes, nov. (ἁβροφνης, tender).

Frons with slight rounded projection. Palpi rather short, porrect; second joint thickened with rough hairs; terminal joint minute, concealed. Thorax with a rounded posterior crest. Abdomen not crested. Posterior tibiae nearly smooth. Forewings with areole very large. Hindwings with cell about $\frac{3}{5}$, its lower angle projecting; 3 and 4 separate at origin, 5 from middle of cell, 6 and 7 stalked, 8 approximated to cell as far as middle.

The neuration of both wings is peculiar.

xuthosoma, Turn.

38. Gen. Epopsima, nov. (ἐποψιμος, conspicuous).

Frons with rounded projection. Palpi long, upturned, appressed to frons; second joint thickened with appressed scales; terminal joint long. Thorax and abdomen without crests. Posterior tibiae smooth, but with a small median dorsal tuft of hairs. Forewings normal. Hindwings with 5 from well below middle ($\frac{1}{4}$).

fasciolata, Butl.

39. Gen. Tarache, Hb.

Frons with a slight rounded prominence. Palpi short, obliquely porrect; second joint shortly rough-scaled; third joint very short. Thorax with a small rounded posterior crest. Abdomen not crested. Posterior tibiae smooth. Forewings normal. Hindwings with cell over $\frac{1}{2}$; 3 and 4 approximated at origin or stalked; 5 from well below middle ($\frac{1}{4}$ or less); 8 anastomosing with cell to near middle.

nivipicta, Butl. *hieroglyphica*, Low. *clerana*, Low. † *elaeoa*, Hmps. † *neurota*, Low. *crocata*, Gn. *xuthota*, Hmps. *detrita*, Butl. *thapsina*, Turn.

TARACHE EUSCHEMA, n. sp.

(εὐσχημος, with conspicuous pattern).

♀, 20 mm. Head, palpi, and antennae brown. Thorax and abdomen brown with some whitish scales. Legs brown; posterior tibiae and tarsi mostly whitish on internal surface. Forewings triangular, costa nearly straight, apex rounded-rectangular, termen slightly bowed, scarcely oblique; reddish-brown, markings whitish, partly edged with fuscous; an incomplete sub-basal line; a slightly dentate conspicuous line from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum; orbicular small, circular, brown-centred, touching antemedian line; reniform large, 8-shaped, with two included brown dots; a fine, indistinct, dentate line from $\frac{3}{4}$ costa; a subapical whitish-ochreous shade, preceded by fuscous, and followed by a submarginal series of white dots, edged posteriorly with fuscous; cilia reddish-brown, apices fuscous barred with whitish. Hindwings with 3 and 4 approximated at base; termen rounded; fuscous; cilia as forewings.

This is the only Australian species in which 3 and 4 of hindwings are not stalked. Type in Coll. Lyell.

Hab.—Northern Territory: Port Darwin, in November; one specimen, received from Mr. F. P. Dodd.

Subfam. EUTELIANAE.

1.	Thorax with sharp ridgelike anterior crest	1. *Bombotelia*
	Thorax without sharp anterior crest ...	2.
2.	Abdomen with dorsal crest on basal segment	3.
	Abdomen without crests	6.
4.	Abdomen with dorsal crest on anal segment	2. *Pataeta*
	Abdomen without crest on anal segment	5.
5.	Posterior tarsi with long hairs on dorsum of first segment	4. *Anuga*
	Posterior tarsi without long hairs on dorsum	3. *Phlegetonia*
6.	Forewings without areole	5. *Anigraea*
	Forewings with areole	6. *Paectes*

1. Gen. BOMBOTELIA, Hmps.

Frons not projecting, but with an anterior tuft of hairs. Palpi long, ascending; second joint thickened with appressed hairs, slightly roughened anteriorly; terminal joint long. Thorax with a sharp ridge-like anterior crest extending to middle. Abdomen sometimes with a few small dorsal crests, but these may be absent in well-preserved specimens; and with small paired anal tufts. Posterior tibiae hairy. Neuration normal.

jocosatrix, Gn. *plumbea*, Wlk.; of this *oxylopha*, Turn., is a synonym.

2. Gen. Pataeta, Wlk.

Frons not projecting. Palpi long, ascending; second joint roughened anteriorly; terminal joint long. Thorax with a posterior crest. Abdomen with dorsal crests on basal and anal segments; and with paired anal tufts. Posterior tibiae smooth. Neuration normal.

In this genus the female frenulum is sometimes multiple.

carbo, Gn. *conspicienda*, Wlk. In this there is a small lobe-like basal expansion of the dorsum of the forewings in the male.

3. Gen. Phlegetonia, Gn.

Frons not projecting; sometimes with an anterior tuft of scales. Palpi long, ascending; second joint thickened with appressed scales, slightly roughened anteriorly; terminal joint long. Thorax with a small posterior crest. Abdomen with a small dorsal crest on basal segment; and with small paired anal tufts. Posterior tibiae smooth. Neuration normal.

fasciatrix, Semp. *delatrix*, Gn.

4. Gen. Anuga, Gn.

Antennae of male unipectinate to middle; often longer than forewing. Palpi moderate, ascending; second joint much thickened with loosely appressed scales, rough anteriorly, expanded at apex; terminal joint moderately long, triangularly dilated with scales anteriorly. Thorax with a small posterior crest. Abdomen with a dorsal crest on basal segment; and with paired anal tufts. Posterior tibiae and first tarsal joint with long hairs on dorsal surface. Neuration normal.

multiplicans, Wlk. One specimen, received from Mr. L. J. Newman; the locality is not certain, but I believe it came from Northern Queensland.

5. Gen. Anigraea, Wlk.

Frons not projecting, but with an anterior tuft of scales. Palpi rather long, ascending; second joint thickened with appressed scales; terminal joint long. Thorax with a small posterior crest. Abdomen without crests, but with paired anal tufts. Posterior tibiae smooth. Forewings without areole, 7, 8, 9 stalked. Hindwings normal.

According to Hampson a minute areole is sometimes present.

ochrobasis, Hmps.

6. Gen. Paectes, Hb.

Frons not projecting, but with an anterior tuft of scales. Palpi long, ascending; second joint with appressed scales, slightly roughened anteriorly; terminal joint long. Thorax with a rounded anterior crest. Abdomen without crests, but with short paired anal tufts. Posterior tibiae with long hairs on dorsum beyond middle. Neuration normal.

cyanodes, Turn.

Subfam. STICTOPTERINAE.

1.	Palpi with third joint long and slightly dilated before apex	1. *Stictoptera*
	Palpi with third joint normal	2.
2.	Forewings without areole	3. *Gyrtona*
	Forewings with areole	2. *Lophoptera*

1. Gen. Stictoptera, Gn.

Frons not projecting, but with an anterior tuft of scales. Palpi long, ascending; second joint thickened with appressed scales; terminal joint long, slightly dilated before apex. Thorax with rounded anterior crest, and long erectile tufts of hair on inner anterior angle of patagia. Abdomen with dorsal crests on first and third segments. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with 3 anastomosing with cell at $\frac{1}{3}$.

Stictoptera pammeces, n. sp. (παμμηκης, very long).

♂, 48 mm. Head fuscous; face fuscous mixed with whitish. Palpi $2\frac{1}{2}$; fuscous mixed with whitish. Antennae fuscous; ciliations in male $\frac{1}{2}$. Thorax brown-whitish; part of tegulae, patagial crests, and a pair of posterior spots fuscous. Abdomen brown-whitish. Legs ochreous-whitish mixed with fuscous; middle tibiae and tarsi very long and blackish externally. Forewings narrow, elongate, dilated posteriorly, costa straight for $\frac{3}{4}$, then arched, apex round-pointed, termen bowed, oblique, crenulate; brown-whitish; a tuft of raised scales in lower angle of cell; apical half of costal area narrowly fuscous with blackish streaks on veins; a broad tornal fuscous area reaching from $\frac{1}{3}$ dorsum to above middle of termen, its edge suffused; contained in this are the ends of a double postmedian line ending in $\frac{4}{5}$ dorsum, and a large circular whitish tornal spot; a blackish terminal line in fuscous area; cilia fuscous with narrow whitish bars, wholly whitish on upper part of termen. Hindwings with termen rounded, wavy; scaleless and translucent except veins and a broad terminal band, which are dark fuscous; cilia whitish, bases fuscous on apex.

Hab.—Northern Queensland: Cairns district; one specimen, received from Mr. F. P. Dodd.

2. Gen. Lophoptera, Gn.

Frons not projecting, but with an anterior tuft of scales. Palpi moderate, obliquely ascending; second joint thickened with appressed scales, slightly rough anteriorly; terminal joint short. Thorax with a small posterior crest. Abdomen without crests. Posterior tibiae with postmedian and apical tufts of hair on dorsum. Forewings normal. Hindwings with 8 anastomosing with cell at $\frac{1}{3}$.

squammigera, Gn. *abbreviata*, Wlk. *Hab.*—Queensland: Brisbane. *aleuca*, Hmps. *illucida*, Wlk. *Hab.*—Northern Queensland: Townsville. *plumbeola*, Hmps. *Hab.*—Northern Territory: Port Darwin; in Coll. Lyell.

Gen. Gyrtona, Wlk.

Frons not projecting. Palpi moderately long, obliquely ascending; second joint with appressed scales; terminal joint moderate. Thorax with a posterior crest. Abdomen sometimes with small crests on median segments. Posterior tibiae smooth with a small apical dorsal hair tuft. Forewings without areole, 7, 8, 9 stalked. Hindwings normal.

There is no areole in the only two specimens I have for examination.

lophota, Turn. *semicarbonalis*, Wlk. *Hab.*—Northern Queensland: Cairns. *divitalis*, Wlk. *Hab.*—Northern Queensland: Cairns; in Coll. Lyell.

Subfam. SARROTHRIPINAE.

In this and in the Acontianae I have followed Hampson rather closely.

1. Forewings without areole, 7, 8 9 stalked	2.	
Forewings with areole, or 7 disconnected and 8, 9, 10 stalked	4.	
2. Forewings with 7, 8, 9, 10 stalked	3.	
Forewings with 10 separate	11.	*Elesma*
3. Hindwings with 3 and 4 coincident	1.	*Microthripa*
Hindwings with 3 and 4 stalked	2.	*Nanaguna*
4. Forewings with 10 connate or stalked from areole	5.	
Forewings with 10 arising separately from aerole or 7 disconnected	6.	

5.	Hindwings with 3 and 4 coincident	3. *Garella*
	Hindwings with 3 and 4 stalked	4. *Gyrtothripa*
6.	Hindwings with 3 and 4 coincident ...	5. *Characoma*
	Hindwings with 3 and 4 stalked	7.
	Hindwings with 3 and 4 not stalked ...	11.
7.	Abdomen with 3 or more dorsal crests ...	8.
	Abdomen with one or two dorsal crests only	10.
8.	Abdomen with large crests on 4th and 5th segments	6. *Lophothripa*
	Abdomen with crests on 3 basal segments only	9.
9.	Palpi with second joint broadly expanded at apex	7. *Mniothripa*
	Palpi with second joint not expanded at apex	12. *Barasa*
10.	Palpi with 3rd joint as long or longer than 2nd and fringed with hair on upper-surface	8. *Sarrothripus*
	Palpi with 3rd joint shorter than 2nd, smooth	10. *Giaura*
11.	Abdomen with one or more dorsal crests	12.
	Abdomen without crests	20.
12.	Palpi porrect, 2nd joint with an apical inferior tuft	9. *Selepa*
	Palpi not so formed	13.
13.	Palpi with terminal joint nearly as long or longer than 2nd	14.
	Palpi with terminal joint not exceeding ⅔ 2nd	16.
14.	Palpi with long hairs on upper-surface of 2nd joint towards apex	14. *Ochthophora*
	Palpi with 2nd joint smooth on upper surface	15.
15.	Thorax with a large rough erect posterior crest	13. *Ochrothripa*
	Thorax with a small smooth posterior crest	18. *Labanda*
16.	Palpi with terminal joint about ½ or ⅔ ...	17.
	Palpi with terminal joint not exceeding ¼	19.
17.	Palpi porrect, terminal joint hairy beneath	17. *Plotheia*
	Palpi ascending, terminal joint smooth ...	18.
18.	Palpi with terminal joint dilated at apex	16. *Gadirtha*
	Palpi with terminal joint not dilated at apex	19. *Blenina*
19.	Palpi with 2nd joint strongly expanded with rough hairs above and beneath ...	21. *Timorodes*
	Palpi with 2nd joint only moderately thickened	22. *Risoba*
20.	Palpi with terminal joint as long as 2nd	15. *Eligma*
	Palpi with terminal joint not exceeding ⅓	20. *Calathusa*

1. Gen. Microthripa, Hmps.

Frons not projecting. Palpi moderate, ascending, rather slender; second joint smooth, with a small posterior apical tuft; terminal joint moderate. Thorax not crested. Abdomen with a dorsal crest on basal segment. Posterior tibiae smooth. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with 3 and 4 coincident, 8 anastomosing with cell to $\frac{1}{2}$.

boeota, Turn.

2. Gen. Nanaguna, Wlk.

Frons not projecting. Palpi long, ascending; second joint smooth, or slightly rough anteriorly; terminal joint long, sometimes as long as second. Thorax with a small posterior crest. Abdomen with a dorsal crest on basal segment. Posterior tibiae smooth, with a small apical dorsal tuft. Forewings without areole, 7, 8, 9, 10 stalked. Hindwings with 3 and 4 stalked, 8 anastomosing with cell to about middle.

breviuscula, Wlk. *albisecta*, Hmps. *Hab.*—Northern Queensland: Cairns. *clopaea*, Turn. *variegata*, Hmps. *Hab.*—Northern Queensland: Cairns, Townsville.

Nanaguna praedulcis, n. sp. (*praedulcis*, very sweet).

♀, 27-29 mm. Head and thorax grey tinged with green. Palpi over 2, ascending, terminal joint stout, nearly as long as second; grey irrorated with white. Antennae grey. Abdomen pale grey, towards base whitish, crest greenish-grey. Legs ochreous-whitish; anterior and middle pairs fuscous on upper-surface. Forewings suboblong, costa strongly arched at base, thence gently; apex rectangular, termen scarcely bowed, slightly oblique; whitish, margins suffused with grey-green and centre with pale pink; antemedian faint and indistinct, grey-green, from $\frac{1}{3}$ costa, incurved below cell, then outwardly oblique to mid-dorsum; postmedian double, fuscous, filled in with whitish, obsolete towards costa, denticulate to below cell, then incurved, outcurved on vein 1, joining antemedian on dorsum, a fuscous subdorsal spot on outer line; subterminal whitish, indistinct; a fuscous terminal spot on vein 3; another subterminal between 1 and 2; cilia whitish. Hindwings with termen rounded; whitish, towards termen suffused with pale fuscous; cilia whitish.

Hab.—Northern Queensland: Kuranda, near Cairns, in September; two specimens, received from Mr. F. P. Dodd.

3. Gen. Garella, Wlk.

Frons not projecting. Palpi rather long, ascending; second joint moderately thickened with appressed scales; terminal joint rather long. Thorax with a posterior crest. Abdomen with small dorsal crests on two basal segments. Posterior tibiae smooth, with a small apical dorsal tuft. Forewings with minute areole, 7, 8, 9 stalked from areole, 10 connate. Hindwings with 4 absent, 3 and 5 stalked, 8 anastomosing with cell to about middle.

rotundipennis, Wlk.

4. Gen. Gyrtothripa, Hmps.

Frons not projecting, but with long anterior tuft. Palpi long, porrect; second joint greatly thickened with appressed scales, especially on upper-surface; terminal joint short. Thorax not crested. Abdomen with flattened dorsal crest on basal segment. Posterior tibiae smooth on dorsum, hairy on ventral surface (at least in male). Forewings with minute areole, 7, 8, 9, 10 stalked from areole. Hindwings with 3 and 4 stalked, 8 anastomosing with cell not quite to middle.

pusilla, Moore.

5. Gen. Characoma, Wlk.

Frons not projecting. Palpi long, ascending; second joint smooth, rather slender; terminal joint long ($\frac{2}{3}$). Thorax with a posterior crest. Abdomen with small dorsal crests on one or two basal segments. Posterior tibiae smooth, with a small dorsal apical tuft. Forewings with areole very long and narrow. Hindwings with 4 absent, 3 and 5 stalked, 8 anastomosing with cell to about $\frac{1}{3}$.

vallata, Meyr.

6. Gen. Lophothripa, Hmps.

Frons not projecting, but with a large anterior tuft. Palpi long, ascending; second joint thickened with appressed scales, expanded at apex; terminal joint long. Thorax with a large posterior crest. Abdomen with a series of dorsal crests, those on fourth and fifth segments large. Posterior tibiae smooth. Forewings normal. Hindwings with 3 and 4 stalked, 8 anastomosing with cell at $\frac{1}{4}$.

vitea, Swin.

4. Gen. Mniothripa, Hmps.

Frons not projecting. Palpi moderate, ascending; second joint greatly thickened with appressed scales so as to be nearly as broad as long; terminal joint moderate. Thorax with a posterior crest. Abdomen with dorsal crests on three basal segments. Posterior tibiae smooth, with a dorsal apical tuft. Forewings normal. Hindwings with 3 and 4 stalked, 5 connate, 8 anastomosing with cell to $\frac{2}{5}$.

lichenigera, Hmps. *Hab.* — Northern Queensland: Cairns.

8. Gen. Sarrothripus, Curt.

Frons not projecting, but with a large anterior tuft. Palpi long, porrect or obliquely ascending; second joint rather short, expanded at apex; terminal joint longer than second, loosely scaled, with a ridge of hairs on upper (posterior) surface from base nearly to apex. Thorax with a posterior crest. Abdomen with a dorsal crest on basal segment, rarely also on second segment. Posterior tibiae smooth. Forewings with areole long and narrow; or without areole and with 8, 9, 10 stalked owing to the non-development of the bar between 7 and 8. Hindwings with 3 and 4 stalked, 5 connate, anastomosing with cell to near middle.

The abnormal neuration of the forewings I find in *parvella*, *symmicta*, *crystallites*, *boeopis*, and *abstrusa;* not in the other species.

parvella, Wlk. *Hab.*—Northern Queensland: Cairns. *symmicta*, Turn. *indica*, Feld. †*strigivenata*, Hmps. *minuta*, Turn. *exophila*, Meyr. *crystallites*, Meyr. *boeopis*, Turn. *abstrusa*, Turn.

9. Gen. Selepa, Moore.

Frons not projecting, but with an anterior tuft of scales. Palpi very long, porrect; second joint very long, with long hairs on lower surface forming an apical tuft; terminal joint moderately long, under $\frac{1}{2}$. Antennae with basal joint thickened, and with a small anterior apical tuft. Thorax with a small posterior crest. Abdomen with dorsal crests on basal two or three segments. Posterior tibiae smooth. Forewings normal. Hindwings with 8 anastomosing with cell at $\frac{1}{4}$.

Best characterized by the palpi and basal joint of antennae.

celtis, Moore. *rhythmopis*, Turn. *geraea*, Hmps. *discigera*, Wlk.

Selepa euryochra, n. sp. (εὐρυωχρος, broadly pale).

♂, 21 mm. Head and thorax brown-whitish. Palpi $2\frac{1}{2}$; brown-fuscous, beneath whitish. Antennae brown-fuscous. Abdomen whitish. Legs ochreous-whitish; anterior tibiae and tarsi fuscous anteriorly. Forewings suboblong, costa straight but arched at base and apex, apex rounded, termen bowed, slightly oblique; brown-whitish; a broad fuscous costal streak not reaching apex; a broader fuscous and blackish dorsal streak reaching beyond tornus to below middle of termen; cilia pale grey. Hindwings with termen rounded; whitish, slightly suffused with grey on apex and termen; cilia whitish.

Hab.—Northern Queensland: Kuranda, near Cairns, in December; one specimen, received from Mr. F. P. Dodd.

10. Gen. Giaura, Wlk.

Frons not projecting. Palpi long, ascending, appressed to frons; second joint smooth; terminal joint long ($\frac{2}{3}$). Thorax not crested. Abdomen with a dorsal crest on basal segment. Posterior tibiae smooth. Forewings with areole long. Hindwings with 3 and 4 stalked, 8 anastomosing with cell near base.

punctata, Luc.

11. Gen. Elesma, Wlk.

Frons not projecting, but with an anterior tuft of scales. Palpi rather short, ascending; second joint smooth, anterior edge slightly rough; terminal joint short. Thorax with a posterior crest. Abdomen with a small dorsal crest on basal segment. Posterior tibiae smooth. Forewings without areole, 7, 8, 9 stalked. Hindwings with cell very long ($\frac{2}{3}$), discocellulars angled, 3 and 4 stalked, 8 anastomosing with cell to about middle.

subglauca, Wlk.

12. Gen. Barasa, Wlk.

Frons not projecting. Palpi long, ascending, appressed to frons; second joint smooth-scaled; terminal joint long (about $\frac{2}{3}$). Thorax with a small posterior crest. Abdomen with dorsal crests on first three segments. Posterior tibiae slightly hairy on dorsum. Forewings normal. Hindwings with 3 and 4 stalked, 8 anastomosing with cell to about middle.

cymatistis, Meyr.

Barasa melanograpta, n. sp.

(μελανογραπτος, inscribed with black).

♂, 22 mm. Head white. Palpi about 1; fuscous, beneath white. Antennae grey, at base white; ciliations in male 1. Thorax white; tegulae blackish except at base and apex. Abdomen grey, beneath white. Legs white; anterior femora dark fuscous in front, anterior tibiae and tarsi fuscous on inner side. Forewings moderate, somewhat dilated posteriorly, costa nearly straight, apex rectangular, termen strongly oblique; white; extreme bases of costa and dorsum blackish; two blackish subcostal spots placed obliquely representing sub-basal line; antemedian blackish from $\frac{1}{3}$ costa, at first transverse, then outwardly oblique, broadly interrupted below cell; postmedian blackish, from $\frac{2}{3}$ costa, wavy, inwardly oblique to $\frac{2}{3}$ dorsum, connected by a broad blackish bar with antemedian above fold; some grey suffusion between the lines; a blackish subterminal line from apex, thickened in middle part, not reaching tornus; a terminal series of blackish dots; cilia whitish, on apex blackish. Hindwings with termen rounded; white, cilia white.

Hab.—Northern Territory: Port Darwin, in August; one specimen, received from Mr. G. F. Hill.

BARASA ORTHOSTICHA, n. sp. (ὀρθοστιχος, straight-lined).

♀, 28 mm. Head whitish with some brownish scales on face. Palpi whitish, irrorated and palely suffused with brownish. Thorax whitish irrorated with pale grey. Abdomen whitish-grey. Legs whitish-grey; anterior pair darker. Forewings sub-oblong, costa strongly arched near base, thence nearly straight, apex rounded-rectangular, termen slightly bowed, not oblique; whitish irrorated with pale grey; markings fuscous; a line from base of costa along fold for a short distance, then bent obliquely to rejoin costa at $\frac{1}{5}$; a fine wavy transverse median line, curved inwards beneath cell, angled outwards on fold, and inwards on vein 1; a brownish subcostal discal dot; a second similar line not far from first, curved outwards beneath cell, angled inwards on fold, outwards on vein 1; a thick line nearly straight from costa to dorsum at $\frac{5}{6}$; some terminal dots; cilia whitish, indistinctly barred with pale grey. Hindwings with termen rounded; white; a narrow fuscous terminal suffusion not extending to tornus; cilia white, bases pale grey, on tornus and dorsum wholly white.

Hab.—Northern Queensland: Claudie River, in February; one specimen, taken by Mr. J. A. Kershaw. Type in National Museum, Melbourne.

13. Gen. OCHROTHRIPA, Hmps.

Frons not projecting, but with an anterior tuft of scales. Palpi long, ascending; second joint reaching vertex, rather slender, nearly smooth; terminal joint as long as second, smooth, slightly dilated towards apex. Thorax with a large rough erect posterior crest. Abdomen with small dorsal crests on three basal segments. Posterior tibiae nearly smooth. Forewings normal. Hindwings with 8 anastomosing with cell at $\frac{1}{4}$.

leptochroma, Turn.

14. Gen. OCHTHOPHORA, Turn.

Frons not projecting, but with an anterior tuft of scales. Palpi very long, obliquely porrect; second joint fringed with hairs on upper edge towards apex; terminal joint much longer than second, smooth, slightly dilated towards apex. Thorax with a large erect posterior crest. Abdomen with a dorsal crest on basal segment. Posterior tibiae slightly hairy on dorsum. Forewings normal. Hindwings with 4 and 5 stalked, 8 anastomosing with cell nearly to middle.

sericina, Turn.

15. Gen. ELIGMA, Hb.

Frons not projecting. Palpi very long, ascending; second joint reaching or exceeding vertex, smooth; terminal joint as long or longer than second, smooth, dilated towards apex. Thorax and abdomen smooth and without crests. Posterior tibiae slightly hairy. Forewings with areole long and narrow. Hindwings with 8 anastomosing with cell to $\frac{3}{4}$.

Hampson describes the tongue as small and aborted, but it seems fairly developed in the Australian species.

orthoxantha, Low.

16. Gen. GADIRTHA, Wlk.

Frons not projecting. Palpi very long, ascending; second joint with short loose hairs; terminal joint about $\frac{1}{2}$, smooth, dilated at apex. Thorax with a slight posterior crest. Abdomen with a dorsal series of hairy crests. Posterior tibiae hairy. Forewings normal. Hindwings with 8 anastomosing with cell to $\frac{1}{3}$ or to middle.

pulchra, Butl. *inexacta*, Wlk. † *hades*, Low.

17. Gen. PLOTHEIA, Wlk.

Frons not projecting, but with an anterior tuft of hair. Palpi very long, porrect; second joint with long hairs above and beneath; terminal joint $\frac{1}{2}$, hairy beneath. Thorax not crested. Abdomen with a series of small dorsal crests. Posterior tibiae smooth. Forewings normal. Hindwings with 8 anastomosing with cell to middle.

Allied to *Gadirtha*, but with porrect palpi, the third joint hairy beneath and not dilated at apex.

elongata, Hmps. *Hab.*—Queensland: Brisbane, Mount Tambourine; five specimens. An extraordinarily variable species, no two specimens being alike, which will, I think, prove identical with *Gadirtha elongata*, Hmps., represented by a single female from Assam; if so *poliochroa*, Hmps., is a synonym.

18. Gen. LABANDA, Wlk.

Frons not projecting. Palpi very long, ascending; second joint smooth, slender, reaching or exceeding vertex; terminal joint nearly as long as second. Thorax with a small posterior crest. Abdomen with dorsal crests on two basal segments. Posterior tibiae smooth. Forewings normal. Hindwings with 3 and 4 separate, 8 anastomosing with cell at $\frac{1}{4}$.

This seems best distinguished from *Blenina* by the much longer and more slender palpi. The neurational character in the hindwing may not be constant.

amabilis, Low.

19. Gen. Blenina, Wlk.

Frons not projecting. Palpi moderate or long, ascending; second joint moderately thickened with appressed scales, not reaching vertex; terminal joint moderate, not exceeding $\frac{2}{3}$. Thorax with a small posterior crest. Abdomen with dorsal crests on basal two or three segments. Posterior tibiae smooth. Forewings normal. Hindwings with 3 and 4 connate, 8 anastomosing with cell at $\frac{1}{4}$.

lichenopa, Meyr. *metachrysa*, Turn. *Hab.*—Northern Queensland: Townsville, Rockhampton, Brisbane.

Blenina samphirophora, n. sp.

(σαμφειροφορος, bearing sapphires).

♂, 23 mm. Head and thorax fuscous, mixed with ochreous-grey-whitish, Palpi pale fuscous with two broad whitish bars towards base. Antennae fuscous. Abdomen ochreous-grey-whitish. Palpi pale fuscous with two broad middle tibiae and tarsi barred with dark fuscous on uppersurface. Forewings triangular, costa rather strongly arched, apex rounded, termen scarcely bowed, wavy, scarcely oblique; whitish densely irrorated with dark fuscous and to a lesser degree with pale ochreous; antemedian blackish, from $\frac{1}{4}$ costa, outwardly oblique, below middle lost in an ill-defined blackish large dorsal spot; postmedian similar, from beyond midcosta obliquely outwards, curved in disc on vein 4, angled inwards on fold, ending on $\frac{4}{5}$ dorsum; a small whitish suffused spot on $\frac{4}{5}$ costa, two black subterminal spots, which in oblique light are a brilliant blue, between veins 4 and 5 and veins 6 and 7; upper spot connected with costa by a blackish line edged posteriorly with ochreous-whitish; a fine short whitish-ochreous streak midway between spots, and a second beneath them; cilia fuscous, bases barred with whitish, on apex and tornus whitish. Hindwings with termen rounded; pale grey; some grey-whitish terminal spots towards apex; cilia as forewings but whitish from midtermen to tornus and on dorsum.

Hab.—Northern Territory: Port Darwin, in October; one specimen, received from Mr. F. P. Dodd.

20. Gen. Calathusa, Wlk.

Frons not projecting. Palpi very long, ascending; second joint rather slender, slightly rough, sometimes with a small posterior apical tuft; terminal joint short or rather long ($\frac{1}{3}$).

Thorax with small posterior and sometimes anterior crests. Abdomen without crests. Posterior tibiae slightly hairy on dorsum. Forewings normal. Hindwings with 8 anastomosing with cell at $\frac{1}{4}$.

basicunea, Wlk.; of this *abebaea*, Turn., *subflavida*, Hmps., and *arethusa*, Fawcett, are synonyms. † *hypotherma*, Low. *ischnodes*, Turn. *octogesima*, Turn. *stenophylla*, Turn. *dispila*, Turn. *mesospila*, Turn. *metableta*, Turn. *eremna*, Turn. *taphreuta*, Meyr.: Trans. Ent. Soc., 1902, p. 215; of this *delosticha*, Turn., is a synonym.

21. Gen. Timorodes, Meyr.: Trans. Ent. Soc., 1902, p. 46.
Gryposoba, Hmps.: Cat. Lep. Phal., xi., p. 423 (1912).

Frons not projecting, but with an anterior tuft of scales. Palpi moderate, obliquely ascending; second joint strongly expanded with rough hairs above and beneath, terminal joint short. Thorax with large erect posterior crest. Abdomen with dorsal crests on second and third segments. Posterior tibiae smooth. Forewings with a scale tooth on tornus; areole long and narrow. Hindwings with 8 anastomosing with cell to $\frac{1}{4}$.

blepharias, Meyr.: Trans. Ent. Soc., 1902, p. 46; of this *catagrapha*, Turn., is a synonym.

22. Gen. Risoba, Moore.

Frons not projecting. Palpi moderate, ascending; second joint rather slender, slightly rough anteriorly; terminal joint short. Thorax with a large erect posterior crest. Posterior tibiae nearly smooth. Forewings with areole long. Hindwings with 8 anastomosing with cell near base only.

According to Hampson the abdomen has minute dorsal crests on median segments. These are not present in my solitary example, but they may have been denuded.

grisea, B-Bak. *Hab.*—Northern Queensland: Cairns.

Subfam. ACONTIANAE.

1.	Forewing without areole	2.
	Forewing with areole	5.
2.	Forewing with 7, 8, 9 stalked	3.
	Forewing with 7, 8, 9 not stalked	4.
3.	Hindwing with 4 absent	1. *Earias*
	Hindwing with 3 and 4 stalked	2. *Alypophanes*
4.	Forewing with 8, 9, 10 stalked	3. *Nertobriga*
	Forewing with 7, 8, and 9, 10 stalked ...	15. *Acontia*
5.	Forewing with 10 stalked with 8, 9 from areole	4. *Beara*
	Forewing with 10 separate or connate with 8, 9	6.

6. Hindwing with 5 from near lower angle of cell	7.	
Hindwing with 5 from well above angle ($\frac{1}{3}$)	14.	
7. Abdomen with two or more dorsal crests	8.	
Abdomen with crest on basal segment only	5.	*Orthocraspis*
8. Posterior tibiae hairy	6.	*Aiteta*
Posterior tibiae smooth	9.	
9. Thorax with a ridgelike posterior crest ...	7.	*Acachmena*
Thorax without such crest	10.	*Lasiolopha*
10. Palpi with 2nd joint triangularly dilated	8.	*Ariola*
Palpi with 2nd joint not so	11.	
11. Palpi with 2nd joint rough-scaled	12.	
Palpi with 2nd joint smooth	14.	
12. Hindwings with 8 anastomosing to $\frac{1}{3}$ or middle	9.	*Westermannia*
Hindwings with 8 anastomosing near base only	13.	
13. Palpi with terminal joint $\frac{2}{3}$ or 1	11.	*Paracrama*
Palpi with terminal joint not exceeding $\frac{1}{3}$	12.	*Maceda*
14. Palpi with terminal joint much longer than 2nd	13.	*Cacyparis*
Palpi with terminal joint much shorter than 2nd	14.	*Armactica*

1. Gen. Earias, Hb.

Frons not projecting, but with an anterior tuft of scales. Palpi moderate or long, rather slender, obliquely ascending; second joint slightly roughened, sometimes with a slight apical anterior tuft; terminal joint moderate or long ($\frac{1}{4}$ to 1). Thorax not crested. Abdomen with small dorsal crests on first and second segments. Posterior tibiae smooth. Forewings with subcostal retinaculum in male obsolete; no areole, 7, 8, 9 stalked. Hindwings with 4 absent, 3 and 5 stalked, 8 anastomosing with cell as far as or beyond middle.

Unusually variable in the length of the terminal joint of the palpi, but the genus is a very natural one.

luteolaria, Hmps. *flavida*, Feld. *huegeli*, Rogen. *parallela*, Luc. † *subviridis*, Luc. *fabia*, Stoll. *smaragdina*, Butl. *ochrophylla*, Turn.

2. Gen. Alypophanes, Turn.: Trans. Roy. Soc. S. Austr., 1903, p. 62.

Frons smooth, not projecting. Palpi moderate, slender, ascending; second joint smooth; terminal joint moderate. Thorax and abdomen without crests. Posterior tibiae smooth. Forewings with subcostal retinaculum in male extremely slender; no areole; 7, 8, 9 stalked. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 anastomosing with cell near base only.

iridocosma, Turn.: *l.c.*, p. 63.

3. Gen. Nertobriga, Wlk.

Frons smooth, not projecting. Palpi moderate, rather slender, ascending; second joint slightly roughened; terminal joint moderate. Thorax without crests. Abdomen with large dorsal crests on four basal segments. Posterior tibiae slightly hairy. Forewings without areole, 8, 9, 10 stalked. Hindwings with 8 anastomosing with cell at $\frac{1}{4}$.

signata, Wlk.

4. Gen. Beara, Wlk.

Frons not projecting, but with short anterior tuft. Palpi moderate, ascending; second joint moderately thickened, nearly smooth; terminal joint moderate. Thorax with an anterior crest. Abdomen with small dorsal crest on basal segment. Posterior tibiae smooth. Forewings with areole narrow, 8, 9, 10 stalked from areole. Hindwings normal.

nubiferella, Wlk. *Hab.*—Northern Queensland: Cairns.

5. Gen. Orthocraspis, Hmps.

Frons smooth, not projecting. Palpi rather short, ascending; second joint rather slender, slightly roughened; terminal joint very short. Thorax not crested. Abdomen with a small dorsal crest on basal segment. Posterior tibiae smooth. Forewings normal. Hindwings with cell long ($\frac{3}{5}$), 3 and 4 short-stalked, 8 anastomosing with cell at $\frac{1}{3}$.

Orthocraspis leptoplasta, n. sp.

(λεπτοπλαστος, lightly built).

♂, 30 mm. Head, palpi, and thorax ochreous-whitish-grey. Antennae grey; in male simple. Abdomen grey, beneath pale-ochreous. Legs ochreous-whitish; anterior and middle tibiae and tarsi partly suffused with fuscous. Forewings triangular, costa strongly arched, apex acute, termen straight, not oblique, angled above tornus; ochreous-whitish-grey; two squarish reddish-fuscous costal spots, at $\frac{1}{3}$ and shortly before $\frac{2}{3}$; costal edge ochreous throughout; termen above angle edged with reddish-ochreous; cilia reddish-ochreous with a purple basal line, beneath angle ochreous-whitish-grey. Hindwings with termen angled on vein 3; grey; an extensive costal and apical suffused ochreous blotch; cilia ochreous, on tornus and dorsum grey-whitish.

Hab.—New South Wales: Sydney, in September; one specimen, received from Mr. G. F. Wyld.

6. Gen. Aiteta, Wlk.

Frons not projecting, sometimes with slight anterior tuft. Palpi moderate, ascending; second joint moderately thickened, slightly roughened; terminal joint short. Thorax with a rounded anterior crest. Abdomen with flattened dorsal crests on first and second segments. Posterior tibiae hairy. Forewings with 10 approximated or connate with 8, 9 from areole (rarely short-stalked), 6 usually from areole. Hindwings with 3 and 4 connate or stalked, 6 and 7 sometimes short-stalked, 8 anastomosing with cell at $\frac{1}{4}$ or $\frac{1}{3}$.

In this genus I include *Carea*, Wlk., and *Careades*, B-Bak.; though there is some range of variation, it seems impossible to draw lines of distinction, and the whole forms a natural group.

elaina, Swin. *plagioscia*, Turn. *unipunctata*, B-Bak.

Aiteta plinthophora, n. sp.

(πλινθοφορος, marked with brick-red).

♂, 40 mm. Head and thorax ochreous-grey. Palpi fuscous. Antennae fuscous; simple. Abdomen pale grey, towards apex suffused with whitish, tuft ochreous-whitish. Legs reddish-brown; tarsi fuscous. Forewings suboblong, costa arched at base, thence doubly sinuate, apex acute, termen strongly bowed, slightly oblique; pale grey; a tuft of long scales on base of dorsum; an oblique line from $\frac{2}{5}$ costa to tornus, beyond which disc is suffused with pale ochreous, and contains some fuscous irroration; cilia fuscous. Hindwings with termen rounded towards apex, strongly sinuate towards tornus; pale red; dorsal area pale fuscous; cilia white, on dorsum reddish and very long.

♀, 42 mm. Forewings with costa scarcely sinuate, apex not acute; reddish-ochreous-grey finely irrorated with dark fuscous; two dark-fuscous discal dots before middle placed longitudinally; a subterminal row of dark-fuscous dots, nearly straight, from shortly before apex to tornus; cilia towards tornus white. Hindwings as in male, but termen not so strongly sinuate, dorsum without long reddish cilia.

Allied to *plagioscia*, Turn.

Hab.—Northern Queensland: Kuranda, near Cairns, in April and May; two specimens, received from Mr. F. P. Dodd.

7. Gen. Acachmena, Turn.

Frons not projecting. Palpi short, obliquely porrect; second joint triangular, thickened with rough scales, forming a large anterior tuft; terminal joint short. Thorax with a rough ridge-like posterior crest. Abdomen with dorsal crests on first and second segments. Posterior tibiae smooth. Forewings normal. Hindwings with 8 anastomosing with cell to $\frac{1}{3}$.

oenocrossa, Turn.

8. Gen. ARIOLA, Wlk.

Frons smooth, not projecting. Palpi rather short, obliquely porrect; second joint triangularly dilated, much expanded at apex, with rough scales above and beneath; terminal joint short. Thorax with a small smooth posterior crest. Abdomen with flattened crests on first and second segments. Posterior tibiae smooth. Forewings normal. Hindwings with 3 and 4 stalked, 8 anastomosing with cell to middle.

coelisigna, Wlk.

9. Gen. WESTERMANNIA, Hb.

Frons smooth, not projecting. Palpi moderate or rather long, ascending; second joint nearly smooth; terminal joint moderate or rather long. Thorax with a small posterior crest. Abdomen with small flattened crests on first and second segments. Posterior tibiae smooth. Forewings normal. Hindwings with 8 anastomosing with cell to $\frac{1}{3}$ or to middle.

argentata, Butl. *concha*, Butl. *gloriosa*, Hmps. *Hab.*—Northern Queensland: Kuranda, near Cairns, in January; two specimens, bred from larvae on the "Guada" or "snake" bean.

10. Gen. LASIOLOPHA, nov. (λασιολοφος, with hairy crests).

Frons not projecting, but with a slight anterior tuft of scales. Palpi long, ascending; second joint thickened with rough scales anteriorly towards apex; terminal joint as long as second. Thorax not crested. Abdomen with small rough dorsal crests on three basal segments. Posterior tibiae smooth. Forewings with areole small and narrow; male retinaculum very large, double, not bar-shaped. Hindwings normal.

Differs from *Paracrama* in the second joint of palpi being dilated with rough scales towards apex, the small anterior frontal tuft, and the hairy abdominal crests; the male retinaculum is highly peculiar.

saturata, Wlk.

11. Gen. PARACRAMA, Moore.

Frons smooth, not projecting. Palpi long, ascending; second joint scarcely thickened, nearly smooth; terminal joint as long as second. Thorax without crests. Abdomen with flattened dorsal crests on first and second segments. Posterior tibiae smooth. Forewings with areole long and narrow. Hindwings with 3 and 4 connate or short-stalked, 8 anastomosing with cell near base.

With this I include *Maurilia*, Möschl., as there seems to be no structural distinction.

dulcissima, Wlk. *iconica*, Wlk. *iocephala*, Turn.

12. Gen. Maceda, Wlk.

Frons smooth, not projecting. Palpi moderate, ascending; second joint smooth; terminal joint short. Thorax with a small smooth posterior crest. Abdomen with small flattened dorsal crests on first and second segments. Posterior tibiae smooth. Forewings with areole broad. Hindwings with 3 and 4 stalked, 8 anastomosing with cell near base.

mansueta, Wlk.

13. Gen. Cacyparis, Wlk.

Frons smooth, not projecting. Palpi very long, slender, ascending; second joint scarcely thickened, smooth; terminal joint about twice as long as second, very slender, but dilated into a club at apex. Thorax and abdomen not crested. Posterior tibiae smooth. Forewings with a rounded boss of scales on dorsum; neuration normal. Hindwings with 5 from well above lower angle of cell ($\frac{1}{3}$).

melanolitha, Turn.

14. Gen. Armactica, Wlk.

Frons not projecting. Palpi moderate or rather long, ascending; second joint but slightly thickened, nearly smooth; terminal joint moderate. Thorax and abdomen without crests. Posterior tibiae hairy on dorsum. Forewings normal. Hindwings with 5 from well above angle ($\frac{1}{3}$), 8 anastomosing with cell to $\frac{1}{3}$.

columbina, Wlk. *endoleuca*, Hmps. *conchidia*, Butl.

15. Gen. Acontia, Ochs.

Frons not projecting, but with anterior tuft of scales. Palpi moderate or long, ascending; second joint slightly roughened; terminal joint short, rather long. Thorax not crested. Abdomen with flattened dorsal crest on basal segment. Posterior tibiae hairy. Forewings without areole, 7 and 8 stalked, 9 and 10 stalked. Hindwings with 5 from well above angle ($\frac{1}{3}$), 8 anastomosing with cell near base.

emboloscia, Turn. *tranversa*, Gn. *amata*, Wlk. *congenita*, Hmps. *malvae*, Esp. *Hab.*—Queensland: Cairns, Charters Towers, Eidsvold, Brisbane, Rosewood.

Additions to the Flora of South Australia. No. 17.

By J. M. Black.

[Read July 8, 1920.]

Plates IX. and X.

Where a district is mentioned, it means a new record for one of the botanical districts of Tate's Flora of Extra-tropical South Australia.

The asterisk indicates an alien plant.

Pinaceae.

Callitris cupressiformis, Vent. var. *tasmanica*, Benth. Slape Gully, near Adelaide (H. Griffith); Cape Borda, K.I. (J. W. Mellor); River Onkaparinga, near Clarendon (J. M. B.); Middle River, K.I. (E. Ashby).

This variety was raised to specific rank as *C. tasmanica* by Baker and Smith (Pines of Aust. 233), principally on the ground that *C. cupressiformis* has erect branches, and *C. tasmanica* spreading, horizontal branches. This statement is borne out by the photographs which accompany Messrs Baker and Smith's fine work, but my experience in the field has been that the direction of the branches of *Callitris* (notably of *C. robusta* and *C. propinqua)* vary greatly in individual trees. The specimen from Slape Gully is described as "a rounded shrub resembling the Native Cherry *(Exocarpus cupressiformis)*, 3-4 m. high." Mr. Ashby tells me that the specimens grown on his land at Blackwood, from seeds obtained some years ago at Middle River, have erect branches. It therefore appears to me safer to retain the varietal name. At the same time I follow Messrs. Baker and Smith in uniting Bentham's two varieties *tasmanica* and *mucronata*. The Slape Gully and Cape Borda specimens have been already recorded under the latter name in these Trans., xxxv., 61 (1911). Our specimens have the wrinkled valves of var. *tasmanica* and the prominent spurs of var. *mucronata*.

C. Drummondii, (Parlat.) Benth. et Hook. Also grown by Mr. Ashby from seeds obtained at Middle River, K.I. Hitherto this species has only been recorded in South Australia from Arno Bay, E.P. The branchlets are light green and very slightly furrowed, while those of *C. cupressiformis* var. *tasmanica* are dark green and deeply furrowed.

GRAMINEAE.

Stipa horrifolia, n. sp. (Tab. ix.) Gramen dense caespitosum 30-80 cm. altum, caulibus erectis, foliorum laminis rigidis involuto-cylindricis erectis patenti-hirsutis vel hispidis apice subpungentibus, ligulâ brevi ciliolatâ, vaginâ supremâ elongatâ sensim inflatâ basin paniculae amplexante, paniculâ 15-30 cm. longâ laxâ denique contractâ, ramorum fasciculis circiter 9 semiverticillatis distantibus, ramis plerisque divisis, pedicellis capillaribus puberulis 5-12 mm. longis, glumis vacuis scariosis purpurascentibus apice 1-3-dentatis, inferiore 8-10 mm. longâ, 3-nerviâ, superiore paulo breviore 5-nerviâ, glumâ floriferâ villosâ 3-4 mm. longâ apice integrâ duplo longiore quam callus, paleâ glumam aequante dorso pubescente, aristâ 4-7 cm. longâ articulatâ sed tantum post spiculam humatam secedente sub geniculo tortâ villosâ supra puberulâ sub lente.

Nullabor Plain (per Dr. R. S. Rogers); Peterborough; Enfield; Pinnaroo; Moonta (J. M. B.).

This plant was placed by me tentatively under *S. arachnopus*, Pilger, in these Trans., xliii., 25 (1919). Since then three specimens have been sent to the Royal Botanic Gardens, Kew, and Dr. O. Stapf reports that, although he has not seen a specimen of Pilger's plant, he considers that they do not belong to that species. He adds:—"The specimens submitted appear to differ in the following points: the leaves are coarser, the panicle has more numerous internodes, many spikelets and long pedicels, the glumes are longer and the awn is more hairy and much longer. I should not hesitate to describe them as a new species. We have nothing in our herbarium to match them."

As a result of this opinion from so distinguished an authority on the grasses as Dr. Stapf, the new species has been here described and figured. The localities given show that *S. horrifolia* is widely distributed throughout the State, in fact almost from its western to eastern boundary.

Panicum decompositum, R. Br. Dr. Stapf considers that *P. Whitei*, described and figured by me in these Trans., xli., 632, pl. 39 (1917), must be included in *P. decompositum*. As his memorandum is of interest to botanists in other States besides ours I quote from it as follows:—"When revising our fairly ample material of *P. decompositum*, R. Br., I came across a specimen collected by Andrews in the 'vicinity of Lake Eyre' consisting of two small pieces very like your specimen, though still smaller, and a piece with a large young panicle and leaves, exactly of the broad-leaved form of *P. decompositum*. The agreement is so great that I have no doubt of their identity. I should say the specimen which you sent us as *P. Whitei* is just a meagre condition of *P. decompositum*. The latter is a rather polymorphic species, but whether the forms which may be distinguished within it represent stable races or indicate merely a wide amplitude of fluctuation or a considerable degree of plasticity I do not venture to say. R. Brown's original matches very well with McGillivray's specimen from Port Curtis and comes very near the form described by Domin as var. *acuminatissimum*, which latter has, however, slightly larger spikelets and somewhat coarser panicle-branches. Brown's type has blades up to 4 mm. wide; most of the remainder of our material have broader leaves and fatter stems. Your specimen and the smaller piece of Andrews' collection have shorter, narrower, and less rigid leaves, but the big piece of Andrews has the blade up to 9 mm. wide. As to Domin's var. *utile*, I doubt whether it can be distinguished from the typical form with broader leaves. We have not been able to confirm the characters he indicates. His var. *scaberrimum* and Bailey's var. *tenuior* may stand as such for the present. Typical *P. decompositum* seems to range all over Australia. The specimens enumerated in the Flora Australiensis under *P. decompositum* also include some referable to *P. paludosum*, Roxb. This is how I name them as far as I have seen them:—

"*P. paludosum*, Roxb.—Victoria River, *F. Mueller* (certain specimens only); King Creek, *Bowman;* Archer Lagoon, *Leukhart (Leichhardt?).*

"*P. decompositum*, R. Br. *typicum*.—Gulf of Carpentaria, *R. Brown;* Port Curtis, *McGillivray;* Macleay River, *Beckler;* Lake Eyre, *Andrews;* W. Australia, *Drummond* 43; Murchison River, *Oldfield*.

"*P. decompositum* var. *acuminatissimum*, Dom. — Victoria River, *Mueller*.

"*P. decompositum* var. *scaberrimum*, Dom.—Cygnet Bay, *Cunningham*."

To Dr. Stapf's remarks I would only add that many of our northern specimens have the lower panicle-branches solitary and alternate, and only some of the upper ones clustered.

**Eragrostis major*, Host. Pinnaroo (per H. W. Andrew). Said to have appeared in the district in 1915, and to be relished by cattle.

Chenopodiaceae.

Arthrocnemum halocnemoides, Nees. Salt swamps near Dry Creek (J. M. B.); Swan River, W.A. (D. A. Herbert).

Var. *pergranulatum*, J. M. Black. Foot of Sellick Hill (H. W. Andrew); Dry Creek (J. M. B.).

A. leiostachyum (Benth.), Paulsen. Dry Creek.

Chenopodium microphyllum, F. v. M. Marree (Dist. C; Prof. Osborn).

CRUCIFERAE.

Stenopetalum sphaerocarpum, F. v. M. Monarto South (Dist. M; E. H. Ising).

S. lineare, R. Br. var. *canescens*, Benth. Monarto South (E. H. Ising); Everard Ranges (S. A. White); Mundowdna (J. M. B.).

Lepidium rotundum, DC. Domin, in Fedde, Repert. xi., 198 (1913), distinguishes *L. eremaeum*, n. sp., from *L. rotundum* by its elongated racemes, narrow petals, winged seeds, and notch of the pod almost closed by the connivent lobes. It is to be observed, however, that in specimens of *L. rotundum* with an open notch the seeds are also conspicuously winged, and the racemes vary greatly in length. The degree to which the lobes of the pod approach or diverge from each other is also variable, especially in var. *phlebopetalum*, Maid. et. Betche (*L. phlebopetalum*, F. v. M.). The Tate Herbarium contains a specimen labelled "*L. rotundum*, 79 Gully," which agrees with Domin's description of the plant "collected by R. Tate, Horn Valley, Central Australia, 1894." In the same herbarium is a specimen labelled "*L. rotundum*—R. Helms, Camp 53." Here the inner margins of the lobes are parallel and close together, resembling the plant from Horn Valley, but the racemes are only 2-3 cm. long. It therefore seems unlikely that *L. eremaeum* (erroneously printed "*eraemeum*" in the Repertorium) is more than a variety, at most, of *L. rotundum*.

**Lepidium campestre*, (L.) R. Br. "Field Cress." Experimental plots at Penola (E. S. Alcock). Europe and Western Asia. Recorded as a weed in Victoria.

**Camelina foetida*, Fries. Experimental plots, Penola (E. S. Alcock). Europe. Usually distributed as an adulterant of flax seed.

LEGUMINOSAE.

Acacia rhetinocarpa, n. sp. (Tab. x.) Frutex erectus resinosus 50-120 cm. altus, ramulis cylindricis minute et evanide puberulis, phyllodiis parvis (2-4 mm. longis 1½-2 mm. latis) oblique obovatis vel oblongis crassis rigidis viscido-nitentibus mucrone deflexo glanduloso terminatis obscure uninerviis, pedunculis solitariis monocephalis paulo longioribus vel duplo longioribus quam phyllodia, capitulis circiter

12-floris, floribus saepius pentameris, calyce usque ad medium lobato ciliato dimidio breviore quam corolla, petalis liberis, bracteolâ cucullatâ, ovario papilloso, legumine lineari stipitato glabro viscido-nitente curvo vel subtorto 4-6 cm. longo 2-2½ mm. lato, seminibus longitudinalibus ovato-oblongis, arillo majusculo cymbiformi, funiculo brevi sub arillo abrupte reflexo.

Scrub near Monarto South (E. H. Ising); flowering August, 1919; fruiting December. Mr. Ising writes:—"I only saw 24 plants and they were all growing within a short distance of one another, in the shelter of three species of mallee (*Eucalyptus gracilis*, *E. incrassata*, and another). The soil was a loose reddish sand, which extended in considerable areas over a flat or undulating country."

This species is, in its oblique-nerved and oblique-pointed phyllodes, allied to *A. obliqua*, *acinacea*, *Merrallii*, and *glandulicarpa*. It has much smaller phyllodes than any of those species except *A. glandulicarpa*, F. M. Reader, and it differs from the last-named in the phyllodes even smaller, with the nerve and glandular point curved outwards or downwards, whereas *glandulicarpa* has the nerve and point incurved towards the axis of the branchlet. In the pod the two species differ entirely, *A. glandulicarpa* having a broader pod, not curved, and covered with rather long glandular hairs, while *A. rhetinocarpa* has a slender, curved, resinous-glossy pod. In the funicle sharply bent backwards under the aril, it resembles *A. rigens*, *Bynoeana*, and *Menzelii*.

A. Merrallii, F. v. M. Minnipa (Manager of Government Farm, per Prof. Osborn). A Western Australian species previously found at Charra, near Fowler Bay, and labelled by Prof. Tate in his herbarium "*A. obliqua*" and "*A. Meissneri*," an error which was first corrected by Mr. J. H. Maiden (these Trans., xxxii., 278). The Minnipa specimens show that the original description must be slightly amplified, as the young phyllodes are silky-pubescent and the pubescence sometimes persists on the mature phyllode, while the peduncles are in many cases twin.

Linaceae.

**Linum strictum*, L. This plant, already recorded for Maitland, Y.P., is also common near Moonta.

Zygophyllaceae.

Zygophyllum fruticulosum, DC. A weed in the wheat-fields at the Point Pearce Mission Station, Y.P., and locally known as "Hop-bush."

Euphorbiaceae.

**Euphorbia terracina*, L. Moonta.

Rhamnaceae.

Pomaderris obcordata, Fenzl. Monarto South (Dist. M; E. H. Ising). Dwarf shrub growing in sandy soil about 50 cm. high.

Malvaceae.

Plagianthus microphyllus, F. v. M. Point Pearce Mission Station, Y.P. (Dist. Y).

Frankeniaceae.

Frankenia foliosa, J. M. Black. Mr. H. B. Williamson has sent me a specimen from Sea Lake, N.W. Victoria, collected by the Rev. W. W. Watts. It has leaves more closely revolute on the margins, and therefore not so broad as in specimens from our northern districts.

Myrtaceae.

Eucalyptus Morrisii, R. T. Baker. On the label of some further specimens from Mount Patawurta, near Moolooloo, Mr. E. H. Ising describes this plant as a shrub 2 m. high.

Melaleuca cylindrica, R. Br. Bentham (Fl. Aust. iii., 146) describes *M. armillaris*, Sm., and after quoting localities in New South Wales and Victoria, has the following:—

"S. Australia. Kangaroo Island, *R. Brown*. Var. (?) *tenuifolia*. Leaves semiterete, very narrow, under ½ in. long. Flowers smaller.—*M. cylindrica*, R. Br. Herb.—Dunk River, *R. Brown*, perhaps a distinct species."

Guided apparently by this statement, Tate (Fl. extratrop. S.A., 93 and 231) records *M. cylindrica* for Kangaroo Island, but there is no corresponding specimen in the Tate Herbarium. Prof. Ewart kindly lent me one of Brown's original specimens from the British Museum labelled "*Melaleuca cylindrica*, R. Br. (*M. armillaris*, Sm. var. (?) *tenuifolia*, Benth.) No. 4702. Duck River." "Dunk River" is, therefore, apparently a mistake of transcription. There is no "Duck" or "Dunk River" on Kangaroo Island, or, as far as the officials of the Land Office are aware, anywhere in South Australia. Mr. J. H. Maiden believes the locality intended to be Duck River, near Paramatta, where *M. armillaris* is common. *M. cylindrica* should therefore, as far as our present knowledge goes, be deleted from the flora of this State. It may be added that an examination of the type of *M.*

cylindrica shows that the leaves are not "semiterete" but cylindrical, very slender ($\frac{1}{2}$ mm. diam.), sprinkled with immersed glands, 5-10 mm. long, on petioles of about 1 mm.

Epacridaceae.

Leucopogon rufus, Lindl. Monarto South. (Dist. M; E. H. Ising).

Scrophulariaceae.

Veronica distans, R. Br. Monarto South. (Dist. M; E. H. Ising).

Morgania glabra, R. Br. var. *floribunda*, Maid. et Betche. (*M. floribunda*, Benth.) Floodbed of Cooper Creek (Prof. Osborn). Locally known as "Blue top."

Mimulus repens, R. Br. Lake Kilalpaninna. (Dist. C; Prof. Osborn.) Leaves usually rather smaller and peduncles rather longer than in the southern form. It was found in saline soil, growing beside *Heliotropium curassavicum*.

Plantaginaceae.

Plantago varia, R. Br. Monarto South (E. H. Ising). Dwarf specimens; scape only 7-15 mm. long; flowers 2-6 in the head.

Cucurbitaceae.

Melothria micrantha, F. v. M. Near Kopperamanna. (Dist. C; Prof. Osborn.) "Common in floodbed of Cooper Creek." The names which this plant has received are:—

Cucurbita micrantha, F. v. M., in Trans. Phil. Soc. Vict. i., 17 (1855).

Cucumis (?) *Muelleri*, Naud., in Ann. sci. nat. 4me sér. xi., 84 (1859).

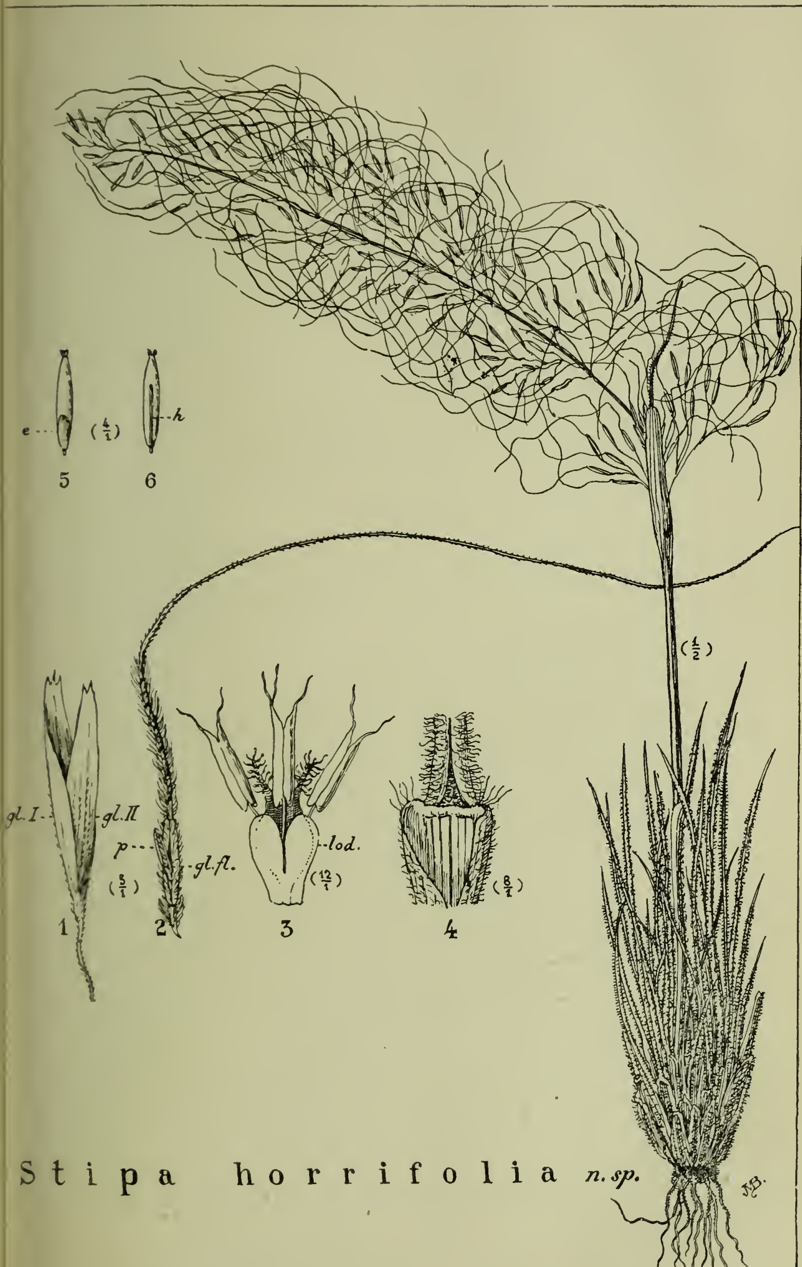
Zehneria micrantha, F. v. M., Fragm. i., 182 (1859).

Mukia micrantha, F. v. M., Fragm. ii., 180 (1861).

Melothria Muelleri, Benth., Fl. Aust. iii., 320 (1866).

Melothria micrantha, F. v. M., ex Cogn. in DC. Monogr. Phan. iii., 603 (1881).

The reason given by Naudin for changing the specific name was that *micrantha* became inapplicable in the genus *Cucumis*, but art. 50 of the Vienna rules expressly states that a name is not to be changed "because it is badly chosen," or because "another is preferable." There appears therefore to be no doubt that Cogniaux was right in re-establishing Mueller's specific name. *Zehneria micrantha*, Hook. f. in Oliver, Fl. trop. Afric. ii., 560 (1871), is inadmissible owing



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Acacia rhetinocarpa n.sp.

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to Mueller's prior use of the name, and has been replaced by *Melothria minutiflora*, Cogn. in DC. Monogr. Phan. iii., 611 (1881).

COMPOSITAE.

Olearia picridifolia, Benth. Monarto South (E. H. Ising).

Chthonocephalus pseudoevax, Steetz. Monarto South. (Dist. M; E. H. Ising).

Senecio odoratus, Hornem. Kilalpaninna, Cooper Creek. (Dist. C; Prof. Osborn.)

DESCRIPTION OF PLATES.

PLATE IX.

Stipa horrifolia, n. sp. 1, outer glumes. 2, flowering glume, palea, and awn. 3, lodicules, pistil, and stamens. 4, summit of leaf-sheath and base of blade. 5, anterior face of grain, showing the embryo *(e)*. 6, posterior face of grain, showing the linear hilum *(h)*.

PLATE X.

Acacia rhetinocarpa, n. sp. 1, flower. 2, bracteole. 3, pistil. 4, phyllodes. 5, fruiting branchlet. 6, seed.

Revisional Notes on the Family Cistelidae (Order Coleoptera).

By H. J. Carter, B.A., F.E.S.

[Read August 12, 1920.]

Cistelidae [1].—Through the courtesy of Professor Poulton, who has personally taken the Hope types to the British Museum, it is now possible to clear up some of the mysteries connected with species unidentified in Australian collections referred to in my Revision,[2] and I gladly quote the result of Mr. Blair's examination of these:—

"Hybrenia (allecula) pimelioides, Hope (N. Holl.). Type male agrees with a single broken specimen in the British Museum from Port Darwin. It is without doubt *Hybrenia princeps*, Blackb. (type female), and is, I think, different from the Queensland species that I had as *pimelioides*. The punctures of both thorax and elytra are finer and more sparsely placed, those of the striae are not connected by any impressed line, the hind tibiae of male are straight, not incurved at apex, and the impression on the last abdominal segment extends nearly ($\frac{3}{4}$ of the way) to the base, and has two blunt tubercles at its limits. This last character sharply separates it from *H. elongata*, Macl., and the lack of impressed striae on the elytra separates it from *H. sublaevis*, Macl. (*id.*, H. J. C.), of which, however, I have no male.

"A. omophiloides, Hope (type female, N. Holl.), is correctly determined as *Metistete singularis*, Haag.

"*A. melancholica*, Hope (type female, N. Holl.) = M. gibbicollis, Newm.

"*A. foveicollis*, Hope (type female, N. Holl.) = H. cisteloides, Newm. (type male).

"A. canescens, Hope (type, Port Essington), is not the species usually so identified, but is nearer *H. maculata*, Haag.

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(1) By the kind permission of the Editor, the following note is added since reading of paper:—"In the catalogue of Junk, Herr Borchmann followed Seidlitz in substituting the name Alleculidae [used in this paper when read] for Cistelidae on the ground that *Cistela* was used by Geoffroy (1764) in another family, and therefore *Cistela* F. (1773) was preoccupied. Geoffroy's names, however, are not accepted, hence *Cistela* F. stands as a valid generic name, with type *sulphurea*, Latr. (1810), and the family name is therefore correctly Cistelidae."

(2) Proc. Roy. Soc. Vict., 1915, p. 82.

I send a specimen that agrees with it for your examination." [=*H. maculata*, Haag., which thus disappears as a synonym; while *H. canescens*, Blackb. (*nec* Hope), also my Revision, p. 80, requires a name, and is described below as *H. scutellaris*.—H. J. C.]

"A. Gouldii, Hope (type, W. Australia), agrees with a specimen unnamed in British Museum from Champion Bay (Duboulay). I send this for your examination." [This is a species of which I have lately seen several in the South Australian Museum from the Perth district, and which I consider congeneric with *Dimorphochilus diversicollis*, Borch., and is redescribed below.—H. J. C.]

"A. nigricans, Hope (type female, Port Essington), agrees with specimen (male) unnamed in British Museum from N.W. Australia. This I send for examination." [Redescribed below.—H. J. C.]

"Allecula rufa, Sol. This is a Chilian insect, from Coquimbo." [Borchmann, in the Junk Catalogue, erroneously ascribed this to Australia; hence Homotrysis rufa, Blackb., is a valid name, and my proposed substitute, *H. rubra*, is superfluous.—H. J. C.]

Homotrysis arida, Blackb. = *H. sitiens*, Blackb. Mr. Blair writes, "I see no real point of distinction between Blackburn's species '*arida*' and '*sitiens*.' "

[N.B.—Names in italics are synonyms.]

Synatractus variabilis, Macl. Mr. Lea has lately pointed out to me that this species has tarsal claws entire, *not* pectinate; a fact which I confirm from examination. Moreover, from British Museum specimens, it seems to belong to the genus *Casnonidea*, Fairm. (Family Lagriidae), of which various species occur from India to New Guinea. The name *Synatractus* thus disappears from the Australian list, and Macleay's species becomes *Casnonidea variabilis*, Macl., unless it should prove to be synonymous with one of Fairmaire's species.

The following are new species, largely from the South Australian Museum or my own collection, examined since the publication of my Revision of the Family:—

Chromomoea gracillima, n. sp.

Elongate, oblong, narrowly tapering behind; whole surface metallic-black, glabrous; base of femora, three basal joints of antennae and palpi testaceous, tibiae also with testaceous band (in one example at least).

Head densely punctate, in male wider than prothorax, in female as wide as the apex of prothorax; eyes widely separated, not very prominent, antennae with joint 3 longer than 4 and cylindric, 4-10 subequal and narrowly triangular, 11 of equal length with 10 but more slender. *Prothorax* slightly longer than wide, very convex laterally, truncate at base, at apex a little produced in middle, in male sides nearly straight, feebly narrowed and rounded in front, hind angles rectangular; in female sides clearly but lightly rounded, gently widening posteriorly, finely, closely but not deeply punctate, a central depressed fovea near base and small triangular basal fovea near angles. *Scutellum* triangular. *Elytra* wider than prothorax at base, convex and elongate, tapering behind, very finely striate-punctate; intervals closely punctate, with feeble pubescence near apex; underside finely punctate, tibiae entire in both sexes. *Dim.*—Male, $5 \times 1\frac{1}{2}$; female, 7×2 (vix) mm.

Hab.—Queensland: Cairns district (F. P. Dodd).

Four examples, of which three are apparently males. The female example is larger, with the thorax more rounded at sides and widened behind; the elytra also show vague indications of paler markings (somewhat as in *C. picta*, Pasc.). The only species with which it could be confused are *C. unicolor*, Bates, var. *lindensis*, Blackb., and *C. affinis*, Blackb.; but besides size and colour differences, the surface of *gracillima* is more glabrous and nitid than either of these, with a much lighter system of punctures, especially on the pronotum, while the form is more cylindric. Types in the South Australian Musuem.

Anaxo dentipes, n. sp.

Elongate, subparallel, nitid dark bronze, labrum, antennae, and basal half of tibiae reddish; head and underside rather thickly clothed with white recumbent hairs.

Head closely punctate, eyes separated by a distance of about the diameter of one eye; antennae moderately stout, the joints thickened at apex, 3 and 4 subequal, 5 to 11 successively shorter, 10 and 11 narrower than preceding. *Prothorax* moderately convex, nearly square, truncate at base and apex, sides nearly straight, the anterior angles rounded off, posterior rectangular; lateral margins not visible from above, basal and apical margins narrowly raised, disc coarsely and unevenly punctate, with one or two smooth spaces on each lobe, medial impression wide and shallow (in one example subobsolete). *Scutellum* round behind, thickly albo-pilose. *Elytra* wider than prothorax at base, sides parallel for the greater part; punctate-striate, the seriate punctures large, round, close, and regular; intervals convex-subcarinate in apical region and almost smooth (a few irregular minute punctures only visible under a lens). *Abdomen* nearly smooth, sternum densely albo-pilose. Front *tibiae* of male armed with a tooth, about one-third of distance from apex. *Dim.*—10-12 × 3½-4 mm.

Hab.—North-western Australia: Wyndham (W. Crawshaw), two males. Western Australia (French Collection in National Museum): one female.

The female specimen is almost certainly the mate of the Wyndham examples, though the pilose clothing is less evident, and the tibiae are unarmed. The red tibiae with darker-coloured tarsi is an unusual feature. Type in author's collection.

ANAXO STRONGYLIOIDES, n. sp.

Oblong, nitid-black, antennae opaque-black.

Head coarsely and closely punctate, arcuate suture well marked; eyes prominent and widely separated, antennae linear, joints 3-5 subequal, 6-8 shorter than preceding, 9-10 shorter than 6-8, 11 longer and finer than 10. *Prothorax* convex, rather strongly produced in middle at apex, wider than long, sides nearly straight, anterior angles obsolete (depressed and rounded), posterior subrectangular, disc coarsely, not closely punctate, with smooth medial line in a depression, terminated behind by a transverse depression. *Scutellum* triangular. *Elytra* wider than prothorax at base, oblong, slightly enlarged behind middle, shoulders rather square, striate-punctate, the seriate punctures very large, round, and regular, the striae nearly as wide as the intervals; the latter apparently impunctate and very slightly convex, with transverse rugosity. *Metasternum* finely punctate, abdomen nearly smooth. Posterior *tarsi* with first joint as long as the rest combined. *Dim.*—8½ × 3 mm.

Hab.—Queeensland: Cairns District (F. P. Dodd).

A unique example, sex doubtful, is unlike any described species, having a coarse system of elytral punctures. In my table[3] the only species which approaches it is *A. sparsus*, Blackb., which is larger, and has red legs, and red base of antennae, besides finer elytral sculpture. In this species even the tarsi are black. It is sometimes difficult to say whether the apparent convexity of elytral intervals is due to their rising above the average surface, or to the striae being so excavated as to give a similar effect. In the above species the intervals appear flat when seen from above, their slight convexity seen from behind is due to the rather deep and wide sculpture of the striae and to the large size of the punctures themselves. Type in South Australian Museum.

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(3) *L.c.*, p. 67.

Hemicistela testacea, n. sp.

Elongate-oblong, whole surface and appendages testaceous and glabrous; eyes black; suture of elytra, apical segments of abdomen (sometimes), pronotum (rarely) fuscous.

Head very finely punctate; eyes widely separated, moderately prominent; antennae long, joints very narrowly triangular, 3-10 subequal, 11 shorter and finer than 10. *Prothorax* depressed; truncate at apex and base, widest at middle, thence arcuately narrowed to apex and obliquely feebly narrowed to base; disc uniformly finely punctate; medial line lightly impressed or wanting; two small transverse foveae at base. *Scutellum* small, semi-circular. *Elytra* wider than prothorax at base and four times as long, parallel, or lightly enlarged behind middle; finely but clearly striate-punctate, punctures in striae round, fine but distinct throughout; intervals quite flat and minutely but clearly punctured. *Underside* smooth and nitid. *Legs* simple, hind tarsi with basal joint as long as the next two. *Dim.*—5-6 × $1\frac{3}{4}$-$2\frac{1}{2}$ mm.

Hab.—Western Australia: Swan River (A. M. Lea).

Fourteen examples show a fragile insect without strongly defined characters. The prothorax is shaped as in *H. discoidalis*, Blackb., and indeed the two species are very similar in structure. The mandibles are clearly simple at apex. *H. testacea* differs from *discoidalis* in colour paler, without the lateral obfuscation of elytra, antennal joints more elongate, elytral intervals quite differently punctured (closely and finely in *testacea*, sparsely "subfortiter" in *discoidalis)*. Types in the South Australian Museum.

As the following two species have never been identified in any Australian collection, and were quite inadequately described in three lines (each) of Latin—in one instance without any dimensions—I append fuller descriptions:—

Dimorphochilus (Allecula) gouldii, Hope.

Elongate, ovate, red or black, glabrous; antennae, tibiae, and tarsi red.

Head produced strongly in front, labrum very prominent; mandibles simple (one-pointed); sparsely and finely punctate; eyes large and prominent, separated (in both sexes) by a space of about half the diameter of one; antennae linear, very slender, joint 3 slightly larger than 4, 4-6 equal, 7-10 shorter and wider than preceding, 11 much narrower than 10. *Prothorax* (about 2 × 3 mm.) truncate at apex and base, hind angles rectangular, sides parallel behind, arcuately narrowed on front half, anterior angles obsolete; disc sparsely, lightly punctate, with small transverse basal foveae, and without medial line. *Elytra* wider than prothorax at base, narrowly oval, or slightly widened behind middle; striate-punctate, the seriate punctures small, only obvious on basal half; the striae deep, intervals convex (especially at sides and apex), lightly punctate; *mesosternum* strongly and sparsely, abdomen finely punctate. *Dim.*—12-13 × 4-4½ mm.

Hab.—Northern Territory: Port Essington (type). Western Australia: Champion Bay (British Museum) and Swan River (J. Clark).

A *Tanychilus*-like insect, of which the red examples (the type is red) are probably immature. It appears to be widespread in Western Australia, and bears a superficial resemblance to the common *Homotrysis rufipes*, F., of Eastern Australia, but has the elytral intervals more convex, and the seriate punctures more hidden in striae, while the head is quite differently shaped, with simple mandibles. It is evidently not *D. sobrinus*, Borch., in which the intervals are quite smooth, and the striae almost vanishing towards the apex; but I consider it most at home under *Dimorphochilus*, a genus on the border line between the two main divisions of the family, but belonging rather to the first than to the second of these Divisions.

Homotrysis (Allecula) nigricans, Hope.

Elongate-ovate, nitid-black, pilose; edge of clypeus, palpi, and tarsi red. Upper-surface sparsely clad with upright reddish hair, under-surface with short recumbent pile.

Head rather strongly and closely punctate, eyes large and prominent, separated by a space equal to half the diameter of one; antennae with joints 3-10 subequal in length, but 6-10 successively wider at apex, 11 narrowly ovate. *Prothorax* a little sinuate (produced in middle) at apex, truncate and widest at base, a little compressed in middle, posterior angles subacute, sides arcuately narrowed in front;. disc coarsely, sparsely punctate, medial line only indicated by an impression at base and a shallow impression near apex; triangular basal foveae well marked. *Elytra* very little wider than prothorax at base, ovate-elliptic; striate-punctate, the seriate punctures well marked, irregular in size; intervals subconvex, coarsely and sparsely punctate and irregularly transversely rugose. *Sternum* coarsely, abdomen very finely punctate. *Legs* very hairy; posterior tarsi with first joint *not* as long as the rest combined. *Dim.*—9 × 2½ mm.

Hab.—Northern Territory: Port Essington and Darwin.

A small, narrow species, nearest to *H. fusca*, Blackb., but the latter has the elytral intervals flat, with a smaller differently-shaped prothorax *inter alia*.

Homotrysis kershawi, n. sp.

Elongate, subnavicular; chocolate-brown, head and pronotum subopaque, elytra and underside nitid; labrum, palpi, basal joints of antennae, and tarsi reddish.

Head and *prothorax* densely (confluently) punctate; the eyes very large and prominent, separated by a distance of about half the diameter of one eye; antennae long and very slender, the joints linear, 3 longer than 4, 5-11 successively shorter. *Prothorax* very convex, about as wide as long, slightly narrowed anteriorly; apex a little sinuate, front angles obtuse, but sharply defined, base truncate, hind angles rectangular, sides nearly straight, on basal half gradually contracting in front; basal foveae scarcely defined, disc without medial line, thinly margined at base and sides, the lateral margin not seen from above. *Elytra* considerably wider than prothorax at base and about three and a half times as long; striate-punctate, the striae wide, seriate punctures less obvious near suture, but large, square, and divided by cancellate ridges on external half; intervals convex, coarsely punctate, with a line of thin pale recumbent hair on each. *Sternum* coarsely, abdomen more finely punctate, each puncture on the latter bearing a short recumbent red hair. *Dim.*—10-11 × $3\frac{1}{2}$-4 mm.

Hab.—Overland Railway, 24 miles west of Kycherny Soak, collected by Mr. Chandler. Western Australia: Eucla.

Four male examples show a species specifically like a common Western Australian insect that I have doubtfully identified as *H. obscura*, Borch., but differing in smaller size, more prominent and closely-set eyes, antennae quite different, elytra pilose, etc. It is evidently not *H. scabrosa*, Champ., whose antennae are "rather stout," joint 3 "shorter than 4," etc. Type in the National Museum, Melbourne.

Homotrysis pallipes, n. sp.

Elongate, subparallel, subopaque-black; labrum, palpi, legs, and tarsi testaceous, knees infuscate. Elytra with short, sparse, reddish hairs, underside with longer recumbent hair.

Head densely punctate; eyes of male separated by a space of half the diameter of an eye, in female more widely separated, antennal joints rather stoutly linear, 3-11 subequal in length, 3-5 slightly widening apically. *Prothorax* truncate at apex, slightly sinuate at base, sides nearly straight on basal half, arcuately narrowed to apex; front angles obsolete, posterior sharply rectangular; surface very densely punctate, the punctures subcontiguous, a shallow basal impression near angles, and a few short reddish hairs near sides. *Scutellum* small and round. *Elytra* as wide as prothorax at base, the rounded humeri causing a slight expansion, sides parallel to half-way, then a little widened behind middle; striate-punctate, the striae deep, the punctures therein close and well marked only near base and sides, intervals flat and very coarsely transversely wrinkled and sparsely pilose. *Underside* distinctly but not coarsely punctate. In the male the front *tibiae* a little bent at apex, the hind tibiae slightly flattened and widened. *Dim.*—9-10½ × 3½-4 mm.

Hab.—Queensland: Port Denison (F. Taylor); Townsville (Ejnar Fischer, in the Melbourne Museum), Kuranda, and Cairns (A. M. Lea).

Eight specimens examined, of which three, including both sexes, were sent me some time ago by Mr. Taylor. The species is distinguished by the combination of subopaque black surface, dark antennae, pale legs with darker knees, and strongly cross-wrinkled elytral intervals. In the male specimen the 1st, 3rd, 5th, and 7th elytral intervals are clearly narrower than the rest. Types in the author's collection.

HOMOTRYSIS DODDI, n. sp.

♂. Elongate-oblong, chocolate-brown; palpi, apical antennal joints, and tarsi paler. Upper-surface (especially at sides) clothed with short, recumbent pile.

Head and pronotum finely, densely (confluently) punctate; labrum prominent and pilose, eyes large, moderately prominent, separated by a space less than the diameter of one, this space rapidly widening behind; antennal joints sublinear, each slightly widened at apex, lessening in length from the 3rd outwards, apical two very short. *Prothorax* truncate at apex and base, widest at middle; gently, arcuately narrowed in front; feebly sinuate behind; anterior angles depressed (widely obtuse from above), posterior subrectangular; disc without medial line; basal foveae lightly impressed. *Scutellum* oval. *Elytra* wider than prothorax at base, shoulders squarely rounded, sides subparallel, or lightly compressed behind shoulders; striate-punctate, the seriate punctures subcontiguous and fine; intervals of uniform width, convex, finely but densely rugose [under a strong lens this rugosity seen to consist of numerous fine tubercles, often bearing a short red hair]. *Underside* densely punctate, abdomen very finely so. *Legs* simple, posterior tarsi with 1st joint nearly as long as the rest combined. *Dim.*—8-9 × 3½-3¾ mm.

Hab.—Western Australia: Fortescue River, Hammersley Range (W. D. Dodd).

Two examples (males), which I name after the collector, a son of the well-known Kuranda naturalist. It is nearest in form and sculpture to *H. pascoei*, Macl., from which it differs in (1) smaller size, (2) much finer sculpture of pronotum, (3) elytral sculpture, which in *H. pascoei* consists of large cancellate punctures in striae, with finely punctured and wrinkled intervals. Types returned to the South Australian Museum.

Homotrysis post-tibialis, n. sp.

Elongate-ovate, castaneous (elytra slightly darker); antennae and legs pale red. Upper-surface clothed with upright, pale-red hairs, legs smooth.

Head finely, densely punctate; eyes very close in male (intervening space the length of 2nd antennal joint), more distant in female; antennae sublinear-joints lightly enlarged at apex, 3-9 subequal in length, slightly successively widening. 10 and 11 of same length, but finer. *Prothorax* widest at base, sides nearly straight to middle, thence rounded and narrowed to apex; truncate at apex and base, posterior angles rectangular; disc rather coarsely, sparsely punctate, without medial line, with three shallow depressions at base. *Elytra* oval, slightly wider than prothorax at base, shoulders rounded; striate-punctate, the striae fine, small seriate punctures clearly evident on basal half only; intervals flat and punctate, the punctures here of about the same size as the seriate. *Epipleurae* and sternum coarsely punctate, abdomen striolate, the apical segments punctate. Posterior *tibiae* of male triangularly widened into a tooth near apex. *Dim.*—$7\frac{1}{2}$-$9 \times 2\frac{1}{2}$-3 mm.

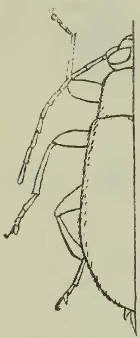

Fig. 1.

Hab.—South-western Australia (the Author). Swan River (J. Clark).

Four examples, two of each sex, before me are distinct from *H. fusca*, Blackb., and *H. nigricans*, Hope, by differences of colour, sculpture, and the male tibiae; no other species comes very near it. Type male in Author's Collection, female in South Australian Museum.

Homotrysis rufo-coerulea, n. sp.

Elongate-ovate. Head, prothorax, underside, basal joints of antennae, and base of femora red; elytra blue, knees and tibiae (in part), antennae obfuscate. The whole thickly clad with upright, whitish hair.

Head and pronotum rather coarsely punctate; eyes in male closely approximate, in female less so, in both the intervening space obliquely widened behind; antennae rather stout, joint 3 cylindric, 4-10 subtriangular and short, 11 finely ovate. *Prothorax* about as wide as long, sides parallel behind, arcuately narrowed in front, apex a little produced in middle; base truncate, posterior angles rectangular. *Elytra* wider than prothorax at base, shoulders rather prominent, sides subparallel for the greatest part, not widened behind; striate-punctate, the seriate punctures round, small, rather close, placed in fine striae; intervals flat and clearly punctured. *Metasternum* coarsely, abdomen very finely punctate. *Dim.*—$7 \times 2\frac{1}{2}$ mm.

Hab.—Queensland: Richmond, on white berry bush (Aug. Simson); Cairns district (A. M. Lea).

Three specimens, one male, of this pretty little species examined. Though very unlike its congeners in its bright colours, I can find no structural characters which separate it from *Homotrysis*. In one example the femora are red. Types in the South Australian Museum.

Homotrysis scutellaris, n. sp.

Obovate, robust; head, prothorax, and tarsi black, elytra and underside violet-brown, tibiae pale castaneous, antennae fuscous. Whole surface clothed with whitish hairs, short on elytra, longer on pronotum, dense and short on scutellum, thick and long on under-surface.

Head and pronotum densely punctate; eyes prominent and widely separated (more widely than in *H. cisteloides*, Newm.), antennae linear, joints 3-10 successively shorter, 11th narrow and as long as 10. *Prothorax* rhomboidal, transverse, truncate at apex and base, sides rounded anteriorly and thence straightly widened to the base, with a faint medial depression and a shallow central-basal fovea. *Scutellum* white, entirely covered by close recumbent white hair. *Elytra* considerably wider than prothorax at base and more than three times as long; convex, the sutural region evidently higher than the general surface; widest behind middle, shoulders rather squarely rounded; striate punctate, the punctures in striae round, close, and regular; intervals flat at base, slightly convex towards apex, minutely wrinkled and lined with short white hairs. *Underside* densely pilose. Male with usual evident forcipital process; female larger, especially wider, eyes more widely separated. *Dim.*—Male, $9\frac{1}{2} \times 4$; female, 12×5.

Hab.—New South Wales: Werris Creek, etc. Queensland: Brisbane.

This is the species identified by Blackburn as *H. canescens*, Hope (=*maculata*, Haag.), and which I so considered in my Revision and Tabulation.[4] I have gladly revived Bates' MSS. name. It is a short, robust species of the *carbonaria* group, and easily distinguished from both *H. carbonaria*, Germ., and *H. cisteloides*, Newm., by the larger seriate punctures and minute punctures of intervals, *inter alia;* from *H. regularis*, Macl., it is distinguished by colour, pilose clothing, and smaller seriate punctures. Types in the Author's Collection.

Homotrysis variolosus, n. sp.

Elongate-oblong, black, subnitid; pilose; extreme edge of clypeus and of labrum pale red, antennae piceous, their apical joints (also tarsi) reddish.

Head coarsely punctate, eyes large and transverse, separated by a space of half the diameter of one eye; antennae long and tapering, joints linear, 3-11 successively a little shorter and finer than preceding. *Prothorax* widest at base, sides parallel behind, lightly converging on apical half, apex as wide as head, subtruncate at apex and base, posterior angles rectangular, anterior obtuse; disc rugose-punctate, some fine vermiculate ridges near centre, more clearly punctate at sides and base; without medial impression, faintly depressed near hind angles; sparsely clothed with long, upright, reddish hairs. Scutellum triangular. *Elytra* considerably wider than prothorax at base, and nearly thrice as long, shoulders fairly prominent, sides a litle widened behind middle with narrow horizontal border; rather thickly clothed with upright hairs at sides and apex; coarsely striate-punctate, the spaces between intervals almost wholly occupied by a coarse system of irregular punctures, varying from large irregularly-shaped ones (where the intervals become, in consequence, undulate) to irregular clusters of smaller ones (sometimes continued in a larger one); intervals convex, a row of unusually large punctures on extreme sides. *Epipleurae*, prosternum, and metasternum coarsely punctate, abdomen more finely so. *Legs* hairy and punctate. *Dim.*—$12 \times 4\frac{1}{2}$ mm.

Hab.—New South Wales: Belltrees, near Scone (S. Jackson).

A single male example, remarkable for the combination of elongate form, dark colour, hairy clothing, and unique elytral sculpture (somewhat as in *Hybrenia occidentalis).* Type in Author's Collection.

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[4] *L.c.*, pp. 80, 81.

The species of *Homotrysis* described above may be distinguished, *inter se*, as follows :—

1	10	Unicolorous (prothorax and elytra of same colour).	
2	6	Colour black.	
3	5	Legs dark.	
4		Size, $12 \times 4\frac{1}{2}$ mm. Seriate punctures large or in clusters	*variolosus*, n. sp.
5		Size, $9 \times 2\frac{1}{2}$ mm. Seriate punctures small	*nigricans*, Hope
6		Legs testaceous	*pallipes*, n. sp.
7	9	Colour chocolate-brown (style of *H. pascoei*, Macl.).	
8		Elytra with seriate punctures large and square, intervals punctate ...	*kershawi*, n. sp.
9		Elytra with seriate punctures small, intervals rugose	*doddi*, n. sp.
10		Colour castaneous, post tibiae of male dentate	*post-tibialis*, n. sp.
11	13	Bicolorous.	
12		Form robust (style of *H carbonaria*, Germ.), colour black and brown ...	*scutellaris*, n. sp.
13		Form narrow, prothorax red, elytra blue	*rufo-coerulea*, n. sp.

HYBRENIA OCCIDENTALIS, n. sp.

Rather widely obovate, black (in one specimen the femora red). Upper-surface rather thickly pilose.

Head closely and rather strongly punctate; the eyes separated by a space of about half the diameter of one eye; antennae with joints 3-6 subequal (the rest wanting). *Prothorax* widely subrhomboidal, and rather flat, the apex slightly advanced in the middle, anterior angles widely rounded, sides nearly straight; widest at base, this truncate, posterior angles acute, surface coarsely punctate, the punctures not very close, each bearing a short upright red hair, basal foveae triangular. *Scutellum* widely triangular, punctate. *Elytra* at base slightly wider than, and closely fitting, prothorax, and about two and a half times as long; gradually widening to near apex, then abruptly narrowed, striate-punctate, intervals convex and punctate; the punctures in striae and on intervals of equal size and commingled, the former in groups rather than in linear series; the middle and front half of elytra having rows of subreticulate impressions, each reticulation containing a cluster of about three punctures; the whole with sparse, short clothing of red hair. *Prosternum* rugose, mesosternum and metasternum coarsely punctate, abdomen more finely so. *Dim.*—$12\text{-}13 \times 5\frac{1}{2}\text{-}6$ mm.

Hab.—Western Australia: Geraldton (J. Clark).

Two specimens (both, I think, male) belong to a species near *H. vittata*, Pasc., var. *concolor*, Cart., in facies, but with much coarser sculpture, more hirsute clothing, and convex elytral intervals. The sculpture is nearest that of the Eastern Australian *elongata*, Macl., but the latter is quite differently shaped, and has a still more coarsely punctured pronotum. Type in South Australian Museum.

Hybrenia pilosa, n. sp.

♂. Elongate-obovate, black nitid. Body sparsely clothed with upright red hairs, legs more densely so.

Head rather densely punctate; eyes large, prominent, very close (separated by a space about the length of second antennal joint); joints of antennae linear, 3 longer than 4, thence successively shorter to 8, rest wanting. *Prothorax* apex bisinuate, produced in middle; here about as wide as head; truncate and widest at base; sides parallel on basal half, thence lightly converging in front; disc rather coarsely and closely punctate, the punctures more sparse towards sides; a faint medial depression on front half and two wide foveate impressions at base, and a slight depression at middle near base. *Elytra* considerably wider than prothorax at base, shoulders prominent, sides lightly widening behind middle; striate-punctate, the seriate punctures close, increasing in size from suture to sides, placed in deep striae; intervals convex, finely punctate and transversely wrinkled; a row of large punctures on the epipleurae. *Metasternum* coarsely, abdomen finely punctate. Posterior *tarsi* mutilated. *Dim.*—14-16 × 5½-6 mm.

Hab.—Western Australia: Geraldton (J. Clark).

Two examples, both male, are easily distinguished from the five species having convex elytral intervals mentioned in my tabulation[5] by its hairy clothing. Type in the South Australian Museum.

Hybrenia torrida, n. sp.

Elongate, narrowly obovate, brownish-black; tarsi and antennae reddish; upper-surface sparsely clad with short reddish hair.

Head closely punctate, eyes in male approximate, but not contiguous; in female more widely separate; antennae sublinear, 3 longer than 4; 5-11 subequal in length but narrowing towards apex. *Prothorax* subrhomboidal and depressed, sides rounded anteriorly, posterior angle rectangular, base and apex truncate, disc densely, subrugosely punctate; the punctures moderately large; faintly bi-impressed at base, and sometimes subobsoletely impressed on medial line. *Scutellum* triangular.

(5) *L.c.*, p. 86.

Elytra wider than prothorax at base and thrice as long, shoulders rounded, sides lightly widened behind middle; striate-punctate, intervals nearly flat on basal half, more convex towards sides and apex; coarsely and closely punctate, the striae deep and clearly cut, the punctures in striae and on intervals of equal size; those in striae forming a close network. *Prosternum* and *metasternum* coarsely and sparsely punctate; *abdomen* and *legs* less coarsely so, except the last segment; this strongly pilose, with large punctures. *Dim.*—Male, 12×5 mm.; female, 13×6 mm.

Hab.—Northern Territory: Alexandria (W. Stalker).

Three examples from the British Museum show a species nearest *H. elongata*, Macl., but clearly differentiated by (1) more widely separated eyes, (2) more densely punctate pronotum, (3) elytral intervals more convex and more closely punctate. Types returned to the British Museum.

Nocar subfasciatus, n. sp.

Very convex, oval; castaneous, legs red. Whole surface rather thickly clothed with white recumbent hair, the elytral clothing arranged more or less in fasciae (the apex, humeral area, and two wide fasciae thus clothed).

Head finely punctate, eyes transverse, separated by a space less than the diameter of one; antennae short, joint 3 slightly longer than 4, these linear, 5-7 obconic, 9-10 cupuliform, 11 ovate, 5-11 successively widening. *Prothorax* arcuately narrowing from base to apex, oblique rounded in front; disc closely covered with recumbent hairs; base lightly bisinuate, hind angles rectangular. *Scutellum* triangular, pilose. *Elytra* convex and oval, closely adapted to prothorax and of the same width at base, widest behind middle; the bald spaces showing a close, even system of punctures. *Underside* more shortly pilose, with longitudinal striation. *Tarsi* clearly lamellate. *Dim.*—$3\frac{1}{2} \times 1\frac{1}{2}$ mm.

Hab.—North-western Australia: Queen Islet (British Museum).

Three examples sent from the British Museum amongst other Cistelidae show the smallest species of the genus yet described, and distinct by its pattern and clothing. Types returned to the British Museum.

N.B.—*Nocar* and *Taxes* are closely allied, as noted by Champion. I think I have identified *T. alphitobioides*, Champ., in specimens from (1) Bathurst Island, Northern Territory, and (2) Stradbroke Island, Moreton Bay. The chief distinction between these genera lies in the widely separated eyes and more transverse prothorax of *Taxes*. The author also says that the antennae have the 3rd joint shorter than 4th, and the tarsi are obsoletely or feebly lamellate beneath; but neither of these seem to apply to my *alphitobioides* (?), in which joints 3 and 4 of antennae are subequal, while the penultimate tarsi are clearly lamellate, as seen under a Zeiss binocular.

Metistete clarki, n. sp.

Moderately robust, obovate, chocolate-brown, subnitid; palpi, antennae, tibiae, and tarsi red.

Head and pronotum very densely punctate, epistomal furrow well marked; eyes rather narrowly transverse and widely separated; antennal joints sublinear, 3 longer than 4, 4-6 subequal, 7-11 successively shorter, 10-11 very slender and of testaceous colour. *Prothorax* bulbous, transverse, base truncate, apex feebly sinuate, sides widely and evenly rounded; all angles obtuse, medial channel distinct, shallow transverse foveae near hind angles. *Scutellum* wide, rounded behind. *Elytra* wider than prothorax at base, and less than three times as long, slightly widening behind middle; striate-punctate, the small seriate punctures only obvious on basal half, larger and elongate towards sides; intervals nearly flat, sparsely punctate and minutely pustulose. *Abdomen* nearly smooth; sternum rather coarsely punctate. *Dim.*—8-10 × 3½-4 mm.

Hab.—Western Australia: Eradu and Geraldton (J. Clark).

Two examples, the sexes, examined show a species not very near any of its congeners. Type male in Author's Collection; type female with Mr. Clark.

Metistete rubicunda, n. sp.

Ovate, convex, whole surface subopaque brownish-red; densely clad with short upright pale-red bristles; legs, antennae, and oral organs pale red.

Head finely shagreened, clypeus wide, truncate with rounded sides; mandibles bifid; eyes large, prominent, widely separated, antennae elongate, sublinear, joint 3 considerably longer than 4; 4-6 equal, 7 finer than 6, 8-11 successively and considerably smaller, 11 very small, finely ovate. *Prothorax* ovate and convex, truncate at apex and base, the latter slightly the wider, sides evenly and well rounded, without raised margin except a very narrow one at apex; disc (like head) shagreened and bristled, without sign of medial line or fovea. *Scutellum* semicircular. *Elytra* ovate and convex, of same width as prothorax at base, shoulders obsolete; sulcate-punctate, the sulci wide, not very deep, containing large square punctures having a circular base; intervals convex, rough, each with a single row of setiform punctures. *Underside* clearly punctate and pilose, hairs recumbent *Dim.*—8-9 × 3 mm.

Hab.—Northern Territory: Daly River (H. Wesselman).

Two examples, both, I think, female, are clearly separated from previously described species by the combination of rough and bristled surface, red colour, and the very distinct elytral sculpture. Type in the South Australian Museum.

Metistete protibialis, n. sp.

Subopaque brownish-black; edge of clypeus, basal joints of antennae and tibiae reddish, oral organs and tarsi paler red. Surface rather densely pilose.

Head and *pronotum* confluently punctate, the punctures on clypeus and pronotum coarser than those on forehead, and forming a system of hexagonal cells; eyes large, prominent, separated by a space as wide as the diameter of one; antennae long and pilose, all jonts clearly enlarged at apex, 3 longest and subcylindric, 4-7 subequal, thence successively narrower and shorter. *Prothorax* very convex, truncate and narrowly margined at apex and base, widest at middle, evenly rounded at sides, lateral margin not evident from above, all angles obtuse (posterior nearly rectangular); disc without sign of medial line or foveae; with moderately thick clothing of very short bristles. *Scutellum* semicircular, densely punctate. *Elytra* considerably wider than the prothorax at base, shoulders squarely rounded, sides lightly enlarging towards apical third, coarsely striate-punctate, each with nine wide striae, besides the short scutellary stria, filled with large square punctures separated by cancellate ridges, the punctures appearing reddish at bottom; the intervals raised, punctate and transversely rugose, the lateral intervals (from the 5th outwards) subcarinate; surface sparsely clad with fine upright red hairs. *Undersurface* coasely punctate and, with the *legs*, clothed with recumbent red hair; front tibiae with a short spine in the middle of inside edge. *Dim.*—Male, 9-11 × 3-4 mm.; female, $11\frac{1}{2} \times 4\frac{1}{2}$ mm.

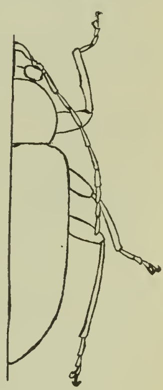

Fig. 2.

Hab.—Western Australia: Kalgoorlie, Mullewa, Geraldton. Central Australia: McDonnell Ranges. South Australia: Minnipakill.

Nine examples before me, of which seven are males and two females, the latter only being apterous. The males are rather like the species I have tentatively taken as *Homotrysis obscurus*, Borch., but besides the difference in the tibiae, this latter species has the punctures of pronotum larger and clearly separated; while the elytral cancellation is less defined. In the shape of prothorax it is very like the male of *M. gibbicollis*, Newm., but the elytral sculpture is quite different. *M. armatus*, Cart., is larger, more cylindric, with much larger protibial spine, surface glabrous and more nitid, and hind tibiae strongly flattened and curved. The female is more ovate and convex, eyes more widely distant. Types in the South Australian Museum.

Metistete vicina, n. sp.

♂. Elongate-ovate, glabrous, opaque brownish-black; elytra more nitid; apical joints of antennae and all tarsi red.

Head and pronotum finely, confluently punctate, eyes moderately wide apart (intervening space about half the diameter of one eye); antennae very fine and thread-like; joint 3 much longer than 4, 4-8 subequal, 9-10 shorter than preceding, 11 shorter than 10. *Prothorax* slightly longer than broad, subtruncate at base and apex, widest behind middle, feebly narrowed in front and even less so behind, basal margin narrowly raised, disc without medial line or foveae. Elytra wider than prothorax at base and nearly four times as long, sides subparallel to behind the middle, thence narrowed to apex; sulcate-punctate, the close subcancellate system of large punctures contained in deep sulci, the intervals convex and strongly punctate. *Protibiae* with a small tooth on inside about half-way. *Dim.*—10-11 × 4-4½ mm.

Hab.—Queensland: Cunnamulla (H. Hardcastle).

Three males show a species that is a curious mixture of several others. The sculpture of head and pronotum and the protibial armature are like *M. protibialis*, the general facies is like *M. gibbicollis*, Newm. (though the prothorax is narrower); the elytral sculpture is very like that of *Homotrysis subsulcata*, Macl. Type returned to Mr. Lea.

Melaps dentipes, n. sp.

Elongate, navicular, castaneous; antennae, legs, and tarsi testaceous. Above sparsely clad with long, pale, upright hairs, beneath more thickly pilose, hairs recumbent.

Head closely and rather coarsely punctate, clypeal suture straight and well marked, mandibles bifid at apex; eyes widely separated; antennae long and slender, extending beyond base of prothorax; joint 3 longer than 4, 5-10 gradually enlarged (though all finely obconic); 11 of same length as but more slender than 10. *Prothorax* convex, about as wide as long, subtruncate at apex and base (feebly produced in the middle at apex), sides gently rounded, all angles obtuse; disc finely and closely punctate, wtihout foveae or medial line, except a slight depression at middle of base, lateral margins not seen from above. *Elytra* wider than prothorax at base and two and one-half times as long; striate-punctate, with close round punctures placed in fine striae, intervals quite flat, each with a row of setiferous punctures of the same size as those in striae. *Femora* robust, fore tibiae with a small tooth at middle, mid-tibiae angulately widened nearer apex, the hind tibiae short, curved, and triangularly widened near apex. *Dim.*—Male, $8 \times 2\frac{1}{4}$ mm.; female, 9×3 mm.

Fig. 3.

Hab.—South Australia: Murray River (A. H. Elston); Tarcoola (A. M. Lea).

Five examples examined, of which two are males, are clearly distinct from described species by the tibial sex characters shown in figure. Type male in the Author's Collection, female in the South Australian Museum.

[N.B.—As the sex characters of this species traverse the slender border-line between *Melaps* and *Metistete*, as given by me,(6) some new distinction is necessary. It may possibly be found later that these two genera merge into one, for it is not easy to find distinct characters which differentiate all the species of the two genera. The following combination of small differences may be noted:—

	Metistete.	*Melaps.*
Size:	Larger.	Smaller.
Prothorax	less strongly convex, sometimes flattened on disc, opaque and coarsely punctate	Very strongly convex, never flattened on disc, more or less nitid, and finely punctate
Elytra	in general obovate (at least in female)	Narrowly ovate
Epipleurae	moderate	Very narrow
Post intercoxal process	widely arched	Narrowly triangular

(6) *L.c.*, p. 78.

The proportion of elytra to prothorax is considerably greater in *Metistete*, the elytra being generally nearly three times the length of prothorax; in *Melaps* not more than two and a half.]

MELAPS GLABER, n. sp.

Elongate-ovate, brownish-black, nitid and glabrous; oral organs, antennae, and legs testaceous.

Head large, epistoma bluntly rounded and rather strongly punctate, rest of head (and pronotum) very finely and closely punctate; eyes small, transverse, and widely separated; antennae with joints 1 and 2 swollen (2 much smaller than 1), 4-10 short, sublinear (very narrowly obconic), 11 oblong, as long as but narrower than 10. *Prothorax* ovate, convex, wider than long; apex subtruncate (with a slightly convex outline), base truncate, sides lightly and evenly rounded, all angles widely rounded off, a very narrow basal margin perceptible, disc without medial line or foveae. *Scutellum* transverse. *Elytra* elliptic, of same width as prothorax at base, humeri obsolete; striate-punctate, the striae very fine, but clearly, not deeply, impressed; the seriate punctures very small, round, and close; the short scutellary series containing larger punctures; intervals quite flat and nearly smooth (a few microscopic punctures can be seen under a strong lens). *Underside* finely striolate. *Dim.*—13-15 × 3-3½ mm.

Hab.—South Australia: Leigh Creek.

Var.—Elytra with deeper, wider striae and larger seriate punctures, the intervals more or less convex.

Four examples, show an unusually smooth species. The variety may be the other sex. I have not been able to make out any sexual characters. As with other members of this genus, it is apterous, and the mandibles are bifid at apex. Types in South Australian Museum.

MELAPS TIBIALIS, n. sp.

Ovate, convex, black (or brownish-black), very nitid, glabrous, front edge of clypeus testaceous; underside, tarsi, and tibiae reddish.

Head densely punctate on forehead, more sparsely so on clypeus, suture shallow and arcuate; eyes small and widely separated; antennal joints linear, 4-10 subequal, 3 slightly longer than 4. *Prothorax* very convex and oval, truncate and finely margined at apex and base, anterior angles obsolete, posterior obtuse, sides evenly rounded; disc with scarcely evident, minute, shallow punctures; without medial impression or basal foveae. *Scutellum* small, transverse. *Elytra* of same width as prothorax at base; and about twice as long, oval, and convex; striate-punctate, with nine rows (besides a short scutellary one) of round, close, deeply-impressed punctures; these rather small near suture, large near sides, increasing in size outwards; intervals smooth and lightly convex; epipleurae with a single line of punctures. Sides of *prosternum* and of *abdomen* with fine sparse punctures. *Pro-tibiae* of male widened in the middle into a blunt tooth (the female specimen is damaged in the appendages, but has four of its tibiae intact, including one front tibia, which is without the tooth). *Dim.*—10 × 4 mm.

Hab.—Western Australia: King George Sound (Australian Museum).

Two examples, the sexes, can only, I think, be confused with *M. (Oocistela) convexa*, Borch., which (if my identification is correct) differs in smaller size, legs pale and bicolorous, more clearly punctate thorax, besides having (apparently) no sexual characters. Types in Australian Museum.

On Ditropidus and Allied Genera (Coleoptera, Chrysomelidae).

By Arthur M. Lea, F.E.S.

[Contribution from the South Australian Museum.]

[Read September 9, 1920.]

The Australian Chrysomelidae of the subfamily Cryptocephalides may be regarded as belonging to two sections:—

1. Cryptocephalides verae. The species of this section have the scutellum large and usually sloping upwards to its end, and the antennae more or less filiform.

2. Monachides. The species of this section have a small scutellum, never sloping upwards, and the antennae have a five or six-jointed club. The main genus is *Ditropidus*, and the ones I am acquainted with may be thus tabulated:—

A. Antennal club composed of five joints.
  a. Intercoxal process of prosternum longer than wide ... ... *Prasonotus*
  aa. Intercoxal process transverse.
    b. Joints of the club rather wide and short *Ditropidus* (1)
    bb. Joints longer and lax ... ... *Elaphodes*
AA. Antennal club composed of six joints.
  B. Eyes close together ... ... *Coenobius*
  BB. Eyes distant.
    C. Scutellar lobe of pronotum entire ... ... *Polyachus*
    CC. Scutellar lobe notched ... ... *Euditropidus*

Ditropidus.

The species of this genus are occasionally extremely abundant on wattles (*Acacia*, spp.), but they occur on many other kinds of trees and shrubs. They are short, thick-set insects, the male occasionally with very powerful jaws; the female has a large, deep, and more or less circular apical fovea on the abdomen, but the males of a few species also have the abdomen foveate, although the fovea on such specimens is much shallower, smaller than on the females, and is not margined with hairs, as it frequently is in the females; in fact on the males of most species there may be seen a vague depression on the apical segment, if this is viewed from several directions; the eyes of the male are usually larger and closer together than those of the female, their distance apart is frequently a useful specific character, but it needs to be considered with the sex; the front legs

(1) *D. antennarius* has exceptional antennae in the male.

are often longer and stouter, and the front and middle tarsi are often more dilated; the male is usually smaller than the female, but in the big-jawed forms it is usually larger; although I have seldom considered it necessary to describe the proportions of the antennal joints they have in every instance been examined, and are short, with the five apical joints forming a kind of club; on some species, especially on their females, the five joints are moderately long, approaching those of *Elaphodes*, but it was not considered desirable to refer to that genus any species whose prothorax and elytra are entirely glabrous. The shagreening of parts of the surface of many species is very conspicuous, but on some it is difficult to decide as to whether the surface should be regarded as shagreened, or as densely and finely punctate. Owing to the scutellar lobe the length of the prothorax is distinctly more along the middle than elsewhere, and its proportions are of use for identification, but these are usually sexually variable; the punctures on the prothorax are often different on the sides to what they are in the middle, being usually denser and coarser, but sometimes smaller and sparser, they frequently become elongated and confluent, or they may be replaced by striae, especially in the front angles; the base is finely serrated, and the serrations are very distinct on pale specimens whose prothorax and elytra are not closely applied together; but on dark ones with those parts close together the serrations are usually concealed. The scutellum is always small, but its apparent length varies according as to whether the prothorax is closely applied to the elytra or not. The elytra usually have rows of distinct punctures, not set in striae on the disc, but on the sides the punctures usually become larger, and set in more or less deep striae, these are two or three (rarely four) in number, but as the depth of the inner one varies, it is not always easy to decide as to their number, the marginal stria, however, is frequently impunctate; on most of the species the shoulders are smooth, obtusely subtuberculate, and interrupt some of the lateral striae. On many species the third segment of the abdomen, although distinct on each side, disappears in the middle. The genus is such a large one (with the exception of *Paropsis* it consists of a greater number of species than any other of the family), so many of the species have varietal forms, and so many may be identified with certainty only from the males, or by characters which may not be readily used for tables, that I have not considered it advisable to give a table of the genus. The species accordingly have been arranged in groups, which may simplify future identifications, but owing to the numerous varietal forms too much reliance should not be placed even on these.

In the following lists species to which an asterisk (*) have been prefixed are unknown to me, and their positions have been assigned to them by published characters.

Prothorax and elytra pubescent.

comans, Chp.
convexiusculus, Chp.
discicollis, Lea
flavipes, Lea
geniculatus, Lea
gibbicollis, Lea
holoporphyrus, Lea
intonsus, Lea
latifrons, Lea
puberulus, Chp.
pubescens, Lea
**semicircularis*, Baly.
whitei, Lea

Prothorax pubescent, but elytra glabrous.

**albertisi*, Chp.
**comptus*, Chp.
crassipes, Lea
cribripennis, Lea
cupricollis, Lea
fasciatus, Baly.
(*canescens*, Chp.)
flavipennis, Lea
globulus, Lea
**godeffroyi*, Chp.
gymnopterus, Lea
hirticollis, Baly.
**lacordairei*, Chp.
mirus, Lea
modicus, Lea
pubicollis, Chp.
striatus, Lea
strigosus, Baly.

Prothorax and elytra both glabrous.
A. Elytra not entirely dark.

**aciculatus*, Chp.
alphabeticus, Lea
amabilis, Baly.
antennarius, Baly.
(*antennarius*, Chp.)
(*baccaeformis*, Chp., var.)
apiciflavus, Chp.
apicipennis, Lea
basiceps, Lea
bimaculatus, Lea
**biplagiatus*, Baly.
cornutus, Baly.
corrugatus, Lea
cribricollis, Lea
cuneatus, Chp.
davisi, Saund.
dimidiatus, Baly., var.
elutus, Lea
**fulvus*, Baly.
imitator, Lea
impuncticollis, Lea
jacobyi, Baly.
laevicollis, Lea
**lateritius*, Chp.
latericollis, Lea
laticollis, Lea
longipes, Lea
longus, Lea
marginipennis, Lea
metallicus, Lea
nigribasis, Lea
nigricollis, Lea
nigriventris, Lea
**obtusus*, Chp.
ornatus, Baly.
**pallidipennis*, Chp.
**pastus*, Chp.
pictus, Baly.
pulchellus, Baly.
pulicosus, Lea
**rufescens*, Chp.
**rufocupreus*, Baly.
schmelzi, Chp.
serenus, Baly.
**subcylindricus*, Baly.
**submetallescens*, Baly.
suffriani, Chp.
tarsalis, Lea
**tarsatus*, Baly.
variiceps, Lea
variicollis, Lea
viridiaeneus, Lea
xanthurus, Lea

B. Elytra entirely dark, but prothorax not.

*aeneipennis, Boi.
caeruleipennis, Lea
davisi, Saund., var.
dimidiatus, Baly., var.
elegantulus, Baly.
fugitivus, Chp.
maculicollis, Chp.
mandibularis, Lea
nigripennis, Lea
pascoei, Baly.
ruficollis, Saund.
subsimilis, Lea
semicrudus, Lea

C. Elytra and prothorax entirely dark.

C. 1. Legs more or less red.(2)

albiceps, Lea
aurichalceus, Suff.
basiventris, Lea
*bicolor, Chp. (?)
clypealis, Lea
*coerulescens, Chp.
costatus, Chp.
cribriceps, Lea
*cupreus, Chp. (?)
*facialis, Baly.
*gagatinus, Er. (?)
*gibbulus, Suff.
glossatus, Lea
insularis, Lea
(*chalceus*, Lea)
(*lateralis*, Lea)
*laetus, Baly.
*laevigatus, Baly.
lentulus, Chp.
macrops, Lea
maculifrons, Chp.
majorinus, Lea
micans, Lea
oblongipennis, Lea
ochropus, Er.
odewahni, Baly.
*opulentus, Chp.
ovatulus, Chp.
punctipennis, Lea
rufipes, Saund.
scitulus, Lea
sobrinus, Lea
splendidus, Chp.
strigiceps, Lea
subaeneus, Chp.
tibialis, Chp.
viriditinctus, Lea
*xanthostomus, Suff.

C. 2. Legs entirely dark.(3)

abdominalis, Chp.
angustifrons, Chp.
*anthracinus, Er.
armatus, Lea
*ater, Boi.
*boops, Suff.
brachysomus, Lea
brevis, Lea
caeruleus, Lea
carbonarius, Baly.
carinaticeps, Lea
*cavifrons, Chp.
coelestis, Lea
cognatus, Lea
concolor, Saund.
(*ater*, Saund., var.)
(*cistellus*, Germ.)
(*maxillosus*, Suff.)
congenitus, Lea
*costipennis, Baly.
*distinguendus, Chp. (?)
doriae, Chp.
*duboulayi, Baly.
foveiventris, Lea
frontalis, Chp.
*fulgidus, Suff.
gagates, Lea
*geminatus, Chp.
glaber, Lea
*globus, Boi.
(? *saprinodes*, Suff.)
(? *seminulum*, Germ.)
*histeroides, Suff.
ignitus, Lea
imperialis, Chp.
indistinctus, Lea
insignis, Lea
*jansoni, Baly.

(2) On some described varieties entirely dark.

(3) On some described varieties partly reddish; the base of the front femora sometimes obscurely red.

labiatus, Chp.
laminatus, Chp.
lobicollis, Lea
melasomus, Lea
nitiduloides, Baly.
nobilis, Chp.
obscuripennis, Lea
**obsidianus*, Chp.
**ophthalmicus*, Suff.
palmerstoni, Blackb.
**phalacroides*, Baly.
puncticollis, Lea
punctivarius, Lea
pygidialis, Lea
**pyriformis*, Suff.
quadratipennis, Lea
rotundatus, Lea
**saprinodes*, Suff.
scutellaris, Lea
solitus, Lea
striatipennis, Lea
striatopunctatus, Lea
strigicollis, Lea
subaeneus, Chp., var.
subarmatus, Lea
**trabeatus*, Chp. (?)
triangulifer, Lea
tropicus, Lea
ventralis, Lea
venustus, Lea
vigilans, Lea
viridimicans, Lea

C. 3. Minute species, usually entirely glabrous.

brevicollis, Lea
coriaceus, Lea
opaciceps, Lea
punctulum, Chp.
rivularis, Lea
rotundiformis, Lea
rufimanus, Lea
similis, Lea
tenuifrons, Lea
tranquillus, Lea
vagans, Lea
vicarius, Lea

D. Front angles of prothorax of male flavous.

flavolateralis, Lea
lateroapicalis, Lea
minutus, Lea
pallipes, Lea

E. Miscellaneous.

brunneipennis, Lea
carinatus, Lea
flavoapicalis, Lea
macrocephalus, Lea
sculptipennis, Lea
subsuturalis, Lea

DITROPIDUS CONCOLOR, Saund.
D. ater, Saund.
D. cistellus, Germ.
D. maxillosus, Suff.

The male of this species has a large head with very prominent jaws, the labrum is large, blackish, often with the sides obscurely reddish, and the inter-ocular space is wide, with a large median depression; on the female the head is much smaller, the jaws are very much smaller, and the inter-ocular space is less. The front legs of the male are considerably longer and stouter than in the female; and its abdomen, owing to its incurvature, has the second, third, and fourth segments shorter in the middle; the female has a large apical fovea margined with pubescence. The prothoracic punctures are small but dense, and are usually, but not always, feebly impressed, towards the sides they become more or less confluent, or the sides may be substrigose. Specimens vary considerably in size, they are usually of an uniform bronze or coppery-bronze, except that some of the basal joints of the antennae are reddish; but a deep blue variety is common; specimens are occasionally black or bluish-green, or purple, and the prothorax and elytra are not always of the same shade of colour. There were specimens in the Blackburn collection labelled by Chapuis as *maxillosus* (a male) and *cistellus* (a female). The specimens before me are from many localities in New South Wales, South and Western Australia, and from Queensland (Bowen), and Victoria (Melbourne).

The other large or fairly large described blue species before me differ from the blue variety as follows:—

D. abdominalis has the abdomen wholly or partly red.

D. coelestis has denser and more sharply defined punctures on the head and prothorax, head with a circular interocular fovea representing the median line, and metasternum with coarser and less crowded punctures on sides.

D. vigilans has eyes much closer together in the female, and almost touching in the male, prothoracic punctures sparser and more minute, and almost absent from the sides.

Prothorax and elytra pubescent.

Ditropidus pubescens, n. sp.

♂. Coppery-bronze, labrum, antennae, palpi, and legs red. Moderately densely clothed all over with white pubescence.

Head with dense, partially concealed punctures. Eyes widely separated. *Prothorax* about twice as wide as the median length; with sparser and smaller punctures than on head. *Elytra* shagreened and densely punctate, striae feeble on sides and scarcely traceable elsewhere. *Legs* stout, the front ones somewhat longer than the others. Length (♂, ♀), 3·25-4·5 mm.

♀. Differs in having the head somewhat smaller, antennae thinner, front legs no longer than the hind ones, and in the abdomen.

Hab.—South Australia: Leigh Creek (Blackburn's collection). Type, I. 10952.

An oblong-elliptic rather densely clothed species, with elytra feebly striated even on the sides; on some specimens, apparently owing to a parting in the pubescence, there seems to be a carina above each eye. It is more oblong and with much denser clothing than on *whitei* and *pubicollis*, the legs entirely reddish or almost so, and the finer sculpture different. The tips of some of the antennal and tarsal joints are often infuscated. On the middle of the pronotum the clothing is usually somewhat rusty, on the pygidium it is usually denser along the middle than elsewhere, giving the appearance as of a median line; on the elytra it occasionally has a vaguely striped appearance. The distance between the eyes is about the width of the clypeus in the male, slightly less in the female.

Var. A. Two specimens from Queensland (Longreach, A. M. Lea) and one from South Australia (Rev. A. P. Burgess) are rather wider and less oblong than usual, but I can find no other distinctions.

Var. B. Two specimens from Leigh Creek are like the preceding variety, but have the knees blackish.

Var. C. Three specimens from Western Australia (Cue and Ankertell, H. W. Brown), one smaller (3-3·25 mm.) than usual, and have the tarsi and club blackish, one has the knees also blackish, and another the knees, hind femora, and parts of the other femora; on two of them the prosternum and mesosternum are reddish.

Ditropidus flavipes, n. sp.

♂. Coppery or coppery-bronze; labrum, antennae, palpi, and legs flavous, tips of some of the antennal joints and the claws blackish, or at least infuscated. Rather densely clothed (except on parts of under-surface) with white pubescence.

Head with dense, partially concealed punctures. Eyes widely separated. *Prothorax* not twice as wide as the median length, somewhat gibbous in front, with a shallow depression near base; with rather dense, partially concealed punctures. *Elytra* subquadrate; with dense, partially concealed punctures, lateral striae well defined, the others feeble. Front *legs* slightly longer than the others. Length (♂, ♀), 2·25-3 mm.

♀. Differs in being more robust, head slightly smaller, eyes more distant, antennae somewhat thinner, front legs no longer than the hind ones, and in the abdomen.

Hab.—South Australia: Leigh Creek, Oodnadatta (Blackburn's collection), Morgan (Mrs. Kreusler). Type, I. 10953.

On most of the specimens the clothing is entirely white, but on some of them the pubescence on the middle of the pronotum has a rusty appearance; where it has been abraded from the upper-surface the punctures are seen to be fairly dense and sharply defined; the punctures on the clypeus are usually less concealed than on other parts of the head. From above the hind angles of the prothorax seem rather acute, but from the sides they are seen to be rectangular. On the males there is usually a feeble depression on the apical segment of the abdomen, but it is very different to the large round fovea of the female. Structurally and in colour, except that the legs are paler, it is close to the preceding species, but is smaller, slightly narrower, the prothorax with more distinct punctures, somewhat different hind angles, and a shallow subbasal depression, of which there is not a trace on that species. In appearance it is very close to *gymnopterus*, but the elytra are not glabrous; it is also close to *intonsus*, but is more oblong, due to the distinctly longer elytra, and the prothoracic punctures are more distinct. In general appearance it is also very close to the species commented upon as possibly *puberulus*, but is at once distinguished by the eyes of the male being considerably smaller and more distant; on that species the distance between them at their nearest, is scarcely more than the length of the white-clothed canthus of each eye; on the present species the space is fully twice the length of each canthus, the punctures on the prothorax are also a trifle larger and more evenly distributed.

A female, from Morgan, has the club of the antennae, the tarsi, and the hind femora more or less deeply infuscated. A female, from Oodnadatta, is rather larger (3·25 mm) than usual, and the depression on the prothorax is more vague than on most specimens.

Prothorax pubescent, but elytra glabrous.

DITROPIDUS CRASSIPES, n. sp.

♂. Coppery-bronze, with a slight greenish gloss; labrum, antennae, palpi, and legs reddish; club, claw-joints, and claws blackish or infuscated. Head, prothorax, and under-surface with rather dense, white pubescence, becoming sparser on legs.

Head with fairly numerous but not very large punctures, becoming more crowded on clypeus. Eyes widely separated. *Prothorax* not twice as wide as the median length, sides strongly rounded; punctures small and numerous, but not crowded. *Elytra* rather strongly narrowed posteriorly; with rows of large, deep punctures, seriate only about base and middle, set in deep striae at the sides and apex; interstices impunctate. *Legs* moderately long and very thick. Length (♂, ♀), 3-3·75 mm.

♀. Differs in having somewhat smaller head and antennae, prothorax at base twice as wide as the medium length, elytra less narrowed posteriorly, legs shorter and much less thick, and in the abdomen.

Hab.—North-western Australia (Macleay Museum), Derby, W. D. Dodd. Type, I. 10920.

About the size of *whitei* and *concolor*, but readily distinguished from all the metallic hairy species by the unusually thick red legs of the male, all the legs are stout, the front ones especially, although they are but little longer than the hind ones; on the female the legs are of normal size, her tibiae and tarsi being only about half the width of those parts in the male; the front tibiae of the male from some directions appear to have a slight tooth where the apical diminution begins; in the female the distance between the eyes is equal to the width of the clypeus, in the male it is slightly less. On each of the three specimens before me the shoulders are thickened and somewhat purplish, and the disc of the pronotum is partly glabrous (but this may be due to abrasion).

Ditropidus cribripennis, n. sp.

♂. Bronze or copper-bronze; labrum, palpi, basal half of antennae, and parts of legs more or less reddish. Head, prothorax, under-surface, and legs moderately clothed with white pubescence.

Head with crowded asperate punctures; median line fairly distinct. Eyes moderately separated. *Prothorax* about twice as wide as the median length, front angles widely rounded off; punctures dense and fairly large, becoming crowded on sides. *Elytra* slightly longer than wide, slightly narrowed posteriorly; with rows of large deep punctures, becoming smaller but set in deep striae at the sides and posteriorly; interstices finely wrinkled and punctate, usually narrower than seriate punctures. *Legs* moderately long, front ones slightly longer and thicker than hind ones. Length (♂, ♀), 2·25-3 mm.

♀. Differs in being more robust, head smaller, antennae thinner, legs thinner, the front ones no longer than the hind ones, and in the abdomen.

Hab.—Western Australia: Geraldton (W. D. Dodd and A. M. Lea), Perth (Blackburn's collection), Swan River, Rottnest Island (A. M. Lea). Type, I. 10921.

An oblong species with coarser elytral punctures than on any species (known to me) with pubescent prothorax; the size and outlines are much as in *gymnopterus*, but on that species the seriate elytral punctures are not even as large as those on the prothorax of this species; the eyes of the male of the present species are also closer together, the distance between them being slightly more than the length of the basal joint of the antennae, in the female it is half as much again. The club varies from moderately infuscated to quite black; the dark parts of the legs are the tarsi, knees, and most of the hind femora, but the extent of the genicular and femoral infuscation varies; the prothorax and elytra are often of a uniform shade, but sometimes the prothorax has a more coppery appearance than the elytra.

Two females, from Rottnest Island, have the seriate punctures somewhat smaller than usual, although still of large size, being distinctly narrower than the interstices, some males associated with them, however, have punctures of normal size. Two specimens, sexes, from the Swan River, have all the punctures larger and denser than usual, on the pronotum some of them being confluent, but on each of them there is a narrow impunctate line on the basal half of the pronotum.

Prothorax and elytra both glabrous.

A. Elytra not entirely dark.

DITROPIDUS ALPHABETICUS, n. sp.

♂. Dark coppery-green (or blue); under-surface black, with or without a metallic gloss; elytra flavous with the suture (rather widely and irregularly), base (with an extension on each shoulder), sides (narrowly), and a large median spot on each (sometimes joined to the shoulder), coppery-green, or blue, or purple; labrum and basal half of antennae flavous. Under-surface and legs with sparse, whitish pubescence, sparser on head.

Head with fairly dense, sharply defined punctures, becoming crowded in front. Eyes widely separated. *Prothorax* about twice as wide as the median length, strongly narrowed in front; punctures rather small and sharply defined, but nowhere dense. *Elytra* slightly wider than long; with rows of small punctures, on the sides set in distinct striae. Length (♂, ♀), 3-4 mm.

♀. Differs in being more robust, elytra less narrowed posteriorly, antennae and legs thinner, and in the abdomen.

Hab.—South Australia (Macleay Museum), Port Lincoln (Blackburn's collection). Type, I. 4408.

Allied to *ornatus*, but the dark parts of the prothorax and elytra with a conspicuous metallic gloss, the elytral markings different, and the inter-ocular space glabrous; in some of these characters the types agree with South Australian specimens that I have regarded as varieties of *ornatus*, but the elytral markings are essentially different, the legs of the males are less powerful, and the punctures are not quite the same. The dark basal and sutural markings of the elytra are

T-shaped; on specimens with the humeral and discal markings conjoined the resemblance is to an irregular M; on some specimens the front half of the clypeus is almost as pale as the labrum, on others it is scarcely paler than the parts behind it; on some the bases of the front and middle femora, or of the front ones only, are obscurely diluted with red. The median line of the head varies somewhat and is usually more distinct on the female than on the male; on the male the eyes are separated about the width of the clypeus, on the female about one-fourth more; the male is without a trace of an abdominal fovea, but on the female it is unusually large.

DITROPIDUS LATERICOLLIS, n. sp.

♀. Coppery-green and flavous, club and claws infuscated. Under-surface and legs with sparse, white pubescence, head still more sparsely clothed.

Head shagreened and with dense punctures; median line moderately distinct. Eyes rather widely separated. *Prothorax* about twice as wide as the median length; with fairly dense and sharply defined but not very large punctures, slightly denser in middle than on sides. *Elytra* slightly longer than wide, sides gently rounded; with rows of small punctures, becoming larger and set in distinct striae on the sides; interstices with very minute punctures. *Abdomen* with a large, round, deep, apical fovea. Length, 3·5 mm.

Hab.—Queensland: Brisbane (A. M. Lea). Type, I. 10963.

The coppery-green parts of the type are the head (except the muzzle), prothorax (the sides obscurely diluted with flavous), scutellum, and a narrow basal edging of the elytra; the sterna have a more reddish tinge than the abdomen and legs. The distance between the eyes is about equal to the length of the front tarsi, but it would no doubt be less in the male. The hind angles of the prothorax from the sides are seen to be slightly less than right angles, but from above they appear to be much more acute, the front ones are really rectangular, but from above appear to be widely rounded off; in fact from some directions the sides and apex of the prothorax appear to form a perfect semicircle. The seriate punctures on the elytra are really rather small, but appear to be much larger owing to waterlogging. On the type the finer sculpture of the head has a curious concentric appearance, but this is scarcely evident on a second female (from Cairns, Dr. E. W. Ferguson); this specimen also differs in having the dark parts more of a purplish-blue and scarcely metallic, the flavous sides of the prothorax wider and sharply defined, the head less shagreened and with more distinct punctures, and the elytral interstices with slightly larger (although still very small) punctures; the seriate punctures, however, have the same waterlogged appearance.

DITROPIDUS IMITATOR, n. sp.

♀. Dark coppery-green and flavous. Under-surface and legs moderately clothed with white pubescence, head more sparsely clothed.

Head densely punctate and shagreened; median line moderately distinct. Eyes rather widely separated. *Prothorax* with dense and sharply defined but not very large punctures on disc, becoming crowded and confluent or substrigose on sides. *Elytra* with rows of distinct but not very large punctures, becoming larger and set in distinct striae on sides; interstices with sparse and minute punctures. *Pygidium* with a slight median carina. Length, 3·25-3·5 mm.

Hab.—Australia (old collection). Type, I. 10981.

Allied to, and with outlines as noted for the preceding species, but prothorax entirely dark, and with much denser punctures, becoming still denser and substrigose on the sides; at first glance it appears as if near *flavipennis*, but the pronotum is glabrous. The coppery-green parts are the head (a variable amount of the muzzle excepted), prothorax and scutellum: the elytra are flavous with a slight metallic gloss, but the suture and base are very narrowly dark; the antennae of both specimens under examination are broken, but the basal joints are pale.

DITROPIDUS VARIICEPS, n. sp.

♀. Red; part of head, scutellum and most of elytra bronzy with a coppery gloss; club black, parts of tarsi and of abdomen infuscated. Head, under-surface, and legs with very short, white pubescence.

Head rather large; with small, dense, and frequently obliquely confluent punctures; median line shallow. Mandibles rather large. Eyes widely separated. *Prothorax* at the base more than twice as wide as the median length; with small and not very dense punctures. *Elytra* suboblong; with rows of fairly large punctures, becoming smaller but set in deep striae on the sides. Front *tibiae* slightly longer than hind ones. Length, 2·5-2·75 mm.

Hab.—South Australia: Mount Lofty (J. G. O. Tepper), Port Lincoln (Blackburn's collection). Type, I. 4407.

Readily distinguished, by the bright red prothorax, from all other species having the elytra metallic with pale sides and apex; in general appearance it is close to *elegantulus*, but that species has the elytra entirely dark. The dark part of the head is basal, but it is usually triangularly encroached upon by the red, or it may even be divided into two; the pale portions of the elytra (which are more flavous than red) are lateral and apical, the apical portion occupies from about one-sixth to about one-fourth of the length; the infuscation of the abdomen is usually confined to the second and third segments, but sometimes extends to the base of its intercoxal process. The incurvature of the prosternal process is rather deeper than usual. One specimen has the head entirely red, the dark portion of the elytra reduced in size, and the infuscation of the abdomen and tarsi feeble. Another specimen has the pale portions of the elytra reduced to very narrow lateral and apical edgings, and its abdomen, except for the tip, is almost entirely black. There are seven males before me, but I have been unable to identify the female amongst the many species examined; as the species is certainly close to *elegantulus* the female may have the prothorax entirely dark; but the following species (which is also allied) has the prothorax red in both sexes.

B. Elytra entirely dark, but prothorax not.

DITROPIDUS SEMICRUDUS, n. sp.

♂. Head, basal half of antennae, palpi (tips excepted), prothorax (extreme base excepted), and legs (the tarsi usually partly infuscated) red, elsewhere black, but the elytra with a bronzy, or slightly coppery gloss. Under-surface and legs with sparse, white pubescence; head almost glabrous.

Head with small and fairly dense but not at all confluent punctures; median line rather slightly impressed. Eyes rather widely separated. *Prothorax* at base more than twice as wide as the median length, sides strongly rounded; with very small and comparatively sparse punctures. *Elytra* suboblong; with rows of rather small punctures, becoming larger and set in rather deep striae on the sides; interstices with very minute punctures. Length (♂, ♀), 2·75-3·25 mm.

♀. Differs in having thinner club and legs, elytra less narrowed posteriorly, and abdomen larger and with a large apical fovea.

Hab.—Victoria: Alps and Dividing Range (Blackburn's collection, No. 4815); Tasmania: Hobart, Mount Wellington, Huon River, and Sheffield (A. M. Lea); South Australia: Kangaroo Island (J. G. O. Tepper). Type, I. 4403.

In general appearance close to the male of *elegantulus*, but the head is smaller, with sparser and smaller punctures, non-strigose, entirely red, and jaws much smaller (on the male no larger than on the female of that species); the sexes also do not differ in the colour of the prothorax. From *ruficollis* it differs in its larger size, pale head, and metallic elytra. *Subsimilis* has the head almost entirely black, legs black, and prothorax with much more distinct punctures. The distance between the eyes of the male is about equal to the width of the clypeus, in the female it is distinctly more. On one specimen the base of the head, and on another the hind knees are infuscated; the Sheffield specimen has a conspicuous coppery-green gloss on the elytra.

Ditropidus caeruleipennis, n. sp.

♂. Head (base infuscated), basal half of antennae (the club blackish), prothorax (partly infuscated), and parts of front and middle legs reddish; elytra metallic-blue; under-surface and most of legs blue or greenish-blue. Under-surface with moderately dense pubescence, shorter and sparser on legs, and still shorter and sparser on head.

Head with fairly dense and rather coarse, sharply defined punctures: median line distinct but shallow. Eyes widely separated. *Prothorax* at base about twice as wide as the median length, sides strongly rounded; punctures small and not very dense, a marginal row of larger ones on each side. *Elytra* no longer than the basal width; with rows of rather large punctures, on sides no larger but set in deep striae. *Abdomen* depressed in middle, with a shallow apical fovea. *Legs* stouter than usual, but not very long. Length (♂, ♀), 3·75-4·25 mm.

♀. Differs in having slightly smaller jaws, eyes more widely separated, club thinner, abdomen larger, more convex, the fovea much larger and deeper, and the legs slightly shorter and much thinner.

Hab.—North-western Australia (Macleay Museum).

The bright blue elytra, with conspicuous rows of punctures, reddish prothorax (although usually largely infuscated), and powerful legs of the male render this a very distinct species. The blue is as in *abdominalis*, *coelestis*, and *vigilans*. The infuscation of the base of the head is usually encroached upon by a reddish triangle; the infuscation of the pronotum is pronounced and extensive on most of the specimens, leaving only parts of the base and apex reddish; the red parts of the legs are usually obscure and confined to the femora. The pubescence is rather longer than usual, more noticeably on the basal segment of the abdomen of the male than elsewhere. The male has an abdominal fovea but it is much smaller and shallower than that of the female, and the abdomen is otherwise different. One male has the head and prothorax entirely bright red; and one female has the elytra purple.

C. Elytra and prothorax entirely dark.

C. 1. Legs more or less red.[4]

DITROPIDUS OBLONGIPENNIS, n. sp.

♂. Coppery, sometimes coppery-green; labrum, antennae (club infuscated), palpi, and legs (claws infuscated) red. Head, under-surface, and legs with rather sparse white pubescence.

Head with dense and sharply-defined punctures, but also shagreened; median line shallow. Eyes very widely separated. *Prothorax* more than twice as wide as the median length; with dense and rather coarse punctures, becoming frequently confluent (or substrigose) on sides. *Elytra* oblong, slightly more than twice the length of the prothorax along middle; with rows of fairly large punctures, on the sides set in distinct striae; interstices slightly wrinkled near sides, elsewhere with minute punctures. *Legs* rather stout. Length (♂, ♀), 2·75-3·25 mm.

♀. Differs in being more robust, eyes more distant, median line of head more distinct, club and legs thinner, sides of prothorax more strongly rounded, elytra parallel-sided almost throughout (on the male feebly decreasing in width posteriorly), and abdomen larger, with a large, round, deep, apical fovea.

Hab.—Tasmania (Blackburn's collection): Frankford (J. J. Towers), Launceston (on *Pultenaea*, Aug. Simson's, No. 2585), Hobart (on "wattle" foliage in August, H. H. D. Griffith); Victoria: Alps (Blackburn's No. 4818); New South Wales: Forest Reefs (A. M. Lea). Type, I. 10982.

I have known this species for a long time as *pastus*, but in error; a cotype of that species (marked "type") in the Blackburn collection has small punctures on the middle of the prothorax, and at the apex and sides is densely strigose, the present species has dense and (for the genus) coarse punctures (much coarser than on the cotype) and the middle of its apex is not strigose, the sides are strigose but not so densely or finely, many of the strigosities being really due to confluence of punctures. From *ochropus* it differs in the

(4) On some described varieties entirely dark.

much coarser prothoracic punctures. It is rather more elongate than *lentulus*, the prothoracic punctures decidedly coarser, the sides substrigose, legs brighter, etc. In appearance some specimens are close to females of *elegantulus*, but are longer, prothorax with more conspicuous punctures, etc. The female is usually more coppery than the male, but occasionally is greenish-blue, or bluish-green; the hind femora are usually infuscated at the base, but on several specimens from Forest Reefs they are infuscated almost throughout. From some directions the median line of the head appears to dilate to a wide fovea, but it is really shallow throughout.

Ditropidus albiceps, n. sp.

♂. Coppery, sometimes with a slight purplish gloss; labrum, antennae (tips of the joints of the club infuscated), palpi and legs (claws infuscated) flavous, or reddish-flavous. Head and sides of metasternum densely clothed with white pubescence, rest of under-surface and legs more sparsely clothed.

Head shagreened and with dense but more or less concealed punctures; median line feeble. Eyes rather widely separated. Antennae somewhat longer than usual in genus. *Prothorax* more than twice as wide as the median length; with dense and small punctures, the sides very densely and finely strigose. *Elytra* suboblong; with rows of punctures of moderate size, becoming larger and set in deep striae on the sides, interstices slightly shagreened. *Legs* stout but not very long. Length (♂, ♀), 2·75-3·25 mm.

♀. Differs in being more robust, head less densely clothed (and in consequence with the punctures and median line more distinct), eyes more distant, club and legs thinner, elytra less narrowed posteriorly, and abdomen larger, with a large, round, deep, apical fovea.

Hab.—South Australia: Oodnadatta (Blackburn's collection). Type, I. 10990.

Allied to the preceding species, but elytra slightly less oblong, head, especially of male, more conspicuously clothed (so that it appears quite white), eyes less distant, prothorax with much smaller punctures, its sides more closely strigose (causing the surface there to appear almost shagreened), elytra slightly shagreened, and legs paler. It is apparently close to the description of *costatus*, but although the prothoracic punctures are dense they could not be regarded as coarse, the elytra also have three, instead of two interstices costate on each side, the head is densely clothed, and only the tips of the joints of the club are infuscated. It is certainly very different to a species I have doubtfully identified as *costatus*.

C. 2. Legs entirely dark.[5]

DITROPIDUS STRIGICOLLIS, n. sp.

♂. Bright coppery-bronze; basal half of antennae obscurely reddish. Head, under-surface, and legs with white pubescence.

Head shagreened and with small dense punctures; median line wide and not very shallow. Eyes separated about the length of four basal joints of antennae. *Prothorax* at apex as wide as the median length, sides strongly rounded; densely and finely strigose all over, but with a few punctures in middle. *Elytra* suboblong, slightly shagreened; with series of small punctures, becoming larger and set in rather weak striae on the sides. Length, 2 mm.

Hab.—South Australia: Port Lincoln (Blackburn's collection). Type (unique), I. 10854.

A small metallic species, with densely strigose prothorax; at first glance it appears to belong to *brachysomus*, but that species has the strigae on the sides of the prothorax replaced by rather coarse punctures; *odewahni* has reddish legs and sides of prothorax nonstrigose; from *aurichalceus* it differs in being smaller, less rounded, legs entirely dark, and eyes more widely separated.

DITROPIDUS ROTUNDATUS, n. sp.

♂. Coppery-bronze, two basal joints of antennae obscurely diluted with red. Head, under-surface, and legs with white pubescence.

Head shagreened and with small dense punctures; median line rather shallow. Eyes moderately separated. *Prothorax* at sides more than twice as wide as the median length, sides strongly rounded; with small, dense punctures in middle, becoming elongated at apex and towards sides, the sides themselves densely and finely strigose. *Elytra* scarcely longer than the basal width, sides rather strongly narrowed; with rows of fairly large punctures, becoming larger and set in deep striae on the sides; interstices with very small dense punctures, or finely shagreened. *Legs* rather stout, front ones slightly longer than hind ones. Length (♂, ♀), 2·5-2·75 mm.

♀. Differs in being more robust, elytra less narrowed posteriorly, legs thinner, the front ones no longer than the hind ones, and in the abdomen.

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[5] On some described varieties partly reddish.

Hab.—Western Australia: Geraldton (Blackburn's collection from E. Meyrick). Type, I. 10910.

A small wide species, in some respects close to the description of *duboulayi* (also from Geraldton), but elytra not "viridiaeneis," being of the same colour as the prothorax, the legs are also entirely dark, and the head is not "remotely punctured," being densely punctured and shagreened. The distance between the eyes of the male is about equal to the length of the two basal joints of antennae, in the female it is about one-third more.

C, 3. Minute species, usually entirely glabrous.

DITROPIDUS ROTUNDIFORMIS, n. sp.

♂. Black with a slight or moderate bronzy gloss, basal half of antennae flavous, the club infuscated, labrum and parts of front legs obscurely diluted with red. Glabrous.

Head shagreened and with minute punctures; median line lightly impressed. Eyes rather widely separated. *Prothorax* about thrice as wide as long, sides strongly rounded; with dense and fairly large, sharply defined punctures. *Elytra* scarcely as long as the basal width, sides beyond middle strongly rounded; with series of small punctures, becoming larger and set in deep striae on sides. *Sterna* with dense sharply defined punctures. Length (♂, ♀), 1·75-2 mm.

♀. Differs in having eyes slightly more apart, legs slightly shorter, and abdomen foveate.

Hab.—Queensland: Cairns district (A. M. Lea). Type, I. 10916.

A small round species, although quite an ordinary looking member of the genus so far as the outlines and punctures are concerned (these being much as those of *venustus* and *caeruleus)*; *punctulum* is much smaller, and with the prothorax shagreened instead of strongly punctate. At a glance all the legs appear to be black, and the dilution of parts of the front ones (sometimes the apical portion only of the tibiae) is not very pronounced on any of the specimens (six) before me.

DITROPIDUS RIVULARIS, n. sp.

♂. Black; clypeus, labrum, mandibles, basal half of antennae, palpi, and parts of legs flavous (sometimes rather obscurely so). Glabrous.

Head opaque and apparently impunctate; median line scarcely defined. Eyes widely separated. *Prothorax* opaque (less so in middle than elsewhere), more than thrice as wide as the median length, sides strongly rounded; punctures scarcely visible. *Elytra* briefly suboblong; with rows of rather small but distinct punctures, on the sides set in rather deep striae. *Legs* rather stout, front ones longer than hind ones. Length (♂, ♀), 1·75-2 mm.

♀. Differs in being larger and more robust, head, eyes, and jaws smaller, clypeus darker than labrum, abdomen larger, more convex, and with a large apical fovea, legs shorter and the front ones no longer than the hind ones.

Hab.—Western Australia: Capel River (W. D. Dodd), Vasse and Swan Rivers (A. M. Lea)., Type, I. 10929.

The jaws of the male are stout and dilated on the front edge, so that the labrum appears considerably smaller than on other species, but on the female the jaws are much smaller and the labrum of normal size; the distance between the eyes of the male is about equal to the length of the six basal joints of antennae (these being rather shorter and stouter than usual), in the female the actual distance is the same, but owing to the antennae being shorter the distance is about equal to the seven basal joints. The tarsi knees and hind femora are the usual parts that are darker than the rest of the legs, but sometimes the tarsi are no darker than the tibiae, occasionally the middle femora are also dark; the opacity of the head and prothorax (also parts of the under-surface) is due to very fine shagreening, the elytra are highly polished.

Ditropidus tenuifrons, n. sp.

♂. Black, head (infuscated about base), antennae (club infuscated); palpi and legs (femora excepted) more or less flavous. Glabrous.

Head shagreened and with minute punctures. Eyes large and close together. *Prothorax* about thrice as wide as the median length, sides strongly rounded; punctures small, but fairly distinct. *Elytra* short, sides rounded posteriorly; striated almost throughout. Length (♂, ♀), 1·5-1·75 mm.

♀. Differs in having the head darker, and in the usual particulars of the eyes, legs, and abdomen.

Hab.—Northern Queensland (Blackburn's collection), Cairns district (A. M. Lea). Type, I. 10864.

In appearance somewhat like *brevicollis*, but consistently smaller, prothorax with distinct punctures (those towards the base become somewhat aciculate), and elytral striae very different; the apical half of the elytra has distinct striae from the sides to the suture (deeper on the sides than elsewhere), but about the base the short subsutural ones change to series of punctures. The distance between the eyes of the female is slightly less than the length of the basal joint of antennae, in the male it is only about half its length. The legs are sometimes almost entirely flavous, but usually the middle and hind ones, or the hind ones only, are infuscated; the elytra are sometimes quite as black as the prothorax, but are usually obscurely paler (dark brown).

Ditropidus similis, n. sp.

♂. Black; labrum, basal half of antennae, and parts of legs pale. Glabrous.

Head subopaque and with indistinct punctures. Eyes rather widely separated. *Prothorax* about thrice as wide as long, sides strongly rounded; punctures very small. *Elytra* short; striae and punctures much as on *vagans* and *tranquillus*. Length (♂, ♀), 1·75-2 mm.

♀. Differs in the usual particulars of eyes, legs, and abdomen.

Hab.—South Australia: Mount Lofty (S. H. Curnow), Port Lincoln and Adelaide (Blackburn's collection, No. 1849), Kangaroo Island (J. G. O. Tepper), Lucindale (A. M. Lea). Type, I. 10872.

At first sight apparently belonging to *tranquillus*, but head subopaque and with much less distinct punctures, punctures of prothorax slightly smaller, and of abdomen sparser, and metasternum impunctate in middle. The lateral striae of the elytra are of the usual depth, but some of the ordinary rows of punctures appear to be in striae, much as on *vagans* and *tranquillus*, although less conspicuously than on the preceding species, from which it also differs in its more widely separated eyes. On the only male in the Museum the tarsi and parts of the tibiae are obscurely pale, but on four females the middle and hind femora only are infuscated, the rest of the legs being usually of a rather bright flavous, the muzzle also is brighter than on the male; on the females the median line of the head is fairly distinct, but it appears to be absent from the male.

D. Front angles of prothorax of male flavous.

Ditropidus lateroapicalis, n.sp.

♂. Black; front half of head, basal half of antennae (club infuscated), palpi, front angles of prothorax, prosternum, part of mesosternum, and most of legs flavous. Under-surface and legs scarcely visibly pubescent.

Head with sparse punctures; median line well defined. Eyes rather close together. *Prothorax* about twice as wide as the median length, sides strongly narrowed to apex; with fairly dense and rather small punctures, in places becoming subaciculate. *Elytra* strongly striated throughout. *Abdomen* with a rather large but shallow apical fovea, margined with erect setae. Front *legs* slightly longer than hind ones. Length (♂, ♀), 2-2·5 mm.

♀. Differs in having the head black to the labrum, or at least to the clypeus, the prothorax entirely black, antennae decidedly shorter, eyes more apart, front legs no longer than hind ones, and abdomen with a larger and deeper apical fovea, without marginal setae.

Hab.—New South Wales: Forest Reefs and Armidale (A. M. Lea); Tasmania: West Tamar and Launceston (Simson's collection), Huon River, Frankford, and King Island (Lea); South Australia: Lucindale (F. Secker), Mount Lofty (A. H. Elston), Kangaroo Island (J. G. O. Tepper). Type, I. 10985.

On this and the following species the antennae of the males are longer than is usual in the genus, and the five apical joints are not so suddenly clubbed. The distance between the eyes of the male is equal to the length of the basal joint of antennae, in the female it is about one-third more; the metasternum has a wide subtriangular depression on the male, but on the female it is reduced to hardly more than the median line. The elytral striae contain fairly large punctures, but as these are at the bottom of the striae, they are distinct only from certain directions; the basal segment of the abdomen is densely punctate. The hind femora are usually deeply infuscated, sometimes the middle ones as well, rarely only the four hind knees are infuscated, rarely also parts of the front legs are infuscated; the flavous portions of the head and prothorax of the males vary slightly in extent, but are always conspicuous.

Ditropidus flavolateralis, n. sp.

♂. Black; front half of head, basal half of antennae (the club infuscated), palpi, sides of prothorax, prosternum, mesosternum, and legs flavous. Under-surface and legs very feebly pubescent.

Head with rather sparse but sharply defined punctures; median line lightly impressed. Eyes moderately distant. *Prothorax* with outlines as in preceding species, but with rather stronger punctures. *Elytra* also as in preceding species, except that the punctures in the striae are larger and more defined, and that the striae themselves are not quite as deep. Length (♂, ♀), 1·8-2 mm.

♀. Differs in having the prothorax, both above and below, and the mesosternum, entirely dark, less of the head flavous, antennae and legs shorter, and abdomen foveate.

Hab.—Tasmania: Huon River, Devonport and Burnie (A. M. Lea); South Australia: Port Lincoln (Blackburn's collection, No. 1110), Kangaroo Island (J. G. O. Tepper), Mount Gambier (Lea). Type, I. 10996.

Close to the preceding species, but smaller, eyes more apart, punctures in the striae more pronounced, flavous parts of the prothorax usually extending to the base on each side, although wider in front, metasternum scarcely differing sexually, and legs nearly always entirely flavous; on a few specimens the hind femora only are infuscated; on one male the flavous part of the head extends almost to the base. The distance between the eyes of the male is almost equal to the length of the three basal joints of antennae, in the female it is slightly more.

Var. Two males, from Forest Reefs, have the legs almost entirely dark and the prothoracic markings reduced to a small spot on each side of the apex.

Ditropidus minutus, n. sp.

♂. Black; most of head, basal half of antennae (the club almost black), palpi, front angles of prothorax, prosternum, and parts of legs flavous. Under-surface and legs scarcely visibly pubescent.

Outlines much as in two preceding species. *Head* with feeble punctures and median line. Eyes separated about the length of two basal joints of antennae. *Prothorax* with sparse and minute punctures. *Elytra* punctate-striate throughout, striae all sharply defined at summit of apical slope, but rather feeble on basal half near suture. Length (♂, ♀), 1·5-1·75 mm.

♀. Differs in having prothorax entirely and head almost entirely black, and in the usual particulars of eyes, legs, and abdomen.

Hab.—Victoria (R. J. Burton), Dividing Range (Blackburn's collection, No. 5848), Gisborne (H. H. D. Griffith); Tasmania: Launceston and Turner's Marsh (Simson's collection, No. 3800), Launceston and Hobart (Blackburn), Hobart, Mount Wellington, Huon River, Swansea, Frankford, Wilmot, and Burnie (A. M. Lea). Type, I. 10870.

Allied to the two preceding species, but smaller, antennae of male scarcely longer than in the female, and the club of normal width, prothoracic punctures decidedly smaller, and middle of mesosternum black in both sexes. The front legs are often entirely pale, or with the knees slightly infuscated, the hind legs often entirely dark, the middle femora are sometimes flavous, except for the knees, but usually only the basal half of their femora is pale; the males usually have more of the legs pale than the females.

DITROPIDUS PALLIPES, n. sp.

♂. Black; head, basal half of antennae (the club infuscated), palpi, front angles and sides of prothorax, prosternum, mesosternum, and legs bright flavous. Glabrous.

Head with small punctures, median line terminating in a small fovea between the eyes. Eyes separated slightly more than the length of basal joint of antennae. Antennae rather longer than usual, the club almost continuous in width with basal portion. *Prothorax* about thrice as wide as long, sides (for the genus) not much narrowed to apex; punctures rather sparse and small, but sharply defined. *Elytra* suboblong; strongly punctate-striate throughout. *Metasternum* with a wide, shallow, median depression. *Abdomen* with a large but shallow apical fovea. Front *legs* stouter and slightly longer than hind ones. Length, 2 mm.

Hab.—Victoria: Dividing Range (Blackburn's collection). Type, I. 10917.

With strongly striated elytra somewhat as in the *jacobyi* group, but prothorax with front angles and sides flavous. It is flatter and more parallel-sided than *lateroapicalis* and *flavolateralis*, the prothorax is shorter and much less narrowed to the apex, and the elytral striae are less divergent from the suture; the antennae, however, are much as on those species. The flavous parts of the prothorax narrowly occupy each side, and are continued across about one-fourth of the apex. The scutellar lobe is shorter than usual, and its notch is very minute; the discal striae of the elytra are almost all parallel with the suture, even the short subsutural one being much less oblique than is usual in the genus. The colours of the prothorax and sterna, the wide depression on the metasternum, the front legs, antennae, and the comparatively small abdomen sloping to both base and apex of the type, are essentially masculine, but it has a large fovea at the apex of the abdomen, which, although decidedly shallower than in females, is quite distinct.

A second specimen (from Nelson, in the Blackburn collection) may be a female of the species, it has similar elytral striae, but has the head (except labrum), prothorax (this with more distinct punctures, especially on the sides), and sterna black, antennae shorter, front legs no longer or stouter than the hind ones, hind femora infuscated, median line of metasternum not dilated, and abdominal fovea larger and much deeper.

E. Miscellaneous.

DITROPIDUS CARINATUS, n. sp.

♀. Chocolate-brown; scutellum, suture, metasternum, and abdomen black; muzzle, antennae, palpi, prosternum, and legs (hind femora infuscated) flavous. Under-surface and legs scarcely visibly pubescent.

Head shagreened. Eyes large and almost touching. *Prothorax* about thrice as wide as the median length, sides strongly rounded; shagreened and aciculate-punctate throughout. *Elytra* short; with rows of large punctures in deep striae; all the interstices acutely carinated throughout. *Abdomen* shagreened; the two basal segments with rather dense punctures, apical segment with a large, deep fovea. *Legs* rather short. Length, 2·25 mm.

Hab.—Victoria: Dividing Range (Blackburn's collection). Type (unique), I. 10878.

Allied to *jacobyi*, but readily distinguished from that species and all its allies by the shagreened prothorax.

DITROPIDUS FLAVOAPICALIS, n. sp.

♂. Black; labrum, basal half of antennae (the club infuscated), tips of elytra, pygidium, and legs more or less flavous. Glabrous.

Head opaque and with minute punctures; median line very feeble. Eyes rather wide apart. *Prothorax* fully thrice as wide as the median length, sides strongly rounded, scutellar lobe short; impunctate or almost so. *Elytra* short; with rows of rather small punctures, becoming larger and set in fairly deep striae on both sides. Intercoxal process of *mesosternum* rather large and with dense punctures. Front *legs* slightly longer than hind ones. Length (♂, ♀), 1·9-2 m.m.

♀. Differs in having eyes slightly more apart, median line rather wide and shallow, tip of elytra scarcely paler than the adjacent surface, legs and pygidium more obscure, front legs no longer than hind ones, and abdomen larger, more convex, and with a large apical fovea.

Hab.—Western Australia: Warren River (W. D. Dodd). Type, I. 10919.

Very close to *brunneipennis*, of which I was at first inclined to regard it as a variety, but the head, although slightly shagreened, is not at all coppery, and the elytra are distinctly striated only on the sides, elsewhere the punctures in the rows are sometimes close together, but at the summit of the apical slope they are not all set in striae as on that species. The distance between the eyes of the male is about equal to the four basal joints of antennae, in the female it is slightly more; the prothorax of the female has very small but distinct punctures, but except on very close examination they appear to be absent from that of the male. On the two males before me the flavous tips of the elytra are very conspicuous, but on the only female the tips are very obscure, and the pygidium is no paler than the rest of the abdomen.

DITROPIDUS MACROCEPHALUS, n. sp.

♂. Black; labrum, basal half of antennae, palpi, and tarsi more or less obscurely diluted with red. Glabrous.

Head opaque and unusually wide, median line very feeble; clypeus rather large and triangularly notched in front; jaws large and prominent. Eyes widely separated. Antennae short, joints of the club close together. *Prothorax* opaque, more than thrice as wide as long, sides moderately rounded, median lobe short and feebly notched. *Scutellum* very minute. *Elytra* slightly shorter than the basal width; slightly shagreened, with inconspicuous rows of punctures, but on the sides set in fairly deep striae. *Legs* not very long, front ones longer than hind ones, their tibiae flat and somewhat curved. Length (♂, ♀), 1·75-2 mm.

♀. Differs in having the head much smaller, clypeus not triangularly notched, jaws much smaller, prothorax much narrower in front, elytra slightly longer, legs shorter, the front ones no longer than the hind ones, and abdomen larger, more convex, and with a large, round, deep, apical fovea.

Hab.—Australia (old collection); Western Australia: Geraldton, Swan River, and Bridgetown (A. M. Lea); South Australia: Mount Lofty (A. H. Elston), Port Lincoln (Lea). Type, I. 10931.

A small, short species, that I was inclined at first to regard as belonging to a new genus. The elongated clypeus triangularly notched in the male is decidedly aberrant, but the powerful jaws, although not common in the genus, occur in several species. The head and prothorax under a hand-lens appear to be impunctate, but under a compound power their opacity is seen to be due to very dense and minute punctures. The distance between the eyes of the female is a trifle less than in the male, but this is due to the much smaller size of its head; on the male, owing to its large head, the front of the prothorax is not much narrower than its base; the intercoxal process of the prosternum is gently incurved at its hind end, in front on the female it is flat, but on the male its front edge is elevated to form a partial protection to the muzzle; both it and the process of the mesosternum have rather dense and sharply defined punctures.

Euditropidus, n.g.

Eyes widely separated. Antennae short; club six-jointed, its joints not very lax. Scutellar lobe notched. Intercoxal process of prosternum transverse, its hind end gently incurved to middle. Other characters as in *Ditropidus*.

This genus practically differs from *Ditropidus* only by the club having an additional joint, and as that has been considered a generic feature by both Baly and Chapuis, it appeared to be undesirable to refer the four species, agreeing in having the extra joint, to that genus. Type of genus, *variabilis*.

Euditropidus variabilis, n. sp.

♂. Black and reddish-flavous. Head, under-surface, and legs with sparse, whitish pubescence.

Head wide, median line rather wide and shallow; with dense and small punctures. *Prothorax* about thrice as wide as the median length, sides strongly rounded; punctures minute and not very dense. *Scutellum* small, subovate, slightly concave. *Elytra* about as long as the basal width, sides rather strongly narrowed posteriorly; with rows of fairly large punctures, on each side set in three deep striae; interstices with minute punctures. *Legs* stout, front ones longer than hind ones. Length (♂, ♀), 3·75-4·25 mm.

♀. Differs in having the head smaller, eyes slightly more apart, elytra less narrowed posteriorly, and with smaller punctures, abdomen larger, more convex, with a large, round, deep, apical fovea, and legs thinner, with the front ones no longer than the hind ones.

Hab.—New South Wales: Tweed River, on *Ficus* sp. (W. W. Froggatt). Type, I. 10932.

No two of the six specimens before me are exactly alike in colour. The type male is flavous, with the joints of the club and the elytra black, the latter, however, with a narrow basal strip (touching neither suture nor sides) flavous, a spot at the apex of each of the front and hind femora, and parts of the upper-surface of the tibiae are infuscated; a second male is close to it, but has the pale basal portion of the elytra about twice as long. The four females have the head, except the labrum and ocular canthi (on one specimen including the canthi), under-surface (except some of the side parts), and legs (except tarsi) black, the prothorax and elytra with very variable markings: the prothorax is black with a medio-apical portion pale, the pale portion on two specimens continued along the front edge almost to the margins, on another it is so continued and has, as well, a narrow strip extending along the median line almost to the base; on the elytra the black markings of one female are the base, suture (both narrowly), a small spot at the basal third of the latter, and the sides and apex irregularly; a second female agrees with it except that it has a small free spot half way between the sutural spot and each side; a third female has all the marginal markings extended and the free spot rather large; the fourth female has the markings still more extended, so that the sutural spot is continued to each side (across the free spot of other specimens) forming an irregular fascia slightly before the middle.

EUDITROPIDUS NIGER, n. sp.

♀. Black; labrum, five basal joints of antennae (the others infuscated), palpi and parts of upper-surface of tarsi more or less flavous. Head, under-surface, and legs with short, whitish pubescence.

Head with rather dense and small but sharply defined punctures; median line narrow at base, but dilated in front. *Prothorax* about twice as wide as the median length, sides strongly narrowed to apex; with small but fairly distinct punctures. *Elytra* short; with rows of not very large punctures, on each side set in three fairly deep striae; interstices with minute punctures. *Abdomen* with a very large apical fovea. Length, 3-3·25 mm.

Hab.—New South Wales: Dorrigo (W. Heron). Type, I. 10901.

At first glance quite an ordinary-looking *Ditropidus*, but the antennal club distinctly six-jointed. On each of the two specimens before me the elytra have a vague bluish gloss.

EUDITROPIDUS ERYTHRODERES, n. sp.

♀. Black; a narrow inter-ocular space, labrum, five basal joints of antennae, prothorax (extreme base excepted), and under-surface, including pygidium red. Head, prothorax, and under-surface with very short, pale pubescence.

Head with dense and small punctures; median line narrow at base, dilated in front. *Prothorax* and *elytra* with outlines and punctures as described in preceding species. *Abdomen* with a very large apical fovea. Length, 3·25 mm.

Hab.—Queensland: Mount Tambourine (A. M. Lea). Type (unique), I. 4405.

In general appearance strikingly close to several species of *Ditropidus (fugitivus, subsimilis, semicrudus*, and the male of *elegantulus)*, but club of antennae distinctly with six joints, instead of five, as on those species.

Euditropidus pallidus, n. sp.

♂. Flavous, extreme base of prothorax and part of abdomen infuscated. Head, under-surface, and legs with very short pubescence.

Head with small, dense, inconspicuous punctures, but becoming sharply defined on clypeus; median line shallowly impressed. *Prothorax* about twice as wide as the median length, sides strongly narrowed to apex, somewhat gibbous in front; punctures small but rather sharply defined, denser on sides than in middle. *Elytra* suboblong; with rows of fairly large punctures, becoming smaller posteriorly, and on each side set in three deep striae; interstices with very minute punctures. Front *legs* slightly longer than hind ones. Length (♂, ♀), 2·25-2·75 mm.

♀. Differs in being more robust, eyes rather more apart, prothorax shorter, abdomen larger, more convex, and with a very large apical fovea, antennae and legs thinner, and the front legs no longer than the hind ones.

Hab.—South Australia: Leigh Creek (Blackburn's collection). Type, I. 10975.

A short, robust species, with vaguely mottled prothorax, at first glance resembling some of the pale forms of *Polyachus geminus;* in general appearance it is very different from each of the three preceding species, but as the club is certainly six-jointed and the scutellar lobe notched it has been associated with them. On the female the metasternum, as well as part of the abdomen, is sometimes infuscated; on one specimen the abdomen is entirely pale; the club of the antennae is usually no darker than the basal joints, but is sometimes slightly infuscated.

Elaphodes vulpinus, Suff.

E. illotus, Lea.

E. illotus was named from a single female, but there are now thirty specimens before me (from New South Wales, Victoria, and South Australia), and these indicate that the species is probably the most variable one of the genus; and also that *vulpinus*, for which an exact locality was not given, was founded upon other females.

The male may be readily distinguished from males of other species by the jaws, these being much larger than usual, projecting strongly downwards, and bent at right angles at the basal third; the labrum is also unusually large and shining; the antennae are considerably longer than on the female, the tip of the apical joint is noticeably curved and pointed, the prothorax is more transverse and very little narrowed in front, the abdomen is smaller, incurved to middle, and with a glabrous space marking the position of the fovea of the female; the front legs are somewhat longer, with the basal joint of the tarsi larger.

The dark markings are very variable on both sexes; on the prothorax there are frequently two parentheses marks enclosing an elongated line, and a spot on each side . (|) . , sometimes there are two spots on each side, frequently each parenthesis mark is split up into two spots, and occasionally all are absent, or confused together. On the elytra there is often a median fascia: complete, interrupted in the middle, or represented by a row of ten or twelve spots; or there may be two—the second one near the base, and the two fasciae may be more or less connected; occasionally there is a large dark blotch about the scutellum; the dark markings of the head, under-surface, and legs also vary. On some specimens of both sexes the derm is of a rather pale castaneous, except that there is a narrow black line where the prothorax and elytra touch; their clothing is also entirely white; the females of such specimens somewhat resemble pale abraded ones of *pilula* and *rutilus*, but are more oblong; the males, however, may be at once distinguished by the jaws.

Elaphodes cervinus, Suff.

E. tigrinus, Chp.

The type of *E. cervinus* appears to be a specimen on which the two apical spots on each elytra are conjoined, and the outer part of the basal zigzag fascia almost separated as a spot on each side; there are several such specimens before me.

E. tigrinus was described as having two transverse fasciae on the pronotum, but these are rarely distinct and are often quite absent; the elytral markings are due mostly to dark patches of pubescence, and if this is abraded they may disappear; on each elytron there are usually two spots (sometimes conjoined) near the apex, and one on the side near them, the irregular subbasal fascia at its middle is V-shaped, and there is usually a round spot half way between its tip and the scutellum, the V, however, is often obscure; the metasternum is usually black or infuscated. There is frequently a median line of golden pubescence on the pronotum, and the middle of its derm often has a large blackish blotch. The species occurs in New South Wales, Victoria, Tasmania, and South Australia.

Elaphodes aeneolus, Chp.

On the male of this species the prothorax is sometimes dark, except for very narrow pale margins, and the elytra are often dark, except that the sides and apex are flavous. On the female the metasternum is black and the abdomen flavous; on the male the black extends to about the middle of the abdomen; the male also has more of the head black than the female. The pubescence is of a beautiful golden-yellow, mixed with semi-upright hairs.

Elaphodes murinus, Chp.

Described as from Rockhampton in Queensland; the only specimens I have seen of it are from New South Wales and Victoria. It is a large species, distinct by the entirely black derm of its prothorax and elytra.

Elaphodes scutellaris, Chp.

Four females, measuring 2-3 mm. in length, from New South Wales and Victoria, may belong to this species; no two are exactly alike in colour, but they all have the metasternum black, and the apical half of the antennae dark (the description implies that the antennae are entirely pale). One agrees well with the description, except for the partly dark antennae, and that the base of the abdomen is infuscated, another is very similar except that the discal blotch of the pronotum is very ill-defined, and that the abdomen is entirely pale; these both have very ill-defined elytral markings in addition to the circum-scutellar one; two smaller specimens have no discal markings on the prothorax, and the elytral markings are very faint.

A male (2·25 mm.) from Sydney, possibly belongs to the species, but has the prothorax almost entirely infuscated, and the elytra dark except for four flavous spots on each: a rather large subapical one and three submedian ones placed as if to mark the corners of an equilateral triangle; the middle of its prosternum and base of abdomen, as well as the metasternum, are blackish. A male of similar size, from Victoria, has the prothorax similarly coloured, and more of the under-surface dark; but it has a large and very conspicuous flavous spot on each elytron, the spot fully one-third its length and occupying almost its entire width (the two narrowly touching at the suture); on one of the smaller females a spot somewhat similar in size and shape is vaguely indicated.

ELAPHODES RUFOVARIUS, Chp.

Some specimens from Longreach and Cloncurry (Queensland) probably belong to this species, described from a female; they have three series of longitudinal flavous vittae on the elytra, so placed that they might be regarded as interrupted fasciae; and a small subapical flavous spot; the mestásternum is sometimes deeply infuscated. The males are smaller than the females, the length ranging 4-6 mm.

ELAPHODES EPILACHNOIDES, Chp.

On this species each shoulder is usually deep black, although on an occasional specimen it is but lightly infuscated; the median fascia is advanced along the suture, usually, but not always, triangularly; the prothorax usually has a conspicuous spot on each side of the base, but occasionally these are conjoined, rarely they are entirely absent; the metasternum is usually black, and the abdomen is sometimes partly dark; but occasionally the under-surface is entirely pale; on one female the elytral fascia is interrupted before each side, and the left spot on the pronotum is broken up into two. The species occurs in Southern Queensland, as well as in New South Wales.

ELAPHODES AMICTUS, Chp.

A specimen in the Blackburn collection received from Chapuis with a label "*Elaphodes amictus*, Chp. type," is probably a cotype; it does not agree with the description, however, as the elytra are without an isolated round spot before the fascia. It is a specimen of *epilachnoides*, having the under-surface pale, the prothoracic spots absent, and the humeral spots only moderately infuscated. If the specimen is correctly named, *amictus* must be regarded as a variety only of *epilachnoides*.

ELAPHODES SIGNIFER, Chp.

Numerous specimens from South Australia (Adelaide, Nuriootpa, and Lucindale), and New South Wales (Sydney), appear to belong to this species, which may be distinguished by the elytra having three transverse series of lines of pubescence (varying on different specimens from white to golden), covering parts of the derm that are slightly paler than the adjacent parts. The type was described as having on the middle of the pronotum a large brown spot, but the spot is sometimes broken up into two or three, and occasionally there are small isolated spots; the head is occasionally immaculate, but there is usually an angular black spot at the base, and often one or two between the eyes. The female is larger (4-4·5 mm.) than the male (3-3·5 mm.).

Elaphodes ziczac, n. sp.

♂. Dingy reddish-brown; antennae (club infuscated), elytra (some parts darker), most of under-surface and legs more or less reddish. With rather dense and mostly pale pubescence.

Head with dense and (where not concealed by clothing) sharply defined punctures. *Prothorax* strongly and evenly convex, apex scarcely one-fourth less than base; punctures as on head. *Elytra* with crowded asperate punctures; striae rather lightly impressed, but deeper on sides. Length, 3·75-4·5 mm.

♀. Differs in being more robust, eyes more apart, legs somewhat thinner, and abdomen with a large apical fovea.

Hab.—Queensland: Bundaberg (Blackburn's collection), Rockhampton (A. M. Lea). Type, I. 10881.

The scutellum and the extreme base of both prothorax and elytra are black. On the prothorax of one specimen there are eight spots on which the pubescence is darker than on the adjacent surface, but four of them are very indistinct, on two other specimens only four spots are in evidence, and on another not one is distinct; on the elytra, however, each specimen has a large sutural spot at the basal third and extending from it a zigzag fascia almost to each side; at the apical third, on each elytron, there is a large transverse spot, disconnected with all other markings, the derm at the markings darker than the adjacent surface, and the clothing on them also darker. It is a suboblong species, allied to *cervinus*, but with coarser punctures and different striae, elytral markings different, notably by the large dark blotch at the basal third, and by the absence of subapical spots; *oblongus* is less rounded, with stronger striae and very different elytral markings; *vittiger* (unknown to me, but also from Rockhampton) was described as having very different elytral markings.

Elaphodes simplex, n. sp.

Rusty-red; extreme base of prothorax and of elytra black, some joints of antennae infuscated. Moderately densely clothed with uniformly pale pubescence. Length, 3·5-4 mm.

Hab.—Queensland: Cairns district (Blackburn's collection and A. M. Lea), Peel Island (Simson's collection), Brisbane (H. W. Cox). Type, I. 10884.

The outlines and punctures, except that the latter are somewhat smaller and denser, are almost as in the preceding species, and the sexual differences are the same; but the upper-surface entirely reddish, except for a narrow line where the prothorax and elytra meet, will readily distinguish it from that, as from most species of the genus; in build it is somewhat like *epilachnoides*, except that it is larger and less oblong; *rutilus* is much larger and with very different clothing; and *pilula* and *signifer* have different clothing and markings.

Elaphodes nigrovarius, n. sp.

♂. Black and red. Moderately densely clothed with pale pubescence.

Head with crowded punctures, becoming smaller and sparser on clypeus. *Prothorax* moderately long; punctures dense and small; a vague median line usually indicated. *Elytra* with dense and small punctures; striae well-defined on the sides, feeble or entirely absent elsewhere. Length (♂, ♀), 3-4 mm.

♀. Differs in being larger, and in the usual particulars of eyes, legs, and abdomen.

Hab.—South Australia (Macleay Museum): Port Lincoln (Blackburn's collection), Murray Bridge (J. G. O. Tepper). Type, I. 3837.

The general outlines are much as in the two preceding species, but the colours and finer sculpture of the elytra are very different; the clothing appears to be easily abraded, as some of the specimens in the Museum are almost glabrous. The black varies in extent and often has a distinct metallic gloss; on the head it extends from the base to midway between the eyes, sometimes almost to the clypeus, but occasionally the head is entirely red; on the prothorax it may extend over the whole surface, or (usually in the females) leave a fairly wide space on each side red; on the elytra it varies from covering almost half of the surface on some males to absent (except for narrow black lines at the base and suture) on some females, but usually is in the form of a large subtriangular medio-basal blotch; the sterna are usually entirely black; the abdomen is sometimes entirely red (usually so in females), but one-fourth or more may be black; usually some of the antennal joints are infuscated.

Elaphodes multimaculatus, n. sp.

♂. Of a dingy rusty-red, with numerous black or infuscated spots or markings. Moderately densely clothed with pale pubescence, becoming darker on the dark parts.

Head with dense but not sharply defined punctures. *Prothorax* about twice as wide as the median length, sides strongly rounded; with small and very dense punctures, and several very shallow depressions. *Elytra* (for the genus) rather elongate, almost parallel-sided to near apex; punctures as on prothorax; striae distinct only on sides, rather feeble at apex and near suture, scarcely traceable elsewhere. Length, 3-4 mm.

♀. Differs in being larger and in the usual particulars of eyes, legs, and abdomen.

Hab.—Australia (old collection); New South Wales (Blackburn's collection), Cobar (H. J. Carter, from Shaw). Type, I. 10886.

Narrower than any previously described species of the genus, elytra multimaculate and prothorax with conspicuous longitudinal markings. The scutellar lobe is not notched, and this would exclude it from the genus by the table given by Chapuis; there are, however, two closely allied undescribed species that have the scutellar lobe slightly notched, but as I have seen but a single female of each they have not been named. The scutellum itself is very small, but is distinctly transverse, another unusual feature in the genus. The markings are not exactly the same on any two of the four specimens (one male and three females) before me; the head in all is obscurely blotched, except in front; the prothorax has two complete longitudinal vittae, three specimens have remnants of another towards each side, and two of these also have a short medio-apical vitta; on the elytra the spots and markings are very irregular and often angularly connected together, but on one female many spots are isolated; on the male most of the under-surface is black, and parts of the femora are infuscated; on the females the abdomen and legs are entirely pale; on one female the dark parts of the under-surface consist solely of a spot on each side of the metasternum. The punctures on the head are partly obscured by the clothing, but even where this has been abraded they are not very sharply defined, although the surface could hardly be regarded as shagreened. From above the front angles of the prothorax appear to be widely rounded off, but they are really rect-angular, similarly the hind angles appear to be less, but are really more than right angles.

Elaphodes coccinelloides, n. sp.

♀. Black and red. Moderately clothed with white pubescence, somewhat longer on upper than on under-surface.

Head with rather dense and sharply defined punctures; median line slightly impressed. *Prothorax* about twice as wide as the median length, sides strongly rounded; punctures dense and small. *Elytra* moderately long, sides gently rounded; punctures slightly larger and somewhat sparser than on prothorax; striae fairly distinct on sides, absent, or almost so, elsewhere. *Abdomen* with a large apical fovea. Length, 3·75-4 mm.

Hab.—Queensland: Brisbane (H. W. Brown and H. W. Cox); New South Wales: Hunter River (Macleay Museum). Type, I. 10954.

An oblong-elliptic species, with general outlines as in *tigrinus*, *signifer*, *simplex*, and similar species, and varying considerably in its colours. By the table given by Chapuis it could only be referred to *Elaphodes* or *Ditropidus*, and as it is clothed all over and the joints of the club are rather elongate, I prefer to refer it to the former genus; in general appearance it strikingly resembles many small Coccinellidae, especially of the genus *Rhizobius*. There are six females before me, of these the type and another specimen have the extreme base of prothorax, scutellum, and elytra (except tips) black, all other parts (except that some of the antennal joints are infuscated) being red; two others differ in having a wide median fascia (connected along the sides with the tips) on the elytra also red (on the two first specimens the fascia is hardly indicated, but in part may be traced from certain directions); the other two have the prothorax entirely black, and only the extreme tips of the elytra red, with the sterna partly infuscated.

Coenobius.

The species of this genus in general are close to *Ditropidus*, but differ in having the antennal club composed of six instead of five joints, and the scutellar lobe not notched; the latter character, however, is not very satisfactory, as it frequently happens that in the small dark species of *Ditropidus* the notch is very indistinct. I have not referred to *Ditropidus*, however, any species with the club six-jointed, or to *Coenobius* any with it five-jointed.

Coenobius lucidulus, Chp.

A male from Darnley Island appears to belong to this species, but has the legs of a rather dingy flavous, with the four hind femora somewhat darker; two other males (from Northern Queensland and Port Douglas) differ from it in having the legs entirely dark. A female, from Cairns, has also entirely dark legs, but differs from the males in being somewhat larger, 2·25 mm., eyes not so close together, and abdomen larger and more convex, with a wide and deep apical fovea.

COENOBIUS INCONSTANS, n. sp.

♂. Black, labrum, and parts of antennae and of legs more or less flavous. Under-surface and legs scarcely visibly pubescent.

Head with rather sparse but distinct punctures. Eyes close together. *Prothorax* at apex much narrower than the median length, sides strongly narrowed from base to apex; with rather sparse and small, but sharply defined punctures in middle, becoming denser and coarser on sides; a distinct row margining base. *Elytra* oblong; with rows of rather large punctures, on the sides set in deep striae; interstices with very minute punctures. Front *legs* slightly longer than hind ones. Length (♂, ♀), 1·75-2 mm.

♀. Differs in being larger and more robust, elytra with smaller punctures, abdomen larger, more convex, with a large apical fovea, legs thinner and the front ones no longer than the hind ones.

Hab.—Queensland: Mount Tambourine (A. M. Lea); New South Wales: Armidale and Forest Reefs (Lea), Jenolan (J. C. Wilurd), Leura (R. J. Burton), Sydney (Dr. E. W. Ferguson). Type, I. 10933.

Structurally close to *lucidulus*, but not at all blue. The distance between the eyes of the female is about equal to the length of the basal joint of antennae, in the male it is decidedly less; on many specimens there are two large punctures between the bases of the antennae. The legs vary from entirely flavous, except for a slight infuscation of the tarsi, to almost entirely infuscated, but the front legs are often paler than the others; variable numbers of the antennal joints are pale, but usually the six joints of the club are darker than the others; three females and one male have the head entirely pale, but usually only the labrum, and that rather obscurely, is flavous; one female (from Jenolan) has the head and legs (except a slight infuscation of the tarsi) entirely pale, and a wide pale space on each side of the prothorax; another female, on the same card, has the base of the head infuscated and the sides of the prothorax obscurely paler than the middle.

Var.? A female, from Galston, probably belongs to this species, but has the head, prothorax (except at the extreme base), and legs entirely flavous, the metasternum and abdomen obscurely diluted with red; the prothorax with fairly large punctures in the middle, and a rather deep oblique impression on each side (the impressions are hardly more than indicated on the typical form).

Coenobius parvoniger, n. sp.

♂. Black; labrum, basal joints of antennae, and parts of legs obscurely paler. Under-surface and legs scarcely visibly pubescent.

Head with rather large punctures in front. Eyes large and almost touching. *Prothorax* at base not twice as wide as the median length, sides strongly rounded; punctures sparse and minute. *Elytra* briefly suboblong; with rows of fairly large punctures, on the sides set in deep striae. Length, 1·75 mm.

Hab.—Queensland: Cairns. Type (unique), I. 10869.

In general appearance rather close to the preceding species, but more compact, eyes even closer together, and prothorax almost impunctate, even on the sides.

Coenobius binotatus, n. sp.

♂. Black; labrum, basal joints of antennae, a large spot on each elytron, and sometimes the tips, reddish. Under-surface and legs slightly pubescent.

Head rather coarsely sculptured in front. Eyes large and close together. *Prothorax* not twice as wide as the median length, sides strongly narrowed in front, somewhat gibbous in middle; with a few large punctures on sides, elsewhere impunctate, or almost so. *Elytra* briefly suboblong; with rows of rather large punctures, mostly in shallow striae, but on the sides in deep ones; interstices scarcely visibly punctate. *Legs* moderately stout, front ones very little longer than hind ones. Length (♂, ♀), 2-2·5 mm.

♀. Differs in being more robust, antennae and legs somewhat smaller, and abdomen larger, more convex, and with a large apical fovea.

Hab.—New South Wales: Sydney (W. du Boulay and Dr. E. W. Ferguson), Galston and Tamworth (A. M. Lea); Victoria: Birchip (J. C. Goudie, No. 234). Type, I. 10877.

The maculate elytra readily distinguish this species from all other Australian members of the genus; the large spot on each elytron is usually shaped like an obtuse-angled triangle, one of the acute angles being on or near the shoulder, the other approaching but not touching the middle of the suture; in addition to the large spots the tips of the elytra, or at least two subcontiguous spots, are also reddish on eight of the specimens before me, but on eight more the tips are dark, or at most very obscurely diluted with red, the difference is not sexual; the tips of the tibiae and the tarsi are sometimes obscurely reddish.

POLYACHUS AMENTATUS, n. sp.

♂. Dark reddish brown with a more or less distinct metallic gloss; muzzle, five basal joints of antennae (the others infuscated), margins of prothorax, elytra (the punctures darker), and legs more or less flavous. Under-surface and legs moderately pubescent.

Head with sharply defined punctures of moderate size, more crowded in front than elsewhere; median line distinct only at base. Eyes very widely separated. Antennae moderately long; club six-jointed. *Prothorax* not twice as wide as the median length, sides moderately rounded. scutellar lobe small and not notched; punctures of moderate size, rather dense and sharply defined, becoming somewhat denser and larger on sides. *Elytra* suboblong; with conspicuous rows of punctures in slight striae, the lateral striae not much deeper than the others. Process of *prosternum* truncated at both ends. Length, 2-2·5 mm.

Hab.—Australia (old collection); South Australia (Macleay Museum). Type, I. 10970.

The punctures on the elytra being darker than the adjacent surface the loops at the apices of some of the rows are very conspicuous, and in this respect the species at first glance resembles *Ditropidus pulicosus;* the pale parts of the elytra are more brightly flavous than the other pale parts. From certain directions the prothorax appears to have a narrow impunctate median line. A second specimen differs from the type in having the head, prothorax (the sides obscurely diluted with red), and scutellum bronzy-black, and most of the under-surface and legs black.

POLYACHUS DOLICHOGNATHUS, n. sp.

♂. Head (parts about the eyes black), basal third or more of antennae, prothorax (extreme base black), legs (parts of tarsi infuscated), and abdomen reddish-flavous; elytra flavous, punctures more or less infuscated, sterna, and sometimes base of abdomen, black. Head, under-surface, and legs moderately, the prothorax slightly pubescent.

Head rather wide; with dense and sharply defined punctures, more distinct on clypeus than elsewhere; clypeus unusually long, semicircularly notched in middle of apex. Eyes widely separated. Antennae moderately long; club six-jointed. *Prothorax* about twice as wide as the median length, sides strongly narrowed to apex, scutellar lobe small;

punctures rather dense and small but sharply defined, becoming slightly larger and denser on sides. *Elytra* suboblong; with rows of not very large but distinct punctures, on the sides set in fairly deep striae; interstices with dense and minute punctures, or faintly shagreened. Hind margin of intercoxal process of *prosternum* almost truncated. Length (♂, ♀), 2·5-3 mm.

♀. Differs in being more robust, eyes slightly more apart, antennae less distinctly six-jointed, legs somewhat shorter, and abdomen with a large apical fovea.

Hab.—Australia (Blackburn's collection); South Australia (Macleay Museum). Type, I. 10965.

In general appearance strikingly close to *Ditropidus nigribasis*, and with prothoracic sculpture very similar, but the muzzle, owing to the clypeus (which scarcely varies sexually), is almost twice as long as on that species, and the club is distinctly six-jointed on the male, but on the female the sixth joint of the antennae might be regarded as belonging either to the club or to the basal portion. On one specimen the scutellar lobe appears to be feebly notched, but on six others it is not. The black parts of the head cause the eyes, at first glance, to appear much larger than they really are; the red middle part extends to the extreme base and is wider on some specimens than on others; the elytral punctures are more conspicuously infuscated on some specimens than on others.

Var. - A male, from New South Wales, has three black spots on the prothorax: a large medio-apical one, and a smaller one on each side, the three narrowly connected across the apex; most of its head is also black; the apical joint of its antennae is longer, and the curved apical portion narrower and more distinct; as the curious muzzle, however, is as on the other specimens, it probably does not represent more than a variety.

An Adventitious Occurrence of *Nautilus pompilius*, Linn., with a Short Bibliography on Ocean Currents affecting the Australian Coast.

By Arthur R. Riddle.

[Read August 12, 1920.]

In January of 1911, the late Mr. James Scott, of Yorketown, picked up in Foul Bay, on Southern Yorke Peninsula, opposite what is locally known as the Old Windmill, a live specimen of *Nautilus pompilius*, Linn. The animal was nearly intact, only small portions having been removed by sea birds, and was not obviously in a state of decomposition.

The shell is very large, beautifully and brightly marked, and is in a perfect state of preservation. The exact measurements are:—

		Inches.	Centimetres.
Maximum length	...	8·94	22·7
Maximum height	...	6·94	17·6
Maximum breadth	...	4·5	11·4

Range.

The occurrence of this shell on Southern Yorke Peninsula is adventitious, the home of the shell being in much warmer seas. Tryon (1) gives the range generally as Polynesia, and specifically as embracing "the islands of the Eastern Archipelago, Erromanga, Aneitum, and other islands of the New Hebrides, and also the Feejee group." Woodward (2) gives its habitat as "Chinese Seas, Indian Ocean, Persian Gulf." Pelseneer (3) locates the specimen in the Indian and Pacific Oceans. The localities given by Woodward and Pelseneer are in marked contrast to those given by Tryon in respect to the Indian Ocean and Persian Gulf. Tryon would be supported by the range given by Willey (4) in his excellent and elaborate treatise, "Contribution to the Natural History of the Pearly Nautilus." The entire range of the species is here given as "Philippines, Moluccas, Bismarck Archipelago, Torres Straits, New Hebrides, and Fiji."

Previous Adventitious Occurrences.

Similar occurrences, although apparently all of dead specimens, have been noted on the Australian coast, in latitudes much higher than those of the home of the shell.

Menke (5), in 1843, reported the species as occurring very rarely near Port Leschenault. This locality is not mentioned in the "Australian Pilot." Mention is made of Cape Leschenault, and of Leschenault Inlet, near Bunbury.

Milligan (6), in 1850, reported the shell from the eastern coast of Van Diemen Land, and remarked "that as a perfect specimen of the same was obtained at Flinders Island some years ago, amongst a vast number of shells of the paper nautilus *(Argonautus argo)*, cast ashore there at same time, it may fairly be set down as an occasional inhabitant of these seas."

Angas (7), in 1877, recorded the shell at Coff Harbour, New South Wales.

Brazier (8), in 1877, reported it from Coogee Bay, and the mouth of the Bellenger River, New South Wales, and in respect to the first locality remarked, "I obtained one specimen at Coogee Bay, south of Sydney, thrown on shore after the great easterly gale of 1857."

Hedley (9), in 1893, exhibited a specimen found by Whitelegge, at Curl Curl Lagoon, near Sydney, and remarked that he had frequently seen it on the Queensland seaboard, and that it had been noticed by Mr. Johnson as wrecked on the Tasmanian coast.

Cox (10), in 1897, found "large numbers of rather broken specimens of *Nautilus pompilius* thrown up in Eden Bay," and remarked, "It is difficult to conceive how they get there; it is an enormous expanse to be drifted away from any of the Pacific Isles. Can it be possible that they are eaten by whales, and that the shells are extruded as excrement? I make this suggestion because great schools of whales come in there, it is said, to rub themselves on the coarse gravel bottom of the bay."

Migration and Drift.

Willey (11), in dealing with food and migration, says: "It is also desirable to remember that *Nautilus* obviously draws its supplies of food from the bottom of the sea, it is a ground feeder. . . . When *Nautilus* has been taken, as a great rarity, at the surface of the sea, it has, generally, if not always, been found that the specimen was in a more or less moribund condition. At the same time, with its known faculty for swimming and migration, . . . it is quite conceivable that an individual specimen might occasionally wander away from its home." It is quite probable, therefore, that if conditions of food and temperature were suitable, a migrating *Nautilus* would fully utilize ocean currents. Based on the range given by Willey, one would scarcely consider as probable a migration *via* the western coast of Australia. The one isolated statement by Menke is apparently the only record on the western coast, and then, presumably, of a dead specimen. At the same time, if there were evidence to show that *Nautilus* did migrate down the western coast, all other conditions are available to account for the specimen in Foul Bay, on Southern Yorke Peninsula.

A migration, however, along the warm Notonectian current, which sweeps past the home of the species, and then down the eastern coast of Australia, seems more probable.

Waite (12), in the "Thetis" Scientific Results, and Hedley (13) both discuss the question and cite cases of the migration of tropical life by this medium. This warm current is not at all superficial, the depth being given by Dannevig (14) as several hundred fathoms. By this medium the migrating *Nautilus* could well arrive at a position east of Bass Strait and Tasmania. How it could then travel westwards against the easterly current from the Great Australian Bight must be considered. Writing of the Notonectian current in 1910, Hedley (15) says, "Neither its origin nor its conclusion has been satisfactorily determined." It is well known that upon its being met by the easterly current from the Bight, in Tasman Sea, it is, in part, deflected towards New Zealand. As to whether a portion of its volume may continue as a warm submerged current with a westerly drift is still to be determined by accurate survey.(1) Dannevig (16) mentions the possibility of such a "deep sea circuit" in studying the migration of the mullet as one to be examined.

Reference is here made to the Bibliography appended for charts dealing with ocean currents affecting the Australian coast.

In discussing the distribution of asphaltum on the southern Australian coast, Ward (17) publishes a chart showing the distribution and trend of the principal currents. This chart apparently covers the observations of all previous charts, and is probably the most complete one issued to date. It takes into account the well-known eddy in the Great Australian Bight, which is not shown in the other charts. The Commonwealth Director of Navigation kindly referred the writer to the "Admiralty Monthly Current Charts." Attempts to see these have so far not been successful. From all the other charts, however, accompanying the articles, and

(1) Such a consideration may not appear physically sound. It is mentioned here on account of its advocacy by Dannevig.

as separates, referred to in the Bibliography, the one outstanding feature along the southern Australian coast is the strongly-developed easterly current. This, coupled with the absence of any knowledge as to a submerged westerly from the Tasman Sea, makes it apparently difficult to account for the live *Nautilus* in Foul Bay. Its position on the western side of the bay, however, suggests a westerly drift. The Australia Directory (18), dealing with ocean currents on the southern Australian coast, says: "From November to April, the easterly current abates in strength, and after a fresh easterly wind it not unfrequently changes its direction to the

Chart showing distribution and trend of Ocean Currents around Australian coast.
[After L. Keith Ward.]

north-westward." It goes on to point out how much the currents are modified by winds. Dannevig (19) makes similar observations of current reversal by wind in respect to the Notonectian current on the eastern coast. With this knowledge of the influence of wind on currents, the explanation of the last stages of the migration is more easily suggested. The time when the *Nautilus* came ashore was during the period when current reversal takes place.

Failing evidence in support of its western origin, it appears reasonable, therefore, to conclude, tentatively, that:—

1. The specimen was derived from the group of islands stated by Willey as its home.

2. It migrated thence to the Australian coast, and then southwards along the Notonectian current.

3. Its further passage from the Tasman Sea was accomplished during the summer period of prevailing easterlies, its final stages being assisted by the westerly shore currents set up by the eddy in the Great Australian Bight.

Acknowledgments.

The writer is indebted to the Government Geologist (Mr. L. K. Ward, B.E.) for permission to reproduce the block depicting the trend of ocean currents on the Australian coast; to Mr. C. Hedley for references to *Nautilus* occurrences on the New South Wales coast; and to Mr. E. R. Waite, Director of the South Australian Museum, for the reference to the work of Dr. Arthur Willey.

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Chitons of the D'Entrecasteaux Channel, Southern Tasmania, including Additions to the Tasmanian Fauna, and Descriptions of a New Species and a New Variety.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read July 8, 1920.]

Plate XI.

On March 22, 1920, Mr. W. L. May and myself left Hobart for Lunawanna, situated on the western side of South Bruny Island, in D'Entrecasteaux Channel, where we were most hospitably entertained by Mrs. Drake, of "Clovelly."

Except for some work done by Mr. May on the occasion of a brief visit paid previously to this spot and a little dredging at the north end of the channel, we believe no systematic chiton-collecting has previously been done in the Channel. It seems therefore desirable that the results of a few days' strenuous work in that locality should be placed on record. A little reefing was done *en route* for Lunawanna, at a spot a few miles north, called Alonnah. Advantage was taken of the low tides of the three following days to examine the chiton fauna both north and south of Lunawanna. On two days, the afternoon as well as the morning tides were tried, but we found that at daydawn the latter was much lower than the former, and the finds were proportionately greater.

The night of the 25th was spent at a place named Woodbridge, much further north, though still in the Channel. Next morning we were in the water as soon as it was light enough to see, working for four hours on what we took to be an exceptionally low tide, with some very interesting results. The extreme cold of the water, and the heavy igneous rocks that had to be lifted out of the water and turned over, added much to the difficulty of our work.

While the number of species obtained in the Channel may not be considered exceptionally large, many good forms were obtained, also the negative results were nearly as interesting as the positive ones.

Species collected at Lunawanna.

Eudoxoplax inornatus, Ten. Woods. While no true *Callochiton* was found in this part of the Channel, a nice series of *Eudoxoplax inornatus* was obtained. When alive the rich orange colour of the underside and girdle gives a rich ruddy tinge to the upper side. This is always a striking chiton, very flat, with widely expanded girdle which puckers in drying. At present it is only recorded from Tasmania, and originally described from the northern side of the island; the locality under review extends its range almost to the extreme south.

Ischnochiton atkinsoni, Ire. and May, was fairly common, and varied from the typical reddish-brown form to a creamy-white one. As compared with *I. crispus*, Reeve, they are always a small chiton, and their station is in decidedly deep water in Tasmania.

Ischnochiton proteus milligani, Ire. and May. Only one somewhat worn specimen of this shell was taken. While it is fairly common at Port Arthur, it looks as if Lunawanna is the extreme limit of its habitat westward and southward.

Ischnochiton iredalei, Dupuis, non *lineolatus*, Blainville. A series of this form was collected, mostly rather old and worn.

Ischnochiton (Haploplax) mayi, Pilsbry. Quite a common species, seldom met with below half tide; its almost circular shape and deep-black colour easily separates it from any other known species.

Ischnochiton (Haploplax) mayi, var. *viridis*, n. var. A very striking variant from the foregoing black form is met with at Lunawanna, and seems peculiar to the southern end of D'Entrecasteaux Channel. The shell is pale green and the girdle jet black. While it is so distinct in outward appearance from the typical shell a careful examination of the sculpture and girdle scales reveals no radical differences from the usual black form. It is interesting that a form that everywhere else seems so constant in both colour and sculpture should in this locality have such a distinct local race.

Ischnoradsia australis evanida, Sow. This chiton, with the exception of *Sypharochiton pellisserpentis*, Q. and G., which, in respect to numbers, runs it very close, was by far the most common species in the locality and there attains a very large size; specimens were taken up to 90 mm. in length, but these large ones were always more or less eroded. They vary from the almost smooth form, common in North-western Tasmania and South Australia, to those in which almost the whole of the pleural area is covered with longitudinal ribbing, and some, in which the ribbing is carried across the dorsal area. In none of them was this sculpture quite as coarse as is the case with the Port Jackson specimens, that being the type locality for the dominant form *I. australis*.

Ischnochiton (Heterozona) sub-viridis, Ire. and May. This species was very numerous in this locality; it appears to replace *I. crispus*, Reeve, which is the common species in the northern and eastern coasts of Tasmania, and from which this species is easily distinguished by its erect girdle scales. Nearly all the larger specimens were considerably eroded.

Plaxiphora albida, Blainville, and *P. costata*, Blainville. These two species were living together at Lunawanna on the sides and upper sides of large rocks at low water. While all were covered with growth, many of them were in a state of good preservation. The vermiform marking or ribbing of the former is in some specimens barely traceable, suggesting a possible transition from one species to the other, but to decide this point will need a more extensive investigation than the extent of this paper or the time available permits. Mr. W. L. May writes me, "My experience is that, generally, *albida* is found in more sheltered situations. I have frequently seen *costata* of large size on the outside rocks, exposed to the full force of very heavy surf, as at Eagle Hawk Neck, *albida* being quite absent. At the same time, from shell characters only, it is difficult to keep them separate."

Kopionella, Ashby. A nice series was met with, but will be dealt with further on in this paper.

Acanthochiton sueri, Blainville, was very common at a shallow depth; a few were large with extremely wide girdles.

Acanthochiton bednalli, Pilsbry. A few specimens were taken in rather deeper water than the former species.

Acanthochiton (Notoplax) costatus, Ad. and Ang. One very fine specimen was collected close to Lunawanna Jetty; the girdle was of great width when alive, but shrinks much in drying. The dry shell measures 24 × 14 mm.

It will be seen that I have placed this species under the sub-genus *Notoplax* instead of *Macandrellus*, Dall., he having adopted Carpenter's name *Macandrellus* for an *Acanthochiton* having no spicules on the girdle, citing *A. costatus* as type of said genus. As well-preserved *costatus* from the type locality have small spicules distributed over the girdle, I can see no justification for separating them from the genus *Notoplax*. Dr. Torr's species, from South Australia, is only differentiated from *A. costatus* by the girdle being clothed densely with coarse spicules, and therefore *A. rubrostratus*, Torr, must be considered a sub-species of *costatus*. The Tasmanian form under review is freely covered with very small spicules of the same character as the Sydney specimens, but more numerous.

Rhyssoplax oruktos, Maughan, although evidently rare, several were secured at lowest tide, or nearly so. One interesting feature, before unrecorded, is that in the juvenile form the characteristic pitting is quite absent, so much so that they might easily be mistaken for *R. translucens*, Hed. and Hull, suggesting that both have the same ancestry.

Sypharochiton pellisserpentis maugeanus, Ire. and May. This, as before remarked, was one of the most numerous species and most variable, many being handsomely mottled with white, and one, almost entirely white, whereas others were almost black. There was a great variation in sculpture also, from strong ribbing throughout the pleural areas to those in which this area was practically smooth. I cannot help questioning the wisdom of separating the Tasmanian shell from *pellisserpentis*, Q. and G., for its exceptional habit of variability, both in sculpture and colour markings, suggests that there are no constant sub-specific differences.

Lorica cimolea, Reeve. One or two specimens only. No doubt rather rare in this locality.

Additional Species collected at Woodbridge.

Woodbridge is, as before stated, much further north, though still in the Channel, and while most of the species collected at Lunawanna were found here, there were some notable exceptions and some very fine additions.

Among the exceptions may be cited that of *Rhyssoplax oruktos*, Maughan, and the green variety of *Haploplax mayi*, Pilsbry, neither of which were here present. No specimen of *Acanthochiton costatus* was found, but it is evidently a rare, species, generally. It is quite possible that a further search at Woodbridge would reveal it. The most noteworthy find at this place was that of three different species of the genus *Callochiton*. This probably easily constitutes a word's record; three distinct species of this genus at the same locality on the same day.

Callochiton platessa, Gould. One small and rather abnormal specimen was found. Instead of the regular convexity of the median valve the outer half is flattened or slightly concave.

Callochiton mayi, Torr. One specimen of this striking and rare species was found here and thereby considerably extending its range. Mr. May writes me that he dredged it in about nine fathoms off Pilot Station, just within the northern end of the Channel; it is doubtless a deep-water shell. The only other locality in Southern Tasmania known is Port Arthur, and there it is very rare.

Callochiton elongatus, May. This striking diminutive Callochiton, with its spoon-shaped girdle scales, has previously to this find, been only known to occur at Port Arthur and Norfolk Bay, and then only taken by Mr. Mawle, who supplied them to Mr. May for description. The girdle in life is broad but very thin and delicate, the general colouration of both shell and girdle being a bright pink, forming a perfect colour protection as they occupy slight hollows in the pink calcarious algae that encrust the rocks.

Eudoxoplax inornatus, Ten. Woods. Although we found one or two specimens it is evidently rarer than at the more southerly locality.

Callistochiton mawlei, Ire. and May. Three specimens were found in the deepest water reached, an interesting extension of its habitat; previously it had only been recorded from Port Arthur and Norfolk Bay.

Acanthochiton gatliffi, Ashby. A very fine specimen of this rare Acanthochiton was obtained, making the first record for the State of Tasmania. When dry it measures just over 8 mm. in length and 4 mm. in width. The method of sculpture is quite typical, the delicate pink colour of the type is quite absent; in this the ground-colour is cinnamon-brown, blotched with darker brown. A large percentage of the granules of the dorsal area and the large flat pustules of the other areas are white, from opaque-white to semi-transparent white, but some are very dark brown. So many of the interspaces were filled in with sand granules that, until they had been cleaned away by boiling, the identification was quite uncertain. The shell was found on the upper side of a rock brought up at the lowest tide by Mr. May, and I recognized it at once as one of our rare *Acanthochitons*. With the exception of the specimens I collected at Port Lincoln in South Australia, the only other known ones have been found in Victoria, which makes this a very interesting addition to the fauna of Tasmania. The median valves in the specimen under review are not as "bow shaped" on the posterior margins as are the Victorian specimens, but are almost straight, except for the beak, which is normal.

Amaurochiton glaucus, Gray. A few specimens were found here in fairly shallow water. This is probably the southern limit of its present range. At Bellerive, opposite Hobart, it is very numerous, and is believed to have been originally introduced with ballast from New Zealand over thirty years ago. The ballast was unloaded at Bellerive, and this chiton has increased most extensively in that locality, and has slowly extended its range down the Derwent and in at the entrance of the D'Entrecasteaux Channel until it has reached as far as Woodbridge. It will be very interesting to watch the extension of its habitat, by which it will be possible to compute the rate a species may extend its range under favourable conditions.

. Mr. May writes me as follows:—"It might be well to add that in addition to the species we collected, the following are known to occur in the Channel: *Ischnochiton falcatus*, *Lepidopleurus*, sp. indet.; and *Acanthochiton speciosus*, H. Adams; all dredged in 9 fathoms off Pilot Station, and also at the same depth between Alonnah and Gordon in mid channel."

"Although it seems unlikely that the chiton fauna will be greatly increased, yet it is probable there are some species still to be found, when we consider the great extent of the coastline and that there are several absolutely land-locked bays, the sort of localities loved by Acanthochitons. It seems reasonable to expect a few of these. Possibly others may occur, such, for instance, as *Loricella*, which is found at Port Arthur, and *Rhyssoplax diaphora*, Ire. and May, which has been taken in the vicinity of Brown River."

In conclusion.—The absence of *Ischnochiton crispus*, Reeve, from the Channel is remarkable, and suggestive that its range westward ends with the mouth of the Derwent. At Frederick Henry Bay and Port Arthur it is very numerous and of exceptional size, and on the northern coast of Tasmania, in Victoria, and eastern South Australia, it is the common chiton. I wish to acknowledge the able help of my colleague, Mr. W. L. May, the well-known conchologist, for the results of the collecting trip would have been far inferior but for his co-operation. The types of *Kopionella tasmanica* and *Haploplax mayi*, var. *viridis*, I am presenting to the South Australian Museum.

Mopaliidae, Pilsbry.

Kopionella tasmanica, n. sp.

In my description of the genus *Kopionella* (Trans. Roy. Soc. S. Austr., vol. xliii., 1919, p. 70) I foreshadowed the probability of the Tasmanian form being ultimately found to be specifically distinct from *K. matthewsi*, Iredale. Now that Mr. W. L. May and I have collected a complete series of fresh, undamaged specimens, I am able to demonstrate the correctness of this surmise. I would take this opportunity to correct the closing paragraph in the same paper which compares the genus *Loricella* with the *Mopaliidae*, it should have been between the former and *Plaxiphora*.

General Appearance.—Shell broad, rather flat, sides slightly rounded, dorsal area raised and beaked, lateral area clearly defined by two raised ribs, girdle beset with spicules, the whole shell usualy covered with a dense growth of algae.

Colour.—When wet a bay-brown (Ridgway's Colour Standards, pl. ii.m.), in others claret-brown, ornamented with two broad, longitudinal, white dashes or stripes across the pleural area; in some valves two additional incipient stripes are discernable. In some specimens these stripes are green or greenish-white. In specimens from Little Norfolk Bay the white longitudinal dashes are more numerous and towards the dorsal area quite crowded. In one specimen the whole of one valve is green and others are blotched with green. Most of those from that locality exhibit a large amount of pink; in these the beak is pink, this colour spreading over fully one-third of each valve. These specimens are extremely pretty, striped with white, banded with brown, extensively washed with pink and blotched with green. The pink shade seems near to what is described in Ridgway (plate as above) as salmon-orange.

Anterior Valve.—Slope steep, 9 raised radiating ribs, which, with the two posterior margins, are composed of a series of large, flattened, more or less circular pustules, smaller at the apex, and increasing rapidly towards the margin. These pustules give a crenate appearance to the margin of valve at the suture. Inside, white tinged with greenish-blue, slits 8, edges of teeth rounded and thickened, some show slight notching.

Posterior Valve.—Valve small, mucro-terminal, elevated, sinus below, a thickening extending from the mucro forwards to near the anterior margin. A bow-shaped continuation of the tegmentum extends behind the diagonal rib, downwards. The anterior margin on many specimens also shows thickening. Except for grooves following the growth-lines, unsculptured. Inside sinus wide, anterior margin of sutural laminae parallel with margin of tegmentum and almost straight, white tinged with greenish-blue, unslit, with a broad sinuosity under the upturned tail.

Median Valve.—Beaked, side slope rather flat, in some slightly rounded; dorsal area raised towards the posterior margin and rounded, defined by a pale wedge-shaped mark which is closely subgranulose; in places, these irregular longish granules are defined, in others they are coated over with a smooth outer coating. The lateral area is defined by two raised ribs composed of coarse, flattened, elongated protrubrances or pustules, set on a diagonal, well defined on the posterior margin, but on the other rib ill-defined, although distinctly raised. The space between these ribs is smooth, or almost so, but not polished. The pleural area is in the type specimen occupied by a series of coarse, broad, wavy ribs separated by irregular wavy sulci. This method of sculpture suggests "ripple marks" on a sandy sea beach. Inside, white tinged with greenish-blue, 1 slit, which is deep and well defined, pillared or produced upwards under the eaves at each side of slit. The eaves are defined, but the insertion plates are produced beyond the eaves.

Girdle.—When cleaned by boiling the girdle is found, under a magnification of 28 diameters, to be covered with a dense mass of minute granules or scales, and is banded white and brown; it is also beset with three forms of spicules: (1) bunches of coarse, horn-coloured, pointed spicules at the sutures, placed similarly to those of an *Acanthochiton*, like bunches of spicules, are scattered indiscriminately about the girdle. (2) A fringe of lance-shaped white spicules, smaller lance-shaped scales cover a good deal of the under side of the girdle. (3) Long, slender, pale-brown spicules, surmounted with lance-shaped heads of porcelain-white. These are dealt with more particularly in the following paragraph.

"Oar-headed Spicules." — These spicules, in the form under description, differ from those of *K. matthewsi*, Iredale, in that the "heads," while porcelain-white and polished, similar to that species, are different in shape, being smaller, more slender, and tapering. They remind one more of a stiletto than an oar-head. On the average these spicules appear to be longer and proportionately more slender, though this may be more apparent than real.

These lance-shaped heads, mostly, seem equally rounded on each side and straight, whereas those in the other species are flat on one side and curved like the blade of a scull. Practically all the specimens taken in the D'Entrecasteaux Channel, and most of those taken by Mr. May in Little Norfolk Bay, have these spicules present as well as the clusters of coarse spicules and fringe spicules. The lance-headed spicules are attached to the girdle either amongst the fringe spicules or just above them. As we took great care with the Channel specimens not to so clean off the vegetable growths that cover them as to break off these spicules, we may conclude that they are well preserved. A comparison with the South Australian species, taken at Marino, reveals the fact that the "oar-headed" spicules are much less numerous in the Tasmanian species than in the South Australian. The specimens examined vary in length from 6 mm. to 36 mm., all sizes, equally, having this feature present.

Measurements.—As before stated, those examined vary from 6 mm. to 36 mm., the latter being 21 mm. in width. The smaller ones are usually about three-quarters as wide as long, giving a flattened, rounded appearance to the chiton. In the type the median valve is 12 mm. from side to side, anterior valve 8 mm., posterior valve under 6 mm.

Radula is furnished with tri-lobed teeth, the central one broader and slightly longer than the two lateral, but seems slightly narrower than is the case in the South Australian species.

Hab.—Mr. W. L. May (to whom I am greatly indebted in connection with this investigation) and I found them both at Lunawanna and Woodbridge, in the D'Entrecasteaux Channel, and I took one on the Sandford Beach, Frederick Henry Bay, and Mr. May has taken them at Little Norfolk Bay and Port Arthur, all in southern Tasmania. The chitons were found on the sides of rocks that could only be reached at lowest tide and are almost always covered with a dense growth of algae, the removal of which requires the greatest care, or the delicate "oar-headed" spicules will be broken off. In addition the sculpture is often hidden under calcareous growths.

Variation.—The series shows a very wide divergence in sculpture. The specimen selected as type may be considered as an example of the most extensively sculptured variety, and those from Port Arthur the extreme in the opposite direction. The Port Arthur shells, while they have the two strongly-raised lateral ribs, exhibit nothing of the flattened, elliptical pustules of the more sculptured form, beyond slight undulations. The space between the two ribs is smooth and free from sculpture. The same absence from sculpture is common to the pleural and dorsal areas, but the ray ribs of the anterior valve are well raised and give a little evidence towards the outer margin of the pustulose character. Intermediate forms, between the highly-sculptured type and these almost unsculptured specimens from Port Arthur, occur both at Little Norfolk Bay and in the D'Entrecasteaux Channel, but most give some evidence of flattened, broad, wavy ribbing in the pleural area which I have likened to ripple marks.

In conclusion.—Owing to the variable character of the sculpture in different specimens I have had more than ordinary difficulty in determining the constant specific differences that distinguish this species from the Marino and other South Australian shells. It is possible that we have living in South Australian waters two species, for the highly-carinated specimen I collected at Port Lincoln, and referred to in my paper (Trans. Roy. Soc. S. Austr., vol. xliii., 1919, p. 71), was treated so roughly in scrubbing off the growth that none of the delicate spicules are left, and it is impossible at present to link it with either *K. matthewsi*, Iredale, or the Tasmanian species now under description. The Tasmanian shell may be distinguished from *K. matthewsi*, Iredale, by (1) the slender, tapering lance shape of the "oar-headed spicules," this feature being constant from the smallest up to the largest specimens; and (2) the sculpture is less raised and prominent, the large, rounded, erect pustules of *K. matthewsi* are, in this species, flattened as if a plane had been passed over them. The general appearance, in spite of its variability, is quite distinct.

A Review of *Chiton crispus*, Reeve, (Order Polyplacophora) and its Allies, with Proposed Recognition of Blainville's *Chiton lineolatus*, and Description of Three New Species.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read September 9, 1920.]

Plates XI. and XII.

Whilst most Australian workers have been aware that under the name of *Ischnochiton crispus*, Reeve, several indetermined species have been bulked, no real attempt has been made to separate these forms and define their specific or subspecific differences to assign their respective habitats. I did a good deal of preliminary work prior to July, 1919, and my thanks are due to Mr. W. L. May, who kindly examined a good deal of my material, and then expressed the opinion that there were four different species living together at Marino, in this State, and usually classed as one. My thanks are also due to Dr. W. G. Torr for material from St. Francis Island and Western Australia; to Mr. A. F. Bassett, Hull, for additional specimens from Port Jackson; and to Dr. John Shirley, for specimens from Caloundra.

The extreme variability in pattern and colouration and, to a lesser degree, in sculpture, of the group of shells we have hitherto designated as *Ischnochiton crispus*, Reeve, has made this one of the most tedious investigations I have attempted.

The use of a good binocular microscope was essential to the task, which has entailed the examination of some thousands of specimens from a great number of localities, extending from Caloundra, in Queensland, to Esperance, in Western Australia, and from many parts of Tasmania.

I propose to recognize *Chiton lineolatus* of Blainville in the large-scaled *Ischnochiton* of Tasmania, Victoria, and parts of South Australia, and to recognize *Ischnochiton crispus* of Reeve in the New South Wales shell, classing it as a subspecies of the former. Iredale and May's *Ischnochiton atkinsoni*, *senu stricto*, is recognized as confined to Tasmanian waters, in both sculpture and colouration, showing very little variation. Then I define, as a sub-species of this latter, under the name of *lincolnensis*, Ashby, a form which is more variable and whose range extends from Victoria to Western Australia. A new species with minute scales is described under the name of *Ischnochiton auratus*, Ashby, and another new species with erect scales under the name of *Ischnochiton properensis*, Ashby. A special paragraph is devoted to the juvenile forms of several species, as these differ so widely from the adults that they have continually been confused.

Ischnochiton lineolatus, Blainville (*Chiton lineolatus*, Blain., Dict. Sci. Nat., p. 541), non. *I. lineolatus*, Blain., of Ire. and May = *C. longicymba*, Blain., of Quoy and Gaimard = *I. haddoni*, of Pilsbry = *I. crispus*, Reeve, of Bednall = *I. crispus*, Reeve, of Torr.

Pilsbry (in Man. Con., vol. xv., p. 105) publishes a translation, and Ire. and May (Proc. Mal. Soc., vol. xii., pts. ii. and iii., p. 107) publish Blainville's original description. Ire. and May recognized *Ischnochiton contractus*, Reeve, of Pilsbry, as conspecific with Blainville's *Chiton lineolatus;* but Dupuis (Ex. Bull. Mus. Hist. Nat., 1918, No. 7) says, "Mr. Tom Iredale puts forward some ingenious hypotheses with regard to the synonymous rectification to be applied to several species, for exmple the *Chiton longicymba*, Blainville (I agree with him on this point), and the *Chiton lineolatus*, Blainville. Here the facts contradict his presumption. According to him the *C. lineolatus*, Blainville, must be the *Ischnochiton contractus* of Pilsbry, 1895, *et auct.* (non Reeve, 1847). Now the specimen of de Blainville, brought from King Island by Peron and Lesueur, is certainly not this species, but rather the *Chiton crispus*, Reeve, a species to which the description of de Blainville may otherwise be well applied. According to Iredale the typical *Chiton crispus* must be from New South Wales. It is certain that the *Ischnochiton contractus*, *auct.*, is not the *contractus*, Reeve, any more than it is the *lineolatus*, Blainville; the latter is the *Ischnochiton* of South Australia and Tasmania which has been regarded as *I. crispus*, Reeve, and which Iredale proposes as a distinct species under the name of *I. decoratus*, Sykes." M. Dupuis then names *I. lineolatus*, of Ire. and May, *Ischnochiton iredalei*, Dupuis, under which name it will now be known.

I am satisfied that the views expressed by M. Dupuis are sound. I therefore propose to recognize Blainville's *lineolatus* in the form common to Tasmania, Victoria, and South Australia, bearing large girdle scales, coarsely fluted (*auct. crispus*, Reeve).

The only alternative, as far as I can see, would be to recognize Ire. and May's *I. atkinsoni* as Blainville's species, but it is quite clear that his description could not apply to the Tasmanian form of that shell, and, further, the large-scaled form was very common at Penguin, in north-western Tasmania, but I did not see a single specimen of *I. atkinsoni*, so, probably, it is a rare form in northern Tasmania. It is probable the same applies to King Island, which I have not visited.

Distribution.—I have pointed out in a previous paper that the shell under review occurs in the mouth of the Derwent, in Tasmania, but does not occur in the D'Entrecasteaux Channel. From the Derwent it extends round the eastern and northern coasts of that island; is common in Victoria, from Port Phillip, westward, reaching its western limit in Gulf St. Vincent, in South Australia. In Frederick Henry Bay and Port Arthur, in southern Tasmania, it appears to attain its highest development. I have specimens measuring 36 × 17 mm., and Mr. May has still larger ones, but the Victorian and South Australian open coast specimens are also often very fine; but in Gulf St. Vincent, although very common, it shows a distinct falling off in size, but maintaining the same characteristics as those from the localities previously named—of course the sculpture in these smaller specimens is proportionally less strong.

Ischnochiton crispus, Reeve (Con. Con., Reeve, pl. xix., fig. 120). The following is Reeve's description:—"The Crisped Chiton (Cuming Museum).—Shell elongately ovate, terminal valves, and lateral areas of the rest finely, decussately, crenulately crisped, central areas smooth, or under the lense very minutely reticulated; olive-green thickly painted with dots of a dark colour, ligament minutely, granulosely coriaceous, obscurely tesselated. Habitat, Australia. Note.—Allied to *C. longicymba*, but distinguished from that species by the minute decussated character of the sculpture of the lateral areas. May, 1847."

I propose to recognize in the New South Wales form Reeve's *Ischnochiton crispus*, which will be a sub-species of *Ischnochiton lineolatus*, Blainville. Reeve's figures are very good, and there can be no doubt as to the shell. It is similar in its remarkable range of marking and colouration to the southern form, and, if anything, in some specimens even more delicate in its colours. The sculpture is less coarse than is the normal character of that shell, Reeve's comment on the sculpture of the lateral areas being fairly appropriate, but the character of the scales on the girdle easily distinguishes it under a good binocular microscope, mag. 28 to 65 times; the flutes or ribs on the scales of the Sydney shell are narrower and the grooves correspondingly less deep, and although the scales are considerably larger than is the case with *I. atkinsoni*, Ire. and May, they are barely as large as those of *I. lineolatus*, Blainville, in shells of a corresponding size. I have collected it at Bulli and Port Jackson, and have been furnished with additional material from that place by Mr. Hull, and from Caloundra, in Queensland, by Dr. John Shirley. The largest specimen I have in my collection measures 30 × 13 mm.

Ischnochiton atkinsoni, Ire. and May (Proc. Mal. Soc., pts. ii. and iii., Nov., 1916, p. 110). The size of the type is given as 8 × 4·5 mm., and senile shell as 13 × 7 mm., and the range given in their paper as northern Tasmania. Since then Mr. W. L. May has taken it in Little Norfolk Bay, southern Tasmania, and he and I took it in considerable numbers in the D'Entrecasteaux Channel. This extension of its range is somewhat interesting, especially the latter, as there *I. lineolatus*, Blainville, was entirely absent. The sculpture is most consistent, the coarse granules being always in evidence in the dorsal area as well as on other portions of the shell. While there is some divergence in colour from dark-brown through buff to dirty-white, this divergence is within very restricted limits.

Juvenile shells of this species are in the D'Entrecasteaux Channel living with large numbers of juvenile *Heterozona sub-viridis*, Ire. and May, described in the same paper. If anything, *I. atkinsoni* prefers deeper water. Except by means of a good lense it is difficult to separate juveniles of these two species, as the characteristic girdle scales of *sub-viridis* only put in an appearance at a later age, but the dorsal area, in the latter, is smooth.

Ischnochiton atkinsoni lincolnensis, n. sp.

Living with *I. lineolatus*, Blainville *(auct. I. crispus)*, in Victoria at San Remo, and in South Australia at Encounter Bay, Cape Jervis, and Gulf St. Vincent, is a small-scaled *Ischnochiton* which was bulked with the large-scaled species, *I. lineolatus*, Blainville, until Ire. and May described from Tasmania *I. atkinsoni*. I have examined a very large series starting from Wilson Promontory, in Victoria, through the localities previously named; from Port Lincoln, where I collected a large series in January, 1917; from St. Francis Island, collected by Dr. Torr; from Venus Bay, collected by the writer, in February, 1910; and a few from Esperance Bay, in Western Australia, collected by Dr. Torr, which place seems the limit of its extension westward. From Port Lincoln, westward, *I. lineolatus*, Blainville, seems entirely absent, and its place is taken by the species now under review.

The following is a comparison with the Tasmanian shell:— The sculpture of *I. lincolnensis* in the pleural areas is similar in character to *I. atkinsoni*, Ire. and May, but is decidedly less coarse, and the umbo has a larger smooth area; the lateral areas hardly show any of the radial sculpture of *atkinsoni*, being fairly constantly ornamented by much raised concentric ribs, or undulations, the ordinary granulose sculpture between the ribs. The "coarse nodulose radials" of *atkinsoni*, as described in the original description, are usually absent in this sub-species. Ire. and May mention that the radials are "dominated by the concentric growth-lines." Under a simple lens the rugged character of the sculpture of the Tasmanian shell is most consistent, whereas the mainland shell always seems to have a polished appearance, and the granulose sculpture is less in evidence.

The girdle scales are the same size as in *atkinsoni*, and the ribbing on the scales is a little more finely cut; most specimens of the latter show rougher and thicker scales, but this difference is not absolutely constant.

Ire. and May in the original description of *I. atkinsoni* (Proc. Mal. Soc., vol. xii., pts. ii. and iii., 1916) state that the colour is "uniform buff," whereas Mr. May and I have collected it in southern Tasmania more often of a dingy grey, or greyish-white, with a buffish dorsal streak; others, again, are distinctly rufous.

The sub-species now under consideration shows a much greater range of variation. At San Remo, in Victoria, from which place I have a long series, a very wide range of variation exists. I quote from Ridgway's Colour Standards. Many are drab (pl. xlvi.), similar to the southern Tasmanian shells; others, again, are tawny-olive to verona-brown (pl. xxix.). Two specimens are prussian-green (pl. xix.), with a white dorsal band; another is dark grey with a white dorsal band. From Cape Jervis, in South Australia, are specimens varying from cream through pale-greenish shades to almost black with cream girdle. Then at Marino the prussian-green and a still more blue form occurs, also specimens ivory-white to buff. Then at Port Lincoln they vary from pale greenish, through grey shades and cream, orange-cinnamon (pl. xxix.), to chestnut.

In nearly all there is a characteristic pattern which may be described as a broad, central, lightish band with a crenulate darker band on each side; in a few cases this pattern is reversed, the central band being dark and the edging light. The girdle mostly shows banding.

Hab.—I am indebted to Mr. James Kershaw for specimens collected by himself at Wilson Promontory, Victoria, which place probably forms the eastern extension of its range, and to Dr. Torr for the examination of two small specimens from Esperance Bay, in Western Australia, which place is probably about the limit of its extension westward. It is rather a curious fact that all the specimens from these two widely-separated localities are creamy-white and show none of the variations so common in the intermediate localities.

Juvenile Forms.—For a long time both Mr. May and I have been under the impression that a number of small, broad, flattish shells of 6 mm. and under in length, with a uniform, shallow, granulose sculpture and smooth dorsal areas, were a distinct species; but on the examination of a very long series, I have come to the conclusion that they are the juvenile form of *I. lincolnensis*, Ashby. The smooth dorsal area in this juvenile form separating it easily from the juveniles of the dominant species from Tasmania.

Ever since February, 1910, when I collected a nice series of this shell at Venus Bay, South Australia, I have considered it a distinct species, but was unable with imperfect instruments to define its distinguishing characteristics. Practically none of the characteristic variations of colour pattern common to *I. lineolatus*, Blainville, and *I. crispus*, Reeve, are met with in this species.

Ischnochiton auratus, n. sp.

General Appearance. — Shell glossy, elliptical, subcarinated, arched, side slope rounded, half as wide as long, finely decussated.

Colour.—Type xanthine-orange, para-type orange-buff, Ridgway's Colour Standards (pl. iii.).

Anterior Valve.—Slope rather steep, slightly convex, evenly decussated, under × 28, with small, flat, polished pustules; in the outer half of valve these pustules run togther, in places, giving an ill-defined appearance suggestive of concentric arrangement or growth-lines.

Posterior Valve.—Mucro well defined, central, the anterior portion of valve and the part immediately behind the mucro minutely decussated and polished, but the mucro itself and surrounding portions almost smooth and very highly polished. The outer half of valve decorated with three concentric, more or less broken, coarsely pustulose ribs.

Median Valves.—Dorsal area not beaked, posterior part smooth and highly polished, this feature extending into the adjoining portions of pleural and lateral areas. Pleural area evenly and finely decussated, highly polished, the outer portion decorated with three concentric ribs of same character as posterior valve.

Girdle.—Clothed with minute, imbricating, flat, highly-polished scales, apparently smooth, but under 65 mag. there is a suggestion of fine scratching. The scales are mostly the same orange colour as the rest of the shell, but a few are buff-orange. The scales remind one of minute, thin, rounded-edged biscuits with the sides uppermost. I can see no girdle fringe on the type, but there is one present in the juvenile specimen collected at Venus Bay.

Measurements.—Type a little more than 8 × 4 mm., the para-type 9 × 4½ mm., girdle rather incurved.

Hab.—Two specimens collected by myself at Marino, South Australia, and one only, 4½ mm. in length, I collected at Venus Bay in February, 1910.

In Conclusion.—This is evidently a rare species; the only striking general characteristic is its rich orange colour and highly-polished surface. It is easily confused with juvenile *Heterozona cariosus*, Pilsbry, but the scales in that species are larger and definitely ribbed. The smallness of the scales, as well as their being unribbed, will separate it from juveniles of *lineolatus*, Blainville, and *lincolnensis*, Ashby, and whereas *I. torri*, Ire. and May, has scales about as small they are always striated, and the shell of this latter is rounded, not sub-carinated.

ISCHNOCHITON (HETEROZONA) PROPERENSIS, n. sp.

General Appearance.—Dingy brown, about twice as long as broad, sub-carinated, flat, side slope slightly rounded, coarsely decussated, and lateral areas concentrically ribbed.

Colour.—More or less Saccardo's umber all over (Ridgway's Colour Standards, pl. xxix.).

Anterior Valve.—Upper fourth, finely decussated, radially ribbed with about forty closely-packed, broken ribs, several clearly-marked growth-lines in evidence, becoming more raised towards the outer margin.

Posterior Valve.—The anterior portion definitely separated from the rest by diagonal lines; this portion, as well as that immediately below the mucro, strongly decussated or granulose, the posterior portion concentrically ribbed with four rows of coarse pustules, remarkably regular, and looking like a string of beads.

Median Valves.—Lateral areas raised, concentrically ribbed with about 10 strongly-raised ribs which are broken by about 8, fairly deep, equidistant, radial grooves, with the result that the concentric ribs are broken into coarse, squarish pustules. Pleural and dorsal areas are coarsely decussated with a system of closely-packed flatish pustules.

Girdle.—Is broad, covered with rather large, finely-striated scales, placed at a more or less erect angle and barely imbricating; they are not pointed as in *cariosus*, Pilsbry; the striae are not carried to the apex—this latter is smooth. As compared with *I. lincolnensis*, Ashby, they are much larger and more clumsy. The semi-erect character of the scales gives them a chaffy appearance, and distinguishes this *Ischnochiton* from any of our other true *Ischnochitons.*

Hab.—I collected the type and one or two other specimens near Port Lincoln, in South Australia, in January, 1917, near the head of an almost land-locked bay, called Proper Bay. I did not meet with it elsewhere.

In Conclusion.—I submitted the type and foregoing description to my friend, W. L. May, for his comments, and select from the latter the following:—"I think your shell is a new species of *Heterozona*, as represented by *sub-viridis*, Ire. and May, with a typical *sub-viridis* girdle but the sculpture of *I. atkinsoni*, Ire. and May." Thinking that this comment will be helpful I have quoted it, and also adopt his suggestion to include the species under the sub-genus *Heterozona*, for the erect character of the scales certainly suggests affinity therewith, also the outer scales are small, increasing to large scales near the shell; but in the species under review, although somewhat irregular, the large scales do not appear in the midst of the smaller ones, nor are they as pointed or prominent as in typical members of this sub-genus, but are similarly finely striated. I conclude, therefore, that it is a slightly modified form of *Heterozona.*

Note.—Just as I was leaving for America, in May, 1918, I had hurriedly to close up the papers I was then writing on Polyplacophora, and wishing at the time to recognize the work done by Mr. F. L. Saunders by naming a species after him, I selected a striking specimen from my collection, giving a brief description only, under the generic name of *Anisoradsia.* I had at that time no opportunity of making a careful examination with a good instrument. On returning from America I felt dissatisfied with the generic identification and sent the type to Mr. Tom Iredale for comparison with a similar specimen I had sent him in 1917, and asking for his opinion.

In the investigation of material for purposes of this paper I have found features connected with *Heterozona cariosus*, C. and P., which lead me to conclude that the shell I named *Anisoradsia mawlei saundersi*, Ashby, was a divergent form of that shell. Until the type is returned to me this must remain an open question.

I have now received a reply from Mr. Tom Iredale, dated July 7 last, in which he says, "The form *saundersi* appears to belong to *cariosus*, but I have not definitely settled it." This rather confirms my surmise. (See note Trans. Roy. Soc. S. Austr., vol. xliii., 1919, p. 73.)

Juvenile Forms.

It appears that very little has been done in the identification of the juvenile forms of the various species of Australian chitons. In the course of my investigations I have found that it is no unusual thing for the chiton in its juvenile stage to differ so widely from the adult that it has been classed as a different species. Thus the distinguishing features of the adult are often entirely absent in the young, and the juveniles of widely-separated forms have been confused together.

I now add some notes on this subject, my conclusions being founded on the examination of a very long series and from a large number of different localities:—

I. atkinsoni, Ire. and May, and *H. sub-viridis*, Ire. and May.—Juveniles of these two rather widely-separated forms are found living together in southern Tasmania, and are difficult to separate. The smooth dorsal area of the latter separates it from *atkinsoni*, and the scales of *atkinsoni* are larger and more strongly striated.

I. atkinsoni lincolnensis, Ashby.—The juvenile form has the whole of the dorsal area smooth; all other areas are finely decussate, and the shell, proportionately broader than the adult form, is often rich buff, sometimes pure white. This was the shell that was wrongly identified as *I. pura*, Sykes, in my 1918 Distribution List. This species always has striated scales, whereas in *I. pura* they are smooth.

Heterozona cariosus, Pilsbry.—Juveniles of this species up to a very considerable size—anyhow up to 12 mm. in length—show none of the large pointed scales which are the distinguishing character of the genus.

These juvenile shells have been classed as "red or orange," *I. crispus*, Reeve, by most collectors, and, latterly, as *I. atkinsoni*, Ire. and May, they having in common with that species small, finely-striated scales. They can be separated from *I. lincolnensis*, Ashby, by their lack of carination, the shell being evenly arched, and also by the scales not being bent over. In size and shape the scales are very similar.

Some six months ago I examined the shell that is recorded by Dr. Torr (Trans. Roy. Soc. S. Austr., vol. xxxvi.,

1912) as *Ischnochiton greyi*, Filhol, and which had been sent to Mr. Suter and identified by him as his New Zealand shell, *I. fulvus*, both the foregoing names beng synonyms for *campbelli*, Filhol. I compared it with this species, with which it certainly does not agree, and my note goes on to say, "This is really Ire. and May's *I. atkinsoni*, as the scales correspond with that species." It is just possible that it may be one of these larger juveniles of *H. cariosus*, Pilsbry. It is certainly referable to one or the other of these two species.

Summary.

Name.	Habitat.	Distinguishing Characters.
Ischnochiton lineolatus, Blainville	Gulf St. Vincent. S. Austr., to San Remo, Vict.; north, east, and south coast Tasmania to River Derwent	Large scales on girdle with broad, much-raised fluting
I. lineolatus crispus, Reeve	Bulli, N.S. Wales, to Caloundra, Q'land	Rather smaller scales, fluting narrower and less raised
I. atkinsoni, Ire. and May	North, east, and south Tasmania	Small, finely-striated scales, decussate sculpture very strong
Heterozona sub-viridis, Ire. and May	Tasmania and Vict.	Juvenile shell arched, dorsal area smoother, scales small, finely striate
Ischnochiton atkinsoni lincolnensis, Ashby	From Wilson Promontory, Vict., to Esperance Bay, W. Austr. Takes the place entirely of *lineolatus* westward of Port Lincoln	Scales similar to foregoing, dorsal area smoother, decussate sculpture generally less strong
I. auratus, Ashby	Gulf St. Vincent and Venus Bay, S. Austr.	Scales minute, practically smooth, orange, highly polished
Heterozona cariosus, Pilsbry	Tasmania, Victoria, S. Austr., and W. Austr.	Juvenile shell arched, not carinated
Ischnochiton (Heterozona) properensis, Ashby	Pt. Lincoln, S. Austr.	Scales medium size, finely striated, erect, decussate sculpture rather coarser than *lincolnensis*

DESCRIPTION OF PLATES.

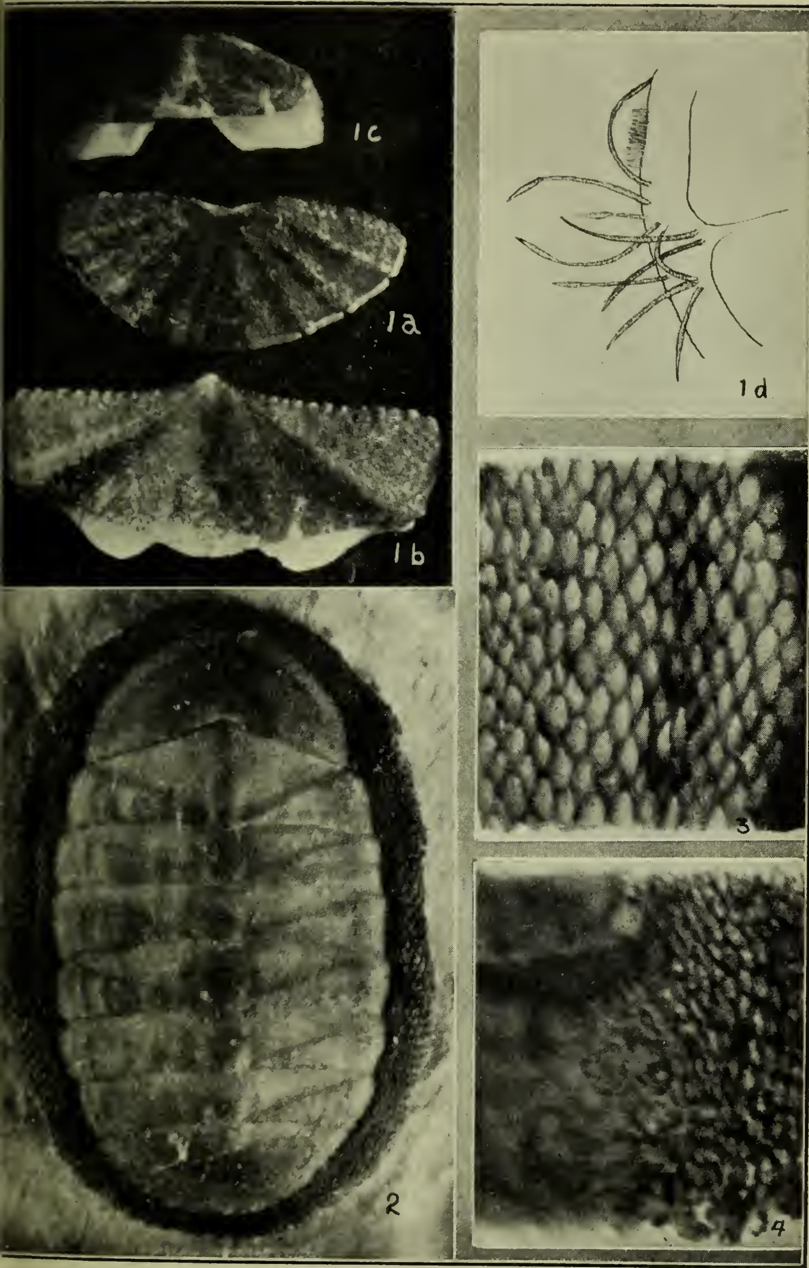
Plate XI.

Fig. 1*a*. *Kopionella tasmanica*, Ashby, anterior valve, ×5.
,, 1*b*. ,, ,, ,, median valve, ×5.
,, 1*c*. ,, ,, ,, posterior valve, ×5.
,, 1*d*. ,, ,, ,, showing 3 classes of girdle spicules.
,, 2. *Haploplax mayi*, var. *viridis*, Ashby, shell, ×10½.
,, 3. *Ischnochiton lineolatus*, Blainville, showing girdle scales, ×28.
,, 4. ,, *crispus*, Reeve, showing girdle scales, ×17.

Plate XII.

Fig. 5*a*. *Ischnochiton atkinsoni lincolnensis*, Ashby, shell, ×6.
,, 5*b*. ,, ,, ,, ,, showing girdle scales, ×28.
,, 6*a*. ,, *auratus*, Ashby, shell, ×8.
,, 6*b*. ,, ,, ,, showing girdle scales and anterior valve, ×28.
,, 7*a*. ,, *properensis*, Ashby, shell, ×4½.
,, 7*b*. ,, ,, ,, showing girdle scales, ×28.

Note.—The girdle scales with one exception are the same magnification, thus showing the relative sizes of the scales.



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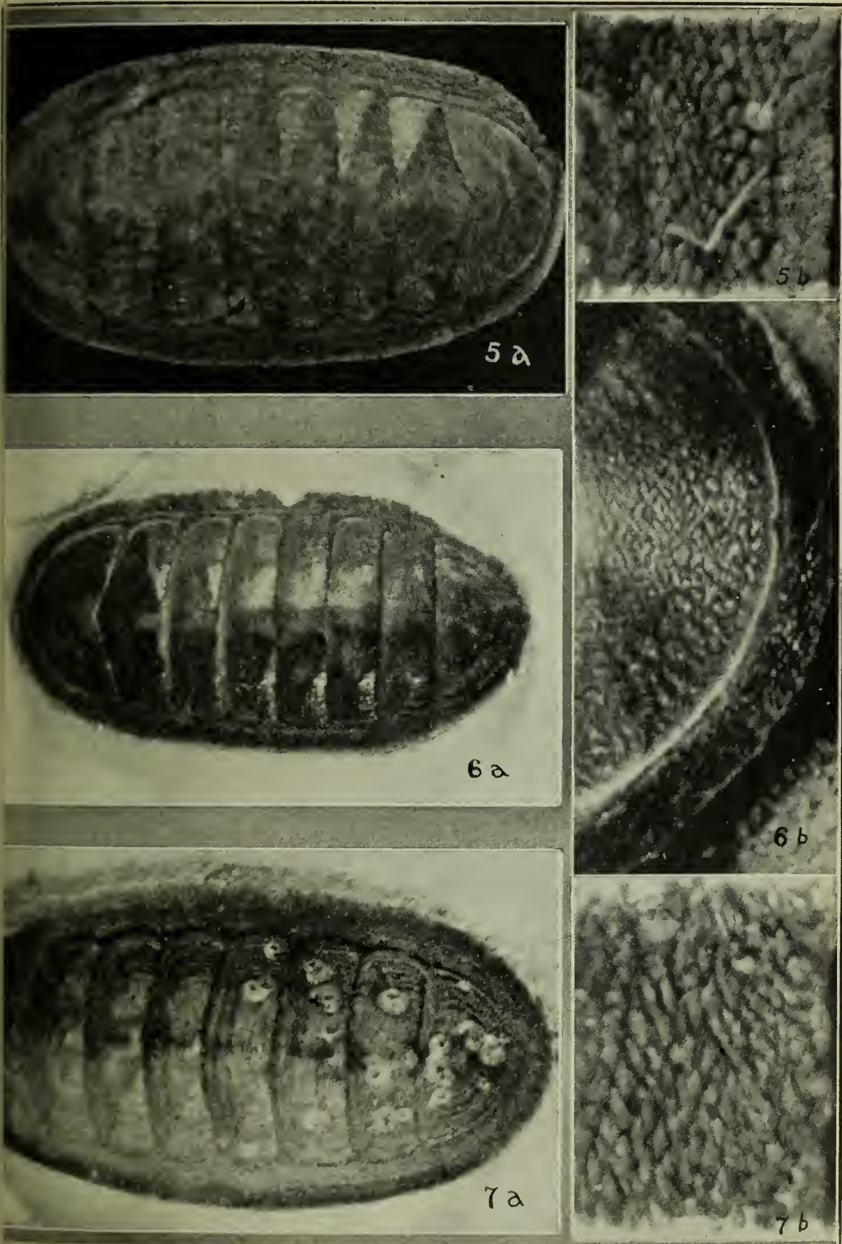

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Further Notes on Australian Polyplacophora, with Additions and Corrections of the 1918 Distribution List.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read October 14, 1920.]

Since the publication of my 1918 List I believe, with the exception of Commandant Paul Dupuis, of Belgium, and myself, no workers have published any notes on Australian Polyplacophora; but the new species and extensions of habitats dealt with in these papers necessitate what may be termed a progress revision of the said 1918 List.

The following notes, additions, and corrections are intended to collate these results, so that students of Australian Polyplacophora may make the necessary alterations and additions to that List and bring it up to date. These additional papers are included in a Bibliograph at the close:—

Lepidopleurus liratus, Ad. and Angas.—Add this to the Victorian fauna; see my paper on the Bracebridge Wilson Chiton Collection (Proc. Roy. Soc. Vict., vol. xxxiii., pt. ii., Nov., 1920).

L. matthewsianus, Bednall.—Add to the Tasmanian fauna on the authority of Mr. W. L. May.

L. badius, Hed. and Hull.—Add to Victorian fauna, taken by Mr. C. J. Gabriel, at Torquay. I have taken it at both Marino and Cape Jervis in South Australia.

L. norfolkensis, Hed. and Hull, and *catenatus*, Hed. and Hull.—Eliminate these Norfolk Island and Lord Howe Island forms from Australian fauna.

L. columnaris, Hed. and May = *pelagicus*, Torr.—Add this to Victorian fauna, received by Mr. J. H. Gatliff from off 90-mile beach, Victoria.

L. inquinatus, Blainville.—Add this species to fauna of Victoria, Tasmania, and South Australia, recorded in paper on Wilson Collection by myself (*loc. cit.*, Nov., 1920).

Callochiton rufus, Ashby.—Add this to Victorian fauna (*loc. cit.*, Nov., 1920).

C. mayi, Torr.—Add to the Victorian fauna. A fine specimen was shown to me by Mr. C. J. Gabriel, taken at Portland in Victoria.

C. elongatus, May.—Correct reference (Roy. Soc. Tas. Pap. and Proc., Oct., 1919).

Stenochiton pilsbryanus, Bednall.—Place this under subgen. *Zostericola*, only recorded from South Australia (Trans. Roy. Soc. S. Austr., vol. xliii., p. 66, 1919).

S. posidonialis, Ashby.—Add to fauna of Western Australia; see my paper (Jour. and Proc. Roy. Soc. of W. Austr., vol. vi., 1920).

S. cymodocealis, Ashby.—Add to fauna of Western Australia *(loc. cit.)*.

S. pallens, Ashby.—Add to Victorian fauna (1 spm. Bracebridge Wilson Collection).

Ischnochiton lineolatus, Blainville, of my 1918 List and of Iredale; *I. contractus*, *auct.*—Alter this to *iredalei*, Dupuis, 1918 (Ex. du Bull. Mus. His. Nat., 1918, No. 7).

I. lineolatus, Blainville, 1925.—Add this to list preceding *I. crispus*, Reeve. — Limit to fauna of South Australia, Victoria, and Tasmania. *I. decoratus*, Sykes, becomes a variety of this species.

I. crispus, Reeve, becomes a sub-species of *I. lineolatus*, Blainville, and is restricted to fauna of New South Wales and Queensland; see my paper (Trans. Roy. Soc. S. Austr., vol. xliv., Sept. 1920). Dr. Torr's record for Western Australia was the result of misidentification.

I. atkinsoni, Ire. and May.—Restrict *senu-stricto* to Tasmania.

I. atkinsoni lincolnensis, Ashby.—Add and record in fauna of Victoria, South Australia, and Western Australia *(loc. cit.*, Sept., 1920).

I. proteus milligani, Ire. and May.—This I have already recorded for South Australia, Victoria, and Tasmania in the 1918 List; they do not always conform to the Tasmanian form, and are often intermediate.

I. albinus, Thiele.—Through an error this was credited to South Australia instead of Western Australia in the 1918 List.

I. intermedius, Hed. and Hull.—Withdraw from Australian fauna; it is a Norfolk Island and Lord Howe Island species.

I. arbutum, Reeve.—Take out of doubtful and place in recognized list; was obtained by Mr. Iredale from Cape York.

Haploplax pura, Sykes.—Withdraw this from South Australian fauna; was included therein as a result of a misidentification.

H. mayi, var. *viridis*, Ashby.—Add this distinctive form to the Tasmanian fauna; see my paper, "Chitons of the D'Entrecasteaux Channel," etc. (Trans. Roy. Soc. S. Austr., vol. xliv., July, 1920).

Ischnochiton longicymba, Blainville, 1825. — Should be placed under *Stenochiton* as an unrecognized form from King Island, Tasmania.

Anisoradsia saundersi, Ashby.—Must be withdrawn from its present setting, as it does not belong to this genus; see my paper *(loc. cit.*, Sept., 1920).

Ischnoradsia australis, Sow.—Should be added to the Queensland fauna, having been collected at Caloundra by Mr. Tom Iredale; it was accidentally omitted from the 1918 List. It should be withdrawn from the Western Australian fauna. I can find no authority for its inclusion; probably it was credited in the printing to Western Australia instead of Queensland.

Heterozona properensis, Ashby.—Add this species to fauna of South Australia; see my paper *(loc. cit.*, Sept., 1920).

Callistochiton antiquus, Reeve.—Must be restricted to New South Wales and Queensland.

C. mawlei, Ire. and May. — Must be elevated to full specific rank and restricted to Tasmania.

C. meridionalis, Ashby (Trans. Roy. Soc. S. Austr., vol. xliii., p. 400, Oct., 1919).—Must be added to the List under the fauna of South Australia, Victoria, and Western Australia; this latter recorded by Torr under the name of *antiquus*. It should be given full specific rank.

C. meridionalis mayi, Ashby *(loc. cit.*, p. 410).—Add to List under fauna of Tasmania. It seems necessary to give some explanation as to the method adopted above in the treatment of our *Callistochitons*.

C. antiquus, Reeve.—Appears to vary very much in Queensland waters. I have specimens from that State in which the adult shell shows no network or ribbing on the dorsal area, but it is smooth; and others, in which nearly the whole of that area shows coarse network; another in which that area is granulose to rugose. As my shells have no locality attached other than Queensland (some were given me by Dr. Torr), I content myself with recording these variations.

C. mawlei, Ire. and May.—In my paper *(loc. cit.*, Oct., 1919, p. 400) I placed this as a sub-species of *C. antiquus*, Reeve, but the fact therein pointed out that the longitudinal ribbing is present in the dorsal area even in juveniles, whereas it is absent in juvenile *antiquus* from Sydney, together with the difference in the girdle scales—these are proportionately thicker and rougher and less imbricating in *mawlei*—justifies us, I think, in giving full specific rank to this species.

C. meridionalis, Ashby.—Needs no comment beyond what is contained in the original description, except that it should be elevated to full specific rank as therein foreshadowed; but its sub-species, *C. mayi*, Ashby, seems a rather exceptionally interesting race. I regret I have not had a longer series to examine. I have compared it with a number of juvenile *meridionalis* from South Australia, and find that these latter, even when only one-sixth the size of the type of *mayi*, exhibit the network sculpture, and it is only in extremely juvenile specimens in which this feature is absent.

It seems that *C. mayi* is a race in which the very juvenile character persists into the adult or semi-adult stage. With a pocket lens and undissected, there is no sign of the network sculpture, but a closer examination reveals its existence in a very modified form which is magnified under the enlarging camera.

Craspedochiton laqueatus, Sowerby.—Add this genus and species to Western Australian fauna as dredged by Dr. Mjoberg in the Swedish Expedition.

Plaxiphora albida, Blainville.—Add to fauna of Western Australia as specimens sent me from Garden Island by Mr. W. B. Alexander show small patches of vermiform sculpture so characteristic of this species. I have called attention elsewhere to the fact that this species and *costata*, Blainville, appear to merge into one another; it is, therefore, doubtful whether they are specifically distinct, although the extremes differ so widely.

P. conspersa, Ad. and Angas.—This becomes a sub-species of *albida*, with Port Lincoln, South Australia, as its type locality. The generic names *Poneroplax* and *Frembleya* must be removed from our list.

Kopionella, Ashby.—Insert this genus under Mopaliidae in the List with *Plaxiphora*, now *Kopionella matthewsi*, Iredale, as its type. Only recorded from South Australia; see my paper *(loc. cit.*, July, 1919, p. 71).

K. tasmanica, Ashby.—See my paper *(loc. cit.*, July, 1920). Add to List, restricted to fauna of Tasmania.

Acanthochiton crocodilus, Torr and Ashby.—Add this to fauna of New South Wales. Mr. A. F. Basset Hull has a specimen collected by the late Mr. Brazier which is undoubtedly this species.

A. maughani, Torr and Ashby.—This becomes a synonym of *A. pilsbryi*, Sykes; see my paper *(loc. cit.*, Oct., 1919, p. 394).

A. pilsbryi, Sykes.—Add to South Australian fauna with *A. maughaneanus*, Ashby, as its sub-species from New South Wales *(loc. cit.)*.

A. brevispinosa, Sow.—Withdraw this; it was included on the strength of Mr. Hedley's Index of Mollusca of Western Australia (Jour. Roy. Soc. W. Austr., vol. i., 1914-1915); probably a synonym or variety of *Acanthopleura spinosa*, Bruge.

A. verconis, Torr and Ashby, becomes a synonym of *Notoplax wilsoni*, Sykes. Distinguishing characters observable in some specimens are not constant.

A. retrojectus, Pilsbry.—Add this to Victorian list. I have specimens from San Remo, and Mr. Gabriel has a long series from various localities in that State.

A. rufus, Torr.—I have carefully examined the type and find it only a colour variety of *A. variabilis*, Ad. and Angas, of which species it therefore becomes a synonym.

A. kimberi, Torr, should be placed next to *A. retrojectus*, Pilsbry, to which species it is very closely related.

A. leuconotus and *A. approximans*, Hed. and Hull.—Withdraw from Australian fauna, being Norfolk Island and Lord Howe Island species.

A. maxillaris, Ashby (*loc. cit.*, Oct., 1919, p. 397).—Add to list, at present restricted to fauna of South Australia.

A. gatliffi, Ashby.—Add to list and include in fauna of South Australia, Victoria, and Tasmania; see my papers (*loc. cit.*, Oct., p. 198, 1919, on the Wilson Collection, *loc. cit.*, Nov., 1920, and "The Chitons of D'Entrecasteaux Channel," *loc. cit.*, July, 1920).

A. bednalli, Pilsbry.—Add this species and include in fauna of South Australia, Western Australia, Tasmania, Victoria, and New South Wales.

A. tatei, Torr and Ashby.—Withdraw this, as only a coloured variety of *A. granostriatus*, Pilsbry, and becomes a synonym thereof.

A. zealandicus, Quoy and Gaimard.—Add this to list as from New South Wales.

Comments on last Three Species and *A. granostriatus*.

I extract from my notes the following comments on the relations and differences of the shells described under the above four names:—

A. granostriatus.	*A. bednalli.*
Dorsal area smooth, or practically so, but so sub-cutaneously longitudinally lined as to make it difficult to realize that it is only imitation grooving.	Deep longitudinal grooving in dorsal area.
Pustules of pleural and lateral areas flat and shallow, ovate to lanceolate. Girdle more spiculose and fringe more strongly developed than in *bednalli*. Never attains a large size.	Pustules flat and strongly raised, generally shorter and more rounded than in *granostriatus*, usually obovate. Sculpture coarser than that of *granostriatus*. Attains a large size.

There seems to be a tendency in both these species to develop special racial characteristics, but these features do not appear as yet to be fixed.

Thus in New South Wales specimens of *A. granostriatus* the lanceolate character of the pustulose sculpture is exceptionally developed. It appears on close inspection that the shallow flat pustules are built on the crown of slight radial undulations, hardly ribs, and the shallow pustules merge into this undulation, giving a lanceolate character to the pustules very distinct from the normal, obovate, well-raised pustules of *bednalli*.

Then, again, in Tasmania we have collected by Mr. W. L. May, in Ralph Bay, a divergent form of *bednalli*, and I note a specimen kindred thereto from Frederick Henry Bay, in the same State.

I collected on March 27, 1920, at the latter locality, one specimen that seems quite typically *A. granostriatus*, and several that correspond with *A. bednalli*, with deep longitudinal grooving between granulose ribs, in the dorsal area. But my comments on the Ralph Bay specimens, lent me by Mr. May, are as follows:—In these specimens the dorsal area is almost smooth, as in *granostriatus*, but the longitudinal grooving exists to a limited extent in some of the valves in each; the girdles are but slightly spiculose and quite typical of *bednalli*.

The pustules are chiefly obovate, the shells are large, and in all the pustules are strongly raised, characters that seem persistent in *bednalli* in spite of other variations. I think we are justified in assigning this variety to *bednalli*, but a more complete investigation of material collected from widely-separated localities may reveal further differences.

In my 1918 Distribution List I referred to a specimen of *A. zealandicus*, Quoy and Gaimard, which is in my collection. This was given to me by Dr. H. Leighton Kesteven, of Sydney. I have since got into touch with him, and he tells me that it was taken in Port Jackson, New South Wales. So I now add this species to the Australian fauna.

A comparison of this shell with those from New Zealand, as well as with *A. bednalli*, reveals some very interesting features, some of which show a distinct relationship between this species and *bednalli*.

But on comparing the shells given me as *A. zealandicus*, by the late Mr. Suter, from Auckland Harbour, with those given me recently by Mr. A. E. Brookes, from Doubtless Bay, reveals the fact that there are considerable differences.

Those from Auckland Harbour have narrow, longitudinally-grooved dorsal areas, whereas those from Doubtless Bay have broad and smooth dorsal areas. In both forms the ray undulations of the anterior valve are practically absent. Both have coarser spicules and larger tufts than is the case with *A. bednalli*, but the character of the sculpture closely corresponds.

The Sydney specimen, given me by Dr. Kesteven, corresponds with the Doubtless Bay specimens; the longitudinal grooving present in *bednalli* is entirely absent. Also the ray ribbing present in that species in the anterior valve is also absent, or indeterminable. It measures 13 × 7 mm.

I would mention that in Mr. May's collection is a single specimen, also collected by Dr. Kesteven at Port Jackson, and measuring 11 × 5 mm., which has the longitudinal grooving in the dorsal area, well-defined ray ribs in the anterior valve, and, generally, sculpture corresponding with *A. bednalli*, Pilsbry, and justifies my recording it as belonging to the New South Wales fauna.

Acanthochiton exilis, Torr and Ashby.—Add this striking species to the Victorian fauna. Mr. J. H. Gatliff has been good enough to lend me a very fine specimen measuring 7 × 3½ mm. from Port Phillip, which I think must certainly be referred to this species.

Macandrellus, Dall. (Bull. Mus. Comp. Zool., xviii., p. 417).—This name was originally suggested by Carpenter, MS., with *M. plumeus* as type, and later was introduced by Dall (in Proc. U.S. Nat. Mus., vol. i., p. 299, 1878), with *M. costatus*, Ad. and Angas, designated as type. As pointed out by Iredale (Proc. Mal. Soc., vol. xi., part ii., June, 1914, p. 129) this name had to replace that of Pilsbry's *Loboplax*, provided Iredale's contention was correct, which reads: "This species (*Chiton violaceus*, Quoy and Gaimard) and Ad. and Angas' *costatus* are undoubtedly congeneric in the strictest restriction."

I think we are justified in questioning this assumption, for *A. costatus*, Ad. and Angas, and its allies have a spiculose girdle, whereas *violaceus*, Quoy and Gaimard, has an extremely broad leathery girdle, which, as far as any specimens I possess are concerned, is quite free from spicules except for the sutural tufts.

Ire. and May (Proc. Mal. Soc., vol. xii., parts ii. and iii., Nov., 1916, p. 101) state that they anticipated the possibility "that *Macandrellus* may fall as an absolute synonym of *Notoplax*."

On carefully examining a number of specimens of *A. costatus*, Ad. and Angas, and *A. rubrostratus*, Torr, I find that the only specific difference is the fact that in the former "the girdle is beset with short, white, evanescent spicules"

(I quote Ad. and Angas' own words), whereas in *rubrostratus*, Torr, the girdle is densely beset with coarse spicules. I therefore propose to withdraw the genus *Macandrellus* from our Australian fauna, placing *costatus*, Ad. and Angas, with *rubrostratus*, Torr, as its sub-species, under the genus *Notoplax*.

I should have liked to have retained Dall's genus, with which we have become so familiar, citing the New Zealand shell *Macandrellus violaceus*, Quoy and Gaimard, as the type; but I fear that we must make another change and revert back to Pilsbry's genus *Loboplax*, of which *violaceus*, Quoy and Gaimard, is the type.

To sum up the position, Dall's genus *Macandrellus* falls with the transference of his type to the sub-genus *Notoplax*. The New Zealand shell, *Chiton violaceus*, Quoy and Gaimard, becomes *Loboplax violaceus*.

Dr. Torr's *Acanthochiton sub-viridis* and H. Adams' *speciosus* are both closely related to *costatus*, Ad. and Angas, and *rubrostratus*, Torr, and should be placed adjoining these two forms in the Classification List.

Notoplax porcina, Ashby *(loc. cit.*, Oct., 1919, p. 395).—Add this species to list, the closely-packed, rounded granules of the lateral areas of juvenile *N. matthewsi*, Bed. and Pilsbry, are evidently absent in this species, and should with its other characters lead to its easy recognition.

N. wilsoni, Sykes.—Add to New South Wales fauna, was accidentally left out of the 1918 List for New South Wales; also include in the Western Australian fauna in place of *verconis*, which is a synonym.

Acanthochiton tatei, Torr and Ashby, and *A. bakeri*, Torr, as previously stated must both be dropped.

Rhyssoplax torrianus, Hed. and Hull.—Withdraw from Tasmanian fauna.

R. bednalli, Pilsbry.—Add this to Victorian fauna recorded by Sykes.

R. limans, Sykes.—Withdraw this name and replace with *R. jacksonensis*, Ashby, and restrict to fauna of New South Wales and Queensland; see my paper *(loc. cit.*, Proc. Vict. Roy. Soc., vol. xxxiii., Nov., 1920).

R. corypheus, Hed. and Hull.—Withdrawn from Australian fauna; Norfolk Island and Lord Howe Island species.

R. vauclusensis, Hed. and Hull.—I cannot find any record of this species from Queensland, and think it must have been included in the fauna of that State in my 1918 List in error.

R. coccus, Menk.—Should be placed with the doubtful *chitons;* it seems questionable as to whether it is Australian at all.

R. howensis, Hed. and Hull.—Withdraw from Australian fauna; is a Lord Howe Island species.

Sypharochiton funereus, Hed. and Hull.—Withdraw; same as last; not Australian fauna.

Tonicia truncata, Sowerby.—Add to list as from Western Australia; collected by Dr. Mjoberg, Swedish Expedition.

T. picta, Reeve.—Alter to *Lucilina shirleyi*, Iredale, restricted to Queensland (Proc. Mal. Soc., vol. xi., part ii., June, 1914).

Amphitomura gemmata, Blainville.—Include in fauna of Queensland.

Loricella angasi, Ad. and Angas.—Restrict to South Australia; see my paper (Trans. Roy. Soc. S. Austr., xliii., 1919, p. 59).

L. torri, Ashby.—Include in fauna of Victoria, Tasmania, and New South Wales (*loc. cit.*, p. 62).

Onithochiton rugulosus, Angas.—Withdraw from list, probably a synonym of *quercinus*, Gld.

O. discrepans, Hed. and Hull, 1912.—Withdraw from Australian fauna; belongs to Norfolk Island and Lord Howe Island fauna.

Note.—In the introduction to my 1918 List, on page 79, I state: "I have with some misgivings included the fauna of Norfolk Island and Lord Howe Island in the New South Wales list." In deference to Mr. Hedley, I now withdraw all the species included in his and Mr. Hull's paper (Proc. Linn. Soc. N.S. Wales, 1912, vol. xxxvii., part 2) from the Australian fauna, but I recognize that some of the species from those islands show close affinities to Australian forms, and consider it wiser to leave it an open question as to whether they should be included, or otherwise, until more material is available and a more exhaustive investigation has beeen carried out. I have made use of some botanical terms, because while technically barely correct, such as the word "subcutaneous," they so well suggest one's meaning.

The following references should be added to the Bibliograph of my 1918 Distribution and Classification List:—

Bibliograph.

1917—Extrait du Bulletin du Museum d'Histoire naturelle, 1917, No. 7, "Notes on the Collection of Polyplacophores du Museum de Paris," by Commandant Paul Dupuis.

1919—Royal Society Tasmania, Papers and Proceedings, "New Species of Tasmanian Mollusca," by W. L. May, Oct., 1919.

1917—Kungl. Svenska. Vetenskapsakademiens. Handlingar, Band 52, No. 16 (pp. 12), Swedish Expedition, by Dr. Mjoberg, also p. 70.

1918—Trans. Royal Society South Australia, vol. xlii., p. 62, 1918, "Review of the genus *Ischnoradsia*," by Edwin Ashby.

Loc. cit., p. 65, May, 1918, "Monograph on the Genus *Stenochiton*," by Edwin Ashby.

Loc. cit., p. 79, June, 1918, "Notes on South Australian Polyplacophora, with a List showing their distribution in the Australian States," by Edwin Ashby.

1919—Trans. Royal Society South Australia, vol. xliii., p. 59, May, 1919, "A Review of the genus *Loricella*, with notes on features previously unnoted," etc.

Loc. cit., p. 66, July, 1919, "Notes on Australian Polyplacophora, including descriptions of two new genera," etc., by Edwin Ashby.

Loc. cit., p. 394, Oct., 1919, "Descriptions of Six New Species of Australian Polyplacophora," etc., by Edwin Ashby.

1920—Journ. and Proc. Royal Society Western Australia, vol. vi., June, 1920, "Notes on the Occurrence of Three Species of *Stenochiton* in Western Australia," etc., by Edwin Ashby.

Trans. Royal Society South Australia, vol. xliv., July, 1920, "Chitons of the D'Entrecasteaux Channel, Southern Tasmania," etc., by Edwin Ashby.

Loc. cit., Sept., 1920, "A Review of *Chiton crispus*, Reeve, and its Allies, with descriptions of Three New Species," etc., by Edwin Ashby.

Loc. cit., Oct., 1920, "Further Notes on Australian Polyplacophora, with additions to the 1918 Distribution List," by Edwin Ashby.

Proc. Royal Society Victoria, vol. xxxiii., Nov., 1920, "A Description of the Bracebridge Wilson Collection, with additions to the Fauna of Victoria and descriptions of New Species," etc., by Edwin Ashby.

An Observation on the Toning of Photographic Silver Images.

By Arthur R. Riddle.

[Read September 9, 1920.]

Toning is a process whereby the colour of a photographic silver image is changed, either by an actual change in composition, or by the deposition of another metal.

The two methods to be discussed are:

1. The sulphide method of producing sepias, browns, etc.
2. The copper method of producing purple, purple-brown, and red tones.

This note concerns a trouble which frequently occurs without obvious cause. The apparent cause and remedy are suggested.

The Sulphide Method.

Here, the silver image of the photograph is changed either wholly or in part to a silver haloid, *e.g.*, silver bromide. This image is then changed over to silver sulphide by the action of sodium sulphide. The reactions probably conform to the following equations given by Roebuck (1):—

$$Ag_2 + 2K_3Fe(CN)_6 = K_4Fe(CN)_6 + K_2Ag_2Fe(CN)_6 \text{ (i.)}$$
$$K_2Ag_2Fe(CN)_6 + 2KBr = K_4Fe(CN)_6 + 2AgBr \text{ (ii.)}$$
$$Na_2S + 2AgBr = Ag_2S + 2NaBr \text{ (iii.)}$$

The formation of the silver haloid takes place in two stages. Firstly, the potassium ferricyanide attacks the silver with the formation of potassium silver ferrocyanide; and secondly, the potassium bromide changes this over to silver bromide, on account of the much greater insolubility of the latter. The silver bromide image is then treated with sodium sulphide, with the formation of the final silver sulphide.

The writer has made experiments with other haloids, in one case with marked success. Smith (2), in dealing with chlorine, gives the following equation:—

$$KMnO_4 + 8HCl = 4H_2O + KCl + MnCl_2 + 5Cl \text{ (iv.)}$$

The writer makes use of this reaction for the liberation of nascent chlorine, in the presence of the photographic print to be toned. The chlorine combines with the silver, converting the image, wholly or in part, into silver chloride. This is then changed to the sulphide as follows:—

$$2AgCl + Na_2S = Ag_2S + 2NaCl \text{ (v.)}$$

A similar method has been recommended by Greenall (3). The writer uses much more dilute solutions, and gains control and variation of tone unobtainable with the concentrations recommended by Greenall. In both methods it will be seen that control of tone is gained, other things being equal, by regulating the amount of silver haloid formed, this in turn determining the amount of silver sulphide which is subsequently formed.

The Copper Method.

Here the silver image is treated with copper sulphate, in the presence of potassium ferricyanide, together with—in the case considered—neutral potassium citrate.

The change in colour is supposedly due to the formation of copper and silver ferrocyanides.

The Trouble.

In all processes for toning bromide photographic prints it is considered essential, in order to obtain satisfactory results, to:—

1. Expose the print to just that stage where prolonged development will not reduce more silver than is essential to the production of a normal fully-developed print.
2. Use fresh developer.
3. "Fix" very thoroughly with fresh "hypo."
4. Wash fully in order to remove the soluble silver sodium salts formed, together with any free "hypo." (This is not required when using the chlorine "bleacher.")
5. Dry prints before toning.
6. Use in the sulphide process fresh sodium sulphide solution. It is preferable to use solutions made up from a concentrated stock, prepared by pouring boiling water on the sodium sulphide, or by bringing the concentrated solution to a boil. A concentrated solution so prepared is very stable.

Now, it sometimes happens that when all these precautions have been taken, unsatisfactory tones occur, especially in the copper process. Here, when only toning to the purple-blacks and purples, the tone is apparently quite good. Proceeding to the warmer tones, the contrast values decrease at a faster rate than the colour contrast change would warrant. The tone ceases to be homogeneous. The shadows, where the silver deposit was rich, tones through to the warmer tones, whilst the lighter half-tones and high-lights become many tones colder.

This double toning is a very marked trouble. An otherwise excellent print might have its denser parts of a good red-brown colour, and its lighter half-tones quite bluish. The print, in addition, often loses in general density, which is the obvious cause of many manuals recommending that toning should be commenced with very vigorous prints, which have been made somewhat darker than finally required.

It occurred to the writer that if the behaviour of the image in toning was exactly according to what chemical theory would suggest, and that the process commenced with a silver image free from any thiosulphates, or salts whence thiosulphates might be derived, that the troubles mentioned above would not occur. Further, whereas it has always been recommended that only vigorous prints of good black colour be used for toning, it should be possible to tone quite delicate prints, provided that no silver losses occurred in the process.

THE CAUSE.

It is necessary to enquire now as to what chemical changes take place after the print has been developed. Development has reduced the original silver haloid in part to metallic silver, which constitutes the image. The unaffected silver haloid has now to be removed. The nearly universal method is the use of sodium thiosulphate ($Na_2S_2O_3 . 5H_2O$), unfortunately, still frequently called sodium hyposulphite, and, worse still, "hypo."

In a solution of this salt, two well-known reactions take place (4, 5, 6):—

$$AgBr + Na_2S_2O_3 = NaBr + AgNaS_2O_3 \text{ (vi.)}$$
$$2AgBr + 3Na_2S_2O_3 = 2NaBr + Ag_2Na_4 (S_2O_3)_3 \text{ (vii.)}$$

The first silver sodium salt formed is practically insoluble in water (7, 8), and is formed when the solution of sodium thiosulphate is weak. With stronger solutions, the reaction takes place according to the second equation. The silver sodium salt then formed is freely soluble in water.(1) The concentration of the sodium thiosulphate solution is of great importance. Few workers appear to realize the importance of using a solution of optimum concentration. In a 50 per cent. solution, the silver bromide is much less soluble than in a 25 per cent. solution. It is considered by some chemists

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(1) There is apparently some confusion as to the relative solubilities of the two silver sodium thiosulphates; *e.g.*, Roscoe and Schorlemmer, "A Treatise on Chemistry," vol. i., p. 456, suggest that it is the $AgNaS_2O_3$ that functions in fixation of a photographic image. No mention is made in this connection of the $Ag_2Na_4 (S_2O_3)_3$. In metallurgical treatises also, on silver extraction, the same uncertainty is frequently apparent.

that the first step in "fixing" is always the formation of the silver sodium salt given in equation vi., and that further treatment in the sodium thiosulphate solution turns this over to the silver sodium salt given in equation vii., which salt is the soluble one.

It will now be seen, that after "fixing," it is necessary to get the print free from: —

1. Free sodium thiosulphate.
2. The silver sodium salt in equation vii.
2. The sodium bromide.

It is also quite possible that a certain amount of the insoluble silver sodium thiosulphate may remain in the film, not having been turned over to the soluble salt.

Now, for a moment, consider another reaction, which is the basis of "reduction"—*i.e.*, reduction of density—in photographic silver images.

When a silver image is placed in a solution of sodium thiosulphate and potassium ferricyanide, the following reactions take place (9): —

$$Ag_2 + 2K_3Fe\,(CN)_6 = Ag_2K_2Fe\,(CN)_6 + K_4Fe\,(CN)_6 \quad \text{(viii.)}$$
$$Ag_2K_2Fe\,(CN)_6 + 3Na_2S_2O_3 = Na_2K_2Fe\,(CN)_6 + Ag_2Na_4(S_2O_3)_3 \quad \text{(ix.)}$$

The potassium ferrocyanide formed in the first equation is soluble in water, and the silver potassium ferrocyanide dissolves in the sodium thiosulphate solution according to the second equation, giving the soluble silver sodium salt. Hence the density of the silver image is reduced.

Now it was found that, after "fixing," three soluble salts, and possibly one insoluble salt, had to be considered as associated with the silver image. In both the ordinary sulphide, and the copper methods of toning, potassium ferricyanide is employed. Hence it will be readily seen from equations viii. and ix., that if any sodium thiosulphate remained, that "reduction" of the silver image could go on, and so be responsible for the trouble. Prints have behaved unsatisfactorily, however, especially with the copper method of toning, in spite of most prolonged washing, which would certainly be credited with having removed the soluble salts. If prints are taken from the wash water at intervals, where washing is accomplished by keeping the prints moving in running water, and these prints are then toned, it is found that the tones improve as the period of their washing increases. Washing in excess of one and one-half hours, however, seems to have no further effect, so far as concerns its influence on the resulting tones. It would appear, therefore, that some other cause was operating which would be responsible for the silver image losses. The only apparent cause is the possible occurrence of the insoluble silver sodium thiosulphate ($AgNaS_2O_3$) in the film, from which, in the presence of the toning solutions, some sodium thiosulphate might be derived, which would act with the potassium ferricyanide in the toning solutions as a reducer of the silver image according to equations viii. and ix.

The results in the copper method would suggest that the copper ferrocyanide was also soluble, and that its removal occurred before that of the silver, for this reason. Muir and Morley (10) give the colour of copper ferrocyanide as "brown-red," and of silver ferrocyanide as "white . . . turning blue in air." Now the colour of the toned image is a resultant of:—

1. The black unaffected silver.
2. The bluish-silver ferrocyanide.
3. The brownish-red copper ferrocyanide.

Consequently if copper ferrocyanide passes into solution, the resultant tone will be much colder than otherwise. The effect would be most noticeable in that part of the image where the original silver deposit was least. This is exactly in accordance with results obtained, and accounts for the lack of homogeneity of colour values.

The Remedy.

Many substances have been used as "hypo" eliminators to avoid the washing of prints to any extent after "fixing." The substances in most general use are strong oxidising agents, and it is believed that "hypo" elimination is made to take place more rapidly by conversion of the sodium thiosulphate to the tetrathionate ($Na_2S_4O_6$) (11).[2] Although the writer would not desire to introduce more complexities into the chemical procedure of photography than necessary, yet the field invited experiment. Tests were made with hydrogen peroxide, potassium permanganate, and potassium persulphate, but most successfully with potassium percarbonate ($K_2C_2O_6$). Since the tetrathionates are easily soluble in water (12, 13) their elimination would be a very simple matter. Failing any evidence that the tetrathionates could combine with any salt used

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(2) The verdict from available literature on the subject of the action of oxidisers on thiosulphates is not unanimous, *e.g.*, Muir and Morley, in "Watts' Dictionary of Chemistry," vol. iv., p. 705, state: "Thiosulphates are converted into tetrathionates by the action of iodine; oxidisers such as HNO_3, $KClO_3$, and $HCl\,Aq$, and $KMnO_4Aq$ produce sulphates."

in toning, with the result that part of the silver image might be brought into a soluble form analogous to that given in equation ix., it would appear unnecessary to insist on the complete elimination of the tetrathionates. At the same time, the writer would not suggest that any salts which can be removed should be left. The whole object of the treatment is to allow toning to commence with a pure silver image.

From the foregoing, then, it would appear that:—

1. The trouble is due to the insoluble silver sodium thiosulphate ($AgNaS_2O_3$).
2. That this becomes completely soluble by treatment with an oxidiser.

The writer is fully aware that their exists no proof as to the correctness of his hypothesis, and that the questions which might arise from the fact that the reactions take place in the presence of a colloid have not been investigated at all. At the same time, the results obtained appear to lend support to the hypothesis which is tentatively advanced.

The tones obtained are wholly homogenous; there is no loss in density values, and there is no uneven toning. Quite delicate prints have been toned after such treatment, with excellent results, quite unobtainable otherwise. The richness of the tones obtained generally is quite an outstanding feature. The method adopted in practice is to wash the prints for, approximately, half an hour in running water, treat them for five minutes in an 0·6 per cent. solution of potassium percarbonate, and continue washing for a further half an hour. No attempt is made to curtail the time of washing. The potassium percarbonate treatment is designed to do what prolonged washing apparently does not do. If the soluble sodium thiosulphate and the soluble silver sodium thiosulphate have not been wholly removed by normal washing, the treatment with the potassium percarbonate will considerably facilitate their removal, as well as remove the insoluble silver sodium thiosulphate.

Concerning the sulphide method of toning, it should be observed that when using the chlorine "bleacher," the preliminary oxidising treatment is quite unessential in order to obtain good tones, since there is no potassium ferricyanide employed in the "bleacher." Hence equations viii. and ix. cannot function, even if some thiosulphates do remain in the film. With the chlorine "bleacher," toning can commence with only a brief rinse after taking the prints from the fixing bath. At the same time, this is not recommended, and the prints should preferably be well washed after "fixing," and then dried before they are toned.

If the hypothesis advanced in the foregoing is correct, and it can be definitely proved that an insoluble silver sodium thiosulphate does remain behind in the film of photographs, then it is to be considered as to whether or not this should not always be removed in all photographic prints, whether for toning or not. According to present knowledge upon the subject, its presence can do no good, and presumably, in course of time, may be responsible for the deterioration of the image.

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4. 1906. Derr: "Photography for Students of Phys. and Chem.," p. 146.
5. 1918. Roebuck: *Loc. cit.*, pp. 9, 18.
6. 1911. "Cassell's Cyclopaedia of Photography," p. 253.
7. 1896. Comey: "A Dict. of Chemical Solubilities Inorg.," p. 475.
8. 1898. Muir and Morley: "Watts' Dict. of Chem.," vol. iv., p. 707.
9. 1918. Roebuck: *Loc. cit.*, p. 108.
10. 1894. Muir and Morley: "Watts' Dict. of Chem.," vol. ii., pp. 334, 337.
11. 1911. "Cassell's Cyclopaedia of Photography," p. 298.
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13. 1911. Roscoe and Schorlemmer: "A Treatise on Chem.," vol. i., p. 461.

Autoclastic, Intraformational, Enterolithic, and Desiccation Breccias and Conglomerates, with References to Some South Australian Occurrences.

By Professor Walter Howchin, F.G.S.

[Read September 9, 1920.]

Plates XVI. to XXI.

CONTENTS.

Introduction.

Of late years much attention has been directed by geologists to certain phenomena in rock masses which indicate the breaking up of rocks, *in situ*, by internal stresses. The particular features shown by such processes vary considerably in different cases, and are apt to be confounded with other processes with which they have no direct relationship. They have, at various times, in the past been erroneously described as "alluvium," "boulder beds," "ancient glacial deposits," "basement beds," etc. That the several stratigraphical features, whether clastic, dynamic, chemical, or otherwise, in their origin should be clearly distinguished is often a matter of first importance in field geology. The subject is still, in some of its aspects, obscure and requires further investigation. It may be useful for such a purpose to supply references to the literature of the subject, with some additional notes based on personal observation. A diversity of terms bearing on the subject has passed into common use, some of which are mentioned below.

One of the earliest observers of dynamic brecciation was J. E. Marr, who noted these phenomena in the Devonian rocks of Devonshire.(1) In the section described numerous small thrust planes occurred in thin-bedded limestones, causing the break-up of these beds into "eyes" of limestone, the separated fragments measuring from a fraction of an inch to several feet in length. These formed lenticular patches interbedded with the normally cleaved argillaceous material—a schist consisting of alternating lenticular patches of limestone and clay slate. Marr did not suggest any name for this particular form of brecciation.

Lithological Nomenclature.

AUTOCLASTIC.

Mr. H. L. Smythe, in an article on "The Geology of Steep Rock Lake, Ontario,"(2) used the terms "autoclastic schist" to distinguish certain features of rock structure that came under his notice in the locality mentioned. In a foot-note he explains that by the above terms he means "schists formed in place from massive rocks by crushing and squeezing without intervening processes of disintegration or erosion, removal, and deposition." Similar effects have been noted by other observers that are not of a schistose character. Usually it follows as an effect of tangential pressure that causes one rock mass to slide over another by which a zone of brecciation occurs, the clastic fragments being of the same kind as the rock immediately above or below the thrust plane.

Mr. Van Hise, in his important work on "The Principles of North American Pre-Cambrian Geology," uses further distinguishing terms with respect to this kind of structure, and says,(3) "When rocks are folded by strong orogenic forces, and they are not so heavily loaded as to render them plastic, they are frequently broken into fragments and '*autoclastic*' rocks are produced. The autoclastic rocks that readily show

(1) Marr, "Some Effects of Pressure on the Devonian Sedimentary Rocks of North Devon," Geolog. Mag., 1888, p. 218.

(2) Am. Jour. Science, 3rd ser., vol. xlii. (1891), p. 331.

(3) United States Geolog. Sur., 16 Ann. Reports, part i., 1896, p. 679.

their origin may be called *dynamic breccias*, and those which resemble ordinary conglomerates may be called *pseudo-conglomerates.*"

In an earlier work, "On Some Dynamic Phenomena," [4] Van Hise had already used the term "*friction-conglomerate*" for similar phenomena. Under the heading, "Some Dynamic Phenomena shown by the Baraboo Quartzite Ranges of Central Wisconsin," he says, "For the most part the rock is merely fractured, the quartz fragments roughly fitting one another, but there are all gradations from this phase to a belt, about ten feet wide, of true friction-conglomerate, the fragments having been ground against one another until they have become well-rounded (a Reibungs breccia). Between the boulders of this zone is a matrix composed mainly of smaller quartzite fragments."

Another interesting observation, of a like kind, was made by Van Hise in the Pre-Cambrian rocks of the Adirondacks Mountains. He says, "In the Adirondacks is a thick formation of gneiss overlain by a bed of crystalline limestone containing interlaminated smaller beds of gneiss. The whole series has been closely folded. The gneiss, as a result of the folding, is closely corrugated, and to a certain extent its upper folds are truncated by the shearing action. The limestone has acted like a fluidal substance, accommodating itself easily to the new position, and by re-crystallization has taken on a massive character. The thin beds of gneiss within the limestone have been broken to fragments. The fragments within the limestone matrix have ground against one another until they became well rounded. They are disseminated through the limestone. As the layers of gneiss are thicker and more numerous near the base of the limestone, this part of the formation appears as a limestone containing numerous boulders and smaller fragments of gneiss resting upon a gneiss formation." [5] The resemblance which such a geological section bears to a basal conglomerate with derived fragments from an older rock along a plane of unconformability is so close, that it cannot be wondered at that in the first instance the section was so interpreted. The true nature of the section was discerned when it was noticed that the conglomerate could be traced along the line of bedding to where it could be seen that the gneiss was interstratified with the limestone.

An important paper was read by Mr. G. W. Lamplugh before the Geological Society of London in 1895, on "The

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(4) Jour. of Geology, vol. i., 1893, p. 351.

(5) Van Hise, "Deformation of Rocks," Jour. of Geology, vol. iv. (1896), pp. 628, 629.

Crush-conglomerates of the Isle of Man." (6) The rocks showing the special features of crush belong to the Skiddaw Slates Series, composed of alternating grits and flags with fine argillaceous shaly slates. The width of outcrop of the crush-conglomerate, in one place, measures 400 yards across the strike, with a vertical depth of over 500 feet. Other sections of a like kind occur over the area of 200 square miles occupied by the rocks of this age on the island. The brecciation has taken place in the passage beds between the gritty beds and the fine slaty series. It is noteworthy that, in places where the rock is fresh, the broken fragments can scarcely be distinguished from the base, but on weathering a difference of colour is developed between the inclusions and the matrix.

The great thrust plane that occurs in North-western Scotland, at the junction of the Lewisian Gneiss and Torridon Sandstone has, in places, developed crush-conglomerates. The Director-General of the Geological Survey, in describing the work of Messrs. Peach and Horne in elucidating this classic geological region, says,(7) "For nearly a mile to the east of its junction with the Torridon Sandstone the Lewisian Gneiss has undergone so much mechanical deformation as to pass into fine flaser-gneiss with a platy structure. In some cases, indeed, the alteration has been so great that all the original structures of the gneiss have entirely disappeared, and it is then hardly possible to determine from what original types the rocks, as we now see them, have been derived. Immediately east of this flaser-gneiss, beyond Kirkton of Loch Alsh, an important band of moine schist, about 300 yards broad, has been thrust over the gneiss, and is again succeeded, on the east side, by massive acid and basic gneisses of recognizable Lewisian types. These latter rocks present on the headland to the south-east of Kirkton of Loch Alsh some remarkable examples of pseudo-conglomerate structure, bands of chloritic and actinolitic schist enclosing rounded and oval masses of biotite-gneiss and small rounded blocks of quartz. The deceptive resemblances to conglomerate have doubtless been produced by mechanical movements. The several bands of gneiss having first been plicated and then subjected to still further crushing, whereby lenticular pieces of these were wrenched off and arranged with their long axes parallel with the foliation planes of the schist. These separated pieces are

(6) Quar. Jour. Geolog. Soc., vol. li. (1895), pp. 563-588, with a Petrographical Appendix by Prof. W. W. Watts, pp. 588-599.

(7) Ann. Reports Geolog. Survey of United King. for the year 1895, in "Forty-third Report of Dept. of Science and Art," vol. xxx., 1896, Appendix E, p. 294.

identical in character with the biotite gneiss amidst which the hornblendic and actinolite schists lie."

In 1896 Archibald Geikie published a paper "On some Crush-conglomerates in Anglesey."(8) The locality was Llangefui, and the strata which had undergone the change were, originally, shales or mudstones, alternating with bands of hard siliceous grit. Geikie says, "They have been crumpled up and crushed into fragments which have been driven past each other along the planes of movement. Every stage may be traced from a long piece of one of the grit bands down to mere rounded and isolated pebbles of the same material."

In 1897 Messrs. C. I. Gardiner and S. H. Reynolds described some crush-conglomerates in an inlier of Bala (Ordovician) beds on the Irish coast at Portraine.(9) The authors state, "The strip of coast which we are describing has been subjected to so much disturbance that conglomerate-like rocks, produced by earth-movements, occur almost wherever the lithological character of the beds admits of their being formed." The authors also attempt to make a distinction between a crush-conglomerate and a thrust-conglomerate. Describing one of such, they say, "These beds are very much faulted, crushed, and folded, and every stage can be traced between a continuous limestone-band and one which has been broken up into small rounded fragments, so as to present precisely the appearance of a conglomerate. To this type of rock we propose to restrict the term 'crush-conglomerate,' applying the term 'thrust-conglomerate' to a conglomerate formed along a thrust-plane." As most crush zones follow some kind of a plane in the direction of a thrust, it is difficult to see how such a distinction can hold good.

In 1898(10) Professor J. E. Marr described a crush-conglomerate which is of interest as showing features that closely resemble those seen in glacial striations. The bed described had been mapped by the Geological Survey as "the Basement Beds of the Carboniferous System" (possibly Devonian). The underlying Skiddaw Slates, as described by Marr, occur "in a much shattered condition, and are immediately succeeded by about 30 feet of a coarse conglomerate with red sandstone-matrix, filled with large pebbles (8 inches in diameter). This deposit is roughly stratified, owing to the alternation of bands containing few pebbles with

(8) Geolog. Mag., 1896, p. 481.

(9) "An Account of the Portraine Inlier" (Co. Dublin), Quart. Jour. Geolog. Soc., vol. liii., pp. 520-535.

(10) "Note on a Conglomerate near Melmerby (Cumberland)," Quar. Jour. Geolog. Soc., vol. lv. (1899), pp. 11-15.

others in which they are abundant; the bands with many pebbles are, however, unstratified. Above this is 20 to 30 feet of sandstone, with small pebbles, and, at the summit of the section, a second coarse conglomerate, the pebbles in which, however, do not attain the dimensions of those in the lower coarse accumulation. . . . . The pebbles consist of fragments of grits, argillaceous strata, and volcanic rocks . . . . They possess the outward form of glacial boulders, but a number of them, especially of the fine argillaceous rocks, show unmistakable signs of being slickensided, though a few scratches are found here and there which it would be difficult, if not impossible, to distinguish from glacial striae." The resemblance to glacial features was still further present in that, at one spot, "the rock beneath (a coarse red sandstone with small scattered pebbles) was found to be marked by groovings. There are two principal sets of these, crossing each other at an angle of about 40°."

In 1898 J. B. Hill, of the British Geological Survey, described a zone of brecciation in the Mylor (Devonian) series, at Gerran Bay, Cornwall. The features were included in "finely-striped slates" and were, at first, regarded as original clastic deposits. The brecciation extended for half a mile across the strike, "the strata being made up of a mass of fragments from the size of peas up to 5 or 6 inches in length, enveloped in a slaty matrix." The fractured rock is "associated with faulting in the last stage of folding."(11)

Mr. Hill, in 1901, published an article "On the Crush-conglomerates of Argyllshire."(12) These occur in the Dalradian schists and were, in the first instance, regarded as clastic sediments. The beds have been subjected to isoclinal folding, which has, "in some instances, proceeded so far that the rock-sequence is now represented by a banded zone in which the alternations are so narrow that they range from a foot to as little as an inch in thickness. While in some cases the process has ended here, in others it has been carried a stage further, and the closely-packed folded bands have been divided by shear-planes severing the continuity of the limbs until lenticular fragments have been produced more or less isolated, culminating, by the rolling out of the lenticles, in the production of pseudo- or crush-conglomerates." The crush-conglomerates occur most commonly near the junction of rocks of dissimilar character, especially so in the junction of epidiorite and limestone. The limestone is coarsely gritty

(11) Hill, Memoirs Geolog. Survey United King., Summary of Progress, 1898, pp. 92, 93.

(12) Quar. Jour. Geolog. Soc., vol. lvii., 1901, pp. 313-327.

and this composite character of the rock is thought, by the author, to be a characteristic that may have been favourable for its production. The hard epidiorite forms the chief brecciated fragments, while the plasticity of the composite limestone has led to its being squeezed and mashed so as to form the main groundmass.

INTRAFORMATIONAL CONGLOMERATES.

This name was given by Dr. C. D. Walcott to certain broken and conglomeratic beds that occur in the Cambrian and Ordovician rocks of North America.[13]

A typical section, exposed on the eastern shore of the Hudson, shows thinly-bedded limestones, containing an *Olenellus* fauna, which, in both the upper and lower portions of the section, are undisturbed, but are separated by a conglomeratic band that is from two to six feet in thickness. The conglomerate consists of limestone pebbles, more or less rounded by attrition, and contains fossils that are identical with those that occur in the undisturbed parts of the section, and are set in a calcareous matrix. Other examples of a similar kind are described from localities situated in Canada (Cambrian and Ordovician); Vermont and New York (Passage-beds between the Cambrian and Ordovician); Pennsylvania (Lower Cambrian); Virginia (Cambrian and Cambro-Silurian); and Tennessee (Cambrian). As to the origin of these conglomerates, Walcott thinks that the calcareous muds, represented by the beds, were solidified soon after their deposit, and were raised in ridges or domes above sea level, and that these latter were subjected to the action of sea-shore ice, if present, and the debris worn from the exposed ridges was deposited in the intervening depressions.[14]

INTRAFORMATIONAL BRECCIAS.

According to Grabau[15] "these are contemporaneous phenomena, formed as one of the sequential divisions of a single rock series. They are almost wholly confined to

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(13) "Palaeozoic Intraformational Conglomerates," by C. D. Walcott, Bull. Geolog. Soc. of Am., vol. v. (1894), pp. 191-198, pls. v.-vii. The same paper, with additional plates, was reprinted at the end of Walcott's paper on "The Cambrian Rocks of Pennsylvania," Bull. U.S. Geolog. Sur., No. 134 (1896), pp. 34-40, pls. x.-xv.

(14) Sir William Dawson also thought that, in the case of the Canadian examples, ice agency was the cause. See Dawson, "On the Eozoic and Palaeozoic Rocks of the Atlantic Coast of Canada," Quar. Jour. Geolog. Soc., vol. xliv. (1888), p. 809.

(15) "Principles of Stratigraphy," 1913, p. 529.

calcareous rocks, and seem to be most typical of calcilutytes or fine calcarenytes. Such rocks, composed largely of the finest lime-mud, accumulate in shallow water or in part even above the normal level of the sea. In form they probably constitute a sort of mud flat delta, the mud being brought and spread out in part at least by streams, which must have derived it from the erosion of earlier limestones. Mud cracks or desiccation fissures testify to the shallow water in which these sediments were accumulating. On exposure partial hardening permits the formation of a superficial crust, which may subsequently break or become deformed by the sliding of the entire mass seaward." Under this heading Grabau also includes, "the *edgewise conglomerates* of many limestone formations," in which the fragments sometimes occur on end, and also the "*Subaquatic, Gliding-deformations,*" which, it it said, sometimes take place on a gently sloping sea or lake bottom, by which the sediments become broken up, contorted, and brecciated.(16)

ENTEROLITHIC STRUCTURE.

These terms have been used respectively by Hahn(17) and Grabau(18) for such deformations as occur within a rock that are caused by chemical changes that produce an increase or lessening of volume. Thus when anhydrite by hydration becomes changed to gypsum there is a great increase of volume which, in expanding, distorts the layers; or, conversely, in the dehydration of gypsum there is a corresponding distortion by contraction. Similar effects have been produced by the recrystallization of the salt deposits in the Zechstein of North Germany. The dolomitization of limestone is often attended by local distortion, as, also, the changes induced by the phosphoratization of beds of limestone. According to Grabau, "The important distinction between enterolithic and other deformations, such as folding under lateral pressure, or gliding in a given direction, lies in the fact that the enterolithic structure folds in all directions—is apolar, or multipolar, instead of unipolar."

DESICCATION CONGLOMERATES.

In the Ohio coal-measures there are a number of thin limestones, usually magnesian with additions of silica

(16) Grabau, *op. cit.*, pp. 779-785, with numerous figures.

(17) Hahn, "Untermeerische Gleitungen bei Trenton Falls (Nord Amerika) und ihr Verhältniss zu ähnlichen Störungsbildern," Neues Jahrbuch für Mineralogie, u.s.w. Beilage Bd. xxxvi. (1912), pp. 1-41, taf. i.-iii.

(18) Grabau, *op. cit.*, p. 756, *et. seq.*

and clay, and apparently of both marine and fresh-water origin. Mr. J. E. Hyde, of the Stratigraphic Laboratory, Columbia University, in describing these limestones, says, "Layers of conglomerate, consisting of fragments of limestone cemented in a limestone matrix, occur throughout the series. Their thickness may vary from a fraction of an inch to two or three feet. The fragments are usually small, from the size of a pea or less up to an inch or two in diameter, and, rarely, four or six inches in diameter. . . . The origin of these limestones is an open question, but it is probable that they were formed in restricted basins which may have had an extent of many miles. The numerous mud-cracked surfaces and abrupt lithological changes show that the area was subjected either to rapid oscillation and consequent successive flooding and drainage, if they be considered of marine origin, or to periods of desiccation if they be considered as lake deposits." For this kind of broken bedding Hyde suggests the name of *Desiccation Conglomerates*,[19] and thinks that they were formed somewhat under similar conditions to the fresh marl lakes that occur at the present time throughout much of the drift-covered area of North America. Hyde says, "The method of formation is briefly this: Extensive areas of lime-mud may be exposed to the atmosphere either by elevation above a body of water, due to land movements, or by the evaporation of an enclosed body of water in which such muds exist. On drying, the surface of these lime-mud flats would become cracked and hardened, and if exposed a sufficient length of time the cakes thus formed might become hard enough to withstand more or less working over by waves on resubmergence. If it should then be covered by succeeding lime-muds, the layers would constitute a true intraformational conglomerate."[20]

Walcott had, in 1896, noticed certain shore features on Rhode Island which might illustrate the formation of desiccation breccias and conglomerates. He says, "The mode of formation of a brecciated limestone conglomerate has often puzzled me when studying Palaeozoic rocks. Geologists frequently observe layers composed almost entirely of thin-bedded, brecciated limestones, or of sandy or argillaceous shales. In many cases the layers of breccia are not more than an inch or two in thickness and occur between layers formed of undisturbed sediment. The breccia is often composed of angular fragments varying from a quarter of an inch to half

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(19) See Hyde, "Desiccation Conglomerates in the Coal-measures Limestones of Ohio," Am. Jour. of Science, Fourth Ser., vol. xxv., 1908, pp. 400-408.

(20) *Loc. cit.*, p. 401.

an inch in thickness, while in the thicker layers of the breccia fragments an inch or more in thickness occur.

"During the summer of 1895, when making observations on the flats exposed at low tide in the inlet west of Noyes Point, Rhode Island, I noticed that when the tide went out before daylight the layer of fine sand and mud exposed to the dry wind and sun during the day hardened, and that when the surface of the water of the incoming tide was broken by small waves the hardened layer was lifted, broken into angular fragments, and piled in some places to a depth of several inches, while in other places it was simply turned over and was very little disturbed. When much disturbed the edges of the fragments were rounded, so as to give them the appearance of having been rolled a considerable distance. In one instance the ensuing outflowing tide deposited a thin layer of sand and silt over the brecciated fragments. From these observations it is evident that should the same phenomena occur on a sinking shore-line, breccias of this character, so often met with by the field geologist, would be formed."[21] (As an illustration of this process see plate xx.)

Classification.

Many of the terms used by the respective authors, quoted above, evidently have a common application and must be taken as synonyms. It appears possible to divide the various deformations into two classes based on a question of time, whether contemporaneous with the deposition of the beds or as occurring at a later geological stage. In the former case the beds became broken and deranged before a final consolidation took place; and, in the latter, the beds had reached a high degree of induration before disruption. Another principle of classification can be based on the nature of the agency which was responsible for the deformation, whether chemical or dynamical. On such lines the following classification has been attempted, utilizing such terms as have been introduced into the subject by other authors, so far as they suit my purpose:—

I. Syngenetic (Contemporaneous deformations).

1. By contraction in drying:—

(a) Desiccation Breccias and Conglomerates (Hyde, 1908).

(b) Endolithic Brecciation (Grabau, in part, 1913).

(c) Intraformational Breccias (Grabau, 1913).

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[21] Walcott, "Camb. Rocks of Pennsylvania," Bull. U.S. Geolog. Sur., No. 134 (1896), p. 40, pl. xv.

2. By Gravitational Deformations:—

(a) Subaquatic Gliding-deformations (Hahn, 1912; Grabau, 1913).

(b) Edgewise Conglomerates (Hahn, 1912).

3. By Ice Movements:—

Glacial Breccias, etc.

II. Exogenetic (Internal Deformation subsequent to Consolidation).

1. By Chemical Change:—

Enterolithic Structures by hydration, dehydration, substitution, etc. (Hahn, 1912; Grabau, 1913).

2. By Dynamic and Tectonic Movements:—

(a) Autoclastic (Smythe, 1891).

(b) Friction Conglomerates (Van Hise, 1893).

(c) Crush Breccias and Conglomerates (Lamplugh, 1895).

(d) Intraformational Conglomerates (Walcott, 1896).

(e) Dynamic Breccias (Van Hise, 1896).

(f) Pseudo-conglomerates (Van Hise, 1896).

(g) Thrust-conglomerates (Gardiner and Reynolds, 1897).

(h) Fault andVein Breccias.

South Australian Examples.

Crush zones, conglomerates, and breccias of different types occur at various horizons in South Australia. Some of these are evidently dynamic in their origin, while others can, with considerable probability, be referred respectively either to chemical changes that have transpired within a rock mass subsequently to its induration, or to a process of desiccation and displacement that occurred contemporaneously with its deposition. In some cases the causes of such internal deformations are obscure.

As in other parts of the world, the beds in which the deformations have taken place are mostly limestones, which, in some cases, are somewhat thinly laminated and others are massive. Limestones are particularly liable to chemical interchanges, both with respect to molecular structure and chemical substitutions. Many of the Cambrian limestones of South Australia have been greatly altered by the interpenetration of silica, either in the form of a diffused silica-skeleton, or as layers of chert that are often closely interlaminated with thin layers of limestone; also by the phosphatization, dolomitization, or ferric oxidation of the limestones. The following localities and geological horizons give illustrations of our subject.

MOUNT REMARKABLE (Autoclastic).

This truly "remarkable" mount, situated in the southern Flinders Ranges, 150 miles north of Adelaide, forms a very prominent horst with quartzites, of Lower Cambrian age, as the chief lithological feature. On its eastern side the mount rises abruptly from the plain to a height of over 2,000 feet, and has a fault-displacement on that side of several thousands of feet. The Brighton Limestone series make prominent features on both the eastern and western sides of the mount, the dip is anticlinal with a high pitch, to vertical, on the eastern side of the mountain. Autoclastic phenomena, on a very extensive scale, occur on the south-eastern, southern, and south-western sides of the mount. The brecciation, whilst associated with several important fault-planes, is something more than an ordinary fault-breccia. The shatter-zone on the south-eastern side of the mount is three miles long, and, near Melrose, is half-a-mile wide. It extends from the level of the Mount Remarkable Creek (a little higher up the stream than Melrose) to a height of 600 feet up the mountain side, at the "Cat Rocks," nearly opposite Melrose. The "shatter" occurs on both sides of the great fault-displacement, and includes, *(a)* the impure siliceous limestones of the Brighton series underlying the true limestone; *(b)* thick, Lower Cambrian, dark-coloured shales (or slates), and *(c)* the adjoining portions of the thick quartzite on the one side, and, to some extent, the thick limestone on the other.

The brecciated beds are in the creek at the southern end of the mount, with the "Gibraltar Rock" (in the form of a high fault-scarp of the quartzite) on the northern side, and a range of brecciated rock on the southern side of the stream, which continues round to the south-western angle.

Over the greater part of this broken country the original planes of stratification are entirely destroyed, and angular and rounded fragments of the associated beds are irregularly distributed through a mylonitic base. In some instances the original lamination of the bedding can be recognized in the included fragments. It forms an example of autoclastic action of a peculiar kind. It did not develop along a thrust-plane of low angle, as commonly is the case in crush-conglomerates, and it is also different from what is ordinarily known as a fault-breccia. It might be described as a long and wide segment (or segments) of the earth's crust, that has slipped down, almost vertically, probably 4,000 feet, and has become shattered, brecciated, and mylonized during the movement. It might be comparable to a "thrust" that was nearly vertical in movement.[22]

UPPER TORRENS-LIMESTONE ([?] ENTEROLITHIC).

The Upper Torrens-Limestone is a dark-coloured, earthy and siliceous limestone that occurs in the Lower Cambrian rocks towards the base of that series. The bed carries much black chert[23] which occurs in the form of nodules, lenticles, and layers. In some localities the chert consists of two very distinct materials (pl. xvi.), the matrix consisting of a light-coloured siliceous base, and in this groundmass there are thickly studded angular and rounded fragments of black chert. The round, pebble-like inclusions vary in size from that of oolitic grains up to half-an-inch in diameter and are not concentric in structure. The angular fragments are flat with vertical sides, and are often about an inch to two inches in length and about a quarter of an inch in thickness. There is no very distinct stratigraphical order in the arrangement of the respective inclusions, for while there is a rough kind of parallelism in the way in which they occur in the rock, they may lie at any angle.

One of the localities in which they occur very abundantly is near Frewville, on the Port Germein road, three miles west of Booleroo Centre. The geological features of the district are much obscured by arable land. The Cambrian tillite crosses the Port Germein road about a quarter of a mile to the eastward of the Gorge Hotel, with quartzite below and the Tapley Hill banded slates on top, dipping east. Very little rock can be seen till the Port Germein road meets the main north road, a little south of Murray Town, where the banded slates are again seen in a quarry near the road with a dip west. On the hill-top above Frewville there are exposures of slates and sandstones with a dip west at 40°, and, nearby, both in heaps by the road and scattered over the paddock (Sec. 54, Hd. of Booleroo), there are large numbers of cherty fragments with brecciated inclusions. The specimens seen were all surface stones, the outcrop probably forming the subsoil of the ploughed ground. Although not seen *in situ* here, there is little doubt that the chert was derived from the Upper Torrens-Limestone beds. Good examples also occur

(22) For further particulars see Howchin, "The Geology of Mount Remarkable," Trans. Roy. Soc. S. Austr., vol. xl. (1916), p. 545.

(23) Howchin's "Geology of South Australia," p. 356.

near Trevilla, the residence of Mr. H. H. Blackham, One Tree Hill; at Mylor, on the Onkaparinga, and other places in the Mount Lofty Ranges.

It is not an easy matter to give a satisfactory explanation of the structure in this case. While the Lower Cambrian beds have been subjected to much distortion from tangential pressure and thrusts, there is no definite evidence of such having operated on the beds in question in a way that might cause a dynamic deformation. It is more likely to have arisen from some form of enterolithic action in which infiltration and substitution have been the chief agents. Secondary silicification probably took place when the black carbonaceous shale became altered to chert and the interpenetrating silica formed the reticulating veining that has united the cherty fragments into a form of brecciated rock.

THE BRIGHTON LIMESTONE HORIZON.

This is the most important limestone in the Lower Cambrian Division, and is remarkably persistent along a line of strike that occurs, at intervals, over several hundreds of miles, in a north and south direction, and is often repeated, transversely, by a succession of foldings. The following localities illustrate its occurrences:—

Brighton.

The limestone is typically developed in the neighbourhood of Brighton, about 10 miles to the southward of Adelaide. The main limestone is underlain by a thick series of banded and siliceous limestones, and is overlain by the Purple Slates Series, which form the lowest beds of the Upper Cambrian Division. The limestone is in three fairly distinct layers of about equal thickness, which, unitedly, give a section of about 50 feet. The lowest member is of a dark blue colour and contains about 40 per cent. of silica. The middle bed is of a dull pinkish colour, often oolitic in the grain, and carries about 86 per cent. of calcium carbonate, the balance consisting of silica with a small percentage of ferric oxide. The top bed is generally of a buff colour, pinkish in patches, and is dolomitic.

The structure of this limestone, especially in the upper portions of the middle bed, is subject to much variation. At Brighton, the middle bed, or "pink limestone," is commonly of a semi-oolitic structure, that can only be recognized by the use of a hand lens. Under the microscope, in thin sections, the groundmass is seen to be partly microcrystalline and partly granular, and is thickly studded with more or less spherical bodies. The latter differ greatly in size. Some are not very sharply defined from the matrix. The majority are less than one-hundredth of an inch in diameter, while some attain the size of one-twenty-fifth of an inch, or even larger. Many are oval in outline, and in such cases there is a tendency for them to occur with their longer axes all pointing in the same direction. These rounded bodies appear to be formed of the same material as the granular part of the matrix. There is an absence of the concentric structure commonly seen in oolitic grains, but the marginal area is usually denser and darker than the rest, probably arising from their spheroidal form and also from the fact that many are filled by crystals of calcite. Many of the spherules also show a faint and dull reddish colour, especially towards their centres. It is this colouring matter in the spherules that gives the dull, pinkish, or reddish colour to the rock in bulk.

These non-concentric spheroids do not appear to have been formed by precipitation around a nucleus (unless the crystals of calcite which occupy the central portions of many of them be regarded as such), but they have the appearance of minute pellets of the groundmass, the constituents of which have become agglutinated by a cementing agent. This cementing agent is clearly the ferric oxide that gives colour to the rock, and probably originated by the hydration and oxidation of a diffused iron compound that formed part of the original material of the rock.

In addition to the minute spheroidal bodies the limestone, in certain layers, is studded with yellowish and earthy-looking patches, up to half an inch in length, which on analysis proved to be portions of limestone coloured with ochreous material. Obscure traces of radiolaria have been detected in some parts of the limestone,[24] and having recently forwarded some etched surfaces of the limestone to Mr. F. Chapman (Palaeontologist, National Museum, Melbourne), he courteously informs me, "The majority of the siliceous spheres are nearly twice the usual diameter of the Barbados and living radiolaria, although some recent forms are even much larger. They average about ·2 mm. in diameter. In more than one I could detect the radial bars and another the central shell. The meshwork, although irregular, could hardly belong to anything outside the radiolaria, and their condition suggests that there has been a tendency for the structure to break down during the silicification of the matrix. The smallest rock specimen carries

(24) David and Howchin, "Note on the Occurrence of Casts of Radiolaria in Pre-Cambrian(?) Rocks of South Australia," Proc. Linn. Soc. N.S. Wales, 1896, part 4, p. 571, pls. xxxix., xl.

some undoubted radiolaria in high relief, with a central capsule. To my mind there is no doubt that these remains are radiolarian."

The siliceous and laminated limestones that underlie the Brighton main limestone exhibit remarkable structures in which calcareous and argillaceous material, in separate fragments, are interlaminated. From the resemblance which this rock makes, in cross section, to vermiform bodies it has been called "vermiculate" structure.(25) The origin of this structure is under investigation.

The Burra (Kooringa).

Pls. xvii. and xviii.

The Burra, which is the railway station for Kooringa, is situated on the main north line, 101 miles, by rail, from Adelaide. The Brighton limestone series is extensively developed in the neighbourhood, and although lacking in the particular textural features now under description, it is worthy of some notice here.

There can be no doubt as to the geological horizon as the limestone is underlain by the banded slates, and within two miles of Kooringa, on the eastern side, there is an extensive outcrop of the Sturtian Tillite, which is the correct order of succession. The beds have been greatly disturbed by folding, faulting, and overthrusting, which have produced a certain measure of metamorphism that has rendered them dissimilar from the rocks of the same horizon both to the south and north of them. No good natural sections occur in the neighbourhood, so that observations are almost limited to the few quarries that have been opened. The most important of these is the Government ballast quarry, on the western side of the railway, not far from the station. The great open cut at the old mine is in very broken country, including a thick band of fault-breccia, so that it is of little service for stratigraphical determinations. The upper members of the Brighton series, which are massive and carry the oolitic-like bodies and brecciated structure, are apparently absent from the Burra outcrops, having been denuded, and the structural features that are present agree, in a general way, with the siliceous limestones that underlie the main limestone in the true order of succession. The limestones are, characteristically, finely laminated in parallel lines of different shades of

(25) Howchin, "Geology of Mount Lofty Ranges," part 1, Trans. Roy. Soc. S. Austr., vol. xxviii., 1904, p. 263, *et seq.* Howchin, "Geology of South Australia," 1918, p. 358.

colour (pls. xvii. and xviii.), cross jointed, very brittle, and under percussion break up into numerous small pieces. There has evidently been some molecular reconstruction as the siliceous constituent is, under normal conditions, distributed throughout the mass, but at the Burra it is, to some extent, segregated into layers and nodules of black cherts, by which the limestone becomes relatively purer and crystalline. The development of black chert in the limestone gradually increases along the strike, from north-west to south-east, until at the New Burra Mine, about nine miles from Kooringa, the cherty layers in the limestone are very numerous.

It is open to question as to whether this unusual development of laminae in the limestone, in this particular district, arises partly from the development of an incipient foliation under pressure. It is evident that there has been some measure of metamorphic reconstruction, and while there is, generally, a remarkable regularity in the parallelism of the layers, the lines sometimes become contorted, broken, wavy, and even concentric (pl. xviii.).

Pekina Creek.

A limestone of the same horizon as the Brighton beds outcrops on the Pekina Creek, near Orroroo (176 miles, by rail, north of Adelaide), and shows a slight variation of structure from that which occurs at Brighton. The groundmass, as seen through the microscope, consists of distinct and clear crystals of calcium carbonate, that are more perfectly developed than at Brighton. In this groundmass are set a number of objects of darker hue than the crystalline matrix. They are of various shapes—circular, quadrate, triangular, fusiform, mushroom-shaped, and irregular, of various sizes up to one-eighth of an inch in diameter. The contours, by which these bodies are defined, are usually rounded and strongly marked. The bodies are composed of granular particles of limestone of very fine texture and, towards the outer margin, the granules are sometimes arranged in a lineal and concentric structure that simulates very fine organic cellular structure. The central areas do not show this regular arrangement of the granules, and are usually more open in texture and pass transmitted light more readily than the marginal portions. The general texture and appearance of the rock are closely similar to the Brighton beds, but the darker coloured bodies in the clear matrix are of larger size and more irregular in shape than those seen at Brighton, but they are evidently of a similar kind and have had a common origin.

Mount Remarkable.

The main limestone of the Brighton series makes outcrops on both the western and eastern sides of the mount, in superior order to the autoclastic zone described above at page 311. On the eastern side, the outcrops are weathered down even with the ground and, therefore, unfavourable for observation. On the western side of the mount they are more prominent and give good sections.[26] The rock is in all respects similar to that seen in the Brighton exposures. The groundmass is somewhat more crystalline than in the Brighton examples, and the pellet-like spherules are abundantly developed and are of a similar type to those at Brighton. There is the same feature of ferruginous cement in the superficial coating, as well as at the centre of the spherules. In many cases the nucleus is formed by either a rhombohedral crystal of calcite, or a combination of two or three such crystals. The yellowish to brownish inclusions, of an ochreous kind, seen at Brighton, occur here also; but of a larger size, reaching, in some cases, two inches in length. These inclusions are mostly flat with serrated edges, and they contain the pellet-like objects in the same manner as the rest of the stone. Specimens were gathered for examination near the residence of Mr. William Gray.

Depôt Creek.

Pl. xix.

The fine-grained, light-coloured quartzites of the Devil's Peak Range end abruptly at the Dutchman's Stern, about five miles north-west of Quorn. The purple slates rise from beneath these beds and continue in outcrop for four miles in a northerly direction. The purple slates are underlain by the Brighton limestones, which make a bold outcrop, a little to the south of the Depôt Creek, near the residence of Mr. Fitzgerald, and then, after crossing the creek, they occupy a higher level on the right bank. The thick limestone varies considerably at different levels with respect to the grain of the stone, the colour, and the structure. It is somewhat ferruginous, giving the rock at some horizons a brownish colour. The colour varies to dark brown, in places, and to a light-greenish tint at others. Like the same limestone further south it has a quasi-oolitic texture, and the granules, individually, vary in shape. They are mostly spheroidal, but also egg-shaped, pear-shaped, elongated, subangular, or irregular. The matrix is somewhat coarsely crystalline and transparent

(26) See Howchin, "The Geology of Mount Remarkable," Trans. Roy. Soc. S. Austr., vol. xi. p. 551.

in moderately thin sections, while the included pellets are very finely granular in texture and of darker colour than the matrix. Most of them are sharply defined from the matrix and are destitute of any distinct concretionary shells. A few exhibit a very thin, dark-coloured exterior ring, and a more translucent and equally thin circle immediately below it, with the usual dark, granular texture below the latter. In some the outer circle forms the semitransparent ring, and, the inner, the darker. Most have no nucleus, while others have either transparent centres or darker than the intermediate zone.

The brecciation (pl. xix.) is more developed in this locality than in the beds further south. Angular fragments, identical in texture with the groundmass, although usually of a lighter colour when viewed macroscopically, are numerous and of all sizes up to three inches in length. In a few instances, noted, they were longer than this, in the form of flat layers, or slightly curved, from a quarter of an inch to half an inch in thickness. A curious feature is present in that the larger brecciated fragments sometimes carry inclusions of smaller angular fragments within them, which also contain the oolitic-like granules. When the edges are straight and sharp the fracture has passed through some of the granules, giving evidence of subsequent movements. In other cases the dark-coloured ferruginous cement has united a number of the spheroidal bodies together and forms a sharp, dark line at the boundary, making a scalloped edge as it passes around the projecting spheres on the margin. While there is generally a rough parallelism in the way in which the fragments lie in the bed, there are instances in which they take a vertical position answering to the form that Hahn has called "edge-wise conglomerates."

As in the case of the Burra section, some of the limestone at the Depôt Creek forms a wavy and concentric structure. Individual examples, when rubbed down, show a certain resemblance to nodules of the Stromatoporoidea, as hand specimens, but on examination of thin sections of the rock under the microscope they show no relationship to such organisms.

General Remarks on Certain Rock Structures of the Limestone that forms the Brighton Horizon in the Lower Cambrian.

1. The outcrops that come under review in this paper extend over a lineal distance of 250 miles. There is a general similarity of rock features, both microscopically and macroscopically, at the same horizons throughout this area, which

seems to prove a remarkable uniformity of conditions as prevailing either at the time of deposition or subsequently.

2. The origin of the quasi-oolitic bodies, as distinct from the crystalline groundmass, is not easy of determination. The differences between these and typically-formed oolitic grains have already been noted (page 314). The presence of hydrous oxide of iron, generally distributed throughout the bed, as well as in patches and as a cementing agent, is suggestive of their origin. Assuming this much, it remains to be proved as to whether they were formed originally, at the time of deposition (syngenetically), or at some later period when the rock was undergoing molecular reconstruction by metamorphic action (enterolithic). The evidence, so far as available, appears to favour the latter view. The segregation of iron oxide in sand and other sediments, forming "iron balls" and other concretions by cementation, is a well-known circumstance. These are common in the superficial beds of Central Australia. A similar segregation of iron oxide under the reconstruction of a rock by crystallization has been observed by the writer in the silicification and calcification of the plants of the coal measures of the north of England. In some cases of silicification the ferruginous material formed circles (or spheres) without obliterating the organic structure; while in the process of conversion to a calcic radial crystallization the cellular structure became destroyed (in places) and the ferro-carbonaceous material formed dark borders between contiguous radial crystalline areas, and also a dark nucleus at the centre of each of these crystalline areas. In the proto-metamorphic process the limestone of the Brighton horizon became crystallized, and we may assume that the matter foreign to the calcium carbonate was excluded from the calcite crystals, forming centres of cementation among the original particles of the limestone and arrested the process of crystallization within such cemented areas. The fact that some of the spherules in the limestone possess a nucleus of clear crystalline calcite is suggestive that the sub-oolitic structure was coincident with and arose out of the condition created by the metamorphic action.

3. The brecciation is an interesting feature, especially as developed in the Depôt Creek outcrops. The angularity of many of the included fragments suggests a mechanical force which must have operated subsequently to the formation of the sub-oolitic structure, as no distinction exists as to form and mode of occurrence between those included in the fragments and those in the crystalline matrix. More than one period of brecciation appears to have occurred, as smaller angular fragments are included in some of the larger ones.

The rock gives no evidence of having been faulted or subjected to tectonic movements that might have caused crush brecciation. It seems probable that the brecciation was caused by some form of enterolithic movements induced by chemical and crystallizing processes during the alteration of the rock by a partial metamorphism.

4. The rock-structure seen in the Burra limestone is quite distinct from the others of the Brighton series described in this paper. This arises from the several reasons that the beds at the Burra are at a slightly lower horizon than the others described, they were laid down under different conditions, and have been subjected to greater alteration than in the case of the other localities dealt with. The wavy and concentric structure sometimes seen in the Burra limestone (pl. xviii.) is an interesting illustration of how susceptible limestones are to deformation under tectonic processes.

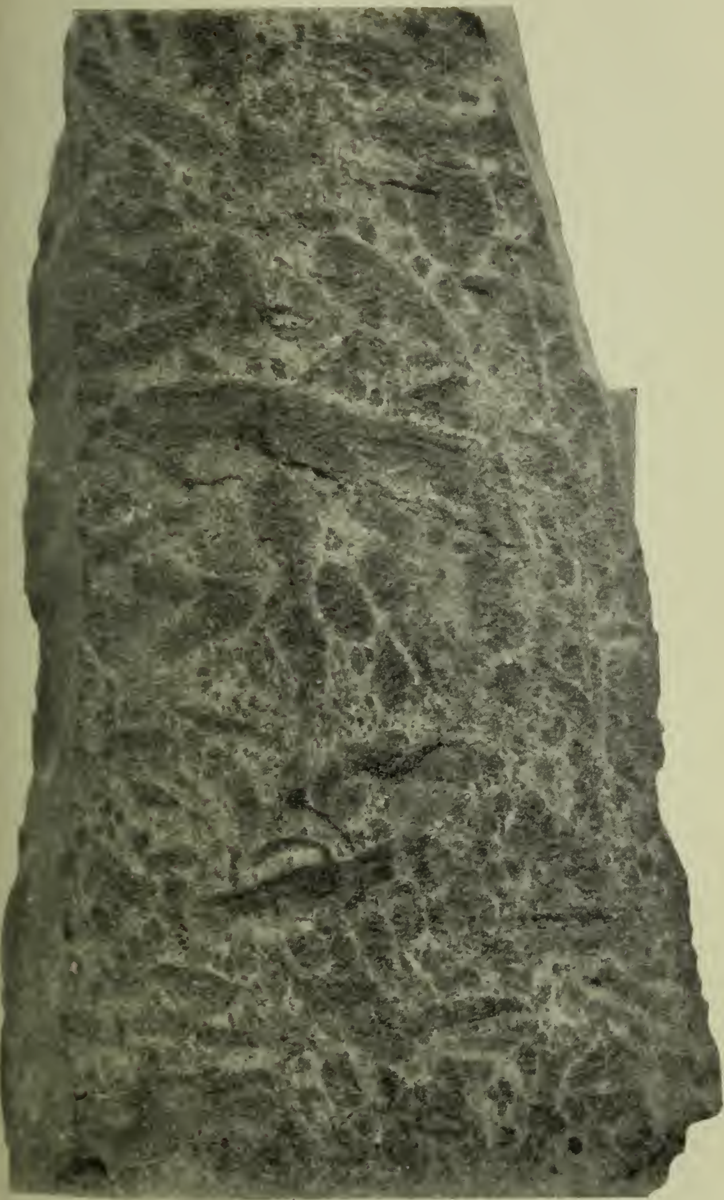
Beltana (Flinders Range).

Pl. xxi.

Beltana is a small township situated on the great northern railway line, between Quorn and Marree (Hergott), 353 miles from Adelaide. On the eastern side of the township a small creek has cut into its bank, exposing a section of thin limestones and calcareous shales of Upper Cambrian age. The beds are in nearly horizontal position and give no evidence of tangential slides or crush in the rock as a whole. At some points, however, the beds are strangely broken in such a manner as to suggest some form of intraformational brecciation. The thin layers of limestone, when in position, are about an inch in thickness, but they pass into a confused conglomeration of shale and limestone fragments, many of the latter being rounded as though having been subjected to attrition. In the same vertical cliff there are to be seen larger fragments, about a foot in length, that have a laminated structure and have been acutely bent so as to have the appearance of a closed fold. An isolated fragment of this kind, enclosed in the horizontal shale bed, proved at the time of observation a most puzzling feature.

The upper part of the section consists of a thin-bedded limestone, the surface of which shows a number of angular or subangular fragments of various sizes and shapes that have become united into a solid slab (see pl. xxi). When viewed on the vertical face it is seen that the brecciation goes down into the limestone to a depth of several inches.

It would seem, from appearances, that the contorted fragment seen in the shales of the middle portion of the



Brecciated Black Chert.

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Fig. 1. Broken Laminae in Limestone (transverse).

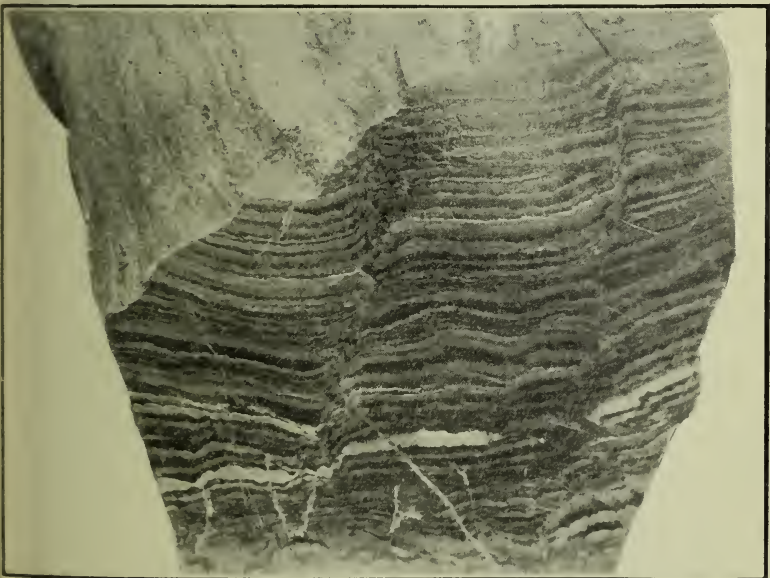

Fig. 2. Broken Laminae in Tangential direction.

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Fig. 1. Broken Laminae on Plane of Lamination.

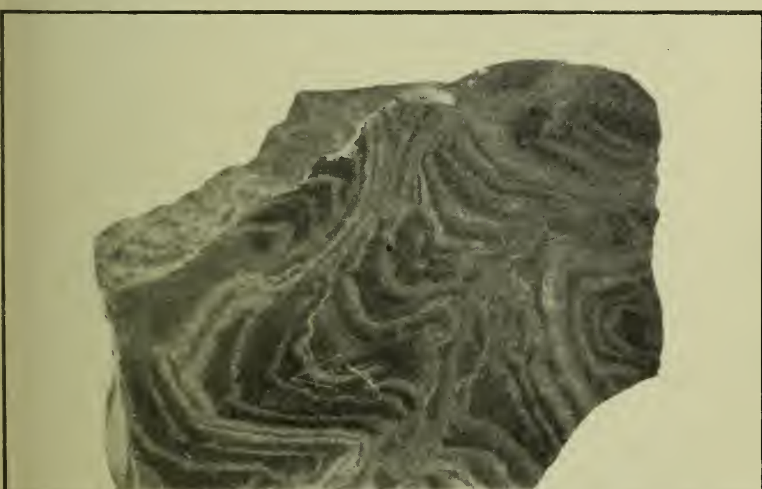

Fig. 2. Wavy and Concentric Structure in Limestone.

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Pseudo-oolitic and Brecciated Limestone.

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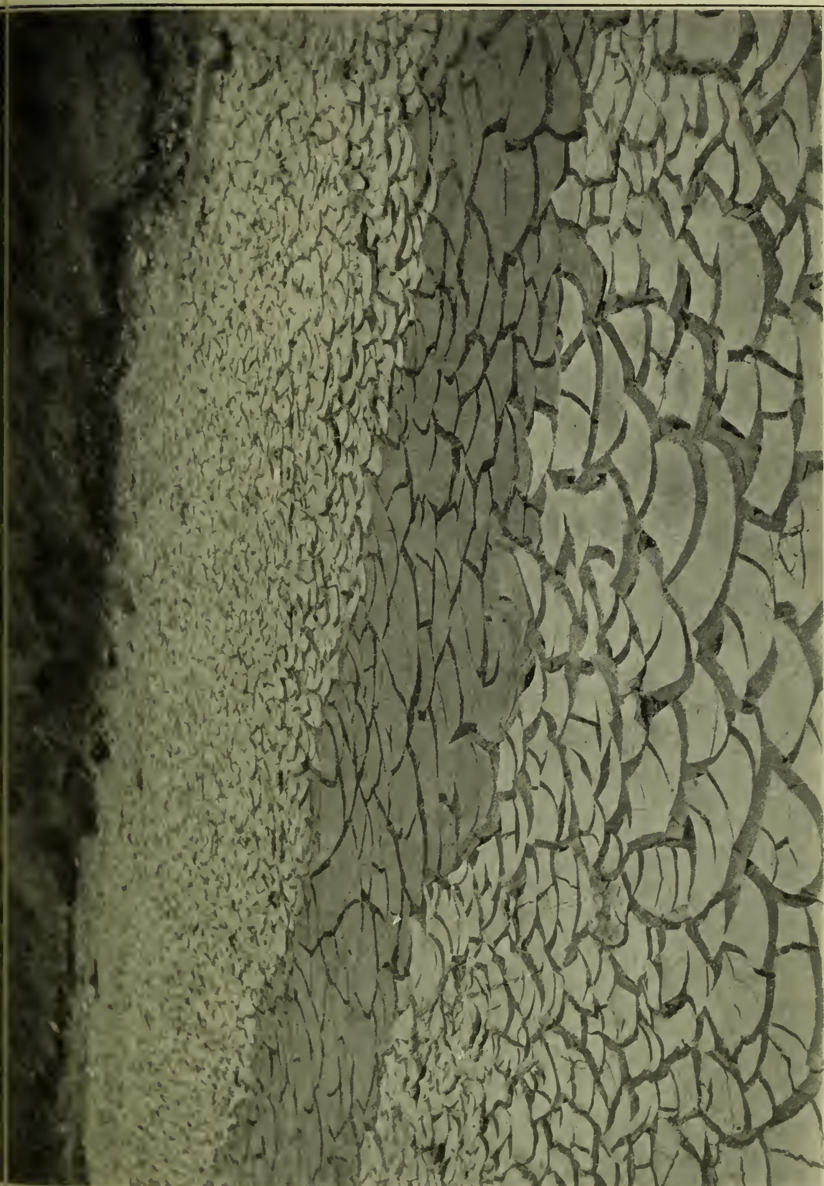

Sun-cracks in Dried Mud.

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(?) Desiccation Breccia.

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section, might be referred to that type of intraformational brecciation which Grabau has called "subaquatic gliding-deformation"; while the recemented angular fragments, that form the top layer, agree equally well with Hyde's "desiccation breccias."

The observations at Beltana were made in 1901, when little was known of contemporaneous brecciation, or otherwise I should have made a more careful examination of the neighbourhood for further clues, and, unfortunately, I have had no further opportunity of visiting the locality.

Plate xx. has been introduced to illustrate how a desiccation breccia might originate.

DESCRIPTION OF PLATES.

Plate XVI.

Hand specimen of brecciated and nodular chert. Upper Torrens-Limestone. Lower Cambrian. Natural size.

Plate XVII.

Fig. 1. Vertical polished section of laminated and brecciated limestone. Government ballast quarry, Burra. Lower Cambrian. Natural size.

Fig. 2. Polished face in diagonal direction to lamination and at right angles to the face shown in fig. 1.

Plate XVIII.

Fig. 1. Polished face taken parallel to lamination, in same specimen illustrated on plate xvii., showing flat faces of brecciation. Natural size.

Fig. 2. Another polished example from the Burra, showing wavy and concentric structure.

Plate XIX.

Example of pseudo-oolitic and brecciated limestone, Depôt Creek. Lower Cambrian. Natural size.

Plate XX.

Sun-cracks in dried mud—the first stage in the construction of a desiccation breccia. Mud flat at outlet of small creek, near high-water mark, on Sellick Hill beach.

Plate XXI.

Surface of impure limestone showing broken fragments of calcareous sediments that have been recemented into the matrix, probably a desiccation breccia. Beltana. Upper Cambrian. Natural size.

Contributions to Australian Orchidology.

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

[Read October 14, 1920.]

Plate XIII.

Drakaea Jeanensis, n. sp.

Plant slender, 18-24 cm. high (in my specimens). Leaf radical, orbicular or broadly ovate-cordate, about 2·5 cm. in diameter, rather rigid, glabrous, upper-surface emerald-green. Stem very slender, glabrous, resilient; a small clasping acuminate bract, about 5 mm. long, considerably below the middle.

Flower single, on a slender pedicel about 9 or 10 mm. long, subtended by a small ovate-lanceolate clasping bract about 5 mm. long. Ovary somewhat pryamidal, about half the length of the pedicel. Segments of the perianth subequal, narrow-linear, yellowish-green, about 12 mm. long. Lateral sepals expanded at their insertion into the base of the columnar-foot, acutely reflexed downwards and backwards, their tips crossed behind the ovary; dorsal sepal retroflexed behind the column. Lateral petals acutely reflexed downwards, their tips crossed behind the ovary. Labellum very mobile, articulated by a narrow-linear claw about 9 mm. long to the distal end of the columnar-foot; peltately attached to the claw where it is contricted into two unequal lobes; the constriction or neck encircled by a shaggy leonine mane of reddish-purple hairs with tufted bifurcated tips; the longer lobe with yellowish-green orbicular base hairless except in vicinity of the claw, and a convex somewhat ovate reddish-brown smooth extremity with somewhat revolute margins; the shorter lobe a more or less globular mass of glistening purple mulberry-like glands interspersed with hairs similar to those on the neck; the two lobes almost in the same straight line; lamina about 12 mm. long, insectiform in appearance. Column very slender, retracted backwards at the base but incurved about the middle; about 9 mm. long (without the foot); very narrowly, and somewhat triangularly, winged in its lower part; produced beyond the wings into a narrow-linear horizontal foot about 10 mm. long. Anther relatively large, blunt, incurved, about 4·5 mm. long. Rostellar point not prolonged beyond the anther.

Found in sandy soil at Ravenswood, near Pinjarra, Western Australia, Jean S. Rogers, 1/10/19. It was then just beginning to flower.

This *Drakaea* should be placed in the section where the labellum is articulated at the end of a basal projection of the column and where the flower is solitary. The following differential table will show its relation to the two other members of this section:—

Lamina of labellum divided into two unequal lobes by a constriction near insertion of the claw.	
Longer lobe markedly glandular and hairy in basal half or third, elsewhere smooth, upturned at its free extremity; shorter lobe hairy and very glandular. Anther blunt but rostellum much prolonged so as to simulate an anther-point	*D. elastica*
Longer lobe very hairy except at its extreme tip which is smooth but not upturned, non-glandular; shorter lobe very glandular but not hairy. Anther blunt, rostellum not prolonged	*D. glyptodon*
Longer lobe quite smooth except for a few hairs at extreme base near insertion of claw, non-glandular, not upturned at tip; shorter lobe very glandular and hairy. Anther blunt, rostellum not prolonged	*D. Jeanensis*

The prolongation of the rostellar point is a very characteristic feature of *D. elastica*, Lindl. This, together with the "cocking-up" of the free extremity of the longer lobe of the lamina and the free distribution of glands and hairs over a considerable area of that lobe, readily serve to distinguish it from the new species. The latter approaches more nearly to *D. glyptodon*, Fitz., but here again the large area of the longer lobe of the lamina covered by hair and the absence of hair on the shorter lobe in Fitzgerald's species, afford a ready distinction between the two plants. Further, the shape of the shorter lobe of the lamina is quite different. While too much reliance cannot be attached to colouring, nevertheless the emerald-green leaf and the bright reddish-brown tints of the flower in the orchid under review immediately attract attention and differentiate it from both the older species, in which the flowers appear to be consistently dark purple.

Prasophyllum lanceolatum, n. sp.

Plant rather slender, 40-77 cm. high (in my specimens) with two long imbricated tubular sheaths at base of stem. Leaf-lamina 12-15 cm. long, not reaching as high as spike.

Spike with rather distant flower, 12-21 cm. long. Flower-bracts ovate or ovate-lanceolate, exceeding ovaries in length. Ovaries rather short and slender.

Flowers dark reddish-brown. Segments of perianth narrow-lanceolate. Lateral sepals connate except at extreme base and extreme tips, about 8·5 mm. long, conjoined breadth about 3 mm.; dorsal sepal slightly incurved, about 10 mm. long by 2 mm. broad, 5-nerved, very acuminate. Lateral petals narrow falco-lanceolate, 5-nerved, 7 mm. long by 1·25 mm. broad. Labellum on a very short claw, slightly arched about the middle, about 6·5 mm. long by about 3 mm. broad, lanceolate, membranous border narrow not crisped, margin entire almost plain; inner plate relatively large, lanceolate, about 5 mm. long by about 2 mm. in its greatest width, extending to within a short distance of the apex, traversed by three main and many subsidiary nerves, not thick or prominently raised, with narrow free margin in posterior two-thirds. Column about 2 mm. high; anther, rostellum, and lateral appendages about same height. Lateral appendages of column blunt linear-falcate, membranous; posterior border notched about half-way down, thereafter forming a receding sinuous line. Pollinia attached by a rather short caudicle to a relatively large ovate-lanceolate disc. Stigma at base of column, apparently ovate (in the dried specimens). Lateral Index 82.

Hab. — Albany, W.A., Dr. A. Syme Johnson, 25/9/19; Muresk, near Perth, W.A., Mrs. W. E. Cooke, 4/9/07.

The name has reference to the lanceolate shape of the segments of the perianth and labellum. These impart to the flower a slender and characteristic appearance which at once distinguishes it from *P. elatum*. It further differs from that species in the fact that the dorsal sepal exceeds in length the lateral sepals, in the presence of a claw to the labellum, and in the very much shorter lateral appendages to the column. In *elatum* these lateral appendages considerably exceed the rostellum in height.

In *P. brevilabre*, Hook. f., the dorsal sepal is shorter and narrower than the lateral ones; the labellum is sessile and abruptly reflexed and recurved in the middle.

In the new species the inner plate is not fringed, nor is there any evidence of a second inner plate as in the case of *P. Fimbria*, Reich. f.

It is differentiated from *P. regium*, Rogers, by the lateral appendages of the column which in that species (as in *elatum*) greatly exceed the rostellum in height; also by the labellum which in *P. regium* is recurved at right angles, with crenulated margins and an inner plate with a wide orbicular base; and further by the long strap-like caudicle in the latter species.

P. flavum, Br., has a characteristic leaf-lamina which rarely exceeds an inch (2·5 cm.) in length; the labellum is sessile and its inner plate commences about the middle of the lamina and not at the base, as in the case of the new species.

It should be placed next to *P. regium* in the writer's table of tall *Prasophylla* in Trans. Roy. Soc. S. Austr., xlii., 29.

PRASOPHYLLUM ELLIPTICUM, n. sp.

A tall robust plant reaching 104 cm. in height (in specimen under examination). Spike rather crowded with numerous pale green flowers, about 28 cm. long. Lear-lamina not reaching to top of spike, 65 cm. long. Flowers sessile, on a slender ovary about 12 mm. long. Ovary subtended by an acute bract about 7 to 8 mm. long. All segments (except labellum) rather narrow. Lateral sepals connate except at the base and extreme tips, about 11 mm. long, conjoined width about 6 mm.; dorsal sepal narrow ovate-lanceolate, 7-nerved, longer than lateral sepals, about 12·5 mm. long and 4 mm. wide, generally erect but becoming reflexed in older flowers, slightly incurved. Lateral petals rather bluntly falcate or falco-lanceolate, erect, about 9·5 mm. long, 2·5 mm. wide, 5-7-nerved.

Labellum on a very short claw, elliptical, about 11 mm. long and 5·25 mm. wide, erect in its basal two-thirds, gradually recurved towards the tip; outer membranous margin white, wide and voluminous, much crisped; inner plate also membranous, oval, with a rather narrow blunt short apical projection commencing about the bend but not nearly reaching the tip, attached to outer plate at base and apical projection, margin otherwise free, 6·5 mm. long (including apex) and about 4·5 mm. wide.

Lateral appendages of column similar to those in *P. elatum*, bluntly falcate membranous, longer than the rostellum, reaching 5·5 mm. above base of column, a basal thickening in the posterior border constituting a basal lobe. Rostellum reaching rather less than 5 mm. above the base of column, apex bifid to receive the disc. Caudicle rather long and stout, attached to the rostellum by a large sticky ovate gland or disc. Anther shorter than rostellum, apiculate. Lateral Index (ratio of petal to lateral sepal) 86.

Hab.—Near Jarnadup, W.A., Miss I. Knox-Peden, 21/12/18.

This *Prasophyllum* has in common with the preceding member of the genus *(Prasophyllum lanceolatum)* and also with *P. regium*, Rogers, a labellum with a thin membranous inner plate with free margins. It may be immediately distinguished from these, however, by its voluminous crisped outer plate. It shares this latter feature with two other large *Prasophyllums* indigenous to Western Australia, *viz.*, *P. Fimbria*, Reich. f., and *P. australe*, Br., and also with a South Australian form, *P. odoratum*, Rogers. The first of these possesses a conspicuously fringed inner plate and within this, again another well-marked plate. The second has a very acutely flexed labellum, with a prominently raised inner plate, the margins of which are not free, and which scarcely reaches beyond the bend in the labellum. The third has an acutely flexed labellum with an inner plate not conspicuously raised, the margins of which are not free. In these three orchids there exists a still further difference in the much shorter columnar lateral appendages which do not exceed the rostellum in height.

The inner plate has free margins in *P. elatum*, Br., but not of the membranous type, and the margin of the outer plate beyond this is quite narrow.

Western Australia must be regarded as the home of the giant *Prasophyllums*, which are evidently more numerous than was formerly supposed. Some of these reach extraordinary heights when compared with some of the diminutive members of the genus, which do not exceed 2 or 3 inches. Quite recently the writer saw on the Upper Kalgan River, in W.A., a specimen of *P. elatum*, which reached the height above the ground of 5 feet 4½ inches (about 161 cm.), with a stem at least an inch in diameter. It was absolutely erect and with other plants of the same species constituted an imposing feature of the landscape.

Microtis truncata, n. sp.

Specimens incomplete, the leaf-lamina being absent.

A plant of slender habit. Spike nearly 24 cm. long, bearing about 40 distant flowers.

Flowers light coloured, shortly pedicellated, subtended by a small awn-like bract reaching a little above the base of the ovary. Pedicel slender, about 2 mm. long. Ovary (without the pedicel) about 5 mm. long, much twisted.

Lateral sepals tightly revolute, oblong-lanceolate, about 2·5 mm. long by ·6 mm. broad; dorsal sepal ovate, cucullate, apex acute and slightly recurved, erect, about 3·75 mm. long by about 2·5 mm. in its widest part. Lateral petals erect, bluntly linear-falcate, about 2·75 mm. long and considerably narrower than the petals.

Labellum almost oblong; contracted laterally about the middle; margins slightly crenulated, but entire; about 3·75 mm. long with an average width of 1 mm., but expanding beyond the contraction to a maximum breadth of 1·5 mm.; lamina 5-nerved, with three callosities; a large anterior mesial callus, usually hastate or oval-hastate, extending almost to the tip; posteriorly two calli usually oblong-oval in shape, but owing to absorptive changes often assuming various crescentic or cuspidate forms, each occupying the basal area between the middle and the marginal nerve.

Anther with minute point, its apex considerably higher than the rostellum. Auricles large, prominent and rounded with small basal lobe on posterior margin, reaching to about the same level as the rostellum.

Hab.—Diamond Tree School, near Jarnadup, W.A., Miss I. Knox-Peden, December, 1918; Greenbushes, W.A., Dr. R. Pulleine, 8/12/17; Albany, W.A., Dr. A. Syme Johnson, 4/12/19.

This plant approaches most nearly to *M. media*, Br. In *media*, however, there are only two callosities on the lamina, both of which are basal and usually comma-shaped; there is no true anterior callosity, but its place is taken by two large oval-shaped groups of tuberculated glands; similar glands fringe the anterior margins of the labellum, which is emarginate at the apex. In the new species the labellum is not retuse or emarginate but is truncate. Further, its lateral petals are linear-falcate with blunt tips, whereas in *media* they are linear-oblong or linear-lanceolate. The following clavis shows the relation of the new species to other members of the genus:—

[Note.—The measurements are all taken from dried specimens.]

Lateral sepals recurved or revolute in mature flowers.
- Labellum with 3 well-defined callosities on lamina, *viz.*, 2 basal (lateral) and 1 anterior (mesial).
  - Labellum emarginate at tip; lateral petals relatively wide, oblong-oval, much shorter than lat. sepals; dorsal sepal wide, concave, exceeding 2 mm. long ... ... *M. porrifolia*
  - Labellum truncate; petals linear-falcate, at least as long as lat. sepals; dorsal sepal broad, exceeding 3 mm. long ... *M. truncata*
- Labellum with 2 definite lat. callosities at base, no anterior callus.
  - Labellum entire, no tuberculate glands on margins or surface; dorsal sepal broad, barely exceeding 2 mm. long ... *M. parviflora*

Labellum emarginate, 2 groups tuberculated glands on upper-surface and similar glands on anterior margins; dorsal sepal about 2·5 mm. long, broad and concave ... ... *M. media*

Labellum with anterior mesial callosity and sometimes 2 marginal callosities, expanded at its extremity into 2 large divaricate lobes; dorsal sepal upwards of 3 mm. long ... ... *M. alba*

Lateral sepals spreading, but not recurved or revolute.

Labellum entire, orbicular; lat. sepals acute, completely hidden behind labellum; lat. petals acute; flowers minute; dorsal sepal barely exceeding 1 mm. long, markedly galeate, broad ... ... *M. orbicularis*

Labellum entire, almost quadrate; lat. sepals very blunt and wide, not hidden by labellum; petals similar in length and shape to lat. sepals; flowers minute; dorsal sepal blunt, wide, cucullate, hardy 1 mm. long ... ... *M. atrata*

Labellum entire, oblong, contracted in middle, a broad callus at the base and a small oblong thickening towards the apex; lat. sepals not reflexed, as long and almost as broad as dorsal sepal; petals incurved over column, same length but much narrower than lat. sepals; dorsal sepal blunt, narrow, hardly broader than lat. sepals, about 2 mm. long ... ... *M. pulchella*

Labellum subemarginate at apex, quadrangular-oblong, crisped in middle, 2 small "appendages" at base and small thickening towards tip; lateral sepals rather blunt and similar to petals, but a little broader; flowers larger than in *M. pulchella;* dorsal sepal broad with small point at the apex ... ... *M. gymnadenoides*

Caladenia iridescens, n. sp.

A slender plant 10-20 cm. in height; stem reddish-purple, beset with fine hairs, a small clasping subulate bract below the middle, a tubular scarious sheath from 5-10 mm. long at the base; leaf narrow-linear, 5-8 cm. long generally reaching beyond the bract, sparsely hirsute.

Flowers usually solitary, rarely 2, a dusky-red mingled with iridescent golden tints, rather more than 2 cm. in diameter; ovary hairy, narrow, elongated, on a slender pedicel 7-10 mm. long, subtended by a narrow acute lanceolate bract; habit approaching that of *Caladenia carnea*, Br.

Lateral sepals spreading as in *C. carnea*, falcate-lanceolate, 11-13 mm. long; upper-surface a deep red (almost claret-colour), sometimes passing into a greenish-gold at the tips; lower-surface dull gold, iridescent, studded with dark-reddish glands. Dorsal sepal erect but much incurved, about 10 mm. long, contracted towards the base, spathulo-lanceolate, rather wider than lateral sepals, its dorsal surface glandular and similar in colour to the lower surface of the lateral sepals. Lateral petals narrower than the other segments, about same length as the dorsal sepal, coloured as in the case of the lateral sepals.

Labellum ovate on a short claw, about 5 mm. long; lateral lobes definite, erect, rather acute with entire margins and transverse red stripes, anteriorly merging into 2 or 3 blunt or clavate teeth; the middle lobe rather broadly triangular, recurved, dark purple and very glandular, with long clavate glandular calli on its margins; lamina between the lateral lobes entirely covered with rather crowded wide-headed short pedicelled dark-purple calli arranged in four rows, the calli becoming sessile without definite arrangement on the tip of the middle lobe and extending to the extreme apex. Column about 6 mm. long, much incurved in its upper part, wings wide and splotched with red, its dorsum marked with intermittent red lines. Anther pointed, incumbent; pollen-masses in two lamellated somewhat triangular pairs easily removed on a needle, no caudicular or other connection with the rostellum. Stigma situated immediately below the anther, fleshy, concave, semicircular in its lower border, the upper border passing into a sticky triangular rostellum.

Hab.—Hall Gap, Grampian Mts., Victoria, Mr. E. E. Pescott, 30/10/13.

The unusual and beautiful colouring of this orchid gives it at first a very distinctive appearance, but a careful analysis shows that it has close morphological affinities with *Caladenia congesta*, Br., and *C. testacea*, Br. *C. congesta* has, however, very much larger flowers which are almost always multiple; the labellum has a very long narrow middle lobe, without any marginal appendages but completely covered with densely-packed fleshy flat-topped calli, arranged transversely so as to give to this lobe a somewhat terete corded appearance; on the lamina behind these, the calli are still as densely packed, they are all sessile with the exception of the pair next to the claw, they are very fleshy and flat-topped. and are arranged longitudinally in two rather obscure rows; the labellum is nearly twice as long as that of the new species.

In *C. testacea* the lateral lobes of the labellum are usually ill defined and sometimes practically obsolete; the calli are not densely packed and do not extend to the extreme apex as in the new species; the calli are also of the linear-golf-stick type, whereas in *C. iridescens* they have short pedicels with large fleshy globular heads. The labellum is relatively very much larger in *testacea* and the lateral petals are about equal in length to the lateral sepals.

The new species should be placed between the above species in the differential table of these *Caladenias* in Trans. Roy. Soc. S. Austr., xlii., 32.

Caladenia cordiformis, n. sp.

A fairly robust plant, 18-32 cm. in height. Leaf broadly linear to oblong-lanceolate, very hairy, about 11 cm. long, 6-10 mm. wide. Stem very hairy; with a single subulate non-clasping bract, about 1·5 cm. long, situated at varying heights above the base.

Flowers single, with a clasping ovate-lanceolate bract subtending the pedicel, a floral rudiment sometimes contained within this bract.

Lateral sepals greenish, 3-nerved, generally with a broad reddish-brown stripe down the centre; spreading, with a tendency to become reflexed; dilated in their proximal part, contracted gradually into long points, the points shorter than the dilated portion; longer and wider than the other perianth segments, about 2·6 cm. long and 3·5 mm. in the widest part; under-surface lighter in colour than upper-surface. Dorsal sepal usually erect and incurved over anther, but sometimes retracted; greenish-yellow traversed by three reddish-brown nerves; gradually contracting into a fine point about the same length as the dilated part; about 2·4 cm. long and 2 mm. wide. Lateral petals spreading with a tendency to become reflexed; 3-nerved; greenish-yellow with a reddish-brown stripe down centre; lanceolate about 2 cm. long and 2·5 mm. wide; points much shorter than dilated part.

Labellum moveable on a short claw; widely cordate; margins entire; rather indefinitely 3-lobed; about 10 mm. long (extended) and 10 mm. in widest diameter; lateral lobes green wide, not very clearly separated anteriorly from the middle lobe; latter dark reddish-brown, broadly triangular, recurved, apex rather blunt, margins slightly crenulated; lamina not very concave, central part dark reddish-brown; calli in four rows (rarely in two rows), of the linear golf-stick type, rather fleshy and dark reddish-brown in colour, extending from the claw to anterior margins of lateral lobes but not invading the tip or middle lobe.

Column incurved so as to be semicircular in profile; very widely winged in its upper three-fourths; 10 mm. in height (unextended); two large yellow glands at the base. Anther incumbent, with a short point. Stigma large, circular, concave, sticky, upper border produced into a short triangular rostellum, situated just below the anther.

This *Caladenia* approaches most closely to *C. ovata*, Rogers, but differs very materially as to the calli, which in the latter species are small and mammillary, usually arranged in two short rows, rarely in four, and occasionally quite absent. In the new species they are well marked, fleshy, stalked, arranged usually in four rows, rarely in two. In the former dark divergent lines are present on the labellum and the points of the sepals are clavate; in the latter the divergent lines are absent, and in all the specimens (about a dozen) examined, there was no evidence of clubbing of the sepal points. *C. Cairnsiana*, F. v. M., has an entire labellum, but in this plant the calli appear to be always arranged in two rows, the tip of the labellum has a dark-red narrow callous margin, suggesting a "binding" (this margin is very constant and characteristic); dark purple divergent lines are present on the lamina. There are no yellow glands at the base of the column, but these are replaced by two horizontal rows of small glandular hairs. The sepals and petals are equal in length, and the former are only half the length of the same segments in the new species, they are not produced into fine points and the tips are consistently *finely hairy;* they are always acutely reflexed against the ovary. In *C. tesselata*, Fitz., the leaf is narrower, the perianth segments are not produced into fine points; the labellum is not recurved, but horizontal in its terminal half; the calli are not of the golf-stick type near the base of the lamina, and although they assume that shape elsewhere they are more fleshy than in *C. cordiformis* and are continued in four well-marked rows to the extreme tip.

In *C. clavigera*, Cunng., the labellum is not cordate in shape, but gradually increases in width from the base to about the middle, where it reaches its maximum diameter; thereafter it is recurved and triangular, the tip ending in a rather long and sharp point. The sepals are usually clavate and the column is only slightly incurved. The flowers are much larger than in the new species and usually reach 3 inches (7·5 cm.) in diameter.

This orchid is not uncommon in Victoria, where it has generally been accepted as *Caladenia Cairnsiana*, F. v. M.

The following Victorian localities have been supplied by Mr. E. E. Pescott, F.L.S.:—

Ringwood, Cheltenham, Bendigo, Geelong, Castlemaine, Grampians, Orbost, Greensborough (Mr. E. E. Pescott);

Oakleigh, Warrandyte, Healesville, Dandenong (C. French, junr.); Gisborne (G. Lydell); Sale (T. S. Hart); Blackburn (The Misses Coleman); Queenscliffe (G. Coghill); Sandringham (A. H. Tadgell); Port Albert.

It blooms in September and October.

During the spring of 1919 the writer paid a botanical visit to Western Australia, chiefly with the object of recovering some of R. D. Fitzgerald's species, very few of which were represented in any of the National collections. Many of the following observations and records are the outcome of this visit.

THELYMITRA.

T. ixioides, Sw.

Western Australia: Perth, J. H. Maiden, November, 1909; Gilgering, O. H. Sargent, 22/9/07; Busselton, Mrs. W. E. Cooke, 22/10/06.

T. canaliculata, Br.

Western Australia: Cut Hill, near York, O. H. Sargent, 9/10/04; Albany, A. G. Hamilton, 1902; Mount Lowly, Rogers, 1/10/19.

T. crinita, Lindl.

Western Australia: Kalamunda Falls, Mrs. W. E. Cooke, 25/10/06; Yallie Gap, Mr. W. E. Cooke, 6/11/10; Perth, J. H. Maiden, November, 1909; Gosnells, Dr. J. B. Cleland; Albany, A. G. Hamilton; Summit of Darling Ranges, C. R. P. Andrews, 10/9/05; Warren River, Dr. R. Pulleine, December, 1917; Weld River, Dr. R. Pulleine, December, 1917; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden; Swan View, Rogers, 28/9/19.

T. fasciculata, Fitz.

Western Australia: Albany and Swan View, Rogers, September, 1919; near Perth, Mrs. W. E. Cooke, September, 1906.

T. aristata, Lindl.

Western Australia: Swan View, Mrs. W. E. Cooke, September 1907.

T. longifolia, Forst.

Western Australia: York, O. H. Sargent, October, 1907; Datatine, near Katanning, Miss Doutch, September, 1919; Diamond Tree School, Miss I. Knox-Peden, November, 1918.

T. villosa, Lindl.

Western Australia: Near Perth, Mrs. W. E. Cooke, 28/9/06; Albany, A. G. Hamilton, 1902; Kalamunda, J. H. Maiden, October, 1919; Gosnells, Dr. J. B. Cleland, 19/10/60; near York, O. H. Sargent, September, 1907.

T. tigrina, Br.

Western Australia: Near Albany Dr. A. Syme Johnson, 4/11/19. Flowers greenish-white, with deep maroon splotches on the inner surface of the perianth segments. Hitherto unrepresented in Australian collections.

T. flexuosa, Endl.

Western Australia: Albany, Rogers, September, 1919; Robinson Hill, Dr. A. Syme Johnson, 19/11/19.

T. stellata, Lindl.

Western Australia: King's Park, Perth, F. Sheath, October, 1909; Warren River, Dr. R. Pulleine, 8/12/17; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, 22/1/19.

T. fuscolutea, Br.

Western Australia: Albany, A. G. Hamilton, 1902; Gosnells, Mrs. W. E. Cooke, September, 1906; Jarnadup to Manjimup, Dr. R. Pulleine, 10/12/17; Robinson Hill, near Albany, Dr. A. Syme Johnson, 19/11/17.

T. antennifera, Hook. f.

Western Australia: Waroona, G. F. Berthoud, August, 1907; Perth, Dr. J. B. Cleland; Albany, A. G. Hamilton, 1902; Muresk, Mrs. W. E. Cooke, 4/9/07; York, O. H. Sargent, 9/9/06; Northam, Mrs. W. E. Cooke, September, 1907.

Victoria: This well-known species was received from Mr. E. E. Pescott with red flowers. He had collected it near the Grampians. The specimens were fairly numerous.

T. variegata, Lindl.

Western Australia: South Perth, Mrs. Tapp, 28/8/07; Gosnells, Mrs. W. E. Cooke, 4/10/10; near York, O. H. Sargent; Northam, Mrs. W. E. Cooke, 10/9/08; Busselton, Mrs. W. E. Cooke, 22/10/06; Warren River, Dr. R. Pulleine, 10/12/17.

Epiblema.

E. grandiflorum, Br.

Western Australia: Albany District, A. G. Hamilton, 1902; Chudalup Plains, E. H. Sutton, December, 1912; Balbarrup, E. H. Sutton, March, 1912; Granite Bar (S.W. District of State), Dr. R. Pulleine, December, 1917.

This remarkable species bears a strong superficial resemblance to a *Thelymitra*, especially *T. ixioides*, Sw. The leaf is basal, narrow-linear. The flowers are blue. The segments of the perianth are veined and much alike in shape (elliptical or elliptical-lanceolate). The lateral petals are, however, dotted along the lines of the longitudinal nerves. The labellum is somewhat similar in shape to the other segments and like them is traversed by parallel veins or nerves, but in addition it is clawed and the lamina has a few worm-like appendages at the extreme base.

It is a late bloomer and apparently flowers well into the hot weather.

Calochilus.

C. Robertsoni, Benth.

This species appears in Mueller's Second Census with a Western Australian habitat, but the writer has never received it from that State.

Diuris.

D. Purdiei, Diels.

Western Australia: Ravenswood, near Pinjarra, Rogers, October, 1919.

The habit of this plant is suggestive of *D. pedunculata*, Br., but the colouring is very different. The upper-surface of the flower is a golden yellow, with a wall-flower colouration at the base of the labellum around the "raised lines." The lower-surface is beautifully marked with wall-flower veinings, parallel or divergent stripes on a yellow ground. Flowers 2-4 in a raceme. Lateral sepals stout, linear-lanceolate, very little longer than the labellum, sometimes hardly as long; dorsal sepal hardly more than half as long as the other segments, ovate-triangular. Lateral petals golden-yellow above, wall-flower below, orbicular or elliptical, on a claw about two-thirds the length of the labellum, almost as long as the lateral sepals. The middle lobe of the labellum is very wide and more than twice as long as the lateral lobes, which are fringed or toothed along the border and separated from the middle lobe a little above the base. The two raised lines are situated widely apart on the base of the lamina. There is a good deal of variation in the relative lengths of labellum and lateral sepals. The lateral appendages of the column are not quite so high as the anther.

This is a very beautiful species and generally dries purple.

It was seen growing in considerable numbers in sandy soil.

D. laevis, Fitz.

Western Australia: Gosnells, Mrs. W. E. Cooke, 4/10/08; Perth, Dr. J. B. Cleland; York, O. H. Sargent, 27/10/07.

It comes very close to *D. setacea*, Br.

D. longifolia, Br.

Specimens of this well-known species were received with flowers of a uniform yellow colour. They were collected by Mr. J. W. Audas, at Nar Nar Goon, Gippsland, Victoria.

Cryptostylis.

C. ovata, Br.

Western Australia: Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, 1/2/19; Albany, Dr. A. Syme Johnson, 4/12/19; Lake Chockerup, Rogers and Mrs. Hassell.

Gastrodia.

G. sesamoides, Br.

Western Australia: Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, December, 1918. In his *Frag. Phytograph. 116*, Diels states that this plant is nowhere to be found in Western Australia and thinks that it should be deleted from the botanical records of that State. Miss Knox-Peden's discovery definitely disposes of this matter.

Prasophyllum.

P. Muelleri, Andrews.

Western Australia: Swan View, near Perth, Rogers, 28/9/19. Fairly numerous on stony hill-tops.

A tall plant, often 120 cm. (4 feet) in height, differing from *P. elatum* in that the labellum is articulate on a short claw in the former but sessile in the latter. The presence of a claw or its absence is of importance, as this feature forms the basis of classification of the genus by Bentham in the "Flora Australiensis." If this plant is admitted as a new species it will become necessary under Bentham's classification to place it in quite another section from *P. elatum*, with which in other respects it would appear to be morphologically identical. It is understood that Mr. Andrews has withdrawn its claim to specific rank. It would, however, appear to be at least a very interesting variety of *elatum*. Another important feature on which Bentham relies for his separation of the members of this genus is the attachment or otherwise of the lateral sepals to each other. The writer has already drawn attention to the inconstancy of both these features (Trans. Roy. Soc. S. Austr., xxxiii., 197). *P. elatum* is perhaps the most constant of all *Prasophyllums* in regard to the cohesion of these segments, nevertheless in that species they are occasionally to be found free. On the hill-top at Swan View numbers of specimens of Andrew's plant were examined, and in a considerable proportion the sepals were quite free. The same thing has been observed as not uncommon in *P. gracile*, Rogers, and *P. Suttoni*, Rogers and Rees. It is exceedingly difficult to discover features sufficiently constant on which to found an absolutely satisfactory system of classification.

P. Fimbria, Reich. f.

Western Australia: Albany and district, Rogers, September, 1919; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, December, 1918; Perth, Dr. J. B. Cleland. This is a very handsome species, reaching a height of 105 cm. (3 feet 6 inches). The white labellum, with heliotrope inner plate, at once distinguishes it from *P. elatum*.

A Victorian habitat is recorded for this orchid in F. v. Mueller's Second Census. This is not supported by any Victorian representative in any Australian National collection and is probably an error.

P. macrostachyum, Br.

The flowers of this common orchid are usually quite green or greenish-yellow. At Lake Chockerup, in the Albany district, in swampy country, a form was found in which the labellum and the petals were a deep purple in colour, giving the plant a very unfamiliar appearance. This form was very prolific and was not associated with others of the common colour.

P. hians, Reich. f.

Western Australia: Albany district, Porongorup, Pinjarra, the Stirling Ranges, Rogers; Lander's Camp (Cape Leeuwin district), Dr. R. Pulleine; York, O. H. Sargent; Perth district, Dr. J. B. Cleland and Mrs. W. E. Cooke; Waroona, G. F. Berthoud. It blooms in September and has a wide range in the western State. The flowers are white with some purple markings; the inner plate of the labellum being tomentose, an olive green in tint, and ending in two raised knuckles just beyond the bend. In stature it is very variable, and specimens were seen varying from 10 cm. (4 inches) to upwards of 60 cm. (2 feet). The lateral sepals are very short (considerably less than the lateral petals), and reach only to the bend in the labellum.

P. cucullatum, Reich. f.

Western Australia: Porongorup Mts. and Ravenswood, Rogers, September and October, 1919. Its distribution appears to be rather localized, but it was found in considerable numbers within restricted areas.

This is a most dainty and attractive orchid. Sometimes it is single-flowered, but often the flowers are very numerous (40 or 50), constituting a dense blunt spike resembling that of *Orchis pyramidalis*, Lin. The flowers are purple and white and very strongly scented.

The lateral sepals are the shortest segments of the perianth (including labellum); they are connate to their extreme tips, the conjoined lamina being widely dilated and erect with incurved tip so as to form a hood in front of the labellum. The dorsal sepal is dark purple, lanceolate and reflexed. The petals contracted and purple at the base, otherwise white with purple stripe down centre; rather inflated towards the tips, spreading, and about the same length as the dorsal sepal. The labellum is attached to a long watch-spring claw and is generally a little longer than the lateral sepals; it is erect for three-quarters of its length above the claw, the tip being then bent forwards almost at right angles; the erect portion at first narrow but gradually increasing upwards towards the bend; the horizontal part dilated into a semicircular tip with crenulated edges; the lamina with two rather wide raised pubescent lines on the erect part, the lines terminating just beyond the bend in the centre of the horizontal part. The lateral appendages are slightly shorter than the rostellum, oblong-falcate with their falcate tips looking backwards. The anther is much shorter than the rostellum; the caudicle very long.

P. cyphochilum, Benth.

Western Australia: Near York, O. H. Sargent, 8/10/19; Welsh-pool to Kalamunda, J. H. Maiden, September, 1909; Perth, Dr. J. B. Cleland; Gosnells, Mrs. W. E. Cooke, 4/10/07; South-Western District, Mr. W. E. Cooke, October, 1906; Staunton Springs, near Pingelly, Rogers, 26/9/19; Ravenswood, Pinjarra, Darling Ranges, Albany District, Rogers, September and October, 1919.

This species bears a close resemblance in its habit to *P. ovale*, Lindl. Apparently the only constant distinction is to be found in the labellum. In Bentham's species the labellum is not relatively broad in proportion to its length; its base is very distinctly gibbous and protrudes between the lateral sepals; it is erect in its lower two-thirds, gradually narrowing upwards to the bend where it contracts and then, once more expanding, recurves forward in its distal third into an undulate tip. In Lindley's species the labellum is oval in shape and more spreading than in *P. cyphochilum*; it is not at all gibbous and its base does not protrude between the sepals in the pressed specimen; it is relatively very wide in proportion to its length; it gradually curves forward from base to tip, and it has no point of lateral contraction as in *P. cyphochilum*.

The segments of the perianth are subequal, about 5 mm. long, and are generally shortly acute, but may be almost blunt; they are relatively narrower and rather longer than in *P. ovale*.

The flowers are generally yellowish or whitish-green with chocolate stripes down the centre of the segments. The plant is slender but may attain the height of 60 cm.

P. ovale, Lindl.

Western Australia: Cut Hill, near York, O. H. Sargent, October, 1905; Perth, Dr. J. B. Cleland; Albany District, A. G. Hamilton; Swan View, Mrs. W. E. Cooke, 13/9/07; Gosnells, Mrs. W. E. Cooke, 4/10/08; Lake Chockerup, Rogers, 21/9/19; Woogenellup, Rogers, 23/9/19.

Flowers small, white, often with purple stripes down the centre of the perianth segments; latter nearly equal in length, about 4 mm. long, the lateral petals being a little shorter, generally very blunt (almost truncate). Lateral sepals commonly *quite* free and not gibbous, in Drummond's specimens shortly connate at the base, broadly linear, slightly expanded about the middle. Dorsal sepal white, wider than the other segments, cucullate, erect or sometimes reflexed. Lateral petals slightly narrower than sepals, not expanded in the middle.

Labellum nearly as long as the lateral sepals, sessile, oval or broadly elliptical, membranous part white, wide, with entire margins slightly crenulated towards the tip; callous part smooth, green, triangular, extending from the base to slightly beyond the middle, shiny, glandular, much narrower than the membranous part; not gibbous at base. Lateral appendages of column very wide, with sinuous basal lobe, shorter than anther and much shorter than rostellum. Rostellum higher than anther, caudicle rather long and slender, attached to a large ovate-lanceolate gland.

var. *triglochin* (Lake Chockerup).

Lateral petals 2·5 mm. long; sepals 3 mm. long; labellum oval or broadly elliptical, 2·5 mm. long.

The leaf of this species is stated by Bentham to have a long lamina. An examination of a large number of specimens in the field and herbarium indicate that the leaf-lamina is almost invariably short as in the case of *P. cyphochilum*.

P. parvifolium, Lindl.

Western Australia: King George Sound, B. F. Goadby, June, 1900; Swan View, Mrs. W. E. Cooke, 13/9/07; Muresk, Mrs. W. E. Cooke, 4/9/07; Bayswater, Mrs. W. E. Cooke, 11/8/07; Busselton, Mrs. W. E. Cooke, June, 1907; Ravenswood (in fruit), Rogers, 1/10/19.

P. gibbosum, Br.

Western Australia: Gosnells, Mrs. W. E. Cooke, 20/9/10.

MICROTIS.

M. porrifolia, Spreng.

Western Australia: Swan View, near Perth, Rogers, 30/9/19.

M. parviflora, Br.

Victoria: Lower Fern Tree Gully and Bendigo, E. E. Pescott, November, 1917; Cravensville, A. B. Braine, 9/12/17.

Tasmania: Hobart, E. Ashby, January, 1913.

M. media, Br.

Western Australia: York, O. H. Sargent; King George Sound, J. H. Maiden and Dr. A. Syme Johnson, November; Perth, Dr. J. B. Cleland; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, December.

M. alba, Br.

Western Australia: Greenbushes, Dr. R. Pulleine, December, 1917; York, O. H. Sargent, November, 1905; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, December, 1918.

M. atrata, Lindl.

Tasmania: Flinders Sound, Bass Straits, Dr. C. S. Sutton and H. Griffith, November, 1912.

Western Australia: Gosnells, Mrs. W. E. Cooke, 4/10/08; Albany, Dr. A. Syme Johnson, 21/9/19.

CORYSANTHES.

C. unquiculata, Br.

South Australia: Glencoe, near Mount Gambier, "in sandy soil, under a Xanthorrhoea-tree," H. W. Andrew, 12/8/19.

PTEROSTYLIS.

P. nana, Br.

This species, though apparently less prolific in the western State than in South Australia, was observed growing vigorously in colonies near Albany on the erect trunks of a large banksia, in one case 8 feet 6 inches above the ground. The surrounding debris seemed to indicate that the tubers had been lodged in this curious position by the action of flood-waters during a previous season.

Western Australia: Busselton, Mrs. W. E. Cooke, 25/10/06; Diamond Tree School, Miss I. Knox-Peden, October, 1918; Albany District, Rogers, September, 1919.

P. pyramidalis, Lindl.

Western Australia: York, O. H. Sargent, August and September, 1906; Gosnells, near Perth, Mrs. W. E. Cooke, 4/10/08; Albany District, Rogers, September, 1919; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, 31/8/20.

This species sometimes attains a considerable size. Specimens from Jarnadup District were nearly a foot (30 cm.) in height, fairly stout, with no sign of rosulate leaves, but numerous stem-leaves, and flowers about twice the size of *P. nana*. The writer is of opinion that this species is quite distinct from *P. nana*, Br.

P. recurva, Benth.

Western Australia: York, O. H. Sargent, September, 1907; Bayswater, Dr. Stoward, August, 1914; Albany, Upper King River, Mount Barker, Stirling Range, Rogers, September, 1919.

Flowers whitish, with dark greenish-grey longitudinal parallel stripes; about 2 cm. ($\frac{3}{4}$ inch) long (excluding points of perianth); funnel-shaped at the top. Lateral sepals nearly erect, bellying forward at base of sinus; sinus very acute; points terete, about 1·5 cm. long, recurved horizontally forwards. Dorsal sepal erect, cucullate, with short recurved point about 3 mm. long; shorter than lateral sepals or petals. Petals shorter than lateral sepals, with very short recurved points; the posterior borders curved inwards and meeting each other at the top in front of the dorsal sepal.

Plants may occasionally be seen which reach a height of 50 cm.

P. turfosa, Endl.

Western Australia: Tukurua, Miss Bryce MacIntyre, 28/9/11; York, O. H. Sargent, September, 1909; Albany, Woogenellup and Pinjarra, Rogers, September and October, 1919; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden.

Closely resembles *P. barbata*, Lindl. Labellum about 2·5 cm. long, filiform, with long lateral hairs and dark green clavate point. The anterior margins of the galea are contracted and in apposition about the middle, so as to form two orifices, a larger one below through which the labellum protrudes and a lesser one above through which the anther may be seen. The upper angles of the column wings are crossed in the live plant and a further barricade against the ingress of an insect visitor to the sexual parts at this point is provided by the hairs on the front of the hatchets. A curious and interesting device forms a still further safeguard. The margins of the galea above the point of contraction are involuted; and in each of these involutions is a hair from 1·5-2·5 cm. long, attached below with the free end pointing upwards and concealed in the point of the dorsal sepal. In the young plant these two hairs may be liberated with a pin, but when the flower is ready for fertilization they are automatically released and cross each other in front of the upper orifice. Though they serve as an impediment to an insect attempting to enter this way, they nevertheless form no obstacle to the egress of such a visitor which has gained admission by the lower, and apparently authorized channel.

P. vittata, Lindl.

Western Australia: widely distributed over the southern part of the State.

The leaves are usually wider in the western forms than in those growing in South Australia or Victoria, and the plant is often quite green and devoid of the rufous tints which characterize it in the two latter States.

South Australia: The writer has seen specimens in which the leaves of this species were variegated (white and green), and the flowers white with heliotrope margins to the galea. The effect was very beautiful.

P. reflexa, Br.

Western Australia: Cut Hill, near York, O. H. Sargent, 25/5/06.

P. revoluta, Br.

Victoria: Mr. E. E. Pescott reports the case of a specimen from his State in which the leaves and flowers were white.

P. constricta, Sargent.

Western Australia: Cut Hill, near York, O. H. Sargent, 14/7/07; Narrogen, Dr. F. Stoward, August, 1913.

P. barbata, Lindl.

Western Australia: Bayswater, Dr. F. Stoward, August, 1914.

P. Mitchelli, Lindl.

Western Australia: Murchison, A. Tisdale; near York, O. H. Sargent.

P. Sargenti, Andrews.

Western Australia: York, O. H. Sargent, 1/8/06.

This orchid would appear to be extremely rare and localized in its distribution. It is now fourteen years since Mr. Andrews described it, and during that period it has been recorded in no other habitat than that in which it was first found. The separation of the labellum into three digitations and the enormous relative size of the basal appendages render it unique and most easy of identification. This species is the most interesting and notable addition to the family since the genus was established.

CALEANA.

C. nigrita, Lindl.

Western Australia: Ravenswood, near Pinjarra, Rogers, 1/10/19; Cut Hill, near York, O. H. Sargent, 24/9/05.

Leaf ovate-lanceolate, clasping at the base, brownish-green above, dark reddish-brown on lower-surface, rather rigid. Stem reddish-brown, slender, rigid, with a blunt clasping bract about 6 mm. below the flower.

Flower reversed, usually solitary. Segments of the perianth greenish, subequal, narrow-linear. Lateral sepals about 12 mm., appressed against the dilated wings of the column, arising from a pronounced columnar-foot. Dorsal sepal incurved and appressed against the back of the column, rather club-shaped at its free end. Petals narrower than the other segments in their lower two-thirds, their free ends spathulate, appressed against the dilated wings of the column. Lamina of labellum peltate and versatile, on a rather wide watch-spring claw which is articulated to the end of the columnar-foot; reddish-brown to deep purple in colour; divided by the insertion of the claw into a short wide lobe with two hemispherical protruberances on its upper-surface, and a much longer truncate conical lobe covered with purple glandular excrescences on its upper-surface; under-surface yellowish, concave; margins of the longer lobe involute and covered with reddish-brown glands. Column yellowish-green, about the same length as sepals and petals, base extended into a horizontal "foot" about 4 mm. long; wings extremely wide and dilated, adnate to the "foot," forming a boat-shaped sac. Anther quite small. Stigma reniform, just below the anther.

Found growing in sandy soil along with *Drakaea glyptodon*, Fitz. Drummond states: "This plant is rare, and where it grows it is not easily found, its whole appearance being that of charcoal, among which it usually springs up." (Swan River Appendix, liv.) The Ravenswood specimens did not resemble charcoal, neither did they grow on burnt ground.

Drakaea.

D. ciliata, Reich. f.

Western Australia: near York, O. H. Sargent, November, 1905.

Mr. Sargent notes in regard to this orchid: "Sandy soil, soaking-wet in winter, and very dry in summer; the leaf is thick, fleshy, and scarcely complicate when living; it folds together as it withers and dies, when flowering commences in November."

D. elastica, Lindl.

Western Australia: York, O. H. Sargent, September, 1907; Gosnells, Mrs. W. E. Cooke, 28/9/06; Tukurua (Albany district), Miss Bryce MacIntyre, 21/10/11; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden; River Murray, Ravenswood, Rogers, 1/10/19.

Grows in sandy soil.

D. glyptodon, Fitz.

Western Australia: Gosnells, Mrs. W. E. Cooke, 28/9/08; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden; Mount Melville, Albany, on the sandy bank of creek, Rogers, 20/9/19; Ravenswood and Pinjarra, growing plentifully in sandy soil, Rogers, 30/9/19.

Acianthus.

A. exsertus, Br.

The usual colour of this orchid is a dusky purplish-red or purplish-brown. The writer has collected specimens on Kangaroo Island, South Australia, which were a bright emerald green.

Eriochilus.

E. scaber, Lindl.

Western Australia: plentiful in the Albany district, in sandy soil and swamps, Rogers, September, 1919; Bayswater and Muresk, Mrs. W. E. Cooke, 11/8/07; Mundijong, Dr. Stoward, July, 1913; Perth, Dr. J. B. Cleland, September, 1906; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden; York, O. H. Sargent, September, 1907.

E. dilatatus, Lindl.

Western Australia: Cut Hill, near York, O. H. Sargent, 27/5/06; Tukurua, near Albany, Miss Bryce MacIntyre, 3/4/12; Busselton, Dr. Stoward, November (?), 1912.

This plant varies much in respect to its leaf which is sometimes reduced to a small acute bract and in other specimens is distinctly ovate (2·5 cm. x 1·5 cm.) or ovate-oblong; also as to degree of hairiness, sometimes quite glabrous, at others moderately hirsute. It varies also as to the shape of labellum which is sometimes much shorter than the claw, sometimes almost equal to it in length; sometimes with the two diameters of the lamina nearly equal, and again with the lamina relatively long when compared with its breadth. Frequently it has only two or three flowers and Sargent has recorded one in which he counted thirteen flowers.

All these variations are to be found in plants collected from the same group, and even in flowers on the same raceme variations in the labellum are to be observed. The writer has never seen any specimens of *Eriochilus* which he could definitely label *E. multiflorus*, Lindl. It is doubtful whether this species should be separated from *E. dilatatus* on the characters assigned to it by Lindley and Bentham.

Lyperanthus.

L. nigricans, Br.

Western Australia: widely distributed throughout the State. It blooms in September.

A pure white specimen of this species was found at Mount Barker, Western Australia. There were several flowers in the raceme without the suggestion of another colour. It was placed between the blotters and on removal, true to its designation, it was found to be absolutely black.

L. serratus, Lindl.

Western Australia: near York, O. H. Sargent, 6/10/07; Gosnells, Mrs. W. E. Cooke, September, 1908; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden; Upper and Lower King River, Rogers, 17/9/19; Pinjarra, Rogers, 1/10/19.

L. Forrestii, F. v. M.

Western Australia: Lake Chockerup, Mrs. A. Y. Hassell and R. S. Rogers, November, 1919.

The leaves of this rare plant were identified *in situ* at Lake Chockerup. Some young plants were removed by Dr. A. Syme Johnson and cultivated in Albany, where they bloomed about the middle of November the same year. An opportunity was thus afforded to examine the plant in a living state and so supplement the original description of F. v. Müeller "from the few dried and much shrivelled specimens hitherto secured." Plant, 18-23 cm.; tuber oblong-ellipsoidal, about 1·3 cm. long; membranous, acute, ovate sheath investing the stem below the leaves. Leaves three, light green tending to turn yellow as flower matures, sessile, at or near the base, clasping the stem at their insertion; the lowest ovate-lanceolate, reticulated, coriaceous, about 5 cm. long and 2·3 cm. broad, spreading, overlapping the base of the second leaf; latter much smaller, lanceolate, more vertical than the one below it, about 2 cm. long, overlapping the base of the upper leaf; upper leaf very similar to the middle one; sometimes an acute lanceolate bract near the middle of the stem. Flowers 2-4 (in specimens examined); on rather long, slender pedicels each subtended by a rather large lanceolate bract; a floral rudiment sometimes arising alongside the uppermost pedicel; white with pink shading and deep crimson marks and dots. Segments of the perianth about equal, ± 16 mm. in length in the dried undissected flower (rather longer when dissected and extended). Lateral sepals spreading, ob-falcate, the bases very attenuated, 3-nerved, spotted; dorsal sepal erect, much wider, very concave and cucullate, contracted at the base. Lateral petals falcate-lanceolate, contracted at the base, 3-nerved, spotted. Labellum almost obovate with long attenuated base; erect in lower half, gradually recurved forward above the middle; margins crenulated but not fringed; about 12 mm. long (or 13·5 mm. when extended); lamina traversed for its entire length with numerous prominent longitudinal nerves, with scattered sessile glands more numerous towards the tip. Column erect, very slightly winged, about 12 mm. long. Anther incumbent with narrow sharp point. Stigma large, prominent, situated just below the anther.

F. v. M. states that owing to the poor condition of his material he was unable to ascertain whether the flowers were reversed as in *L. ellipticus*, Br. If so, he proposed to include these two species under a new genus, *Fitzgeraldia*. The flowers are not reversed, and the species under review takes its natural place in Brown's genus. It is separated from *L. nigricans*, Br., by the fact that its labellar margins are merely crenulate whereas they are fringed in the latter species; and in the case of *L. serratus*, Lindl., and *L. suaveoleus*, Br., the long linear leaves of those species afford a ready distinction.

Cyrtostylis.

C. reniformis, Br.

Like *Acianthus exsertus*, Br., this species is usually a dusky purplish-brown in colour, but it has been received from localities in different States, of a bright verdant green colour.

Victoria: Cravensville, near Tallangatta, Mr. A. B. Braine. South Australia: Cherry Gardens, Mrs. Jacob. Western Australia: Diamond Tree School, near Jarnadup, Miss I. Knox-Peden.

In the latter locality the green form would appear to be quite plentiful.

Caladenia.

C. Menziesii, Br.

Western Australia: Muresk, Mrs. W. E. Cooke, 4/9/07; Kalamunda Falls, Mrs. W. E. Cooke, 6/10/06; Cut Hill, near York, L. O. Sargent, September, 1905; Ravenswood, Rogers, 1/10/19.

C. discoidea, Lindl.

Western Australia: Perth, Dr. J. B. Cleland; Welsh-pool to Kalamunda, J. H. Maiden, September, 1909; Cape Leeuwin, Mr. W. E. Cooke, September, 1907; Staunton Springs, near Pingelly, Mrs. R. S. Rogers, 26/9/19.

C. Bryceana, Rogers.

Western Australia: Gnowangerup, Miss Bryce MacIntyre, 3/9/14.

C. Cairnsiana, F. v. M.

Western Australia: York, O. H. Sargent; Porongorup Mts., Rogers, 24/9/19; Pingelly, Miss Winnie Bostock, October, 1914; Mount Barker, Rogers, 26/9/19.

This orchid has a very characteristic habit, and the impression gained from its examination in the field is apt to be very different to that obtained from a herbarium specimen. In spite of its large labellum with the beautiful deep reddish-purple divergent lines, it may easily escape observation, because this organ is carried erect, or nearly vertical, against the column. Its lamina is comparatively flat with slightly depressed margins. The dorsal sepal is erect, or but slightly recurved from the column; all the other perianth segments are acutely and closely reflexed against the ovary. Consequently the collector looking down on this plant sees very little to attract his attention. This has led to confusion in the eastern States between it and other *Caladenias*, which though of very different habit, bear a more or less close resemblance to it in the dried state. The eastern plants generally have a more or less spreading labellum and perianth segments (except the dorsal sepal), which give them a totally different appearance when growing to F. v. Müeller's species. Hence it is thought advisable to supplement the description appearing in the "Flora Australiensis," by further details derived from a careful examination of the type specimen in the National Herbarium, Melbourne. The *type* was collected from the "Base of Stirling Range, W.A., in basaltic valleys, October, 1867."

In addition to the features referred to above, *viz.*, lateral sepals and petals appressed against the ovary, erect dorsal sepal and vertical labellum, it is noted that the extreme tips of both lateral and dorsal sepals bear a number of minute hairs. This appears to be rather a peculiar but constant feature which the writer has observed in all specimens examined from Western Australia. The labellum is ovate, its extreme apex edged by a narrow dark callous border or "binding" already described under *C. cordiformis*, p. 331 of this paper. Calli in two rows occupying posterior half of the lamina. No basal yellow glands at base of column, but two horizontal rows of small glandular hairs in their place. Anther blunt, without a point.

Measurements:—Lateral sepals 12·75 mm. long x ·6-2 mm. wide, lanceolate. Dorsal sepal linear, with a point not very sharp, 12·75 mm. long x 1 mm. in widest part. Lateral petals lanceolate, 11·6 mm. long x 1·5 mm. in widest part. Labellum (including claw) 10·6 mm. x 8·5 mm. wide. Column 9·5 mm. long. The average measurements of a large number of specimens collected on the Porongorup Mountains are as follows and are interesting as showing how little variation actually occurs in the relative size of the parts:—Lateral sepals, 12·75 mm. x 2 mm. wide (maximum); dorsal sepal, 12·75 mm. x 1 mm. wide (maximum); lateral petals, 12 mm. x 1·5 mm. wide (maximum); labellum 10·5 mm. long x 8·5 mm. wide; column 9·5 mm. long. In this State (South Australia) Tate's species *C. cardiochila,* which was reduced to a synonym of *C. Cairnsiana,* F. v. M., should now be restored to specific rank. He gives the following measurements for this species:—Lateral sepals 17 mm. x 4·5 mm. wide, lanceolate; dorsal sepal narrower than lateral sepals; lateral petals 17 mm. x 2 mm. wide. Labellum 10 mm. long x 11 mm. wide (claw apparently not included). These measurements show a wide departure from those of the type specimen of *C. Cairnsiana.* In *cardiochila* the lateral sepals and petals are more or less spreading; there are no hairs on the tips of the sepals. The anther has a short acute point and there are two yellow oval glands at the base of the column.

C. Cairnsiana has not yet been collected in this State (South Australia), nor as far as can be ascertained, in Victoria.

C. multiclavia, Reich, f.

Western Australia: Staunton Springs, near Pingelly, Miss Winnie Bostock and Rogers, 26/9/19; Datatine, East Katanning, Miss L. Doutch, 15/10/19.

This is apparently a rare and little known species, and like *C. Cairnsiana* it is a plant of characteristic habit. The only known drawing of it is to be found in Reichenbach's *Xenia II. t. 188,* and this conveys a very imperfect impression. Its peculiar appearance is due to the vertical position of the labellum, the horizontal position of the curiously winged column which is retracted at right angles to the ovary like a serpent about to strike, and to the union of the dorsal sepal and lateral petals (a very unusual feature in a *Caladenia)* to form a hood.

The following descriptive remarks are intended to supplement those given in the "Flora Australiensis":—

Segments of the perianth yellowish with red longitudinal stripes, nearly equal in length, tapering to fine non-clavate points. Lateral sepals lanceolate-falcate, the inflated portion somewhat exceeding the point, divaricate, spreading, about 24 mm. long. Dorsal sepal retracted at base then incurved, sharply falcate, with long fine rigid point, much narrower than the lateral sepals, about 24 mm. long. Lateral petals lanceolate-falcate, wider than dorsal sepal, but not quite so wide as the lateral ones; lightly adherent to the margin of the former from the stigmatic wing of column almost to their tips, leaving a fenestrum on either side below the wings, thus giving to the column an appearance of greatly increased width; free at their points; about 22 mm. long. Labellum ovate-rhomboid on rather long and slender claw; about 9 mm. (extended without the claw) long, and from 8-9 mm. wide; claw vertical, 2·5 mm. long; marked with wide deep red stripes and yellow interspaces; very mobile but generally vertical, slightly recurved from about the middle. Calli collected on upper part of claw and central portion of base of lamina; anterior calli numerous on yellow pedicels with reddish heads, all pedicels connate so as to form a raised mat or cushion on which the heads are seen to be arranged in several indefinite rows; posterior calli much larger with purple clavate heads, several joining together in flat plates with multi-papillose summits. Column blunt or only slightly pointed, about 12 mm. long; retracted horizontally almost at right angles to the floral axis, then incurved; stigmatic wings very large, bluntly and widely falco-triangular, membranous with thickened upper margins, the hood formed by the dorsal sepal and lateral petals stretched over them; no yellow glands at base.

Owing to the vertical position usually assumed by the labellum the plant is generally inconspicuous as in the case of *C. Cairnsiana*. The column is quite as wide as that of *C. macrostylis*, Fitz.

C. reticulata, Fitz.

Western Australia: Sand loam, near Gilgerring, O. H. Sargent, 22/9/07; Woogenellup, Rogers, 23/9/19.

Mr. Sargent's specimens showed no departure from type, except that the clavate points were missing. At Woogenellup three specimens were found close together, two had clavate points to the sepals, one had not.

In South Australia, near Bordertown, the writer collected numerous crimson specimens of this species.

C. filamentosa, Br.

Western Australia: Perth, Mr. J. Sheath and Dr. J. B. Cleland; Waroona, Mr. G. F. Berthoud, July, 1907; Muresk, Mrs. W. E. Cooke, 4/9/07; Cut Hill, near York, O. H. Sargent, 25/8/07; Northam, Mrs. W. E. Cooke, September, 1907; Albany and Mount Barker districts, Rogers, September 22-25, 1919.

Much variation is noted in this species particularly in regard to colour and size. The following forms are common:—

1. Flower wholly yellow with exception of the labellum, which is yellow with brown divergent lines on the lamina; tendency for calli to become imbricated; calli fleshy and thick.

2. Red tentacles, white labellum with deep crimson divergent lines on lamina; calli fleshy and thick with a tendency to become imbricated. Flower sometimes wholly red. 3. Flower considerably smaller than either of the preceding, wholly crimson or red; calli more definitely linear, with no tendency to become imbricate.

The first two appear to be morphologically identical. In the third in addition to the differences referred to, there appears to be also a difference in the shape of the labellum. It is very doubtful, however, whether this is a specific difference, and for the present it would seem desirable to include the three under the same specific name.

Occasionally this species may be found with four rows of calli. In such circumstances the plant is unusually large and robust.

It has been customary to regard *C. tentaculata*, Tate, as distinct from *C. filamentosa.* The morphological differences are, however, too slight to constitute valid grounds for a separation, and Tate's species should therefore be considered merely as another of those colour variations to which *filamentosa* is subject.

C. Patersoni, Br.

Brown's description is unfortunately of too general a nature to exclude certain other filamentous *Caladenias* which should be known under a different name. Added to this, there are real structural difficulties connected with the polymorphic group to which it belongs, the members of which are often linked together by intermediate forms and thus pass, almost imperceptibly, the one into the other. Hence it has become the botanical dumping-ground for almost every *Caladenia* with caudate sepals, clavate or otherwise. Natural hybridism is undoubtedly responsible for some of this confusion, perhaps for more than is suspected.

In the consideration of this species it is necessary to remember that Brown derived his material from Tasmania. An examination of a large collection of caudate *Caladenias* from the Island reveals one which is very common there, and which must have claimed Brown's attention at the time of his visit. This is fairly well illustrated in Hooker's Fl. Tas., ii., t. 123, under the title of *C. Patersoni*, and the drawing may be accepted as a correct interpretation of Brown's species. There would therefore appear to be no practical difficulty in identification of the typical form which Brown had before him when he wrote his description. This plant is not so robust as many of those which bear the specific name on the mainland. The flowers are commonly solitary, but are sometimes two in number and very rarely three. They are usually white or yellowish-white with reddish-brown stripes down the centres of the perianth segments; the labellum generally pale, but sometimes with a reddish apex and similar coloured combings and calli. Occasionally, however, the flowers are of a deep uniform crimson or some intermediate shade. *The sepals are not clubbed*, but are generally darker coloured at the tips and their free extremities are beset with glandular hairs; they are equal in length, the dorsal one erect or incurved, the lateral ones spreading or slightly dependent. The labellum is ovate-lanceolate and gradually tapers to a long and rather acute point, the apex of which is usually revolute; the margins are pectinate to about the middle, thereafter dentate or serrate to the apex; the pectinations are not as in *C. dilatata;* the calli are of the linear and non-fleshy type and are arranged on the lamina in 4-6 rows. The column is incurved, distinctly winged in its upper half, and has two sessile yellow glands on its anterior surface near the base. The anther has a distinct point.

This type of tentacular *Caladenia* is easily recognized and will be found to be fairly consistent, if those with definitely clavate lateral sepals are excluded. It is possible that there may be an occasional exception, but these will be so few that they are not likely to create any systematic difficulties. The more notable departures from type will be found as regards size, colour, and some variations in the shape of the labellum. The flower of the Tasmanian plant averages from 1½ to 3 inches (about 3-7·5 cm.) in diameter and rarely reaches 1 foot (30 cm.) in height; whereas the Western Australian representative *(C. longicauda*, Lindl.), which should be regarded as a variety, sometimes reaches a diameter of 10 inches (about 25 cm.) and 2½ feet (75 cm.) in height.

Var. *longicauda*, n. comb.

Western Australia: widely distributed throughout the State. Blooms in September and October.

This is the largest and the most beautiful of all the *Caladenias*. The flowers are white (or almost so) with long dusky tentacles which are covered with glandular hairs. The labellum is not typical in shape, being ovate-oblong with generally a very obtuse apex; the lateral margins have long graceful combings about as far as the middle, thereafter the margins are serrate to the apex; the calli are linear, arranged in from 4-6 rows.

An illustration of this orchid will be found in Lindley's Swan River Appendix, pl. viiiA. The colouring of the plant is incorrect. It is shown as being very distinctly yellow with purple caudae to the segments of the perianth, and purple combings and calli on the labellum.

C. PECTINATA, n. sp.

A robust plant reaching 60 cm. or more in height; stem hairy with one acute bract; leaf narrow-linear, very hairy. Flowers about 6-9 cm. in diameter, yellowish with reddish markings on perianth segments and labellum. Lateral sepals spreading; dilated in their proximal ends, thereafter contracted into long and rather rigid clavate points, total length about 5 cm., dilated part about 2 cm., greatest breadth about 5 mm.; a reddish stripe (not very intense) down the middle of the dilated part, with often a subsidiary one on either side; dilated part almost glabrous, clubs dark and glandular. Dorsal sepal erect or slightly incurved; its proximal end dilated and concave, but narrower than in the case of the lateral sepals; points clavate; in other respects and measurements similar to the lateral sepals. Lateral petals spreading or reflexed backwards; narrow lanceolate; yellowish with red stripe down the centre; points very acuminate, but not clavate; about 3·5 cm. long and about 4 mm. in the widest part.

Labellum on a short claw, erect in lower half with recurved tip; yellow in posterior two-thirds with crimson or dark reddish-brown apex; ovate-oblong or broadly ovate-lanceolate; about 2 cm. long (when extended) and 11-12 mm. wide (without fringe); lateral lobes indefinite, their margins deeply pectinate with reddish linear or filamentous calli, which are often forked or dentate at their free extremities; middle lobe triangular, or somewhat oblong with blunt tip, recurved, with shortly denticulated margins; calli arranged on the lamina in 4 rows posteriorly increasing to 6 or 8 rows near the tip, light coloured and stalked near the base, crimson and almost sessile anteriorly, their apices often darker than their stalks, mostly of the golf-stick variety, not very fleshy.

Column about 2 cm. high, much incurved, moderately winged below with wide triangular membranous expansion on each side near the stigma; two yellow sessile glands on anterior surface near the base. Anther reddish, shortly mucronate. Stigma concave, more or less circular, situated just below the anther, its upper margin projected into a small triangular rudimentary rostellum. No caudicle or gland.

Western Australia: Albany district, Rogers, September, 1919; York district, O. H. Sargent; Cork Swamp, near Perth, Mrs. Tapp, 3/9/07; Swan View, Mrs. W. E. Cooke, 13/9/06.

This beautiful *Caladenia* is fairly common and apparently hybridizes freely with *C. Patersoni*, var. *longicauda*, giving rise to perplexing intermediate forms. These hybrids generally resemble the new species in colouration and in the peculiar winging of the column, but the flowers are larger and the tentacles longer and unclubbed as in *longicauda*.

C. lobata, Fitz.

Western Australia: Upper Kalgan River, Rogers, 22/9/19.

This magnificent orchid was just beginning to flower on the banks of the Kalgan. Fitzgerald has not exaggerated its beauty; it is undoubtedly an extremely handsome species.

C. dilatata, Br.

Western Australia: Albany, Rogers, September, 1919; near Perth, Mrs. W. E. Cooke, 13/9/06; Cape Leeuwin, Mr. W. E. Cooke; Cut Hill, near York, Mr. L. O. Sargent, September, 1905; Greenbushes, Dr. Pulleine, December, 1917.

It is curious that this, the most definite of all the caudate *Caladenias* and also one of the most common, should be given the status of a mere variety in the Flora Australiensis. The influence of Baron von Müeller is apparent here. It is probably the best known of the "*spiders*," and throughout its wide range in the Commonwealth is subject to extraordinarily few variations. The writer once collected specimens at Monarto (in South Australia) in which the lateral sepals were non-clavate; and he on one occasion received specimens from Western Australia (Mr. O. H. Sargent) in which the combing of the lateral lobes of the labellum was absent. Apart from teratological changes, these are the only morphological variations that have come under his notice. Chromatic variations are, however, occasionally met with. These seem to be due to the omission of one of the colours from a three-colour scheme, in a flower in which the three primary colours—green, yellow, and red—are much in evidence. The red is most frequently omitted, causing stripes to vanish from the perianth, and conspicuous markings from the labellum. This gives to the flower a strangely unfamiliar appearance.

C. clavigera, Cunng.

Western Australia: Beverley, Dr. Stoward, September, 1913: Tukurua, near Albany, Miss Bryce MacIntyre, 15/10/11.

South Australia: Bordertown, Mrs. R. S. Rogers, 16/10/09.

In Dr. Stoward's specimens the dark veining in the labellum was unusually prominent for this species.

C. macrostylis, Fitz.

Western Australia: Upper Kalgan River, Rogers, 21/9/19; Mount Barker district, Rogers, 23/9/19; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, December, 1919.

This orchid chooses the most barren of ironstone country on which to grow. On the Upper Kalgan a few specimens occupied a small area of ground shunned by every other living plant. At Mount Barker it was quite numerous amid scrub almost equally inhospitable.

It varies from a few inches to 8 inches in height, has one or two flowers, and is a very hairy plant. The features which chiefly attract notice are the short clavate points to *all* the perianth segments, the broad yellow dilated bases of the lateral sepals with their reddish central stripe, the dark reddish-brown fleshy calli crowded along the central area of the labellum, the dark purple glandular denticulations on the margin of the apex.

It is a very well defined species.

C. hirta, Lindl.

Western Australia: the summit of the Porongorups and many other places, Rogers, 24/9/19. Common.

C. plicata, Fitz.

Western Australia: Lake Chockerup, Dr. Syme Johnson, Rogers, and others, 21/9/19; Tukurua, Miss Bryce MacIntyre, 28/9/11.

This interesting species, with its short and extremely club-pointed sepals, its crab-shaped fringed labellum, with the dark central lobe tucked below like a crustacean tail, is quite characteristic and cannot be mistaken for any other member of its genus. It is localized in its distribution, but numerous in certain localities.

C. Drummondii, Benth.

This species was carefully looked for, but was not seen, nor has it ever been received from Western Australia. Bentham gives the Swan River as its habitat. He says that the chief characteristic is a leaf broader for its length than in any other *Caladenia*. It is known to science only from two specimens in Hooker's Herbarium.

C. Roei, Benth.

Western Australia: Gnowangerup, Miss Bryce MacIntyre, 3/9/14; Cootarring, school children, September, 1919.

The most outstanding feature of this *Caladenia* is its labellum, the lateral lobes of which are light-coloured with entire margins and so broad in comparison with the small middle lobe that the labellum appears almost orbicular, or wider than it is long.

C. Barbarossae, Reich, f.

Western Australia: Woogenellup, foot of Stirling Range, Mrs. R. S. Rogers, 23/9/19; dry bed of the Avon River, near York, L. O. Sargent, 29/9/05; Bridgetown, Mrs. W. E. Cooke, 4/11/10; Swan River, near Perth, Mrs. W. E. Cooke.

C. flava, Br.

Western Australia: Swan View, Mrs. W. E. Cooke, 13/9/07; Mundijong, Dr. F. Stoward, August, 1913; Welshpool to Kalamunda, J. H. Maiden, September, 1909; The Weld River, Dr. Pulleine, December, 1917; Waroona, G. F. Berthoud, July, 1907; Muresk, Mrs. W. E. Cooke, 4/9/07; near York, O. H. Sargent, 28/9/06; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, October, 1918; King River, Albany district, Rogers, September, 1919.

C. latifolia, Br.

Western Australia: Busselton, Mrs. W. E. Cooke, 27/10/06, and Dr. F. Stoward, November, 1912; Yallingup, J. H. Maiden, October, 1909; Balbarrup, Bridgetown, and Donnelly Road, E. H. Sutton, September and October, 1912; Weld River, Dr. Pulleine, 8/12/17; Darling Ranges, Dr. J. B. Cleland, 1906; Perth, J. H. Maiden, November, 1909; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden, November, 1919; Albany district, Rogers, September, 1919; River Murray, Ravenswood, Rogers, October, 1919.

C. reptans, Lindl.

This species was looked for, but not seen. The writer has never received any specimens which he could definitely identify as *C. reptans*, and the British Museum, to which he is deeply indebted for much orchidaceous material, was unable to supply him in this instance. The plant must be extremely rare. The specimen which forms the subject of Fitzgerald's illustration was obtained at Mahogany Creek, Western Australia, at the end of August. Diels also reports it from the Darling Range and Blackwood River in August.

C. unita, Fitz.

Western Australia: Albany district, Rogers, September, 1919; Tukurua, Miss Bryce MacIntyre, 13/10/11; Mandjimup, E. H. Sutton; Stirling Ranges, Rogers, September, 1919; Darling Ranges, Rogers, September, 1919.

This orchid has a fairly wide range and is extremely abundant in certain districts. It is surprising that it was not obtained by the old collectors, and also that it remained so long undiscovered after its establishment as a species by Fitzgerald. The connate sepals are very characteristic, and it is thought that they would have attracted attention.

C. Purdieana, Andrews.

Western Australia: Robinson's Hill, Albany, Dr. A. Syme Johnson, 16/10/19.

This would appear to be distinct from *C. paniculata*, Fitz., with which the writer long believed it to be identical, a view which the founder also subsequently shared. There is, however, no central callus on the labellum as in the case of Fitzgerald's and some allied species. Mr. Andrews states that it was found in ironstone gravel on the slopes of the Darling Range at Kelmscott; also near Midland Junction and at Pinjarra. He gives the time of flowering as October-November.

C. paniculata, Fitz.

Western Australia: Gosnells, Mrs. W. E. Cooke, 4/10/08; near Perth, Mrs. Tapp, 19/10/07; Balbarrup, E. H. Sutton, October, 1912; Karridale (South-western district), Mrs. W. E. Cooke, 25/10/06; Ravenswood, near Pinjarra, Rogers, 1/10/19.

This plant is about the size and habit of *C. carnea*, Br., but with a much wider leaf. Flowers pink or white with dusky reddish-brown on lower-surface of the perianth segments, and many glandular hairs on all segments; 3 or 4 in number in a panicle. The lateral lobes of the labellum are large and erect, their anterior margins more or less fringed and everted; the middle lobe rather large, recurved, margin fringed throughout. Calli form a plate in two converging rows in middle of lamina.

C. aphylla, Benth.

Western Australia: Tukurua, near Albany, Miss Bryce MacIntyre, 3/4/12.

This species is at first inspection suggestive of an *Eriochilus*, the sepals and petals being entirely white or yellowish-white, and similar in shape. The labellum is markedly 3-lobed, the middle lobe being long and yellow-tipped. The column is slightly winged and is that of a typical *Caladenia*. The stem is glabrous.

C. saccharata, Reich.

Western Australia: Cut Hill, near York, O. H. Sargent, 27/9/19.

Flowers about the size and with the habit of *C. carnea*, Br. Segments of perianth white on their upper-surfaces, dusky coloured with very glandular-tipped hairs on lower- or outer-surfaces.

The lateral sepals spreading as in *C. carnea*, broader than the lateral petals; dorsal sepal erect or incurved, lanceolate with a purple stripe down the centre.

Labellum 3-lobed; middle lobe large and rounded, white or yellowish-white, recurved but not revolute, apex blunt, margins quite entire; lateral lobes violet or partially violet on outer-surface, violet with striae on the inside, erect with entire margins; lamina with double row of yellow linear clavate calli extending almost to the extreme tip. Column purple or purplish, incurved. Anther with a short point.

There is rather a poor illustration of this orchid in Reichenbach's Xenia, ii., t. 188.

C. deformis, Br.

Western Australia: near Perth, Dr. J. B. Cleland, August, 1906; Muresk, Mrs. W. E. Cooke, 4/9/07; Cape Naturaliste, J. C. Wiburd, September, 1904; Karratta, Mrs. W. E. Cooke, 4/8/07; near York, in clayey soil, O. H. Sargent, 1/8/06.

Victoria: this species has been received from Cheltenham (22/8/20), of a bright canary colour. The collector, Alfred J. Todgell, found a group of these plants all of the same remarkable colour.

C. sericea, Lindl.

Western Australia: Waroona, G. F. Berthoud, July, 1907; near Perth, Dr. J. B. Cleland, September, 1906; Albany, A. G. Hamilton, Rogers, September, 1919; Balbarrup, E. H. Sutton, October, 1912; Diamond Tree School, near Jarnadup, Miss I. Knox-Peden; Darling Range, Rogers, 28/9/19; Pinjarra, Rogers, 1/10/19.

C. gemmata, Lindl.

Western Australia: Swan View, Mrs. W. E. Cooke, 13/9/07; near Perth, A. G. Hamilton, September, 1902; Welsh-pool to Kalamunda, J. H. Maiden, September, 1909;

Cut Hill, near York, O. H. Sargent, October, 1905; Cape Naturaliste, Mr. W. E. Cooke, October, 1906; Albany, Dr. A. Syme Johnson, September, 1919; Mount Barker district, Rogers, 23/9/19.

The low stature, large soft deep blue flowers, short and very wide basal leaf, and the broadly ovate labellum, its lamina studded with gem-like calli, easily reveal the identity of this orchid. It grows in vast quantities in the neighbourhood of Mount Barker.

C. ixioides, Lindl.

Western Australia: near Perth, Mrs. W. E. Cooke, September, 1907; Swan River, James Drummond.

Except for the linear calli and slight serration of the apical margins there appears to be no definite structural differences between this and the preceding species. Its yellow colour is similar to the colour variation already referred to in the case of *C. deformis*. It appears to be very local. Fitzgerald collected it at Henley Park, near Perth, in August.

GLOSSODIA.

G. Brunonis, Endl.

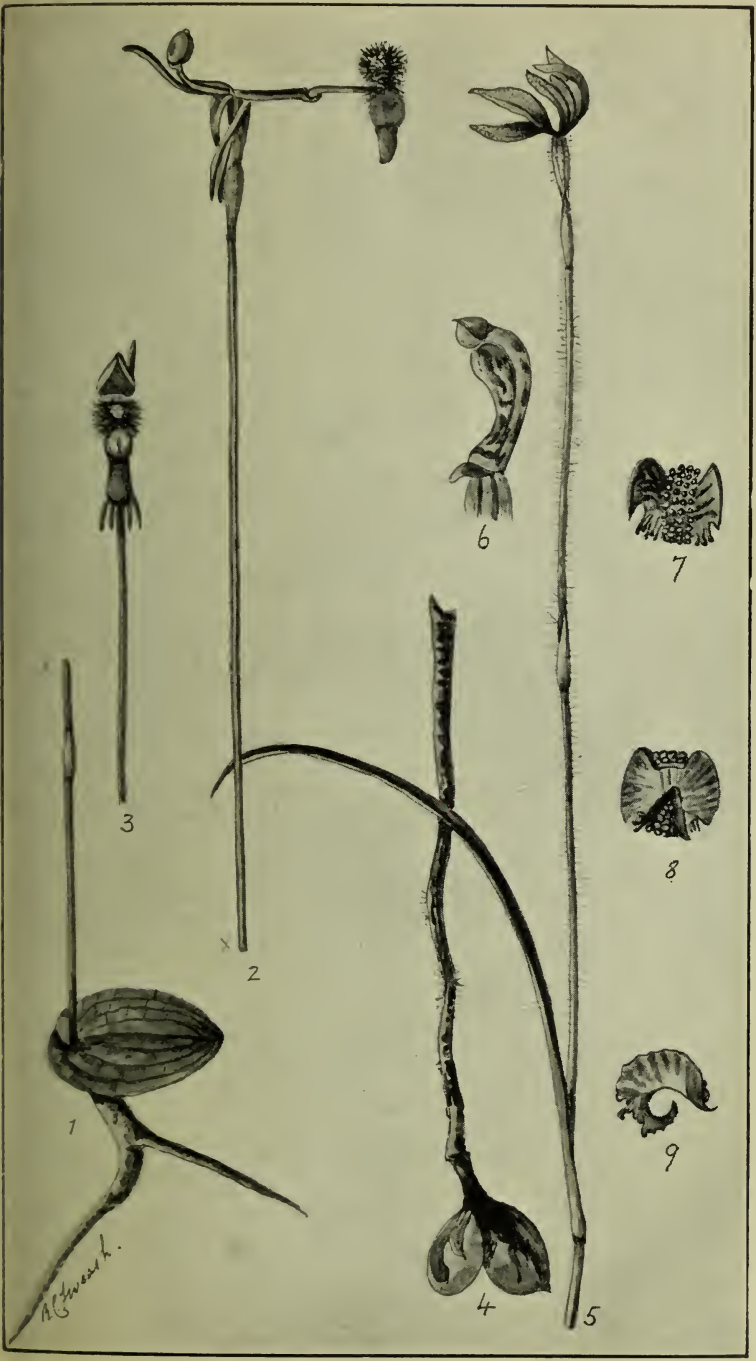
Western Australia: Perth, Mrs. W. E. Cooke, 25/9/08; Muresk and Swan View, Mrs. W. E. Cooke, September, 1907; York, O. H. Sargent, 22/9/07; Tukurua, Miss Bryce MacIntyre, 15/10/11; Waroona, G. F. Berthoud, August, 1909; Busselton, Dr. F. Stoward, November, 1912; Kalgar Plains, J. H. Maiden, December, 1909; Perth district, J. Sheath, December, 1910, and Dr. J. B. Cleland; Mundijong, Dr. F. Stoward, August, 1913; Lake Chockerup, Kalamunda, and Ravenswood, Rogers, September and October, 1919.

G. emarginata, Lindl.

Western Australia: Cut Hill, near York, L. O. Sargent, 24/9/06; Muresk, Mrs. W. E. Cooke, 4/9/07; Darling Ranges, Dr. J. B. Cleland; Waroona, G. F. Berthoud, August, 1907; Busselton, Dr. F. Stoward, October, 1914; Albany, Dr. A. Syme Johnson, 4/12/19; Darling Ranges, Rogers, 28/9/19; Pinjarra, Rogers, 1/10/19.

Flowers one or two, of varying shades of pink, marked with lilac or pink dots, glossy on upper-surface (but not so markedly so as in *G. Brunonis*); the under-surface covered with small purplish hairs. Column dotted with pink or lilac, its hood tomentose; anther violet.

The flowers are larger than those of *G. Brunonis*, and not nearly so artificial looking.



Drakaea Jeanensis. *Caladenia iridescens.*

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DESCRIPTION OF PLATE XIII.

Drakaea Jeanensis, n. sp.

1. Basal leaf with a portion of stem and bract (nat. size). 2. Remainder of plant (nat. size); flower shown in profile. 3. Flower shown from front (nat. size); the tip of the dorsal sepal is seen behind the anther, and the tips of the lateral sepals and petals below the long lobe of the labellum. In this figure, and also in the previous one, the artist has shown the short lobe (the head) of the labellum more hairy than is natural. In this situation the hairs should be shown in tufts interspersed among the numerous mulberry-like glands of which this lobe is composed. Around the insertion of the claws (*i.e.*, around the neck) the hairs are numerous, long, and shaggy.

Caladenia iridescens, n. sp.

4. The root (nat. size). 5. Remainder of the plant (nat. size). 6. The column viewed from the side (enlarged). 7. Labellum (enlarged), showing lateral lobes and some denticulations of middle lobe; also lamina with 4 rows of calli, which should have been shown more closely set together than is depicted in the drawing. 8. Under-surface of labellum (enlarged), showing lateral lobes with entire margins; posterior portion of lamina with a few calli; recurved middle lobe with calli extending almost to tip. 9. Side view of labellum (enlarged).

The External Characters of Pouch Embryos of Marsupials.

No. 1—*Trichosurus vulpecula*, var. *typicus*.

By F. Wood Jones, D.Sc., F.Z.S.,
Professor of Anatomy in the University of Adelaide.

[Read October 14, 1920.]

Plates XIV. and XV.

Introductory.

The necessity for recording all details concerning the Australian mammalian fauna needs no emphasis. No one acquainted with the conditions prevailing in Australia to-day will dispute the fact that the marsupial fauna is a rapidly dying one, and no systematic zoologist will deny that current descriptions, written very often from dried museum skins, may well be amplified by the inclusion of charts of hair tracts, etc., which can only be done with advantage in the pouch young. The amount of fresh or well-preserved material is comparatively limited, and it is highly desirable that descriptions of such material as is available should be made accessible, while it is still possible to deal with adequate series of any given type. From time to time pouch embryos and fresh and spirit-preserved adult material are (as a generous response to correspondence) coming under the observation of the writer. It has been deemed important that before any of this material is subjected to anatomical investigation, either gross or microscopic, it should be dealt with from the comparatively uninteresting, but nevertheless important point of view of the systematist, who is concerned in the main with the more striking features of gross external anatomy. Following this maxim, the writer has adopted the plan of recording, in the form of notes, drawings, and photographs, all material submitted to him. The completeness of these records, rather than the systematic position of the animal, must determine the order in which material is prepared for publication. Expediency demands this method. But its disadvantages are at once obvious. In the first place, until the whole series of descriptive papers is collected and correlated, any consecutive ideas of the interrelations of types will be difficult to come by. In the second place, a great amount of duplication of work must be done, since contrasts between, and comparisons with, other types will be practically impossible in the descriptions of any given type. This disadvantage has a corresponding advantage, since each type must be described fully without reference to other descriptions. More labour is entailed, but maybe a compensating degree of accuracy is attained which may repay the additional work spent on recording by pen or pencil. The anatomical and histological examination of the material submitted to review must occupy attention later, and subsequent work will be planned so that microscopical and anatomical details may be correlated with the gross form of specimens examined and described in these papers.

The External Characters of the Pouch Embryos of *Trichosurus vulpecula*, var. *typicus*.

For pouch embryos of the common Phalanger I have to thank especially the authorities of the Perth Museum, and of the South Australian Museum, as well as students of the Adelaide University. *Trichosurus vulpecula* is still a comparatively common animal, and material both adult and immature is not difficult to obtain, and from various sources I have collected a series of young specimens which cover practically the whole range of pouch development.

In the general form of the pouch embryo the initial size of the forelimbs is noteworthy, as is their gradual outstripping by the hind limbs as pouch development proceeds. The great development of the posterior axillary fold is also a conspicuous feature of the embryo in the later stages of pouch life.

Hair.—Hair is visible at the 32 mm. R.V. stage (see fig. A, pl. xiv., Specimen male A, Perth Museum). At the 80 mm. R.V. stage a new growth of secondary hair is developed among the primary hairs, which have now become considerably elongated. By the 100 mm. R.V. stage the hair is distinctly pigmented, the secondary hairs being still distinct from the primary hairs, which are more highly pigmented than the more recent hairs. Some irregularity is seen in the correlation of hair growth and embryonic length; thus, though embryo Specimen male A, Perth Museum, has a distinct hair growth at 32 mm., embryo Specimen male C, Piper, is almost hairless at 65 mm.

Hair Tracts.—In Specimen male D, Perth Museum, the hair covering was complete, and afforded the most favourable material for determining the hair trends over the entire body. The description of the hair tracts on this specimen has been checked and confirmed by the examination of older and younger examples.

Upon the head the hair tracts are somewhat complicated; passing from the rhinarium backwards the following well-marked territories are to be noted (see fig. 1):—

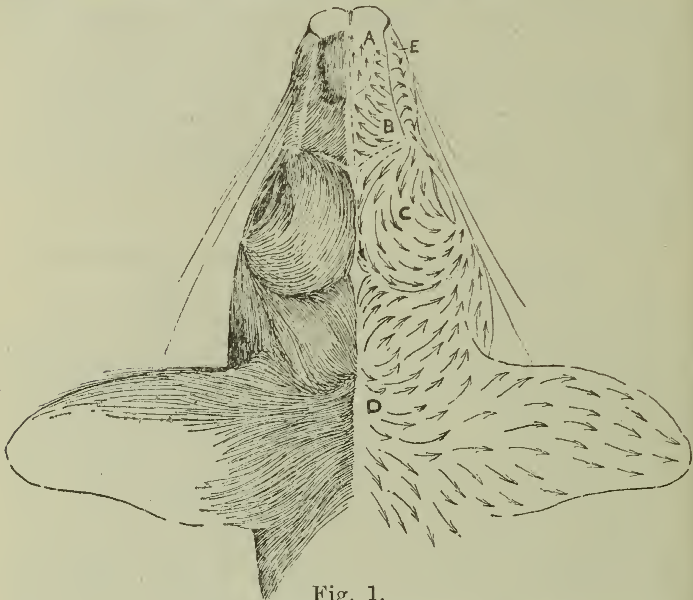


Fig. 1.

Hair tracts of the head (Specimen male D, Perth Museum).

(A) Upon the dorsal surface of the anterior extremity of the muzzle a field of very short hairs is uniformly directed straight forwards towards the base of the naked rhinarium.

(B) Behind this is a larger area, extending caudad almost to the anterior margin of the palpebral fissure. Within this area the hair, which is far longer than that in field A, is directed forwards and towards the middle line. The boundary line between fields A and B is marked by a very obvious hair ridge.

(C) Around each eye, upon its dorsal aspect, is another territory of hair directed backwards in a curved direction above the orbital margin. This field is marked off from B by a well-marked divergent hair parting.

(D) Behind this is a radiating field in which the hair of the crown of the head is directed (1) downwards and forwards to the posterior angle of the eye, where at a convergent stream line it meets C; (2) directly outwards on to the dorsum and posterior surface of the auricle; and (3) backwards and downwards to join the general body stream.

At the middle line of the head from before backwards the two areas of the right and left sides are separated as follows:—The area A shows no middle line demarcation, the tracts of the two sides being continuous over the bridge of the nose. A well-marked ridge of convergent hairs separates the two areas marked B. A backwardly-directed stream line separates the two areas indicated as C. Upon the middle line of the muzzle, between the areas B and C, is a convergent interval, and between areas C and D is a divergent interval, forming conspicuous landmarks. Upon the crown of the head a radiating divergent centre is situated, almost midway between the auricles; from this centre the hair is distributed in the area D.

Upon the face, at a lower level on the muzzle than the area A, is a hair field, E, occupied by hairs which stream downwards and backwards from the rhinarium along the upper lip. In this area the mystacial sensory vibriscae are situated. This field runs backwards, and without any obvious line of demarcation, joins a tract of caudally-directed hairs which stream around the lower margin of the orbit, diverging from the stream C at the anterior (inner) canthus of the palpebral fissure. Upon the lower jaw the hair is directed uniformly backwards, and at the angle of the mouth this stream becomes confluent with the sub-ocular stream (E) of the upper jaw.

Behind the orbit is a somewhat complicated convergent region in which the sub-ocular stream runs both upwards and downwards to meet a radiating stream which runs forwards from the anterior margin of the auricle. This pre-auricular stream also runs downwards and meets, at a convergent line, the mandibular stream which is directed backwards. The general line of convergent streams runs downwards and forwards over the cheek and to the lower jaw near to its angle.

Upon the body and limbs (see fig. 2) the hair disposition is, on the whole, extremely simple. There is a uniform body flow directed ventrally and caudally, and a uniform limb distribution having a ventral and post-axial trend. There are no hair reversals upon the limbs, and no whorls or partings upon the body.

Hair is continued to the extremity of the ungual phalanx of both fingers and toes; the heels are hairy.

The hair when first uniformly distributed over the body is almost black in colour; but when the young leaves the pouch the dorsal surface is black-brown and the ventral parts bright-tan.

The Chest Gland.—At no stage have I been able to recognize in any of the young specimens that I have examined any naked-eye trace of the "chest gland" said to characterize the adult.

Sensory Vibriscae.—In ontogenetic sequence the first of these vibriscae to appear is the ulnar carpal tuft, which is present as an elevated cutaneous papilla before any visible

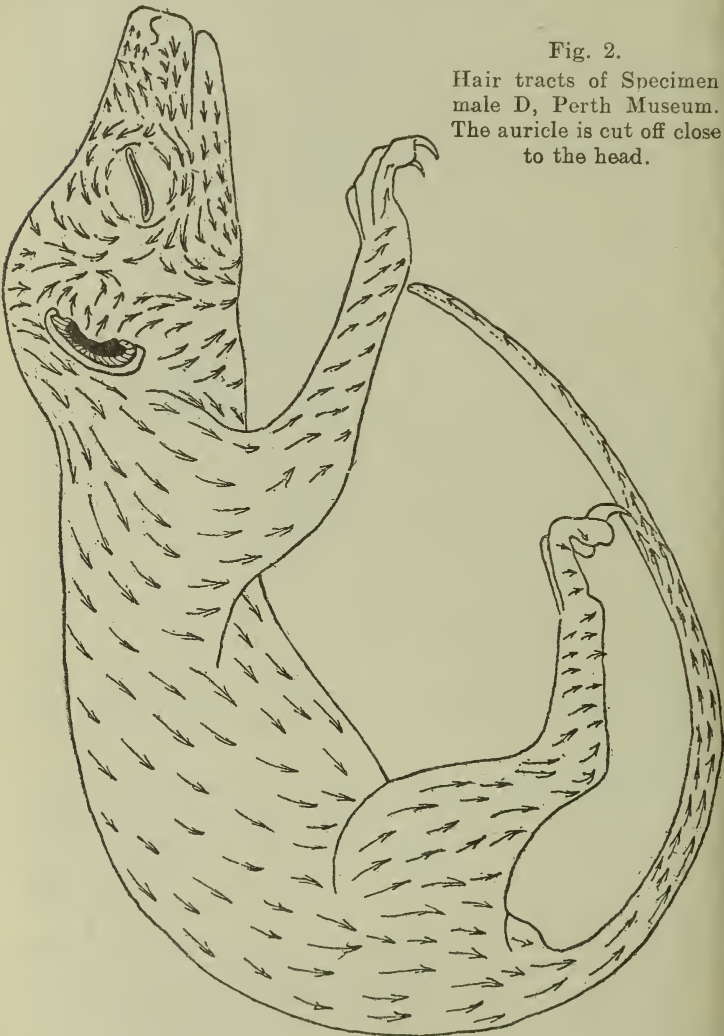


Fig. 2.
Hair tracts of Specimen male D, Perth Museum. The auricle is cut off close to the head.

hair springs from it. This papilla is conspicuous at the 32 mm. stage. All the remaining papillae and their accompanying vibriscae are well developed at the 65 mm. stage.

Facial Vibriscae.—Of the buccal set, the naso-labial or mystacial vibriscae are arranged in 5 rows (see fig. 3, A). The superior row contains 2, the next 4, the next 6, the next 7, and the lowest, or labial, 4, papillae, from each of which a long, backwardly-directed bristle springs. The mental or submental set (E) consists of a series of far smaller papillae, which give rise to slender, and comparatively short, vibriscae. The interramal (B) is a large papilla from which 3 or 4 elongated and stout vibriscae take origin. The genal or zygomatic (C) is the largest, and consists of an ovoid and definitely tuberculated mass giving origin to five stout vibriscae. The superciliary or supraorbital (D) gives rise to only two vibriscae, and though small is a very prominent and distinctly delimited papilla situated above the fore part of the orbit.

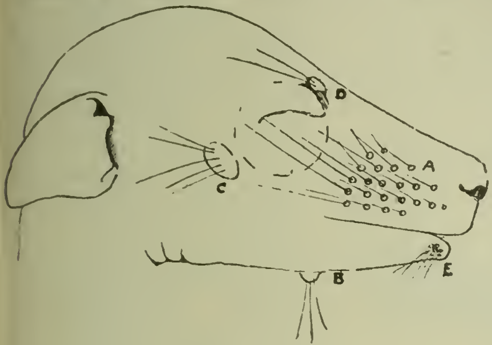


Fig. 3.
Facial vibriscae (from Specimen female B, Perth Museum).
A, mysticial. B, interramal. C, genal. D, supraorbital. E, submental.

Brachial Vibriscae.—The ulnar carpal papilla (see fig. 4, A), situated upon the volar surface of the forearm, is present and well developed. From its summit 4 or 5 long

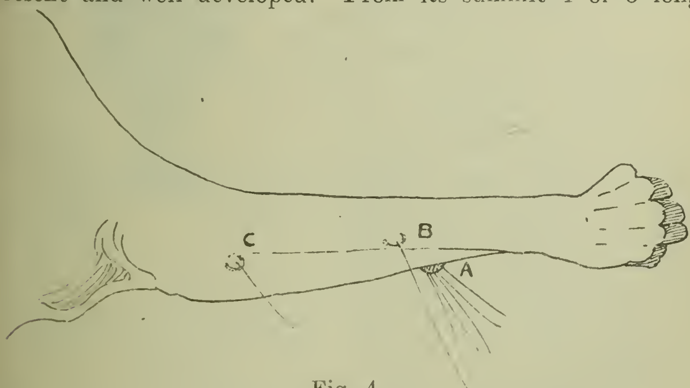


Fig. 4.
Brachial vibriscae (from Specimen female B, Perth Museum).
A, ulnar carpal. B, medial antebrachial. C, anconeal.

and stiff vibriscae arise. These vibriscae are pale in colour and are conspicuous features even in adults. Upon the ulnar margins of the arm, but more upon its dorsal aspect, are two other papillae, each of which gives rise to a single tactile hair. Of these the lower (most distal) one is situated at about the mid-point of the fore-arm upon its lateral aspect. It is here termed the medial antebrachial papilla (B). The other is situated nearer to the point of the elbow, and is here termed the anconeal papilla. Both of these papillae are constant, and the pale stiff vibriscae which spring from them are conspicuous when the animal is clothed with its general body hair. They are readily identified in dried museum specimens.

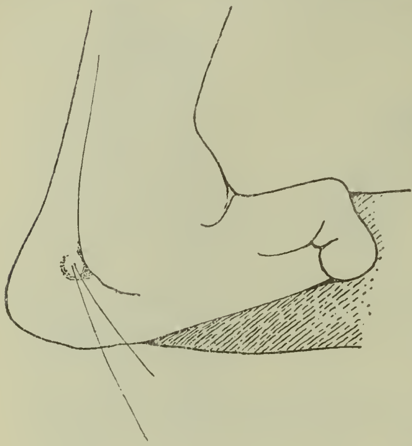


Fig. 5.
Calcaneal vibriscae (from Specimen female B, Perth Museum).

Crural Vibriscae.—Upon the mesial aspect of the ankle, just behind the mesial maleolus, is a large papilla which gives rise to two long and stout tactile hairs. These vibriscae are constant and easily identified in the adult. They are quite distinct in skins prepared for museum use, and are here termed the calcaneal vibriscae (see fig. 5).

Cloacal Vibriscae. — A group of long bristle-like hairs is present around the cloacal margin in both sexes. These hairs are conspicuous in the adult, but they make their appearance later than the other tactile hairs, being present only when the general body hair has become well developed.

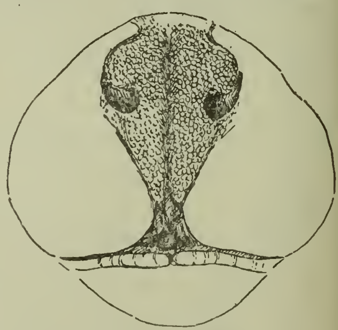


Fig. 6.
Rhinarium embryo 100 mm. (Specimen female B, Perth Museum).

Rhinarium.—The rhinarium is triangular in form (see fig. 6). The superior surface is cleft by the upward continuation of the middle line sulcus. The naked area is a fine pink colour, and the surface has a finely-granulated texture. The narial slits are bounded above by naked skin for the whole of their length, but the inferior margins are pubescent a short distance from their anterior ends. The infra-narial portion of the rhinarium is marked by a median sulcus, and is continued to the free margin of the upper lip, narrowing rapidly as it approaches the lip. The hair on the supra-narial margin is directed towards the distal end

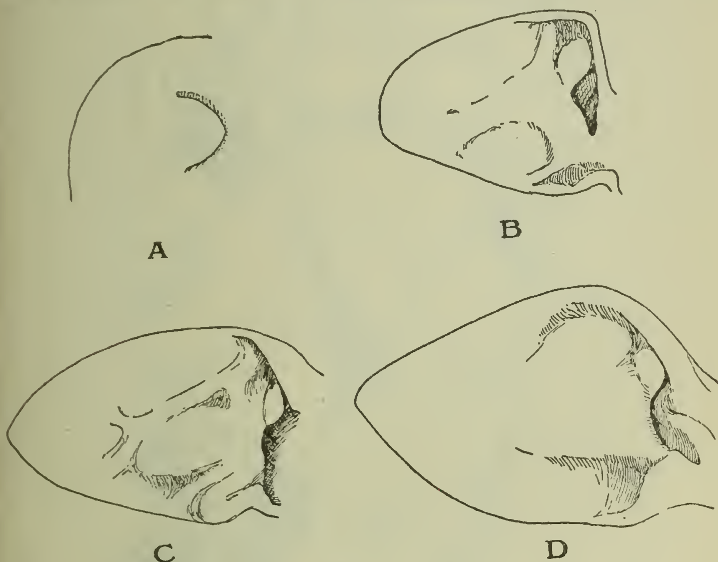
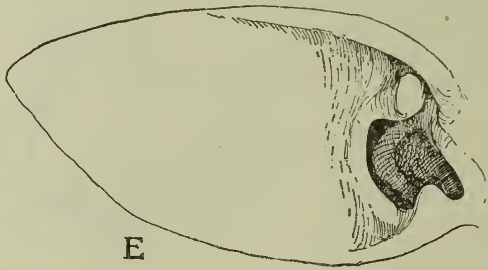


Fig. 7.
The form of the external ear.
A, 32 mm. B, 65 mm. C, 80 mm. D, 100 mm. embryos.

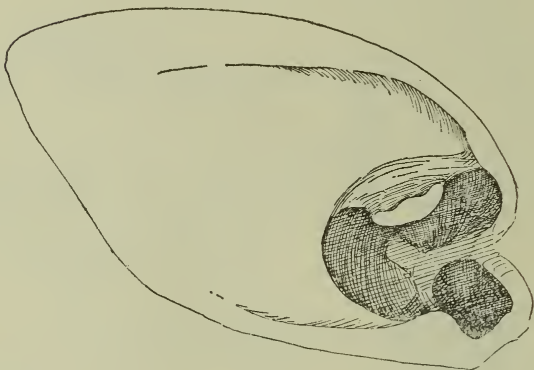
of the rhinarium, whilst on the infra-narial margin the hair direction is reversed.

The External Ear (see figs. 7 and 8).—In the 32 mm. stage (see fig. 7, A) the auricle is folded with the free tip directed forwards, and the whole pinna is tightly adpressed to the side of the head. In the 45 mm. stage it is folded with the free tip directed backwards, and again the pinna is closely applied to the head. At 65 mm. (see fig. 7, B) the enlarging auricle is not so closely applied to the head, and at 80 mm. (see fig. 7, C) it projects from the side of the head, the direction of folding being now variable. In older examples the free auricle usually has its tip folded forwards again. As soon as the auricle is folded backwards the crus helicis becomes a prominent feature, and after rising vertically upwards it takes a sudden turn backwards at right angles to its former direction. This right-angled bend is removed at later stages as the whole of the auricle elongates.

Within the concha, when the auricle is first turned backwards, is seen the developing region of the antihelix upon



E



F

Fig. 8.

The form of the external ear.
E, fully-haired embryo. F, young adult.

which certain elevations are prominent. Since the nomenclature of the various processes of the auricle is by no means uniform, and since the processes under consideration are definite elevations of the developing antihelix, they are here termed the *processi antihelicis*. Of several such processes which are apparent in the earlier stages, that which is situated most dorsally (cephalic) upon the antihelix retains the greater degree of independent development as growth proceeds.

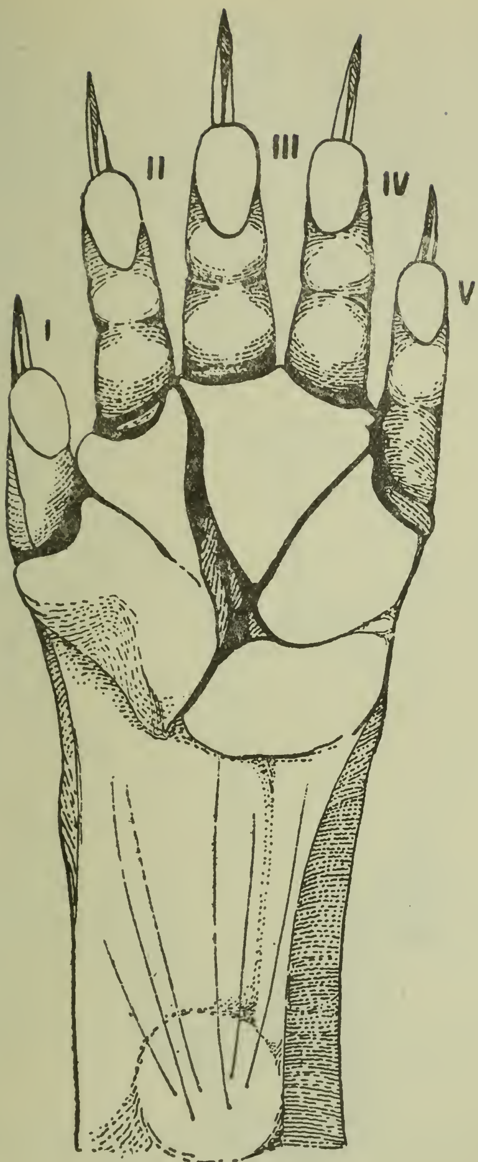


Fig. 9.
Left manus (drawn from Specimen female B, Perth Museum).

This processus antihelicis becomes the "tragoid projection"; "metatragus," or "supratragus" of authors. A true tragus cannot be said to be present, but a small antitragus is developed on the ventral (caudal) border of the helix margin. The single processus antihelicis which is present in *Trichosurus* is a purely functional structure which fits into the conchal orifice of the auditory meatus when the auricle is folded downwards and forwards as in sleep. As such the process may be described as a meatal operculum.

Manus.—The digital formula of young specimens is either $3>4>2>5>1$, or $3=4>2>5>1$ (see fig. 9). The classical formula $4>3>2>5>1$ is not seen in young examples, and it is by no means invariable in the adult. Claws

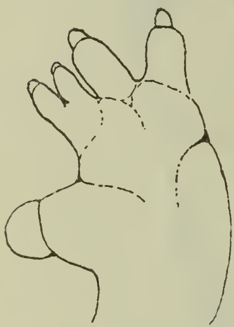


Fig. 10.
Left pes, plantar aspect. 32 mm. embryo (from Specimen male A, Perth Museum).

Fig. 11.
Left pes from the plantar aspect. 45 mm. stage (from embryo Specimen male E, Perth Museum).

are developed at the 32 mm. stage upon all the digits. Upon the dorsal surface the hair is continued to the ends of the ungual phalanges, the hair having a distal and an ulnar trend.

Apical pads are well developed. Interdigital pad I fuses early with the thenar pad. The second interdigital pad is displaced considerably towards the radial side by the very large third interdigital pad, which occupies in most specimens the palmar surface opposite digits 3 and 4. In the adult this

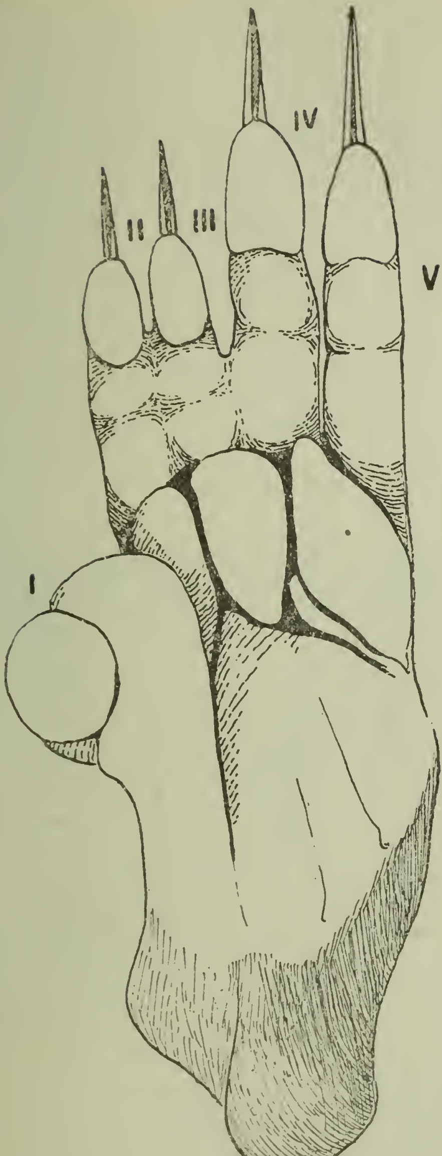


Fig. 12.
Left pes (drawn from Specimen female B, Perth Museum).

pad is more normal in proportion. The fourth interdigital pad is displaced considerably proximally and towards the ulnar side. The hypothenar pad is well developed.

Pes.—The digital formula for the pes is 4>5>2.3>1 (see figs. 11 and 12). The early specialization of the first digit is remarkable, as is also the high degree of development of the syndactylous elements. Claws are developed upon digits 2.3, 4, and 5; but, as John Hunter noted, no claw is present on digit 1. At no stage have I been able to detect any naked eye appearance of a nail or claw on this

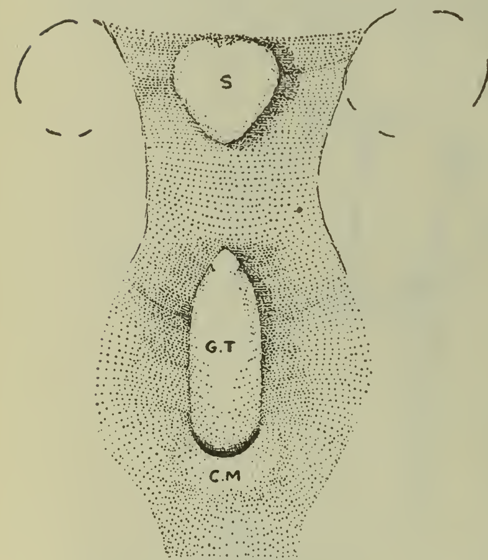


Fig. 13.

External genitalia of the male (from Specimen male A, Perth Museum).

S, scrotum. GT, genital tubercle. CM, cloacal margin. 32 mm. stage.

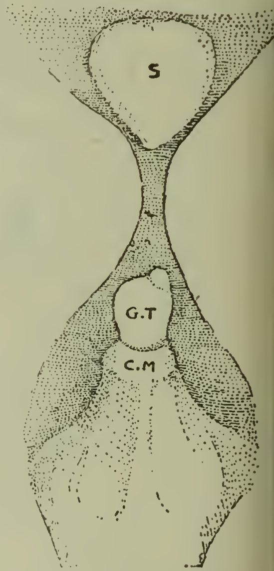


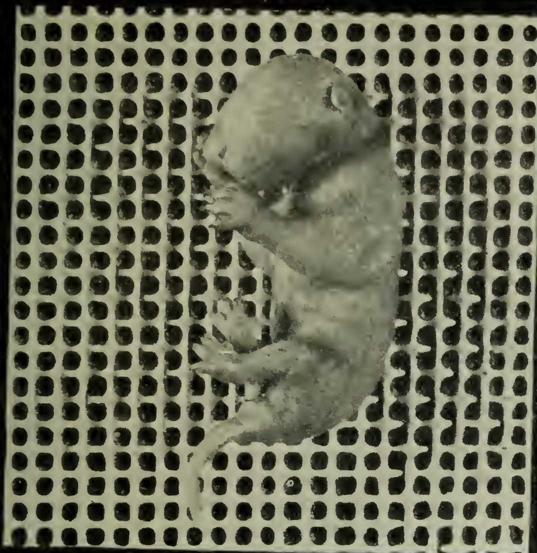
Fig. 14.

External genitalia of the (from Specimen male Piper).

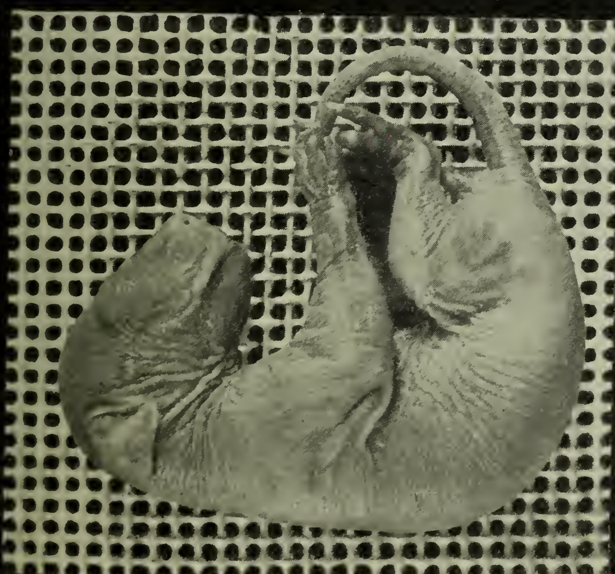
S, scrotum. GT, geni tubercle. CM, cloacal ma 65 mm. stage.

highly-specialized digit, which in the earlier stages stands in marked opposition to the rest of the digits.

It is noteworthy that the syndactylous toilet digits 2 and 3 are early and progressively specialized, and that the webbing between 3 and 4 becomes more marked with increasing development. Apical pads are well developed. Interdigital pad 1 and the thenar pad are fused. Interdigital pads 2,.3, and



A



B

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C

D

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4 are well developed and normal. It is to be noted that syndactylism does not destroy the primitive mammalian distribution of the interdigital pads. The hypothenar pad becomes flattened in older examples.

External Genitalia.—The genital tubercle of the male is at first freely exposed beyond the limits of the cloaca (see fig. 13). In later stages the tubercle becomes hidden from the surface by its own retraction within the cloaca and by the upgrowth of the cloacal margins (see fig. 14).

Two mammary areas disposed bilaterally exist within the pouch of the female (see fig. 15).

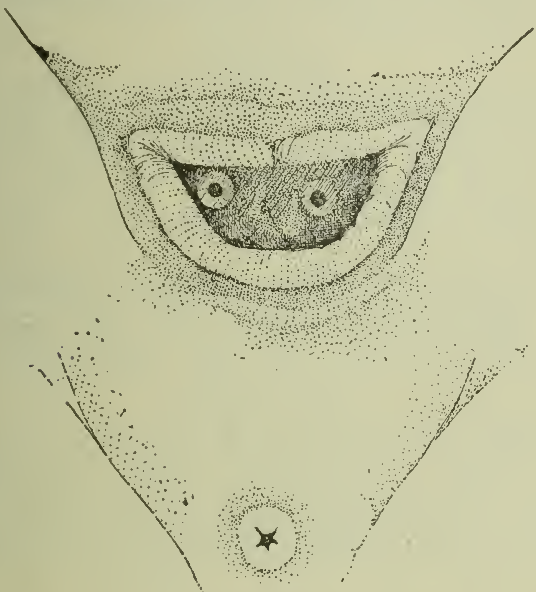


Fig. 15.
The pouch and mammary glands of the female at the 100 mm. stage (from Specimen female B, Perth Museum).

DESCRIPTION OF PLATES.

Plate XIV.

Pouch young of *Trichosurus vulpecula*, var. *typicus*, photographed against a background of $^1/_{12}$-inch squares.
A, Specimen male A, Perth Museum. B, Specimen male C, Piper.

Plate XV.

Pouch young of *Trichosurus vulpecula*, var. *typicus*, photographed against a background of $^1/_{12}$-inch squares.
C, Specimen female B, Perth Museum.
D, Specimen male D, Perth Museum.

Additions to the Flora of South Australia. No. 18.

By J. M. Black.

[Read October 14, 1920.]

Plates XXII. and XXIII.

The districts mentioned refer to those in Tate's "Flora of Extra-tropical South Australia."

Gramineae.

Leptochloa subdigitata, (R. Br.) Trin. Hookey Waterhole, near Oodnadatta (H. W. Andrew). The stout, rigid, glaucous stems and the straw-coloured leafsheaths resemble those of the two "cane-grasses" of the North—*Spinifex paradoxus* and *Glyceria ramigera*.

Aristida calycina, R. Br. Oodnadatta (Miss Staer; Dist. C).

Chloris acicularis, Lindl. A specimen brought by Mr. H. W. Andrew from the Alberga Creek has only 3 digitate spikes. Bentham says: "Spikes 6-12 or even more," and Moore (Fl. N.S. Wales, 490) says: "Spikes from few to above 12."

Loranthaceae.

Loranthus Murrayi, F. v. M., et Tate in Trans. Roy. Soc. S. Austr., vi., 109 (1883). Alberga River (H. W. Andrew). The type came from Ideyaka, between Mount Lyndhurst Railway Station and Lake Torrens (Dist. S). It was also found on the Upper Arkaringa by R. Helms in 1891 (Dist. C), and near Tarcoola in 1912 by J. W. Mellor (Dist. W).

Chenopodiaceae.

Arthrocnemum halocnemoides, Nees, var. *pergranulatum*, J. M. Black. Lake Tyrell, Vict. (per H. B. Williamson).

Aizoaceae.

Glinus Spergula, (L.) Pax in Engl. u. Prantl, Nat. Pflanzenfam. iii., 1b, 40 (1889). *(Mollugo Spergula*, L.) Alberga River, near Todmorden Station. (H. W. Andrew; Dist. C).

Cruciferae.

Lepidium hyssopifolium, Desv. Alberga River (Dist. C; H. W. Andrew).

LEGUMINOSAE.

Acacia prolifera, nov. sp. (Tab. xxii.). Frutex ramosus viscidus glaberrimus sesquimetralis usque bimetralis, ramis ramulisque valde costato-angulatis, phyllodiis rigidis linearibus quadricostatis quadrisulcatis resinoso-marginatis rectis vel falcatis 3-9 cm. longis 1½-2 mm. latis 1 mm. crassis apice pungentibus basin versus paulo angustatis, glandulâ marginali 5-10 mm. supra basin sitâ saepe nullâ, racemis 3-5-cephalis quasi proliferis partem inferiorem aphyllam rhacheos superne foliosae occupantibus, pedunculis 10-12 mm. longis, capitulis globosis 15-20-floris, floribus pentameris glabris, sepalis lineari-spathulatis, petalis leviter conjunctis sed mox liberis uninerviis calyce semel longioribus, bracteolâ superne cucullatâ, ovario glabro, legumine non viso.

Wynbring or Barton, East-West railway (J. M. B.); flowering September 22, 1920. This species seems to be nearest to *A. quadrisulcata*, F. v. M., from which it differs in the much longer phyllodes, the sepals glabrous and half as long as the petals, the ovary glabrous, and in the inflorescence. To understand the inflorescence fully would require further observation of the shrub during the flowering and fruiting period. As seen at the time of gathering, the 3-5-headed racemes formed the lower part of axillary shoots bearing flower-heads towards the base, and in the upper part bearing young phyllodes which were soft and flexible, but otherwise similar to the mature, rigid, pungent-pointed ones. In a few instances the upper part of this growth, which should probably be considered the leafy rhachis of the inflorescence, had fallen or been broken off, and the question remains as to what becomes of the leaf-bearing portion in other cases during the fruiting season. All the shrubs seen were healthy and apparently normal, two or three enlarged ovaries crowning those heads from which the flowers had fallen, and giving promise of curved pods.

Acacia salicina, Lindl. "Native Willow" (S. Austr.); "Cooba" (N.S. Wales). (Pl. xxiii.)

Acacia ligulata, A. Cunn. "Umbrella Bush." (Pl. xxiii.)

The vexed question as to the correct scientific names of the "Native Willow" and the "Umbrella Bush" is in a fair way to be settled by a note received from Lieut.-Col. Sir D. Prain, Director of the Royal Botanic Gardens, Kew, to whom I forwarded specimens of each, with a request that they should be compared with the types. The note, which bears date June 22, 1920, is as follows:—

"In 1909 we looked into the question of the identity of Lindley's type specimen of *Acacia salicina*, which is at

Cambridge, and we found it to be identical with Bentham's *A. salicina*, var. *varians*. Although of a weeping willow-like habit this plant has broader leaves than *A. ligulata*, A. Cunn., which, as you say, is nothing like a willow, but is an erect bush. It is quite clear from Bentham's notes on the herbarium sheets that he applied the name *A. salicina* to the narrow-leaved *A. ligulata*, and redescribed the real *A. salicina* as var. *varians*. We have Cunningham's type of *A. ligulata*.

"Your contention, therefore, is correct, that the 'Native Willow' (specimens 1 and 2) is *A. salicina*, Lindl. (syn. *A. salicina*, var. *varians*, Benth.), and the 'Umbrella Bush' (specimens 3-9) is *A. ligulata*, A. Cunn. (syns. *A. salicina*, Benth., non Lindl.; *A. salicina*, var. *Wayae*, Maiden").

It is unnecessary to give here the systematic history of these two species, as that has been done very fully by Mr. J. H. Maiden in his Forest Flora of N.S. Wales, iv., 146-152 (1910). At that date, however, Bentham's error was not known in Australia, and Mr. Maiden considered the large Umbrella Bush *(A. ligulata)* to be the normal form of *A. salicina*, and also dealt with a smaller maritime form of the Umbrella Bush as *A. salicina*, var. *Wayae*. In these Transactions, xli., 641 (1917), I urged that the two plants (Native Willow and Umbrella Bush) were distinct species and detailed the characters which differentiate them, but the nomenclature which I adopted was erroneous, the Native Willow *(A. salicina)* being there termed *A. varians*, Benth., and the Umbrella Bush *A. salicina*. I had, at the time, a strong feeling that these names could not be the correct ones, and added:—"One would suppose *primâ facie* that the 'curious willow-like acacia' found by Major Mitchell near Oxley, on the Lachlan, in 1836, and described by Lindley as *A. salicina*, was the Cooba, or Native Willow."

Mr. Maiden gives, opposite p. 150, an excellent photograph of Native Willows growing on the Hillston Road, near Gunbar. This locality is not very far from the Lachlan River, and the trees shown are doubtless co-types of Lindley's *A. salicina*. On specimens gathered near the Rocky River, South Australia, I have seen the "numerous reddish minute drops of resin" sprinkled on the young phyllodes, as mentioned by Mitchell in his original note on the tree.

The type of *A. ligulata* was collected by Cunningham at Dirk Hartog Island, near Shark Bay, Western Australia, probably on January 21, 1822, when he landed on that island, and observed its "barren, parched appearance." The same shrub has also been found on the south coast of that State. It therefore stretches right across Australia from the Indian Ocean to at least as far east as the Darling, the

Paroo, and the Mallee district of Victoria. It is common in most parts of South Australia, and is equally at home on the coast, in the Flinders Range, along the Murray, or in such dry country as the Alberga River, Ooldea, and Lake Perigundi. A specimen found by Mr. H. W. Andrew at Sheila Well, near the Alberga, attained, according to his note, a height of 6-7 m., with the appearance of a tree, whereas in other districts it varies between a small and a large shrub. It extends northwards at least as far as the Finke River, Northern Territory. It grows in dry situations, whereas *A. salicina* loves moist rich soil beside running streams or flats subject to inundation.

The funicle in *A. salicina* appears to be always scarlet, and this is also its usual colour in *A. ligulata*, but in the latter species it is sometimes bright yellow. The two colours are found in the same locality and without any other accompanying difference.

In northern specimens of *A. ligulata* the phyllode has a wrinkled cylindrical base 2-3 mm. long, while in *A. salicina* the base is swollen and smooth. In some moist districts of the south the wrinkling of the base in *A. ligulata* is less conspicuous.

Seedlings of *A. ligulata* found under a bush at Ooldea Soak in September had thick, broadly lanceolate, dark green, somewhat 3-nerved phyllodes. The leaflets were oblong and 9 in number, supported on slender, cylindrical petioles which could not become normal phyllodes and doubtless fall off early. Some of the broad, normal phyllodes were so small that it seemed impossible that they could ever have been surmounted by leaflets. There would thus appear to be two forms of leaf in the seedling: the one caducous and bearing leaflets, and the other (the persistant and normal phyllode) bearing no leaflets. I have never seen seedlings of *A. salicina*, because, as explained in a previous paper, propagation appears to take place usually, if not always, by young plants rising from underground branches. These suckers have all the appearance of seedlings. The phyllodes are light green, thin and oblanceolate; the leaflets are 8, 9, or 10, more distant than in *A. ligulata* and supported on normal, persistant phyllodes or petioles.

Acacia rivalis, J. M. Black. In the hills near Blinman, with ripe pods (August, 1920; H. W. Andrew). Locally known as the "Silver Wattle," and stated to be the shrub which, in the summer season, produces a large amount of gum, fetching in Adelaide a price of £60 to £70 per ton. Mount Lyndhurst—a specimen received in 1913 from Mr. J. H. Maiden without name of collector, but probably one of

Koch's. The ripe seed is black, glossy, ovoid-oblong, subcompressed, 5 mm. long. Now that it is known that the inflorescence is frequently racemose, this species seems related to *A. retinodes*, Schlecht., of which it has the calyx, but not the glabrous petals; the seed is very similar, but the pod is different and the phyllodes are narrower and shorter, with the marginal gland much further removed from the base.

Acacia estrophiolata, F. v. M. Alberga River; flowering August, 1920 (H. W. Andrew; Dist. C). Phyllodes linear-lanceolate, rather thick, 3-5 cm. long, faintly or distinctly 3-nerved, 2-4 mm. broad; the phyllodes on the barren branches longer. A tree about 15 m. high, the butt nearly 1 m. in diameter; locally known as "Ironwood." The type came from the Finke River, Northern Territory. Specimens were collected by R. Helms on the Arkaringa Creek, South Australia, in the Elder Expedition of 1891.

Myoporaceae.

Eremophila neglecta, J. M. Black. Copley Hill, between Oodnadatta and Todmorden Station (H. W. Andrew).

Compositae.

Pterigeron cylindriceps, J. M. Black. Alberga River, near Todmorden Station (H. W. Andrew). These are the first complete specimens obtained, and show the plant to be a herb, 8-20 cm. high, with several ascending or procumbent stems, which are branched in the upper part. The outer involucral bracts are dark purple. The type was collected near the Everard Range, about 100 miles further west.

DESCRIPTION OF PLATES.

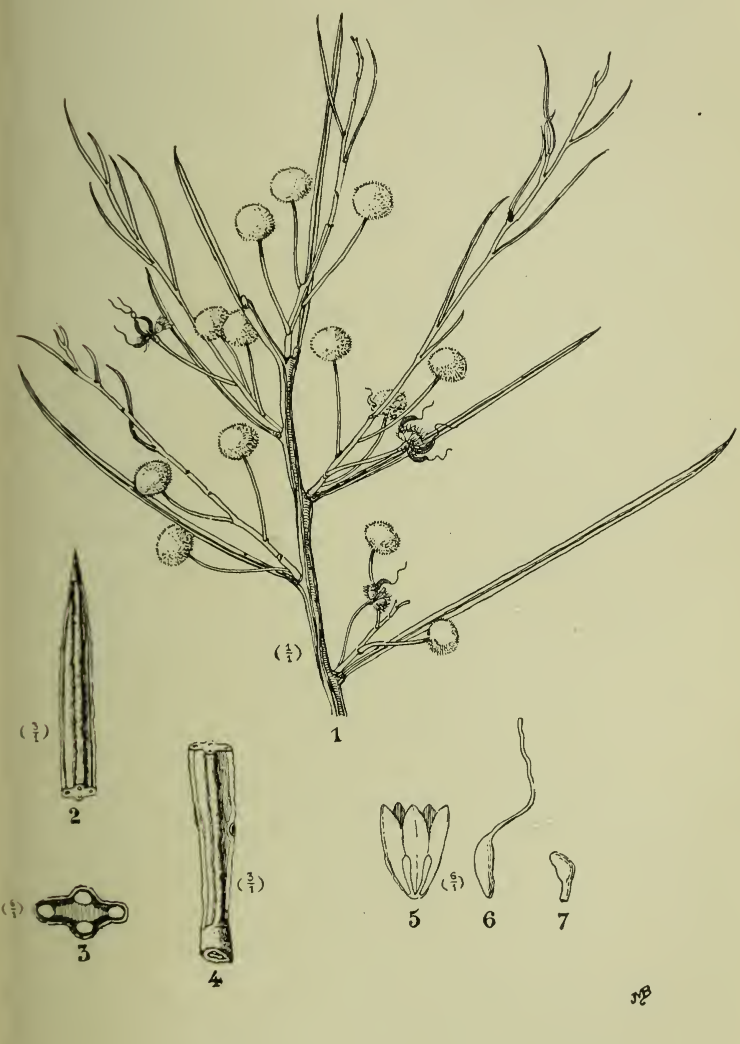
Plate XXII.

Acacia prolifera, n. sp. 1, flowering branch. 2, summit of phyllode. 3, transverse section of phyllode. 4, lower part of phyllode. 5, flower. 6, pistil. 7, bracteole.

Plate XXIII.

Acacia salicina, Lindl. 1, fruiting branch with pod; from Gladstone, South Australia. 2, phyllode. 3, lower end of phyllode, showing the smooth, swollen base. 4, flower. 5, seed and funicle; *a*, point at which the funicle is attached to the placenta.

Acacia ligulata, A. Cunn. 6, flowering branch; from Ooldea. 7, lower end of phyllode, showing the wrinkled, almost cylindrical base. 8, flower. 9, pod; from Ooldea. 10, pod; from Kingscote, K.I. This is the form which Mr. Maiden distinguished as *A. salicina*, var. *Wayae*, but the transitional forms between the moniliform pod and that which is but slightly constricted between the seeds are so numerous and complete that I do not see how var. *Wayae* can be maintained. 11, seed and funicle; *a*, point of attachment to placenta.



Acacia prolifera *nova sp.*

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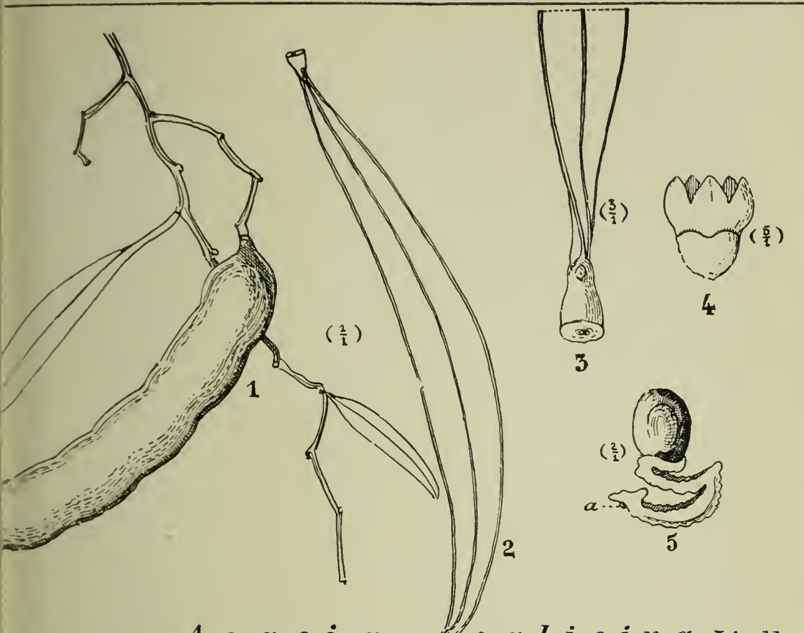
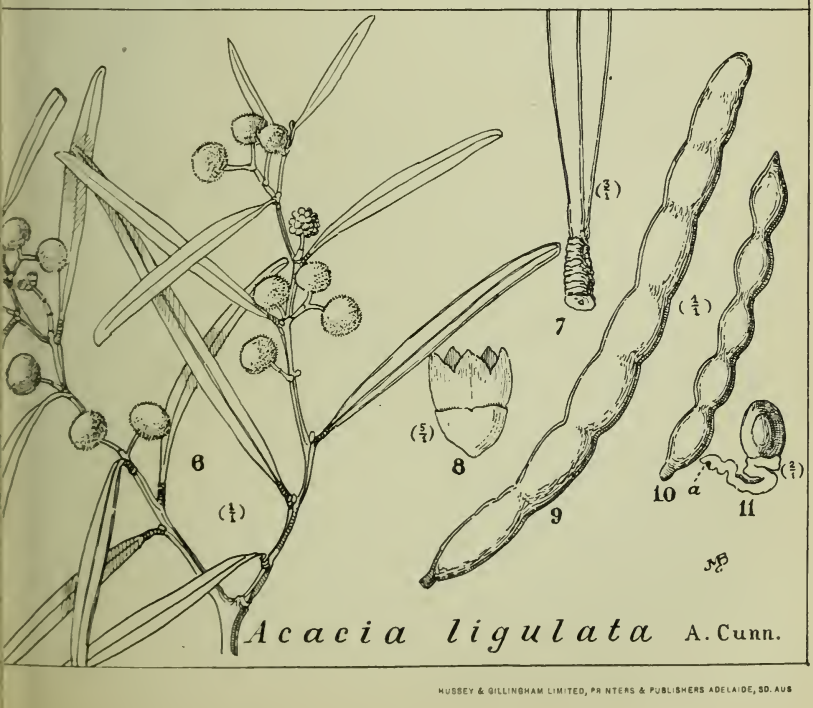


Acacia salicina Lindl.



Acacia ligulata A. Cunn.

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MISCELLANEA.

Notes on Occurrences during Summer Recess, 1919-20.

Speaking at a meeting of the Society on Thursday, April 8, 1920, the President (Sir Joseph Verco) welcomed the election as a Fellow of Mr. Herbert Mayo, LL.B. Mr. Mayo, he said, was a son of Mr. G. G. Mayo, who had nominated him that he might step into his father's place. The latter, who had tendered his resignation, had been elected a member of the Adelaide Philosophical Society 46 years ago. Only one name stood before his on the roll of the Society, and that was the name of the Secretary (Mr. Walter Rutt, C.E.), who had been elected in 1869. When Dr. W. L. Cleland had been elected President of the Society in 1897, and had resigned as Secretary, Mr. G. G. Mayo had been chosen as his successor, and had retained the position for 12 years. In 1909 he had been followed by Dr. R. H. Pulleine. The Society owed him a debt of gratitude for the work he had done in that capacity for so many years, and members were pleased that he would still be represented on the register by his son and daughter. He also referred to the knighthood (Knight Commander of the Order of the British Empire) conferred upon Professor W. H. Bragg, an Honorary Fellow of the Society. He said that in the last four numbers of *The Illustrated London News* were well-illustrated abstracts of four Christmas lectures recently delivered by Sir W. H. Bragg at the Royal Institution on "Sound." The Professor had been elected a Fellow of the South Australian Society in 1886, and an Honorary Fellow in 1910. He also reported that the late Sir Edwin T. Smith had bequeathed to the Society the sum of £200, which would in due course be added to the Endowment Fund.

Obituary Notice of Robert Etheridge.

The death, since our last meeting, of Mr. Robert Etheridge, late Director of the Australian Museum, Sydney, removes from our midst one of the most prominent and distinguished geologists, not only of Australia but of the world. His father (Mr. Robert Etheridge, sen.) was for many years a well-known specialist in British geological circles, first as palaeontologist to the English Geological Survey, and later as assistant keeper in geology at the British Museum, so that his son was to the manner born. Mr. Robert Etheridge, jun., was appointed one of the pioneer officers of the Geological Survey of Victoria, but as the latter was disbanded for a time, the young geologist returned to the Homeland and was appointed palaeontologist to the Geological Survey of Scotland, and later as assistant to his father at the British Museum. In 1887 he returned to Australia and held official appointments in both the Department of Mines, New South Wales, and the Australian Museum, Sydney. In 1895 he was made Director of the latter, an office that he filled with great efficiency up to the time of his death. Mr. Etheridge was one of the most noteworthy pioneers in the elucidation of the geology and palaeontology of Australia. Two of his late colleagues, Professor David and Mr. C. Hedley, in an appreciative notice in *The Sydney Daily Telegraph*, have said:—"It is not too much to say that the classification and correlation of the coalfields, goldfields, artesian water basins, oilfields, and other mineral deposits of the Commonwealth are based essentially on the work of Mr. Etheridge."

His palaeontological knowledge was of a very wide and cosmopolitan range, and he was ever ready to assist other observers in the determination and description of fossil remains. He was also interested in ethnological studies, and made valuable contributions to our knowledge of Australian aboriginal weapons and utensils.

I have to express my personal indebtedness to the late Mr. Etheridge for valuable aid covering a period of many years. In referring to my letter-file I find that our correspondence dates from 1877, when he was in Edinburgh and I on the Tyne, and at that time was based on the investigation of the microzoa of the Carboniferous Limestones of Scotland and the North of England, and this correspondence was continued up to a few days before his death.

Mr. Etheridge was elected an Honorary Fellow of the Society in 1890, and at the time of his death was the senior Honorary Fellow on the roll.

His contribution to scientific serial literature was most voluminous, in which our Society shared, including a most valuable monograph on the Cretaceous Mollusca of South Australia and the Northern Territory, which forms a portion of the Society's Memoirs, vol. ii., part i. One of his last efforts of this kind was a very careful and comprehensive revision of the South Australian Cambrian Trilobites, published in the last volume of the Society's Transactions, and although the final proof had passed his hands he did not live to see it published.

Mr. Etheridge's death from pneumonia, at the age of 73, was sudden and unexpected, as his many friends looked forward to several more years of useful work in his original researches. He was awarded the Clarke Memorial Medal in 1895 and the Mueller Memorial Medal in 1911, but he seems to have been singularly overlooked in the bestowment of scientific honours that were commensurate with his great abilities. This may be largely accounted for by his retiring disposition and his dislike for everything that was of a public or ostentatious character. He buried himself in his work, and from the pleasures of his work found his true recompense and reward.

WALTER HOWCHIN.

Evening Meeting, April 8, 1920.

The Solvent Effects of Sea Water on Limestones.

When limestones become exposed to sea water they pass readily into solution and exhibit evidences of rapid waste. The under-cutting of the limestone cliffs and islets within the lagoon of an atoll are familiar instances. An example of the same process under other circumstances can be studied on the shore near Ardrossan, Yorke Peninsula, in the differential weathering of limestone pebbles on the beach, which have been derived from the Upper Cambrian fossiliferous limestones of the neighbourhood. The chief points of interest consist in the very marked effect of sea action in etching the exposed surfaces of some of these pebbles. Near to Ardrossan township the stones move freely along the beach by the waves, and by friction are rounded and smoothed, but give no evidence of etching. On a stony spit, situated about three-quarters of a mile to the southward of Ardrossan, which is exposed at low water, the limestone pebbles have become more or less fixed, being partly embedded in the stony ridge. In this case that portion of the pebble which is below the level, and is more or less fixed, exhibits a smooth surface, while the upper and exposed surface is deeply incised, with the included fossils and more siliceous portions of the stone standing out in bold relief. Those pebbles which possess the greater contrasts in the relative proportions of impurities distributed through the limestone show the strongest reliefs. It is well to remember that sea water, on the average, contains from 18 to 27 times more carbon-dioxide than the atmosphere, and is, therefore, a more effective solvent, and may account for the very striking effects produced in the case before us. [Specimens were exhibited in illustration.]

WALTER HOWCHIN.

Evening Meeting, May 13, 1920.

Note on the Generic Position of Certain Australian Cambrain Trilobites.

At the evening meeting of the Society on October 9 of last year (see vol. xliii., p. 373) a paper was read from our late Honorary Fellow (Robert Etheridge) on the Cambrian Trilobites of Australia and Tasmania. Most of the specimens therein described consisted merely of more or less imperfect cephalic shields, and consequently obscure and difficult of determination. As the author of the paper died before its publication, I took the initiative of sending reprints of the paper to a few American palaeontologists whom I knew to be interested in the subject. One such paper was forwarded to Dr. Charles D. Walcott, who has an intimate and cosmopolitan knowledge of the Cambrian fauna, and whose judgment on all questions relating to Cambrian palaeontology carries much weight. Dr. Walcott has been good enough to express his opinion on Mr. Etheridge's determination, based upon the very excellent figures of the respective forms described in the paper referred to, and from the interest which Australian geologists take in this subject I think it desirable that Dr. Walcott's conclusions should be made public.

Under date of March 12, 1920, Dr. Walcott writes:—"I thank you for your letter of February 8, also the paper on the Cambrian Trilobites by R. Etheridge, jun. . . . With relation to Etheridge's determinations, I do not think that any of the forms on plate xxxix. should be referred to the genus *Ptychoparia*, but at present I am not prepared to say where they should go, unless it is fig. 1, which may be a *Redlichia*. Fig. 8, pl. xl., is a good *Ptychoparia*, but fig. 7 is not."

It is only just to Mr. Etheridge to say that he was by no means confident in his determinations, as will appear from the following extract from his letter of transmission, dated September 8, 1919:—"I now after several previous attempts forward you, under separate cover, my MS. on the Cambrian Trilobites for what it may be worth, but, frankly, I am not satisfied with the production; it is so difficult to handle these small fragmentary organisms. The effusion is for the Royal Society if the Council care to accept it."

WALTER HOWCHIN.

Evening Meeting, May 13, 1920.

Sarsen Stones and Drift Pumice in New Zealand.

Extracts from a letter from Mr. R. Speight, M.A., M.Sc.:—

"There are many points of more than ordinary interest to me in your 'Geological Memoranda.' We have here in Otago numerous 'sarsen' stones, called by the miners 'chinamen,' which lie on the surface of the schist area. Sections made from them show that they are formed by the cementation by silica of quartz grains and pebbles derived from what is called the quartz-drift, a loose conglomerate of quartz pebbles, etc., which contains the alluvial gold of the old basin of Otago. The great majority of this has been stripped off by erosion, leaving the 'chinamen' on the surface. Miners nearly always regard them as favourable for gold, as this is occasionally found under them."

"Your note on 'Pumice Drift' is also interesting. One can hardly explain the presence of pumice in drift material on this coast on the present distribution of ocean currents. Although pumice is plentiful in the North Island, it is found on the shores in all parts of the South Island, and specially of Stewart Island. This may be carried down the west coast and lodge at Stewart Island by a branch of the Australian current, but the shore drift is generally from south to north. Much of the flotsam of the Tasman fetches up on Stewart Island."

Walter Howchin.

Evening Meeting, May 13, 1920.

Notes on X-Ray Phenomena.

1. Phenomena in a Punctured "Coolidge" X-ray Tube.

The exhibited tube is one having done three years of very heavy service in the X-ray Department at Keswick. It recently failed owing to puncture. Upon admission of air, the incandescent filament of the cathode evidently combined with oxygen with the formation of an oxide of tungsten, which is shown by the dense white deposit. The purple manganese colouration of the glass, due to bombardment by X-rays, is now very beautifully shown, owing to the white background of the oxide of tungsten. Certain beautifully rich sections suggest industrial applications in Ceramics. Several bands of differential deposit of the oxide well illustrate the physics of the tube existent at the time of puncturing.

A. R. Riddle.

Evening Meeting, November 13, 1919.

2. Coolidge Tube, Radiator Type, for X-ray Work.

In exhibiting this, the most specialized type of X-ray tube, the structural and physical points of difference with the standard type of "Coolidge" electron type of X-ray tube were discussed. The very much greater thermal capacity of the anti-cathode in the exhibited tube, together with the radiator, allowed the convergent bundles of cathode-rays to be intercepted much nearer their exact point of convergence. This narrowing down of the point of cathode-ray bombardment made it possible to far more closely approximate a point source for the resulting X-rays, thus giving a much more critical definition in any radiographic projection. One very great advance made possible by the new tube was stereoscopic fluoroscopy. Stereoscopic radiography has long been possible, but to examine on a fluorescent screen in a darkened room, say a chest, in stereoscopic relief, with all movements, is a more recent achievement. The thermal capacity of the anti-cathode of the tube in question has allowed the bulb to be made smaller, only 3·75″ in diameter. By placing two of these tubes side by side, their focal spots would not be at a very much greater distance than the normal separation of the eyes. In stereoscopic fluoroscopy, the two tubes are placed side by side behind the patient. In front of the patient is placed the usual fluoroscopic screen. The two tubes are then excited alternately at a frequency of, say, 25 per second. There will be, therefore, on the screen alternately two distinct shadows of the object being examined. It is only necessary now to hold in front of the eyes a reciprocating shutter, to block the vision of the right and left eyes alternately, in such a way that the right eye sees the image on the screen formed by the left tube, and *vice versa*. The brain then combines the two images, and reveals the object examined in stereoscopic relief.

A. R. Riddle.

Evening Meeting, April 8, 1920.

3. The Amethystine Colouration produced in Glass by Ultra-violet and X-ray Radiation.

On August 14, 1919, exhibits and remarks were set before the Society on the above subject *(vide* Trans. and Proc. Roy. Soc. S. Austr., vol. xliii., p. 420). It had been suggested in various quarters that the colouration produced was always due to ultra-violet radiation as from solar sources, etc., and not due to X-ray radiation, in spite of the marked effects seen in X-ray tubes, especially of the electron type, where the colouration was definitely associated with the field of X-ray activity. The results of experiments mentioned at that meeting, which had been commenced to determine the matter, were tabled. Samples of glass-headed pins, the glass of which presumably contained manganese, had been well protected by black paper from any ultra-violet radiation which might come from the incandescent filament in the "Coolidge" tube. Each pin so protected was fixed by a similar pin to the inside of the box containing a "Coolidge" tube in frequent use. Results show that the amethystine colouration produced is equal in both pins. As one pin was protected from ultra-violet radiation, it is obvious that its colour change is due to X-ray radiation as apart from ultra-violet radiation.

A. R. Riddle.

Evening Meeting, May 13, 1920.

Radio-active Photograph of Autunite.

Three specimens of Autunite (calcium uranium phosphate) from Mount Painter were placed on an Ilford X-ray plate which had been wrapped in two thicknesses of light-proof paper. They occupied this position for 48 hours, when the plate was developed. The tabled photograph demonstrates the radio-active nature of the mineral, the results being somewhat akin to the photograph made by Sir William Crookes of pitch-blende. The energy which affected the X-ray plate was derived entirely from the autunite specimens.

A. R. Riddle.

Evening Meeting, November 13, 1919.

Radiograph of a Skull of an Australian Aborigine.

A lateral radiograph was exhibited, made from the living subject, of the head of an Australian aborigine. The development of the frontal region generally, the frontal sinus and the very thick development of bony tissue anterior to it, together with the development of the lower mandible, especially the ascending ramus, were among the most interesting points of difference compared with the skull of the normal white.

A. R. Riddle.

Evening Meeting, April 8, 1920.

Coorongite.

[The Alfred Flats, which many years ago, after heavy floods, yielded a large quantity of coorongite, have been once more submerged, in the lower portions, and fresh supplies of this substance have appeared on the waters. Mr. A. C. Broughton, who recently visited the locality, has supplied the following notes, which were read at the evening meeting of the Society on October 14, 1920.—Ed.]

"To-day, on these new lagoons, a thick scum, like green paint, is forming. This scum is drying on the water in places to a semi-elastic substance, forming around reeds, it extends laterally, growing over the surface of the water. On the edges of the lagoons it is collecting along hundreds of yards of shore-line to a distance of five yards from the shore. The drier portion can be scraped in with sticks. It is a nascent substance in process of formation. Like green paint, a quarter of an inch thick, it covers hundreds of square yards of water, and as it drys it forms a skin like linseed oil drying on an overturned mass of paint. This skin in places is yards in area, and can be dragged along in sheets. It is driven by the changing winds in streaks and films and hardening masses from shore to shore.

"Last December (1919) it was practically unknown. In February about four gallons were observed. In May it had increased to hundreds of gallons. To-day it is there in thousands of gallons. It is coorongite in process of formation. On rises between lagoons, deposited as the water recedes, and on the edges of the lagoons, the thin films of new coorongite may be collected. Every stage from the green, liquid, paint-like substance to the tough, elastic, sand-containing coorongite may be observed. Scooped with the hand from the surface of the lake this substance, within a few minutes, changes before the eyes from a green liquid, which drips from the fingers, to a brown, plastic solid. Large areas are now drying to sheets of coorongite, and is undergoing a change, both in colour and in the nature of the substance. The conditions are now very satisfactory for field work from a geological aspect, and microscopical work from the biological side, to determine facts in connection with this occurrence, which may determine the origin first hand of the coorongite."

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia

(Incorporated)

FOR 1919-20.

ORDINARY MEETING, NOVEMBER 13, 1919.

THE PRESIDENT (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

NOMINATIONS.—Herbert Mayo, LL.B., and W. W. Weidenbach as Fellows.

EXHIBITS.—Professor HOWCHIN, on behalf of Sir Joseph Verco, showed pseudomorphs of shells in precious opal sent by Mr. Hackendorf from Stuart Range, Central Australia. They included 2 *Mytilus*, 1 *Trigonia*, and several bivalves. The matrix was travertine limestone, which was interesting in a petrological way. Mr. A. M. LEA exhibited some longicorn beetles *(Sceleocantha gigas)*, the male of which is hairy and has four remarkable basket-shaped appendages to the head, rendering it one of the most curious species of the family in the world; the female is about twice its size, is much less hairy, and the head appendages are normal. He also showed the sexes, eggs, and newly-hatched young of a curious walking-stick insect *(Acrophylla chronus)*. Mr. F. R. ZIETZ showed *Oenothera missouriensis*, a plant growing wild at Mitcham, apparently escaped from an old garden. Mr. A. R. RIDDLE showed a new electric lamp, and other exhibits connected with X-ray work [*vide* Miscellanea].

PAPER.—"The Igneous Rocks of Encounter Bay, South Australia," by W. R. BROWNE, B.Sc., communicated by Professor Howchin, F.G.S.

ORDINARY MEETING, APRIL 8, 1920.

THE PRESIDENT (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

ELECTIONS.—Herbert Mayo, LL.B., and W. W. Weidenbach as Fellows.

NOMINATIONS.—Professor Frederick Wood Jones, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., and Professor J. R. Wilton, M.A., D.Sc., as Fellows.

The President referred to the resignation as a Fellow of Mr. G. E. Mayo, who had been a member of the Society since 1873 and Honorary Secretary from 1897 to 1908; to the bestowal upon our Honorary Member, Professor W. H. Bragg, of the honour of Knight Commander of the British Empire; and to the bequest to the Society by the late Sir Edwin Smith of £200, which would in due course be added to the Endowment Fund.

Professor Howchin referred to the death of our Honorary Member, Mr. Robert Etheridge, and gave a *résumé* of his scientific work [*vide* Miscellanea].

Professor Howchin reported that the deferred meeting of the Australasian Association for the Advancement of Science would be held at Hobart next January.

Exhibits.—Captain S. A. White exhibited a fungus from the Queensland scrub resembling lumps of pitch. Mr. A. M. Lea exhibited a collection of biting March flies *(Tabadinae)* from various parts of Australia; also some almonds eaten by squirrels and opossums, which were attacking them badly, as also were, according to other speakers, rats and birds. He also showed twigs from a kurrajong tree, illustrating the fact that this and similar trees shed their small branches as well as their leaves. Dr. E. Angas Johnson showed native currants *(Styphelia depressa)* preserved in formalin, 5 parts to 100 water, which retained the natural colour; also eggs of the rock parrot *(Neophema petrophila)* from Thistle Island, near Port Lincoln, where they were rapidly increasing since being protected. Mr. A. G. Edquist showed photograph of a eucalyptus leaf, taken by using the leaf itself as the negative, which showed very clearly the venation and structure. Mr. A. R. Riddle showed a Coolidge tube, radiator type, for X-ray work, and radiograph of skull of an Australian aborigine [*vide* Miscellanea].

Papers.—"Vocabularies of Four South Australian Languages, with special reference to their Speech Sounds," by J. M. Black; "New Australian Lepidoptera," by Oswald B. Lower, F.E.S., F.Z.S.; "Certain Diophantine Problems," by Professor J. R. Wilton, M.A., D.Sc.

Ordinary Meeting, May 13, 1920.

Major R. H. Pulleine, M.B. (Vice-President), in the chair.

Elections.—Professor F. Wood Jones, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., and Professor J. R. Wilton, M.A., D.Sc., were elected Fellows.

Exhibits.—Professor Howchin exhibited pebbles from Ardrossan beach, showing the solvent effect of sea water on limestone [*vide* Miscellanea]. Mr. A. R. RIDDLE showed a driving glove illustrating the effect of high-temperature steam upon leather, and also referred to further experiments on the amethystine colouration of glass by ultra-violet and X-ray radiation [*vide* Miscellanea]. Mr. A. M. LEA exhibited a drawer of useful ladybirds from various parts of Australia; some wood and lead foil bored by an auger-beetle *(Xylopsocus)* in a consignment from Ceylon, recently condemned by the Department of Agriculture; a ball, about the size of a golf-ball, made from the sticky fruit of a species of *Casytha*, from Mr. J. Wright; and some gastroliths, or belly-stones, from the crayfish (from Mr. J. Formby). Captain S. A. WHITE showed the following birds from the Queensland scrub:—Rifle bird *(Ptiloris paradisea)*, white-throated thickhead *(Pachycephala pectoralis)*, yellow-rumped shrike-robin *(Eopsaltria chrysorrhos)*, rose-breasted robin *(Belchera rosea)*, male and female, silver-blue wren *(Malurus cyaneus cyanochlamys)*; also samples of strata from a well at Fulham, near Adelaide. Mr. EDWIN ASHBY exhibited *Petauxus poliocephalus*, flying fox, male, shot in orchard at Yinnar, Gippsland. One or two of these came each night, and are very destructive, eating large numbers of apples. One that was shot in the wing and unable to fly accepted half an apple from one of the bystanders and quite unconcernedly commenced chewing it. Also Taquan flying phalanger *(Petauxoides volans*, Kerr), which was also obtained at Yinnar, Gippsland, on April 6, 1920. It is a fine male specimen measuring: head and body, 19 in.; tail, 22 in.; or a total of 41 in. Long black to dark-grey silky fur on the upper-side, under-side white. Mr. F. R. ZIETZ showed four specimens of sepia bone, probably a new species, obtained from Cape Leeuwin, Port Noarlunga, and also from American River, Kangaroo Island, and for comparison, *Sepia braggi*, Tate, from Cape Leeuwin. Mr. F. R. ZIETZ also showed galls from a *Casuarina*, which had been destroyed by shrike tits; also an aboriginal grinding-stone from the Avoca district, Victoria, and a stone axe, showing how it corresponded with the worn surface of the grinding-stone.

PAPERS.—"Studies in Comparative Physiology. I.—Observations on the Physiology of the Fly's Intestine," by Professor T. BRAILSFORD ROBERTSON, Ph.D., D.Sc.; "Essential Oil from the Fruit of *Callitris verrucosa*," by H. H. FINLAYSON, communicated by Professor E. H. Rennie, D.Sc.; "Note on the Generic Position of Certain Australian Cambrian Trilobites," by Professor W. HOWCHIN, F.G.S. [*vide* Miscellanea].

ORDINARY MEETING, JUNE 10, 1920.

THE PRESIDENT (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

PAPERS.—"A Revision of the Australian Noctuidae," by A. JEFFRIES TURNER, M.D., F.E.S.; "Contribution to the Orchidaceous Flora of Papua (British New Guinea)," by R. S. ROGERS, M.A., M.D., and C. F. WHITE, F.L.S.

EXHIBITS.—Professor OSBORN exhibited a "Rome Beauty" apple, showing pure-red skin colour over a sector of the surface. The phenomenon was referred to as a bud sport. Also photographs of a hybrid *Delphinium* which had dark and pale-blue flowers, also some harlequin. It was considered that there had been a segregation of the colour factors in the embryo. Dr. J. B. CLELAND exhibited portion of the root of a cultivated olive, 1½ in. in diameter, cut through in making a trench for water-pipes at Beaumont. The parent tree was approximately 20 ft. away. Numerous roots, some of larger diameter, from other olive trees had been also cut through. Some rootlets were only about 2½ in. below the surface, and other roots were about 2½ ft. down, in a subsoil of limestone. The olive is a notoriously hungry tree, affecting adversely the growth of other trees, such as almonds, planted even a considerable distance away. The extensive root-spread, enabling a wide stretch of soil to be exploited for water during dry spells, explains this "hungriness." The superficial position of many of the smaller roots shows that it may be injurious to the tree to cultivate the soil anywhere near it. This same trench in another place, near Glen Osmond, has cut through roots of the carob-bean tree, up to 2¼ in. in diameter, at a distance of about 15 ft. from this hedge. Mr. EDWIN ASHBY exhibited a male and female of the Victorian lyre bird (*Menura novae-hollandiae victoriae*, Gould). The male was an exceptionally fine specimen, the tail measuring 2 ft. 6 in. in length, and in perfect preservation, was obtained in Gippsland. This specimen before being shot gave a fine exhibition of its powers of mimicry. Besides its natural note of "chunck chunck," and the imitation of the twittering of some small birds that could not be identified, it produced the songs and calls of the eleven following species of native birds:—Butcher bird, gang-gang cockatoo, coach-whip bird, funeral cockatoo, wattle bird, white-backed magpie, crimson parrot, grey crow shrike, grey shrike thrush, king parrot, and the white-throated thick-head. A hen bird was watched while it hopped from bough to bough of a wattle tree until 15 or 20 ft. high, and then volt-planed down into the thick bush of the fern gully. Mr. A. M. LEA exhibited a collection of insects from Central Australia, recently obtained by Professor Wood Jones, the most remark- of which was an ants'-nest beetle *(Paussoptinus dolichognathus)*, the specimen being only the second known; also some curious mud-wasps' nests from Western Australia, received from Mr. P. V. Klem, and a sample of pea-soup meal, bought in Adelaide, riddled by the bread-beetle *(Anobium paniceum)*. Mr. Edquist showed a cup presented by the South Australian Ornithological Association, awarded annually to the State school whose scholar sent in the best essay or drawing bearing upon our native birds or trees. Dr. Angas Johnson showed matte tea *(Ilex paraguensis)* from Argentina, ginsing-root from China, and talc from Tumby Bay.

Ordinary Meeting, July 8, 1920.

The President (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

Business.—Letter was received stating that His Excellency Sir Archibald Weigall, K.C.M.G., accepted the position of Patron, *vice* the late Governor. Dr. R. H. Pulleine was elected delegate to the Council at the forthcoming Hobart meeting of the Australasian Association for the Advancement of Science.

Nomination.—A. A. Simpson, C.M.G., was nominated a Fellow.

Resolved, on the motion of Mr. E. Ashby, seconded by Mr. J. M. Black—"That in the opinion of this Society all scientific publications, irrespective of the country of origin, or of the language in which they are printed, should be admitted on equal terms into Australia, and that a copy of this resolution be forwarded to the Prime Minister through the Advisory Council of the Commonwealth Institute of Science and Industry."

Papers. — "Chitons of D'Entrecasteaux Channel, Southern Tasmania," by Edwin Ashby, F.L.S., M.B.O.U.; "Additions to the Flora of South Australia, No. 17," by J. M. Black.

Exhibits.—Professor Howchin exhibited and read some notes on Crinoids from the Cretaceous beds of Central Australia [publication deferred]. Mr. E. Ashby exhibited two abnormal apples and abnormal specimens of *Hardenbergia*. Dr. Angas Johnson showed gourd and tube used in drinking matte tea in Argentina; samples of barytes; and granite from Bird Island, near Cape Thevenard, South Australia, polished, as he thought, by the feet of countless sea birds frequenting the island, but in the opinion of Professor Howchin the glaze was the result of chemical action, and was due to an alkaline silicate that sometimes formed on the surface of rocks in saline situations both near the sea coast and in Central Australia. He also showed a skull from Molokolo, New Hebrides, flattened by bandaging in infancy, and now painted in imitation of the living features; also types of "Rome Beauty" apples, showing great variation in size and colouration. Mr. A. M. Lea exhibited some scale insects, one of which had proved very troublesome in New Zealand, where it had been introduced from Australia; also a beetle that causes spherical galls on the native plant *Hibbertia;* also, on behalf of Captain S. A. White, coloured plates by Neville Cayley for a new book on Australian birds, by A. S. Le Souëf, including one of eggs, by a new process which produces a stereoscopic effect. Mr. F. R. Zietz showed feathered chaplet and wand from Point McLeay, used by medicine men in localizing foreign bodies introduced by magic. The doctor was called "mumkumbulie," the chaplet "kardukie" (meaning "light"), and the wand "pinnowrie." Mr. A. G. Edquist showed gold-bearing laterite from sandstone, Western Australia. Mr. W. J. Kimber showed a board riddled by *Teredo.*

Ordinary Meeting, August 12, 1920.

The President (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

Election.—A. A. Simpson, C.M.G., was elected a Fellow.

Papers.—"An Adventitious Occurrence of *Nautilus pompilius,* Linn., with a short Bibliography of Ocean Currents affecting the Australian Coast," by Arthur R. Riddle; "Revisional Notes on the Family Cistelidae (Order Coleoptera)," by H. J. Carter, B.A.

Exhibits.—Mr. A. R. Riddle exhibited electric lamps known as "Daylight Light," and demonstrated their superiority in showing the true colours of birds, minerals, and shells with comparatively small consumption of current. Captain S. A. White showed Australian rifle bird *(Craspedophora alberti)* from Cape York, Queensland; also male and female freckled duck *(Strictonetta naevosa).* Mr. L. K. Ward exhibited specimens of minerals. Mr. A. M. Lea showed a drawer of butterflies *(Huphina perimale),* showing how month by month their colours alter until their winter and summer colourations are strikingly distinct. Dr. Angas Johnson showed apples and oranges preserved from decay, for lengthened periods, by a coating of gum varnish; also specimen of *Ankylostoma duodenale,* the cause of the hookworm disease. Mr. F. R. Zietz exhibited the hind foot of a kangaroo with the bones pared down by the aborigines to form needles; also the introduced grey squirrel, and oranges and almonds destroyed by the same. Mr. W. J. Kimber showed a fossil *Nautilus* from Port Willunga cliffs.

Ordinary Meeting, September 9, 1920.

The President (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

Papers.—"Autoclastic, Intraformational, Enterolithic, and Desiccation Breccias and Conglomerates," by Professor Walter Howchin, F.G.S.; "*Ditropidus* and Allied Genera (Coleoptera, Chrysomelidae)," by Arthur M. Lea, F.E.S.; "A Review of *Chiton crispus*, Reeve (Order Polyplacophora), and its Allies," by Edwin Ashby, F.L.S., M.B.O.U.; "An Observation on the Toning of Photographic Silver Images," by Arthur R. Riddle.

The President referred to the appointment of our Hon. Fellow, J. T. Wilson, Professor of Anatomy in the University of Sydney, to a similar position in the University of Cambridge, England.

Exhibits. — Mr. E. Ashby exhibited seedless apples developed without flowers as outgrowths adjacent to scars of previous fruit stalks, and, for contrast, small second-crop apples developed from out-of-season flowers. Professor J. B. Cleland showed the flower of the Western Australian species, *Eucalyptus macrocarpus*, Hook., from a shrubby tree in the garden of Mr. J. H. Fleming, Fullarton. Mr. A. G. Edquist exhibited a plant, *Chara* (stonewort), grown from a spore that had been kept dry in a tin for 12 years; also two tadpoles of identical age, one of which had commenced to develop legs before the other as the result of a dose of thyroid tablet.

Annual Meeting, October 14, 1920.

The President (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

Nomination.—John Neil McGilp was nominated a Fellow.

The Annual Report and Balance-sheet were read and adopted.

A letter from the Australasian Medical Congress, enclosing resolutions passed at Brisbane, in August, were read, and referred to the Council for consideration and action.

Election of Officers.—The following were elected for the year 1920-21:—*President*, Sir Joseph C. 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*, Lieut.-Col. R. S. Rogers, M.A., M.D., and Professor T. B. Robertson; *Hon. Auditors*, W. L. Ware, J.P., and H. Whitbread; *Representative Governor* on Board of Public Library, etc., Professor Walter Howchin, F.G.S.

Papers.—"Further Notes on Australian Polyplacophora, with Additions and Corrections of the 1918 Distribution List," by Edwin Ashby, F.L.S., M.B.O.U; "Additions to the Fauna of South Australia, No. 18," by J. M. Black; "The External Characters of Pouch Embryos of Marsupials," by Professor F. Wood Jones, D.Sc., F.Z.S.; "Notes on the Formation of Coorongite on Alfred Flat, South Australia," by A. C. Broughton [*vide* Miscellanea].

ANNUAL REPORT, 1919-20.

During the year our Patron (His Excellency Sir Henry Lionel Galway), having completed his term of office as Governor of the State, was succeeded by Sir Archibald Weigall, who consented to our request that he would accept the position of Patron.

Papers presented by former contributors to our *Transactions* include one on some of the South Australian Aboriginal Languages by Mr. A. M. Black, who also continues his series on South Australian Flora; notes on geological subjects by Professor Howchin; on Entomology by Mr. Oswald B. Lower, Dr. A. J. Turner, Mr. H. J. Carter, and Mr. A. M. Lea; on Chitons by Mr. E. Ashby; and on Orchids by Dr. Rogers. Authors whose names will appear for the first time in our next volume, are:—Professor Wilton, who deals with Mathematics; Professor Robertson with Physiology; Professor Wood Jones with Zoology; Mr. W. R. Browne with Geology; and Mr. H. H. Finlayson with Chemistry.

The in-flow of books into our library, owing to the improved transit facilities since the cessation of the war, has rendered it necessary for us to approach the Board of Governors with a request for additional shelving, which the Board has promised to lay before the Government.

The indexing of our own publications from the year 1901 to the present date is now in hand. This is a laborious and expensive work, but is absolutely necessary if the information gathered during these years is to be made easily available for reference. Our former Index covered the period from 1877 to 1900.

The proposal to establish a local branch of an International Research Council, referred to in our last Annual Report, is still under consideration. The movement has advanced considerably in Europe, where several conferences have been held, but the scientific societies of Australia deemed it wise to refer the question of forming a local branch to the Australasian Association for the Advancement of Science, which will meet next January in Hobart.

Our Endowment Fund has been augmented by a legacy of £200 from the late Sir Edwin T. Smith, who was for so many years a generous supporter of useful and philanthropic institutions.

We cannot allow the resignation of Mr. G. G. Mayo to pass without a reference. He had been a Fellow of the Society since 1874, and, although not a contributor to our publications, was a constant attendant at our meetings, and was from 1897 to 1908 our Honorary Secretary. We have also lost through death our Honorary Fellow, Mr. Robert Etheridge. An obituary notice, referring to his valuable scientific work, will appear in our annual volume.

The present membership of the Society is 9 Honorary Members, 4 Corresponding Members, 80 Fellows, and 1 Associate.

Jos. C. Verco, *President.*

Walter Rutt, *Hon. Secretary.*

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Revenue and Expenditure for 1919-20.

	£	s.	d.	£	s.	d.
To Balance October 1, 1919				534	2	2
,, Subscriptions—						
Royal Society	92	13	0			
Field Naturalists' Section ...	38	18	9			
				131	11	9
,, Grants from Government—						
On Subscriptions	81	10	1			
For Printing Reports and Scientific Investigations ...	150	0	0			
				231	10	1
,, Receipts for use of Room by other Societies	6	9	6			
,, Sale of Publications	3	16	11			
,, Savings Bank Interest	12	2	11			
,, Interest transferred from Endowment Fund	141	13	8			
				164	3	0
				£1,061	7	0

	£	s.	d.	£	s.	d.
By Transactions—						
Printing	177	15	11			
Illustrating	120	19	9			
Publishing	2	10	11			
				301	6	7
,, Grant—						
Field Naturalists' Section				35	0	0
,, Library—						
Librarian, Cataloguing, Receiving, and Issuing	42	3	9			
Librarian, Indexing Transactions	42	3	3			
				84	7	0
,, Sundries—						
Cleaning and Lighting ...	11	3	6			
Printing, Postages, Stationery	20	1	11			
Insurance	2	10	8			
Advertising	2	13	8			
Re-caning Chairs	2	3	0			
				38	12	9
,, Balance September 30, 1920—						
Savings Bank of S.A.	373	18	1			
Bank of Australasia	228	2	7			
				602	0	8
				£1,061	7	0

Audited and found to be correct—

Howard Whitbread, } *Hon. Auditors.*
W. L. Ware

W. B. Poole, *Hon. Treasurer.*

Adelaide, October 1, 1920.

ENDOWMENT FUND.

(CAPITAL, £3,797 17s. 6d.)

	£	s.	d.	£	s.	d.
1919—October 1.						
To Balance	3,579	17	6			
,, Bequest to Fund	200	0	0			
,, Discount on Stock redeemed ...	18	0	0			
				3,797	17	6
,, Interest received on Government Stock	141	10	6			
,, Savings Bank Interest	0	3	2			
				141	13	8
				£3,939	11	2

	£	s.	d.	£	s.	d.
1920—September 30.						
By £2,000 S.A. Government 3¾% Inscribed Stock at cost ...	1,997	10	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			
,, £100 S.A. Government 5% Inscribed Stock	100	0	0			
,, £650 S.A. Government 5½% Inscribed Stock at par ...	650	0	0			
,, Savings Bank Account ...	4	8	1			
				3,797	17	6
,, Interest transferred to Revenue Account				141	13	8
				£3,939	11	2

Audited and found correct—

HOWARD WHITBREAD,
W. L. WARE, } *Hon. Auditors.*

W. B. POOLE, *Hon. Treasurer.*

Adelaide, October 1, 1920.

DONATIONS TO THE LIBRARY

FOR THE YEAR ENDED SEPTEMBER 30, 1920.

TRANSACTIONS, JOURNALS, REPORTS, ETC.,
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LIST OF FELLOWS, MEMBERS, Etc.

AS EXISTING ON

SEPTEMBER 30, 1920.

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 Members.

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.
1905. Gill, Thomas, C.M.G., I.S.O., Glen Osmond.
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, Cambridge University, England.
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.
1905. Thomson, G. M., F.L.S., Dunedin, New Zealand.
1908. *Woolnough, Walter George, D.Sc., F.G.S. (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.
1902. *Black, J. McConnell, 82, 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 Engineering and Mechanics, University of Adelaide.

1904. Christie, W., 49, Rundle Street, Adelaide.
1895. *Cleland, John B., M.D., Professor of Pathology, University of Adelaide.
1907. *Cooke, W. T., D.Sc., Lecturer, University of Adelaide.
1912. Corbin, H. H., B.Sc., University of Adelaide.
1914. Cornish, K. M., Coast View, Adelaide Road, Glenelg.
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., 2nd Avenue, Sefton Park.
1918. *Elston, A. H., F.E.S., 69, Lefevre Terrace, 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., 35, Dequetteville Terrace, Kent Town.
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. Jennison, Rev. J. C., Mount Barker.
1910. *Johnson, E. A., M.D., M.R.C.S., 295, Pirie Street, Adelaide.
1920. *Jones, F. Wood, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., Professor of Anatomy, University of 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., Broken Hill, N.S.W.
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.
1920. Mayo, Herbert, LL.B., Brookman Buildings, Grenfell Street.
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., D.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., Supreme Court, Adelaide.
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.
1919. *Robertson, Professor T. B., University of Adelaide.
1905. *Rogers, Lieut.-Col. R. S., M.A., M.D., Hutt Street, Adelaide.
1919. Rowe, Alan, Hon. Custodian of Archaeological Collection, South Australian Museum.
1869. *Rutt, Walter, C.E., College Park, Adelaide.
1891. Selway, W. H., Treasury, Adelaide.
1920. Simpson, A. A., C.M.G., Burnside.
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., North Terrace, Adelaide.
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.
1919. Whalley, Rev. D. T., Hall Street, Semaphore.
1920. Weidenbach, W. W., Fullarton.
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.
1920. *Wilton, Professor J. R., D.Sc., University of Adelaide.
1912. *Zietz, F. R., South Australian Museum.

Associate.

1904. Robinson, Mrs. H. R., "Las Conchas," Largs Bay, South Australia.

APPENDIX.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

THIRTY-SEVENTH ANNUAL REPORT OF THE COMMITTEE

For the Year ended September 30, 1920.

Another year closes with a record of useful work accomplished by the Section. Interest has been maintained in natural history by both Field Naturalists and Nature-lovers generally, and by the discussions in the daily Press and week-end papers.

The Section comprises 115 financial members, and the attendance at the excursions and lectures has been very good.

Excursions.—Field work has been well carried out and excursions have been held as follow:—

September 20, 1919—Highbury. Leader, Mr. W. H. Selway. Subject, Botany.

October 8, 1919—Hermitage. Leader, Mr. W. Ham, F.R.E.S. Subject, Botany.

October 18, 1919—Long Gully. Leader, Mr. A. H. Elston, F.E.S. Subject, Entomology.

October 25, 1919—Mount Lofty South. Leaders, Messrs. B. B. Beck and E. H. Ising. Subject, Botany.

November 8, 1919—Bridgewater. Leader, Mr. H. W. Andrew. Subject, Weed Pests.

November 22, 1919—Glenelg. Leader, Mr. A. G. Edquist. Subject, Ant Lions.

December 6, 1919—Snowden Beach, Outer Harbour. Leader, Mr. W. J. Kimber. Subject, Conchology.

January 17, 1920—Port River. Leaders, Messrs. E. R. Waite, F.L.S., and A. G. Edquist. Subject, Dredge Material.

March 20, 1920—Port River. Leader, Mr. E. R. Waite, F.L.S. Subject, Dredge Material.

March 27, 1920—National Park, Belair. Leader, Mr. A. E. Ridley. Subject, Bees.

April 17, 1920—Seacliff. Leader, Mr. W. Ham, F.R.E.S. Subject, Geology.

May 10, 1920—Norton Summit to Basket Range. Leader, Mr. W. H. Selway. Subject, Autumn Botany.

May 22, 1920—Morialta. Leader, Dr. C. Fenner, F.E.S. Subject, Physiography.

June 7, 1920—Montacute. Leaders, Messrs. W. Ham, F.R.E.S., and E. H. Ising. Subjects, Geology and Botany.

June 28, 1920—Hallett Cove. Leader, Messrs. B. S. Roach and E. H. Ising. Subjects, Glacial Rocks and Botany.

July 10, 1920—Botanic Gardens. Leader, Mr. F. J. Bailey. Subject, Queensland Trees.

July 24, 1920—Museum. Leader, Mr. E. R. Waite, F.L.S. Subject, General.

August 7, 1920—Waterfall Gully. Leader, Mr. H. W. Andrew. Subject, Introduced Flora.

August 21, 1920—Blackwood. Leader, Mr. E. H. Ising. Subject, Orchids, etc.

September 4, 1920—Bridgewater. Leader, Mr. A. H. Elston, F.E.S. Subject, Entomology.

September 18, 1920—"Carminow." Leader, Mr. B. B. Beck. Subject, Forestry.

Lectures.—Last year a series of lecturettes was inaugurated, and proved very successful. The following lectures and lecturettes have been given this year:—

September 30, 1919—Mr. A. H. Elston, F.E.S., "Injurious Insects"; Mr. W. Ham, F.R.E.S., "Echinodermata"; Dr. C. Fenner, F.L.S., "Fossils."

October 14, 1919—Mr. W. H. Selway, "Victor Harbour Nature Notes"; Mr. E. H. Lock, F.R.H.S., "Fossils"; Mr. E. H. Ising, "Plants at Home."

October 28, 1919—Mr. A. M. Lea, F.E.S., "Wheat Insect Pests"; Mr. H. M. Hale, "Mosquitoes"; Mr. A. G. Edquist, "Some Plant Experiments"; Captain S. A. White, C.M.B.O.U., "Flinders Chase, Kangaroo Island."

November 11, 1919—Mr. J. F. Bailey, "Epiphytical Orchids"; Mr. H. W. Andrew, "Seed Germination"; Mr. J. M. Black, "Some Eucalyptus Fruits"; Mr. P. Runge, "Interesting Minerals."

March 16, 1920—Mr. A. H. Elston, F.E.S., "Some Injurious Insects"; Mr. A. G. Edquist, "The Nature and Formation of Fossil Remains."

April 20, 1920—Captain S. A. White, C.M.B.O.U., "Trip to Bunya Mountains, Queensland."

May 25, 1920—Mr. E. Ashby, M.B.O.U., "American Birds at Home."

June 15, 1920—Mr. W. Gill, F.L.S., F.R.H.S., "Forest Scenes."

July 20, 1920—Mr. J. F. Bailey, "Australian Ferns"; Mr. W. J. Kimber, "Bivalve Molluscs."

August 17, 1920—Mr. H. M. Hale, "Defensive Devices of Fishes."

August 31, 1920—Dr. R. H. Pulleine, "Tasmanian Scenes."

EXHIBITS.—During the year a fair number of exhibits have been tabled and named, comprising most of the branches of natural history. The exhibits always give an added interest to our meetings, but a greater number would be welcome. Anything of interest to Field Naturalists could be brought, and there are competent experts on the various subjects who would willingly name and describe the exhibit. The Secretary will be glad to receive with each exhibit the name of the exhibitor and the name of the specimen, if known, and locality where obtained, etc., for recording in the Minutes.

NATURE NOTES.—Notes would be welcome on such subjects as the following:—(1) Opening and closing dates of bird songs, their breeding and migration times, plumage changes, etc. (2) How long certain flowers remain in bloom, when the bark falls from certain Eucalypts, the hosts of the mistletoe (*Loranthus*, sp.).

"THE S.A. NATURALIST."—The fourth number of *The S.A. Naturalist*, issued in August, completes the first year of its publication. The articles contributed by certain members have been very interesting and original, and we hope to have many more of them. The branches of natural history dealt with during the year have been Botany, Entomology, and a General Section.

We are fortunate in having as editor Dr. C. Fenner, F.G.S., who has had similar experience in a sister State, and we hope that we will be able to have his help in this direction for a long time.

The publication of *The S.A. Naturalist* necessitated an increase in the annual subscription, which has now been fixed at 7s. 6d. per annum, this sum also covering the subscription to the magazine.

CHARLES FENNER, *Chairman.*

ERNEST H. ISING, *Hon. Secretary.*

THIRTY-FIRST ANNUAL REPORT OF THE NATIVE FAUNA AND FLORA PROTECTION COMMITTEE.

Six meetings of the Committee were held during the year.

Following upon correspondence conducted previously between the Committee and the Local Government Department, delegates consisting of the Chairman (Captain S. A. White), the Secretary (Mr. H. W. Andrew), and Mr. J. M. Black, waited upon the Commissioner of Crown Lands and urged steps to be taken to restrict the destruction of timber and native flora on roadsides. The Commissioner received the deputation sympathetically, and promised to try and induce the Government to introduce a Bill to this end. Subsequently a communication was received from the Secretary of the Local Government Department that the Government had directed that a Bill be prepared with a view of prohibiting the removal of trees and shrubs from the roads without the consent of the Commissioner of Crown Lands, as desired by the deputation. This Bill has now been drafted, and is on the list of Bills for consideration by the House this session, and, as far as can be seen, there will be but little opposition.

The Royal Society appointed a Committee to confer with our Committee, with a view to discussing the advisability or otherwise of transferring direct control of the latter from the Field Naturalists' Section to the parent body; the whole question has been held in abeyance.

A letter protesting against the renewal of the lease of Macquarie Island, and urging the reservation of the island as a sanctuary for the fauna and flora of sub-antarctica, was sent to the Tasmanian authorities.

The need for direct representation of the Committee on the National Park Board was again brought under the notice of the Government. A letter supporting the Government in its determination to adhere to the period already fixed for the close season for ducks in the South-east was also forwarded to the responsible Minister.

The proposal made by Mr. T. B. Bellchambers to establish a Nature-lovers' League was considered, but the Committee came to no decision on the matter.

A proposal outlined in a section of the Press regarding the organization of a kangaroo and emu hunt on the occasion of the visit of H.R.H. the Prince of Wales to Australia was discussed, but it was decided no action be taken by the Committee.

The Chairman during the year addressed meetings in the rural districts, chiefly under the auspices of Agricultural Bureaus, on the subject of "Useful Native Birds and their Protection." He visited the Coorong in connection with bird protection, and made an annual visit of inspection to the nesting islands of pelicans and swans. He also visited Kangaroo Island on general protection work, with particular reference to Flinders Chase.

The Hon. Geo. Laffer, M.P., and the Chairman waited on the Minister of Industry and made a strong representation to shorten the open season for opossums, but the Minister controlling the Act stated that having unfortunately issued licences for the period nothing could be done to shorten the time this year. It is not likely that the opossum season will be open again, owing to the slaughter having been so great during the three months the embargo was removed.

S. A. White, *Chairman.*

H. W. Andrew, *Secretary.*

E. H. Ising, *Hon. Sec. F.N. Section.*

Field Naturalists' Section of the Royal Society.

Statement of Receipts and Expenditure for Year ended September, 1920.

General Account.

RECEIPTS.	£	s.	d.	EXPENDITURE.	£	s.	d.
By Balance brought forward	5	3	7	To Members' Subscriptions paid to Royal Society	38	18	9
,, Grant from Royal Society	35	0	0	,, Stationery	0	19	6
,, Members' Subscriptions	38	18	9	,, Hire of Hall and Lantern	9	18	11
,, Sale of Magazines	0	5	7	,, Postages	9	13	9
,, Advertising in Magazine	2	15	0	,, Printing	30	4	4
,, Bank Interest	0	11	10	,, Carriage	0	1	4
,, Loan from Excursion Account	7	16	10	,, Wreath	0	15	0
	£90	11	7		£90	11	7

Excursion Account.

	£	s.	d.		£	s.	d.
By Credit Balance	9	17	5	To Hire of Motor	24	10	0
,, Excursion Fares	29	19	3	,, Hire of Dredge	5	5	0
				,, Tips to Sailors	0	10	0
				,, Refreshments	0	9	5
				,, Loans to General Account	7	16	10
				,, Balance	1	5	5
	£39	16	8		£39	16	8

	£	s.	d.
By Balance on Hand	£0	12	10
,, ,, in Bank	0	12	7
	£1	5	5

Audited and found correct,

Walter D. Reed, F.C.P.A., } *Auditors.*
A. M. Drummond, }

GENERAL INDEX.

[Generic and specific names printed in italics indicate that the forms described are new to science.]

TRANSACTIONS AND PROCEEDINGS

OF THE

ROYAL SOCIETY of SOUTH AUSTRALIA

(INCORPORATED).

VOL. XLV.

[WITH TWENTY-TWO PLATES, AND TWENTY-SEVEN FIGURES IN THE TEXT.]

EDITED BY PROFESSOR WALTER HOWCHIN, F.G.S.
ASSISTED BY ARTHUR M. LEA, F.E.S.

PRICE, NINE SHILLINGS

Adelaide:

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Royal Society of South Australia

(INCORPORATED).

Patron:

HIS EXCELLENCY SIR ARCHIBALD WEIGALL, K.C.M.G.

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CONTENTS.

THE

Transactions

OF

The Royal Society of South Australia

(Incorporated.)

Vol. XLV.

Crinoids from the Cretaceous Beds of Australia, with Description of a New Species.

By Professor Walter Howchin, F.G.S.

[Read April 14, 1921.]

Plate I.

The Crinoidea are only sparingly represented in beds of Cretaceous Age in Australia. Up to the present time there has been only one species determined, and this only reported from two localities, both of which are in Queensland.(1) The muddy character of the Cretaceous sea in this part of the world appears to have been unfavourable for the development of this class of organisms. It is now my privilege to submit to the Society brief descriptions of three additional examples, including a new species.

Pentacrinidae.

Genus Isocrinus, Von Meyer.

Isocrinus australis (Moore).

Pl. i., figs. 1 and 2.

Pentacrinus australis, Moore, Quart. Journ. Geol. Soc., xxvi., 1870, p. 243, pl. 17, fig. 3; pl. 18, fig. 1.

Pentacrinus australis, Eth. fil., Cat. Austr. Foss., 1878, p. 105.

Pentacrinus australis, Eth. fil., Geol. and Pal. Q'land, etc., 1892, p. 439, pl. 20, figs. 1-3.

Isocrinus australis, Eth. fil., Dept. of Mines, Q'land, Geol. Sur. Bull., No. 13, 1901, p. 6, pl. 1, fig. 4; pl. 3, figs. 1-3.

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(1) It is unfortunate that in each instance where the remains have been described no columnals have been present, which is a distinct loss in the way of determination. Moore says, "In a block from Wollumbilla a portion of a column, with 95 regular joints, is present, of probably the same species" *(loc. cit.)*. It is to be regretted that these were not figured.

In 1869-70 Charles Moore described and figured a number of fossils that had been collected in Queensland by the Rev. W. B. Clarke, among which were two examples of crinoids contained in calcareous nodules obtained at the Amby River, Mitchell Downs, and which were named by Moore, *Pentacrinus australis*. One of the specimens exhibited the base of the pelvis with the lower portions of three arms and the basal stumps of two others. The other specimen, from the same locality, shows the interior of the pelvis with truncated portions of several arms extending from it.

In 1892, Robert Etheridge, jun., in his "Geology and Palaeontology of Queensland" (p. 439), reproduces Moore's descriptions and plates, but no further examples had, at that date, been found.

Subsequently, the late Mr. George Sweet, of Melbourne, made a valuable collection of Cretaceous fossils in Queensland, which was placed in the hands of Mr. Etheridge for determination, the publication of which forms Bulletin No. 13 of the Geological Survey of Queensland. In Sweet's collection there were two specimens of crinoids which were referred by Etheridge to Moore's species, *P. australis*, but subsequently, following the lead of F. A. Bather (Nat. Science, xii., 1898, p. 245) in his redefinition of the genus *Pentacrinus*, Etheridge placed the Queensland specimens under *Isocrinus*, Von Meyer. The specimens, like those described by Moore, are much crushed and imperfect. Etheridge concludes that *Isocrinus australis* possessed five radials supporting as many rays or arms, and these latter were each divided at a higher level into two, and then, each of these divided arms was again forked at least seven times, or fourteen times to each radial. In no case has a radial arm, or brachium, been found complete, but it is considered that the arms must have been, at least, 8 in. in length.

I have now the pleasure of recording the occurrence of two more examples of this species. The specimens were received by the President (Sir Joseph Verco) from Mr. M. W. Hackendorf, late of Stuart Range, and were obtained from the precious opal deposits of that locality. The specimens form pseudomorphs in precious opal, but are coated with a thin superficial layer of a ferruginous kind which obscures the opaline structure. As the specimens are more or less covered by small circular-shaped lichens, they must have formed surface stones on the outcrops. The two specimens are of about equal size and character and consist of portions of brachia, or arms, which have been broken off at the radials near their basal connection, with the respective calices or cups. The length of the larger example extends to only 1½ in., and the other is a trifle smaller. There are the remains of five arms in each specimen, consisting of the lower portions, and the longest fragment shows twelve brachial plates, or ossicles. The arms are three-tenths of an inch in diameter, uniserial, and nearly circular in transverse section. There is no bifurcation present, as the arm-fragments are too short to show forking. The several features of the specimens from Stuart Range, so far as shown, are in all respects similar to those of *Isocrinus australis*, and I have no doubt that they belong to that species.

Isocrinus parvus, n. sp.

Pl. i., fig. 3.

In 1909 Mr. A. S. Giles forwarded to the Adelaide Museum a small piece of limestone, of Cretaceous Age, containing crinoidal remains, and stated that the specimen had been obtained from a locality 20 miles north of Macumba Creek. The specimen was courteously placed in my hands for examination. The fragmentary condition of the remains did not offer much encouragement in the way of description, so that the specimen has remained undescribed until the present. The discovery of two additional examples of *Isocrinus australis*, described above, made it desirable that, in recording their occurrence, some notice should be taken, at the same time, of the examples obtained near Macumba Creek.

The crinoidal remains obtained from the last-named locality are included in a piece of shelly limestone, of flattened shape, 2½ in. in diameter; the fossils, which are of a fragmentary character, are exposed on both the flat faces, as well as the edges, of the stone. The remains are limited to brachia and pinnules, affording only scanty data for specific determination; but the rarity of fossils of this type in the Cretaceous beds of Australia and its manifest distinction from the hitherto only known Australian species of this age, may be assigned as sufficient reasons for the present restricted and imperfect diagnosis.

Def.—Stalk and cup unknown. Arms bifurcate equally (isotomous). Brachial plates, uniserial; rectangular in vertical figure and suboval in transverse outline; destitute of striae; with ambulacral grove on ventral side; minutely perforated, centrally. Pinnules numerous. Distinguished from *I. australis* by its greatly inferior size.

As previously stated, the remains are restricted to brachia and pinnules. These are represented by 21 fragments, probably representing more than one individual, especially as some of the fragments lie in reversed positions to each other. The arm-fragments are imperfect at each extremity, so that it is impossible to define the position which they severally occupied in the crown. The largest example, present, has a length of 2 in. The lower portion of this fragment consists of five ossicles, each deeply niched at half distance. An axial joint marks the beginning of bifurcation (the only one seen on the slab), beyond which the brachial ossicles are somewhat reduced in size, but are equal to each other in the respective branches, and destitute of the divisional niche seen in the plates below the point of bifurcation. There are 28 brachials in one branch and 35 in the other—neither are complete.

In the case of the lower limb (below bifurcation) the ossicles measure one-tenth of an inch in diameter, but those in the limbs above the axial joint gradually taper to a fourth of the original size. This would lead us to infer that the specimen shows the last fork in the arm and the respective rays, thus formed, would be finials. All the arm-fragments seen on the stone are closely pinnulated, and the latter extend along the entire length of those exposed.

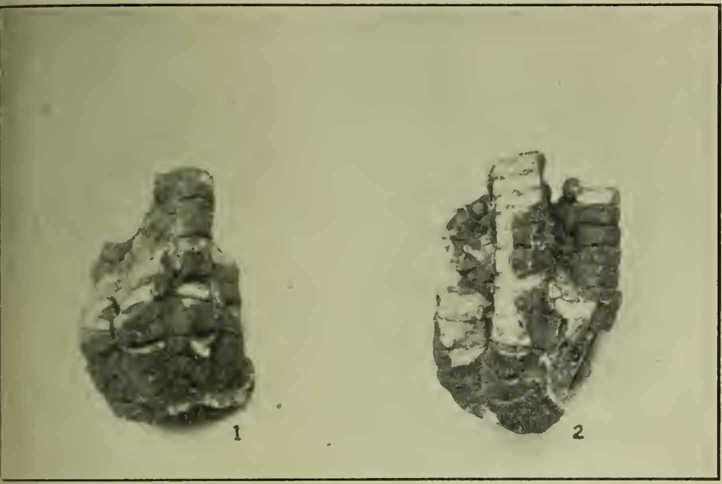
The specimen agrees with the genus *Isocrinus* in the characteristic feature of its isotomous bifurcation, but is distinguishable from *Isocrinus australis* by its relatively small size. The type specimen has been placed in the National Museum, Adelaide.

DESCRIPTION OF PLATE I.

(All objects of natural size.)

Figs 1 and 2. *Isocrinus australis* (Moore). Pseudomorphs in precious opal. The light-coloured portions show the opaline interior where the surface "skin" has been removed by abrasion. The darker portions represent the ferruginous coating of the specimens.

Fig. 3. *Isocrinus parvus*, n. sp. Brachia, probably finials, showing pinnules and isotomous bifurcation.



Isocrinus australis (Moore).

Isocrinus parvus, n. sp.

Gillingham, Swann & Co. Ltd., Printers, Adelaide.

Additions to the Flora of South Australia. No. 19.

By J. M. Black.

[Read April 14, 1921.]

Plates II. to IV.

This paper deals principally with collections made in the Far North by Mr. H. W. Andrew in July and August, 1920, by Professor J. B. Cleland in country about 80 miles north of Renmark and about 5 miles from the New South Wales border in January, 1921, and by myself at various points on the East-West Railway as far west as Ooldea at the end of September, 1920.

Three new species, in the genera *Salicornia*, *Calandrinia*, and *Calotis*, are described and figured.

The reference to "districts" indicates a new record for any of the botanical districts into which South Australia is divided in Prof. Tate's Flora.

An asterisk indicates an alien species domiciled here.

Gramineae.

Eragrostis Dielsii, Pilg. Mount Gunson (Mrs. Beckwith); Port Augusta West; Gawler Ranges (Dist. W). Stems often prostrate.

E. laniflora, Benth. 80 miles north of Renmark (Dist. W; J. B. Cleland).

Amphipogon strictus, R. Br. Murray scrub near Mannum (Dist. M; H. Griffith); 80 miles north of Renmark (Dist. M; J. B. Cleland).

Cyperaceae.

Schoenus aphyllus, Boeck. Eighty miles north of Renmark (J. B. Cleland). The spikelets examined contained 2 flowers, the lower one bisexual with 5-7 stamens, and the upper one (enclosed in a small hyaline glume) male with 3-6 stamens.

Juncaceae.

Juncus maritimus, Lamk., var. *australiensis*, Buch. Bank of Torrens Lake, Adelaide.

Liliaceae.

**Asparagus officinalis*, L. "Common Asparagus." Renmark; "growing wild along the irrigation channels" (J. B.

Cleland).—Europe. Recorded in Victoria by F. M. Reader in the Journal of Pharmacy as long ago as 1887 as a garden escape (Ewart, Weeds Vict., 72).

Casuarinaceae.

Casuarina lepidophloia, F. v. M. Tarcoola; Wynbring; Ooldea (Dist. W; J. M. B.). "Black Oak." Seventy miles north of Renmark (J. B. Cleland). A tree 5-6 m. high, with erect-spreading branches; cones smaller than in *C. stricta*, and the valves (bracteoles) pubescent on the back; bark rough, dark brown and fissured, especially near the base; sheathing teeth 9-12. I have seen in the Tate Herbarium a specimen of the type, "from between the Darling and Bogan Rivers." It has slender branchlets (1 mm. diam. when dry), minutely hoary, and 9-10 ciliate teeth. Our specimens seem to agree with the type except that the branchlets are sometimes a little stouter (1½ mm. diam., dry) and that the number of teeth varies from 9 to 12.

Loranthaceae.

Loranthus miraculosus, Miq. Eighty miles north of Renmark (flowering January on *Myoporum platycarpum;* J. B. Cleland); Ooldea (flowering February; Mrs. D. Bates). Umbel 2-4-rayed; flowers all sessile; petals and style deep-red, the former usually 5, sometimes 4 or 6, 15-20 mm. long (much longer than in the description of the type); leaves always obtuse and tapering towards the base, usually nerveless, when very broad sub-3-nerved.

L. linophyllus, Fenzl. Eighty miles north of Renmark (J. B. Cleland). Flowering in January on *Acacia Burkittii.*

Santalaceae.

Three species of *Fusanus* are found along the East-West Railway as far west as Ooldea: *F. acuminatus*, R. Br., the edible native peach or quandong, sometimes only a shrub 2-5 m. in height, with a drooping scarlet fruit often 3 cm. in diameter and a deeply pitted endocarp; *F. persicarius*, F. v. M., the inedible quandong, with a mesocarp thinner and bitter to the taste, and the endocarp nearly smooth; *F. spicatus*, R. Br., the "fragrant sandalwood," with thick, usually obtuse leaves, an inedible fruit which remains green, a smooth endocarp, and very fragrant flowers, which make their appearance from May to July.

Chenopodiaceae.

Kochia triptera, Benth. Fl. Aust. v., 185 (1870). Tarcoola (J. M. B.). Vertical wings 4-5. The more specimens

I see the more I feel convinced that *K. decaptera*, F. v. M., Fragm. ix., 75 (1875), cannot be maintained even as a variety. Most of our South Australian specimens have 4-5 vertical wings on the fruit, but at Stuart Pass (Tate Herb.) and at Broken Hill, N.S.W., specimens are found which have normally 3 wings, but occasionally 4 or even 2 wings; sometimes, where there are apparently only 3 wings, abortive fourth or fifth wings are present. Other specimens from Broken Hill, similar in all other respects to the above-mentioned, have 4 or 5 vertical wings. *K. pentatropis*, Tate, in Trans. Roy. Soc. S. Austr., vii. 67 (1884), was later on united by its author with *K. decaptera*.

K. triptera, var. *erioclada*, Benth. Between Mounts Parry and Playfair (Tate Herb. as *K. pentatropis*); Dublin (H. Griffith); Leigh Creek and Tarcoola (Dr. Cannon); north of Murat Bay and Port Augusta West (J. M. B.).

K. villosa, Lindl., var. *tenuifolia*, Benth. Eighty miles north of Renmark (J. B. Cleland). Appears to be a rather stiff, erect, almost glabrous shrub or under-shrub; perianth-tube hemispherical with 10 slender ribs.

K. pyramidata, Benth. Tarcoola (Dist. W; J. M. B.).

Bassia Tatei, F. v. M. Farina and Murnpeowie (Dist. C; H. W. Andrew). The Tate Herbarium contains the following specimens: the type collected in 1883 by Prof. Tate near Lake Torrens, but not described by Mueller until 1890; Cootanoorinna (near Warrina, coll. M. Murray, without date); Mount Lyndhurst (Max Koch, 1898, and described by the collector as "a perennial plant with upright branches, grey-tomentose").

B. sclerolaenoides, F. v. M. Beltana (H. W. Andrew). Here the 5 spinelike appendages are wanting, and only the 5 herbaceous, bifid or sometimes trifid appendages are present, so that the fruiting perianth resembles externally those of *K. ciliata* and *coronata*.

Threlkeldia inchoata, J. M. Black. Todmorden Station, Alberga River (H. W. Andrew).

Th. salsuginosa, F. v. M. Port Augusta West (Dist. W; J. M. B.). It now seems to me preferable to place the wingless species under *Threlkeldia*, and to retain *Babbagia* for the winged species, according to Mueller's original definition of the genus (Rep. Babb. Exped. 21), instead of uniting the gibbous-fruited and wing-fruited species under *Osteocarpum*.

Rhagodia Gaudichaudiana, Moq. Tarcoola (J. M. B.). A fair-sized straggling shrub growing near the creek; leaves soft, all hastate; flowers in a dense panicle; berry scarlet; fruiting perianth 5 mm. diam. when closed over the fruit, 8 mm. across when spread open after the fruit has fallen; testa black pitted.

Rh. Billardieri, R. Br. Ooldea Soak, flowering and fruiting in September (Dist. W; J. M. B.).

Atriplex Muelleri, Benth. Todmorden Station, Alberga River (Dist. C; H. W. Andrew).

A. limbatum, Benth. At Port Augusta West I collected a form in which the fruiting bracteoles are of the normal length (10-12 mm.), but the broad spreading interior lobes of the bracteoles are reduced to a short membrane terminating at each end in 2 small erect horns much shorter than the 2 erect toothed outer lobes or appendages. The fruiting bracteoles resemble those of *A. leptocarpum*, and this form emphasizes the close relationship which exists between the two species.

A. crassipes, J. M. Black in Trans. Roy. Soc. S. Austr., xlii., 171, t. 16 (1918). This name must be reduced to a synonym, as a comparison with specimens in the Tate Herbarium proves it to be the same as *A. elachophyllum*, F. v. M., Fragm. vii., 8 (1869). The type was collected by Mueller in the "desert of Sturt Creek," N.T. My specimens came from Marree (Hergott). Those in the Tate Herbarium are from Lake Weatherstone (west of Lyndhurst Railway Station, 1883, R. Tate), and Birksgate Range (1891, R. Helms).

Salicornia pachystachya, n. sp. (Tab. ii.) Fruticulus humilis, caulibus primo suberectis denique prostrato-radicantibus, ramis ascendentibus saepius oppositis, sterilibus articulis 5-15 mm. longis 3-6 mm. crassis saepe rubellis, lobis inconspicuis appressis, spicis 12-25 mm. longis, floriferis 4-6 mm. crassis viridibus, fructiferis 7-8 mm. crassis rubro-brunneis, fertilibus articulis 4-10, floribus in singulis semi-verticillis plerumque quinis, summis saepe ternis, inferioribus rarissime septenis, omnibus bisexualibus diandris proterogynis, perianthio primum succulento deinde duriusculo duobus lobis latissimis et brevissimis vel paene rimâ simplici longitudinali hiante, pericarpio hyalino, semine suborbiculari compresso exalbuminoso circiter $1\frac{1}{4}$ mm. diametro, testâ chartaceâ stramineâ margine papillosâ faciebus rugulosâ, endopleurâ et embryone *S. australis*. Floret ab Augusto ad Novembrem, fructificat a Novembri ad Januarium.

South Australia. Near mouth of Patawalonga River (Glenelg); Port Elliot (J. M. B.).

Victoria. Lake Tyrrell (per H. B. Williamson).

Western Australia. Near Perth (C. Andrews, Nos. 706, 707). I have not seen these specimens, but the Director of the Kew Gardens states that they quite agree with samples of *S. pachystachya* forwarded to that establishment.

Differs from *S. australis*, Banks et Sol., in its shorter and thicker spikes, fewer fertile articles, stamens constantly 2 in each flower, flowers usually 5 in the half-whorl, and in the outer seed-coat, the hairs on the margin of which are straight, obtuse, and so short that they can only be termed papillae. It grows along with *S. australis* on the banks of the Patawalonga River, but usually further back from the brackish tidal water. The flowering period is much earlier; in 1920 at Glenelg *S. pachystachya* had ripened almost all its seeds before there was any sign of flowering on *S. australis*. As the 2 species were combined in my description of *S. australis* in these Trans., xliii., 365 (1919), it will be well to enumerate here the points of difference:—

S. australis.	*S. pachystachya.*
Spikes 15-60 mm. long; 4-5 mm. thick, diameter not increased in fruiting.	Spikes 12-25 mm. long, when ripe 7-8 mm. thick.
Fertile articles 10-20.	Fertile articles 4-10.
Flowers usually in 7's, often in 5's or 3's in the upper articles, rarely in 9's in the lower articles, and very rarely all in 5's.	Flowers usually in 5's, often in 3's in the upper articles, very rarely in 7's in the lower ones.
Testa covered on the margin with long hooked hairs.	Testa papillose on the margin.
Flowers November - March; fruits April-May.	Flowers August-November; fruits November-January.

Observations made at Glenelg show that *S. pachystachya* is proterogynous. This does not agree with European experience of the genus, judging by the statement of Volkens in Engl. u. Prantl, Nat Pflanzenfam. iii., 1a, 48 (1893). He says: "Was die letztere (Dichogamie) angeht, so besteht Proterandrie ganz sicher bei den *Beteae* und *Salicornieae*, Proterogynie ebenso bei den *Chenopodieae* und *Suaedeae*." In *S. australis*, on the other hand, the anthers protrude before the styles in the truly bisexual flowers, but there seems to be a tendency towards unisexualism, the upper flowers of the spike having often sterile pistils, while the lower ones have often sterile stamens, or perhaps in some cases none at all. In both species the perianth opens by two lobes so short and broad that the opening appears little more than a vertical or longitudinal slit in the centre of the truncate summit.

S. quinqueflora, Bunge. Through the kindness of the Director of the Royal Botanic Gardens, Kew (Sir D. Prain) I have received the original description of this species from Ungern - Sternberg's monograph "Versuch einer Systematik der Salicornieen," p. 59 (1866). From this it appears to have been correctly identified as a synonym of *S. australis*, Banks et Sol. Part of the description reads: "Maximallänge der Aehren $10\frac{1}{4}$-20 mm.; Maximaldicke der Aehren $2\frac{1}{4}$-$3\frac{1}{4}$ mm.; Samenhärchen ziemlich lang, angedrückt, an der Spitze zurückgekrümmt oder-gerollt." It is true that the number of flowers is given as 5, but short-spiked specimens of *S. australis* occur sometimes in which all the flowers of the spike are arranged in 5's. The specimens on which Bunge's species were founded came from Port Adelaide (Blandowsky, F. Mueller); Melbourne (Hillebrand); Port Jackson (Rieder).

Halocnemum australasicum, Moq. This species must, judging by the descriptions, have some affinity with *Arthrocnemum Lylei*. *Halocnemum* is described as having a "perianthium *tripartitum*" (Bentham and Hooker), "perigonium triphyllum" (Moquin), and the albuminous seed of *Arthrocnemum*. *A. Lylei* differs in the perianth not tripartite but 3-lobed near the summit, more slender spikes, and also in the seed-coat. The type of *H. australasicum* was not seen by Bentham and was only shortly described by Moquin. By the courtesy of Prof. Lecomte, of the Paris Museum of Natural History, the type has been re-examined, and the following particulars, which may prove useful to botanists who seek to rediscover this plant at King George Sound, W.A., have been obtained: "épi floral long de $2\frac{1}{2}$ à $3\frac{1}{2}$ cm., large de 5 â 7 mm.; il est conique-cylindrique, obtus au sommet; la graine ovale, oblongue, noire est aplatie, bordée tout autour de tubercules coniques, allongés, blanchâtres, disposés sur 5 à 6 rangs; le milieu de la graine a de petites épines noirâtres."

Arthrocnemum halocnemoides, Nees, var. *pergranulatum*, J. M. Black. Patawalonga River, Glenelg. Observations made on the typical form at Ethelton, on the Port Adelaide River, go to prove that this species has proterandrous flowers.

Suaeda australis, (R. Br.) Moq. (*S. maritima*, Benth. non Dumort.) Port Adelaide River and seacoast near Adelaide. Perennial, 50-80 cm. high; leaves light green; plano-convex; flowers in distinct clusters and then 3-5 in each axil, or in continuous clusters (a dense, leafy spike), with 4-9 flowers in the axil, often female only with abortive stamens; fertile stamens exserted; flowers and branches usually becoming purplish-red.

Phytolaccaceae.

Gyrostemon ramulosus, Desf. Ooldea Soak (J. M. B.). A shrub 2-4 m. high, growing in sandy soil, with spreading branches; bark corky and brittle; wood when dry extraordinarily light in weight; locally known as "Christmas Bush" on account of its evergeen appearance.

Portulacaceae.

Calandrinia disperma, n. sp. (Tab. iii.) Herba annua, caulibus diffusis usque metrum longis, foliis carnosis clavatis subcompressis, radicalibus 1-4 cm. longis caulinis brevioribus, racemis paucifloris paniculam formantibus, pedicellis fructiferis deflexis demum sub calyce sursum curvatis et incrassatis, floribus parvis inconspicuis, petalis 4-5 sepala obtusa 1 mm. longa parum superantibus post anthesin calyptram efficientibus, staminibus 4-5 basi in annulum coalitis nec petalis ejusdem floris numero plerumque aequalibus nec iis oppositis, styli ramis 3, ovulis 2, capsulâ conico-cylindricâ circiter 5 mm. longâ sexcostatâ basi in modum tori columnae subito ampliatâ apice velut per porum apertâ alioqui non dehiscente, seminibus 2 pyriformibus superpositis comparate magnis (1½-2 mm. longis) nigris nitentibus basin versus granulatis, radiculâ superâ.

Flowering and fruiting in sandy ground at Ooldea in September (J. M. B.). Nearest to *C. corrigioloides*, F. v. M., both in the long capsule and in the fewness of ovules and seeds. Differs in the longer and stouter stems; more numerous stamens; fruiting pedicels much longer, spreading, curved upwards and thickened under the calyx; capsule of firmer consistence, not opening by valves, swollen at the base like the torus of a column; and especially in the comparatively large pear-shaped seeds, granular towards their base, suspended from long funicles which rise from the base of the capsule and are bent over in the upper part, somewhat after the manner of those of the section *Basigonia* of *Frankenia*. Following the shape of the seed, the embryo is not perfectly annular and the superior (epitropous) radicle extends considerably beyond the cotyledons. In all the flowers examined I have found only 2 ovules, and normally both these ripen into seeds.

C. polyandra, (Hook.) Benth. The common parakeelya at Tarcoola and other places in the sandhill country as far west as Ooldea appears to be this species and not *C. balonnensis*, Lindl. The styles (3, rarely 5) are quite free and stigmatic in their whole length; stamens 40 to 50, in 2-3 rows united in a ring towards the base; anthers from ovoid to oblong; petals large, showy, red, 5, rarely 6; peduncles swollen at base; pedicels reflexed in fruit; seeds minute (½ mm. diam.), copper-coloured, concentrically granular. A white-flowered form grows at Ooldea Soak. Mueller at one time expressed the opinion (Fragm. i., 177, ann. 1859) that *C. polyandra* scarcely differs from *C. balonnensis*, but later, in his 1st and 2nd Census, he kept them separate.

I have specimens from the River Finke, N.T. (S. A. White), and there is a similar one from Chambers' Pillar in the Tate Herbarium, with stouter stems than the parakeelya of the East-West Railway and much larger seeds (1 mm. diam.), dark-coloured and concentrically granular; anthers narrow-oblong. These are the true *C. balonnensis.*

C. pleiopetala, F. v. M., although the number of petals probably varies considerably, seems to be well distinguished by its small amber-coloured smooth shining seeds, and I have specimens with this character from Mount Gunson (Mrs. Beckwith), and Koonowarra on Cooper Creek (S. A. White). From *C. calyptrata*, Hook. f., which has also smooth shining seeds, but larger and dark red, *C. pleiopetala* differs in its stouter, probably perennial growth, much larger flowers, and numerous stamens.

C. pusilla, Lindl., varies much in size but is a smaller plant with smaller flowers than *C. polyandra.* The colour of the petals varies from purple to pure white. The stamens are usually 7-10, but in an Ooldea specimen I found them to vary between 6 and 12. Mueller says (Fragm. x., 68) that he has sometimes seen the flowers with 20 stamens. The seeds are minute ($\frac{1}{2}$ mm. diam.), copper-coloured or almost black, and concentrically granular, but in spite of the wrinkling of the surface they shine with a metallic lustre.

Cruciferae.

Blennodia curvipes, F. v. M. Murnpeowie (Dist. C; H. W. Andrew). "Sweet-scented and plentiful locally."

Thlaspi cochlearinum, F. v. M. Murnpeowie (Dist. C; H. W. Andrew).

Stenopetalum sphaerocarpum, F. v. M. Tarcoola (J. M. B.). Growing in sand; stems lying prostrate in a circle.

Lepidium leptopetalum, F. v. M. Eighty miles north of Renmark (J. B. Cleland). The petals, longer than the sepals, tapering into a point at the summit and twisted, at least when dry, are practically those of the genus *Stenopetalum*, with which this species forms a connecting link.

Crassulaceae.

Crassula colorata, (Nees) Ostenf. (*Tillaea acuminata*, Reader). Port Augusta; growing with *C. Sieberiana.*

Leguminosae.

Leschenaultia divaricata, F. v. M. Redbanks, near Murnpeowie. (Fruiting, August, 1920; H. W. Andrew). The Tate Herbarium contains a flowering specimen from Anna Creek, coll. M. Murray, April, 1885.

Acacia ligulata, A. Cunn. Meteor bore, near Murnpeowie; near Mount Lyndhurst Mine (H. W. Andrew).

A. Sowdeni, Maiden, in Journ. Roy. Soc., N.S. Wales, liii., 180, t. 11 (1920). Park-lands of Port Augusta, near the Roman Catholic Cathedral (flowering September; J. M. B.). A handsome shrub 2-5 m. high, with abundance of flowers and several stems, rough brown fissured bark and drooping branches. The type was collected here by Mr. J. H. Maiden during a visit to South Australia in January, 1907. Tarcoola (September; J. M. B.). I considered this to be a desert form of the same species, but Mr. Maiden, to whom specimens were submitted, has doubts as to their identity and thinks the Tarcoola plant may be *A. Loderi*, a Broken Hill species which he has recently described. The phyllodes are narrower than in most of the specimens collected at Port Augusta, being usually 1½-2 mm. broad. The inflorescence and flowers are the same, but no pods have yet been obtained. My field note at Tarcoola says: "Tree with large butt, branching near base, 6-7 m. high, the upper branches spreading and drooping; bark rough, whitish." It also grows further west along the East-West Railway, and is locally known as "myall."

A. Burkittii, F. v. M. Eighty miles north of Renmark (Dist. M; J. B. Cleland). This species is well known in the Broken Hill district, N.S.W., but has not, as far as I know, been hitherto recorded from any part of South Australia except the typical locality near Lake Gilles, E.P.

A. tarculensis, J. M. Black. Tarcoola (J. M. B.). To the particulars already published, the following field note may be added:—A dense glaucous shrub, 1-2 m. high, almost globular in shape, the spreading stems rising from the base of the plant, which is clothed with foliage down to the ground. Growing near the old town of Tarcoola, beside the creek in front of the Tarcoola Blocks Mine, and on the plain. Pods not yet ripe (September 20), curved, 4-8 cm. long, about 1 cm. broad, flattish, thick on the margin, not constricted between the seeds, covered by a close golden or reddish tomentum. Seeds not fully developed but apparently oblique.

A. brachystachya, Benth. Wynbring. A neat, compact shrub or tree, about 4 m. high, of grey appearance owing to the colour of the foliage; pods beginning to ripen in September, numerous, 3-5 cm. long, almost flat.

Zygophyllaceae.

Zygophyllum Howittii, F. v. M. Murnpeowie (flowering August; H. W. Andrew). Mueller's types were in fruit and he does not mention the number of stamens. In all my specimens I found them to be 6 only—3 opposite the 3 glands at the base of the 3-celled ovary and 3 alternate with the glands. Thus in this species the number of stamens is twice as many as the ovary-cells, and does not depend on the number of sepals and petals, which is 4. The anthers are almost globular, and the filaments are slightly dilated towards the base but not winged. The glands are fleshy, ciliolate at summit, quite distinct from each other, united very slightly to the base of the ovary, and doubtless represent the disk. The yellow petals scarcely exceed the sepals, both being about 2 mm. long. The ovules are 2 in each cell, suspended, with a ventral rhaphe, and a superior micropyle. Tate in his Flora, and Koch in the MS. note to his specimens in the Tate Herbarium, state that the number of stamens is 8, but a careful examination of the material—from Lake Torrens Plain (Tate) and Mount Lyndhurst run (Koch)—proves the number to be only 6. The same is true of Tate's specimens from Crown Point, Finke River, N.T. The lower stem-leaves are often entire.

Z. Billardieri, DC., var. *ammophilum*, J. M. Black. Tarcoola. Petals white, shorter than sepals; stamens 8; fruits small.

EUPHORBIACEAE.

Euphorbia australis, Boiss. Near Mount Bayley, about 5 miles north of Beltana (H. W. Andrew). This appears to be a rare or at least localized species, and in this respect it contrasts with the ubiquitous *E. Drummondii.*

Adriana (?) *Hookeri*, (F. v. M.) Muell. Arg. Ooldea Soak, where it is known as "Water Bush," owing to the belief that water may be struck below the soil where it grows (J. M. B.). This seems to be a different species from *A. tomentosa*, Gaudich., which was found by Capt. White in January, 1917, at the Ooldea condensers—a shrub only 60 cm. high, with broad leaves (3-5 cm. long by 2-3 cm. broad), cordate at base, and often 3-lobed. The shrub at the Soak is over 1 m. high, has oblong-lanceolate leaves 3-5 cm. long and 1-2 cm. broad, not 3-lobed or cordate at base, but coarsely crenate and narrowing abruptly into the petiole. The styles are very shortly united at the base, but the leaves are too large for typical *A. Hookeri.* In both plants the female flowers are almost solitary. F. v. Mueller united *A. Hookeri* with *A. tomentosa.* The specimens from Ooldea Soak agree very closely with some in the Tate Herbarium collected by R. Helms in the Victoria Desert, W.A., and placed under *A. tomentosa.*

**Eremocarpus setigerus*, Benth. Fields near Glenelg (per E. H. Ising). A Californian weed, strongly scented and covered with bristly stellate hairs, not hitherto recorded. Called "woolly white drought-weed" in California and (among the Spanish-speakers) "yerba del pescado," because the Indians used to employ it to stupefy fish in small streams (Jephson, Fl. West. Mid. Cal. 245).

Sapindaceae.

Dodonaea attenuata, A. Cunn. Yadnarie, E.P. (Dist. L; per A. G. Edquist); Port Augusta; Ooldea Soak (J. M. B.). Shrub 1-2 m. high, with rough brown bark.

Malvaceae.

Sida cryphiopetala, F. v. M. Near Oodnadatta (Miss Staer). This appears to be the first record of this species for South Australia proper. Tate only gives it for his Dist. F, which is in the Northern Territory.

S. calyxhymenia, J. Gay. Tarcoola.

Hibiscus Farragei, F. v. M. Eighty miles north of Renmark (Dist. M; J. B. Cleland).

Frankeniaceae.

Frankenia pulverulenta, L. Foreshore at Geelong, Vict. (H. B. Williamson, 1908). This identification has been confirmed by Mr. E. Surgis, of the Paris Museum of Natural History, who is engaged on a revision of the *Frankeniaceae*. He adds that it agrees in all points with the European plant and with specimens brought to France by the Baudin Expedition of 1801 from the east coast of Australia, also with two others collected by Max Koch in South Australia in 1899. Max Koch's researches were principally made near Mount Lyndhurst (Flinders Range), so that the plant probably exists in that district. Having been discovered so early in the history of Australia it seems not unlikely that this Mediterranean species is also indigenous here. Among our endemic species it stands nearest to *F. pauciflora*, DC., both in the flowers, placentation, and number of ovules, but differs altogether in the shape of the leaves, which are flat, obovate, truncate, or almost emarginate, and covered below with very short white hairs which gave the surface a mealy appearance.

F. fruticulosa, DC., collected at Murat Bay (Thevenard Peninsula), has sometimes 3 placentas and 3 style-branches, but in such cases I have only found 1 ovule to each placenta.

Myrtaceae.

Melaleuca glomerata, F. v. M. Rep. Babb. Exped. 10 (1859).

M. hakeoides, F. v. M., ex Benth. Fl. Aust. iii., 151 (1866).

These two species were afterwards united by Mueller in his Census, but Bentham, in the Flora Australiensis, kept them separate, and E. Cheel, in Ew. and Dav. Fl. N.T. 303 (1917), distinguishes them by the size of the leaves. It seems to me that an examination of the flowers supports the specific distinction. The flowers of *M. glomerata* were unknown when Mueller's and Bentham's descriptions were written.

Leaves slender, 1-1½ mm. broad; staminal bundles 3-4 mm. long, filaments 3-5; claw ¾-1 mm. long, much shorter than the petal. . . . *M. hakeoides.*

Leaves stouter, 2-2½ mm. broad; staminal bundles 6 mm. long, filaments usually 7, sometimes 6 or 8, claw 2 mm. long, equalling or slightly exceeding the petal. . . . *M. glomerata.*

The localities for South Australia are as follow:—

M. hakeoides. Aroona Range (R. Tate); Dalhousie Springs, Moolooloo, Petermorra Springs (S. A. White); Nuccaleena (E. H. Ising); Murnpeowie, Blanchewater Creek (H. W. Andrew). The type came from "N.S. Wales. Mount Goningberi, near Cooper Creek. *Victorian Expedition.*" (Benth. Fl. Aust. iii., 151.) The "Victorian Expedition" is the name applied by Bentham to the Burke and Wills Expedition of 1860-61, and "Mount Goningberi" is the Mount Koonenberry of modern maps, situated near the route of the unfortunate explorers and about 120 miles north-east of Broken Hill. The collector was Dr. Hermann Beckler, botanist and medical officer of the expedition.[1]

M. glomerata. Leigh Creek (R. Tate); Glen Ferdinand, Musgrave Range (S. A. White); Mount Ilbillie, Everard Range (S. A. White). Mueller gives the type localities as Lake Gregory, Arcoona, Lake Campbell; collector, D. Hergolt. The "Lake Gregory" of Babbage's Expedition is South Lake Eyre, and not the Lake Gregory of modern maps. This species has a white "paper-bark"; I have no record of the bark of *M. hakeoides.*

Eucalyptus intertexta, R. T. Baker. Mount Patawurta, near Moolooloo (E. H. Ising). Maiden (Crit. Rev. Euc. iv., 171, ann. 1919) has already recorded the occurrence of this

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(1) Not to be confused with Dr. Ludwig Becker, "artist, naturalist, and geological director" of the expedition, who died at the Bulloo Camp, in Queensland, just beyond the border of New South Wales, on April 30, 1861. Dr. Hermann Beckler was also at this camp, in charge of the sick. He had, along with Landells, tendered his resignation in September, 1860, but at request of Burke "he agreed to remain in charge of the stores at Menindie until arrangements could be made to forward them to Cooper Creek." He returned from Bulloo to Menindie with Wright (the third officer) in May, 1861. Dr. L. Becker drew and lithographed several of the plates for Mueller's "Plants indigenous to the Colony of Victoria" (1860-62).

gum in South Australia at the following places:—Murray Desert; east of Hawker and Umberatana (Flinders Range); Mount Ilbillie (Everard Range); Mount Watson (Birksgate Range).

E. microtheca, F. v. M. Murnpeowie Creek (H. W. Andrew). This is the most southerly record for South Australia, although in New South Wales it has been collected near the Barrier Range.

E. dumosa, A. Cunn. At Ooldea Soak a large "white mallee," with fruits 6 mm. in diameter; at the 407-mile Station (next to Ooldea) a small mallee 1½-2 m. high, with fruits 8-9 mm. diameter. In both cases the points of the valves are so much exserted that at the first glance the specimens might be pronounced *E. oleosa*, but the buds, of egg-in-egg-cup shape, with truncate ribbed opercula, oblong anthers opening in longitudinal slits, and fruits not contracted at the orifice determine the species. Also collected by Dr. Cleland 80 miles north of Renmark.

E. oleosa, F. v. M.. Between Ooldea Railway Siding and Ooldea Soak. "Water mallee," so called because the natives obtain water from the roots; known to the natives themselves as "nabbari" or "ngabbari," and further north it is called "nabbara" or "abbara."

This is the form which Mr. J. H. Maiden described in 1911 (Journ. W.A. Nat. Hist. Soc. iii., 171) as var. *glauca*, and in 1919 (Journ. Roy. Soc. N.S. Wales liii., 58) raised to specific rank as *E. transcontinentalis*. He distinguishes it as having glaucous leaves, "buds with elongated opercula about twice as long as the calyx-tube, and which are somewhat constricted, particularly on drying." I have specimens from Moolooloo and Leigh Creek (Flinders Range), Tooligie and Donald Plain, E.P., the Musgrave Range, also from the MacDonnell Range, N.T., all with whitish leaves and acuminate opercula considerably longer than the tube, often twice as long, but other specimens from Quorn southwards to Maitland, Y.P., and Enfield, and eastward to the Murray Scrub have similar flowers with long acuminate opercula, but green leaves. My field note on the specimens from the Murray Scrub states: "leaves lanceolate, dark green on both faces."

Thryptomene Whiteae, J. M. Black. Specimens collected by me at Wynbring, East-West Railway, with more mature and ribbed calyxes, prove that this name must be reduced to a synonym of *Th. Elliottii*, F. v. M. I have been allowed an opportunity of examining the type of *Th. Elliottii*, which was collected by E. Giles between Ooldea and Charlotte Waters, and is now in the National Herbarium of Victoria.

Umbelliferae.

**Bupleurum semicompositum*, L. Murray Bridge (A. R. Hilton).

Solanaceae.

Solanum chenopodinum, F. v. M. A specimen from Murnpeowie (H. W. Andrew), just beginning to flower (July), with short, sometimes branched extra-axillary racemes bearing about 7 flowers, ovate-lanceolate leaves, sinuate towards the base and hastate or even cordate, green and sprinkled with stellate hairs above, lighter coloured and more densely tomentose below, appears to be this species.

S. coactiliferum, J. M. Black. Wynbring, East-West Railway (J. M. B.); 80 miles north of Renmark (E. B. Cleland).

S. hystrix, R. Br. Ooldea (Mrs. D. Bates). Native name "walga walga."

**S. rostratum*, Dun. Murray Bridge (per J. F. Bailey). Previously recorded from Bute.

Duboisia Hopwoodii, F. v. M. Rênmark (Dist. M; E. C. Black); 80 miles north of Renmark (J. B. Cleland).

Myoporaceae.

Eremophila Latrobei, F. v. M., var. *Tietkensii*, J. M. Black. Ooldea (J. M. B.). Corolla deep pink.

E. maculata, F. v. M. Ooldea (J. M. B.). The corollas are sometimes pure white.

Compositae.

Calotis ancyrocarpa, n. sp. (Tab. iv.) Herba glabrescens verisimiliter annua, caulibus erectis dichotome ramosis, foliis caulinis linearibus vel anguste oblanceolatis 5-25 mm. longis integris vel breviter ac remote paucidentatis, floribus radii 25-30 albis, capitulis fructiferis globosis circiter 6 mm. diametro, achaeniis complanatis glabris, alis lateralibus basi valde ampliatis sursum incurvatis (ancorae formam simulantibus) breviter ciliatis, pappi aristis 12-20 retrobarbellatis inter se inaequalibus sed universim achaenio fere aequilongis.

Murteree, Strzelecki Creek (S. A. White, September, 1916). Recorded in these Trans. xli., 648, as a form of *C. multicaulis*. Capt. White, in his field note, says: "Growing in tufts on the flooded ground 4 or 5 inches high." Our two specimens do not show the base of the plant, which differs from *C. multicaulis* and *C. porphyroglossa* in the narrower leaves and chiefly in the ripe achene, which is glabrous except for the short ciliation of the wings; the wings much broadened at the base and incurved upwards so as to each form a deep sinus and present a hooked or anchor-like appearance. In its foliage the new species bears a close resemblance to *C. pterosperma*. The inset figures (4, 5, 6) show that in their fruits these three last-named species stand much nearer to one another than to *C. ancyrocarpa*. Bentham states that *C. porphyroglossa* has a pappus of numerous barbed awns but in my specimens from Alberga Creek I have only been able to find 4-7 awns. For *C. pterosperma* Bentham gives "8 to 10 very short awns"; in Robt. Brown's type (kindly lent me by Mr. J. R. Tovey, officer in charge of the Victorian National Herbarium), I found 4-6 awns ½ mm. or less in length.

C. multicaulis, (Turcz.) J. M. Black. Tarcoola (Dist. W; J. M. B.). Leaves rather broader, shorter, and less toothed than in the far-northern specimens, but the achenes are the same and the ray is white.

C. erinacea, Steetz. Bentham (Fl. Aust. iii., 502) says: "achenes with 3-5 awns." In very dry country such as our North-West or Far North (Port Augusta, Nilpena, Ooldea, Everard Range, and Finke River, N.T.), or even as far south as Ardrossan, the number of awns is usually only 2, but the achene is easily distinguished from that of *C. cymbacantha*, because in the latter species the 2 awns are separate, strongly barbed, and placed at right angles to the compressed tuberculate faces of the achene, while in *C. erinacea* the 2 awns are united in a cup at the base, are very slightly barbed, and placed parallel to the compressed faces of the smooth achene. In a Renmark specimen I have found some achenes with as many as 8 awns, 2 of the normal broad awns being each replaced by 3 smaller awns. Specimens in the Tate Herbarium from Ideyaka have 8 or even 9 awns. The type (from Swan River) had 4 awns: "aristis 4 subaequalibus achaenium laevissimum aequantibus obverse aculeatis" (Steetz in Pl. Preiss. i., 424). Similar specimens with 4 or sometimes 3 awns united in a cup at the base are from Renmark, Lake Perigundi, and in the Tate Herbarium from the MacDonnell Range, N.T., and the Barrow Range, W.A.

Leptorrhynchus tetrachaetus, (Schlecht.) combin. nov. (*L. pulchellus*, F. v. M., in Linn. xxv., 500, ann. 1852; *Doratolepis tetrachaeta*, Schlecht., in Linn. xx., 593, ann. 1847). Nov. var. *penicillatus*. Variat pappi setis 1-3 superne plumoso-penicillatis, pedunculi squamis inferne herbaceis in folia caulina transientibus.

Marree, Leigh Creek, Tarcoola (J. M. B.); Strzelecki Creek (Tate Herb.). This appears to be a dry-country form of the species. The pappus resembles closely that of *Athrixia* *tenella*. In some specimens both the few female and the numerous bisexual flowers have only 1 pappus bristle. In outward appearance the variety can be distinguished from the type only by the scales of the peduncle, which are not wholly scarious, but herbaceous in the lower part, and thus pass gradually into the stem-leaves.

Cratystylis conocephala, (F. v. M.) S. Moore. Eighty miles north of Renmark (J. B. Cleland).

Cephalipterum Drummondii, A. Gray. (Plate ii.) Tarcoola, Barton, Ooldea. A common plant along the East-West Railway, covering considerable areas with its snow-white flower heads. Diels and Pritzel (Fragm. phyt. Aust. occid. 615) divide this species as follows:—

1. Forma minor capite universo 1-1·5 cm. diam., pappo exteriore deminuto.

2. Forma major (typica autoris) capite universo 2·5-5 cm. diam., pappo exteriore conspicuo.

All the plants which I collected at the places above-mentioned were of the smaller form, but the type appears also to exist in our State, as I have specimens with the large compressed heads gathered by B. S. Jobson in 1918 at some station stated to be east of Ooldea. The difference in the scale or outer pappus in the two forms is easily discernible. In the type (fig. 1 of the plate) it is a small ovate ciliate membranous unilateral extension of the border of the achene; in the smaller form (fig. 2) it is very short, thick, fleshy, and so inconspicuous that it is rather difficult to recognize. In the innermost sterile flowers of both forms it is quite obsolete. The scale is situated on the inner or posterior face of the achene. The hairs of the outer achenes are of two kinds. Those which occupy vertically the outer face of the achene are seen under the microscope to be twisted spirally (figs. 1, 2, 3), but when moistened they often unroll from the base and show that each apparently simple hair consists of two hairs coiled round each other, loosely in the lower part and tightly towards the summit. These are distinct in character from the long intricate hairs which cover the inner face and sides of the achene and which are furnished with hooked barbs towards the end (figs. 1, 2, 4). The pappus proper, or inner pappus, consists of 3-6 erect bristles rising inside the very obtuse border which crowns the achene. These bristles are almost plumose in the upper part and penicillate at the summit. As the bristles fall off almost at a touch, even before the achene is ripe, it is evident that they serve no purpose except to protect the flower. The dispersal of the fruits is probably effected by animals, as the long flexuose hairs of the achene have small hooked branches near their extremities, and the hairs on the outer face have the faculty of coiling.

Angianthus brachypappus, F. v. M. Ooldea, half-mile west of the siding and on the edge of the Nullarbor Plain (Dist. W; J. M. B.). My field note says: "Plant with prostrate stems and short ascending branches; leaves rather thick, compressed horizontally; compound heads conical, yellowish, the vertical rows of partial heads usually twisted spirally as flowering proceeds." In comparing this species with *A. tomentosus*, Wendl., it should be noted that while the latter has 2 conduplicate and 2 inner flat sessile bracts to each partial head, *A. brachypappus* has 3 outer bracts, subherbaceous and rigid in the lower half and placed on the lower or outer side of the partial head, and 1 flat sessile hyaline bract, after which come the 2 lateral conduplicate bracts and 2 inner clawed flat bracts, or 8 bracts in all to each partial head. The anthers have no tails. This species is recorded in Tate's Flora only for his S district, and in these Trans. iv., 107 (1882), he gives the localities as Kanyaka, Wonoka, and Edeowie, but there is no specimen in the Tate Herbarium. In the Flora Australiensis the only locality given for South Australia is "North-West interior, MacDouall Stuart's Expedition." The name does not appear in either of Mueller's lists of the plants collected on that expedition, but the site was probably near the MacDonnell Ranges, N.T. Mueller (Report Babbage's Expedition, 13) gives for this species the locality of Stuart Creek; D. Hergolt, collector. This creek is a little south-west of Lake Eyre and in Tate's Dist. C.

Gnephosis skirrophora, Benth. Ooldea (Dist. W; J. M. B.).

Helichrysum Lawrencella, F. v. M., var. *Davenportii*, Benth. Specimens collected by me at Ooldea have ripe achenes distinctly beaked and varying from pubescent to scabrous with short stiff hairs, most of which wear off in time. The pappus bristles of the outer fertile flowers are forked, sometimes twice, plumose from the base but merely barbellate towards the summit; those of the inner sterile flowers are similarly plumose and barbellate, but are not branched.

H. Mellorianum, J. M. Black. East-West Railway, 407-mile Station, near Ooldea. The number of heads in the cluster varies from 4 to 12.

Helipterum roseum, (Hook.) Benth., var. *patens* (Ewart), combin. nov. Variat parvitate omnium partium plantae, caulibus circiter 8 cm. longis, involucri bractearum intimarum laminis albis tantum 4-5 mm. longis ovatis potius quam lanceolatis.

Ooldea, July, 1920 (Mrs. Daisy Bates). Very different in appearance from the typical form, with long pink or white rays, so frequently cultivated in gardens. There are two similar specimens in the Tate Herbarium collected by R. Helms in the Fraser Range, W.A., October 4, 1891, and labelled "*H. Troedelii*, F. v. M., var. *patens*, A. J. Ewart." In the Proc. Roy. Soc. Vict., xxii. (n.s.), part 1, 15 (1909), where the varietal name is published, the localities given are "Mount Lyndhurst, M. Koch, No. 1644, 1899; Fraser Range, W.A., R. Helms, 1891." This plant differs from *H. Troedelii* in its glabrous character, the shape of the involucre and its radiating laminae, the greater number of flowers in the head, the more numerous pappus bristles, penicillate and golden at the summit and not united in a tube. In all these respects it agrees with *H. roseum*. It is probably the form of that species "capitulis parvis" mentioned by Diels and Pritzel (Fragm. phyt. Aust. occid. 628) as having been collected on the Victoria Plains, W.A. They also observe that *H. roseum* is very variable in size and colour of flowers. The varietal name is not appropriate in respect of *H. roseum*, but it must be retained under art. 48 of the Vienna rules.

H. Humboldtianum, (Gaudich.) DC. Ooldea (J. M. B.). First record for South Australia of this species, of which the type was gathered in Western Australia. It cannot be the closely allied species *H. Haigii*, F. v. M., described from specimens collected near Eucla, because our plant has pubescent achenes and only the outer involucral bracts are woolly. It is a handsome everlasting, the inner bracts having small obtuse golden radiating laminae. The number of flowers in the head is 12-14 and the pappus-bristles 14-15.

H. Tietkensii, F. v. M. Eighty miles north of Renmark (J. B. Cleland). Flowers in head only 6-7; pappus-bristles 18-20.

Senecio dryadeus, Sieb. The existence of this species in South Australia seems to be only an assumption. Bentham in the Flora Australiensis quotes in his list of localities: "South Australia. Loddon River, *F. Mueller*." This river is of course in Victoria, and is situated more than 150 miles east of our border, as the crow flies. Mueller, in his 1st Census of Australian Plants (1882) gives *S. australis*, A. Rich. (*S. dryadeus*, Sieb.), for South Australia. In his Key to the system of Victorian plants (1887-8) he locates *S. dryadeus* in his SW District, which extends as far west as "the vicinity of the Glenelg River." There is no mention of the species in any of Tate's lists of South Australian plants until the year 1883, when in his "Additions to the Flora of

South Australia" (Trans. Roy. Soc. S. Austr., vi., 113) *S. australis*, A. Rich., is located "near the Glenelg River, *F. v. M.*" Then in his Flora of Extra-tropical South Australia *S. dryadeus* is quoted for the Mount Gambier District. It is well known that Mueller was in the habit, when a plant was found within 10 miles or so of the boundary of one State, of transferring it to the flora of the adjoining State, on the assumption that it would be found growing there also. There is no mention of the plant either in Tate's own "list of unrecorded plants in the south-east part of this colony" (Trans. Roy. Soc. S. Austr., vi., 95-99, ann. 1883) or in Eckert's list of plants growing in South Australia between the Glenelg River and MacDonnell Bay (Proc. Aust. Ass. Adv. Sc., v., 410, ann. 1893). There is no specimen in the Tate Herbarium, nor have I seen one from any part of our State. Until a specimen is actually found it would therefore be safer to delete the species from the South Australian flora.

Podolepis capillaris, (Steetz) Diels. Tarcoola (J. M. B.). Flowers pure white, the inner ones with 2 of the corolla lobes more deeply cut than the other 3; the 5 arranged digitately on one side of the staminal tube.

P. acuminata, R. Br. Gladstone (Dist. N; J. M. B.); Pinnaroo (Dist. M; from local public school).

Waitzia acuminata, Steetz. (*W. corymbosa*, Benth., non Wendl.) This handsome golden everlasting is common near Tarcoola and Ooldea. The laminae of all the involucral bracts are reflexed when the head is in full flower, with the exception of those of the innermost bracts, which are very short and uncoloured. Diels and Pritzel point out (Fragm. phyt. Aust. occid. 625, ann. 1904) that F. v. Mueller stated in the Zeitschrift des allgemeinen österreichischen Apotheker-Vereins, vol. 50, p. 934 (1896), after examining Wendland's type in the Steetz Herbarium, that *W. corymbosa*, Wendl., is really the plant described by Bentham as *W. nivea* and is quite distinct from *W. acuminata*, Steetz, with which Bentham had confused it. Mueller thus confirms the correctness of Steetz's arrangement in the Plantae Preissianae. Maiden and Betche make the correction in their Census of New South Wales plants, but attribute the discovery to J. G. Luehmann.

**Aster subulatus*, Michx. Recorded on insufficient material as *Erigeron canadensis*, L., in these Trans., xxxv., 2 (1910), xliii., 354 (1919). When fuller material was obtained it became evident that this identification was incorrect and specimens were sent to Kew with the result mentioned above. A North American plant with habitat from New Hampshire to Florida. It seems to have established itself in South

Australia, having been found at Renmark, Murray Bridge, Pompoota, and quite recently within the City of Adelaide, on wet ground along the north bank of the Torrens Lake, near the University boatshed, where it often reaches a height of nearly 2 m. The minute ligules of the corolla, which even at the time of flowering are no longer than the pappus, give it the appearance of an *Erigeron*, but the involucral bracts are in 4-5 rows. Also established in Victoria and Queensland. Described in American floras as an annual, but often survives at least two years here.

DESCRIPTION OF PLATES.

Plate II.

Salicornia pachystachya, n. sp. 1, stem and fruiting branches. 2, budding spike. 3, summit of flowering perianth. 4, vertical section of perianth, showing pistil and 2 stamens. 5, fruiting spike. 6, withered spikes, showing cavities after fruits have fallen. 7, seed. 8, transverse section of seed; *t*, testa; *epl*, endopleura; *rad*, radicle; *cot*, cotyledons.

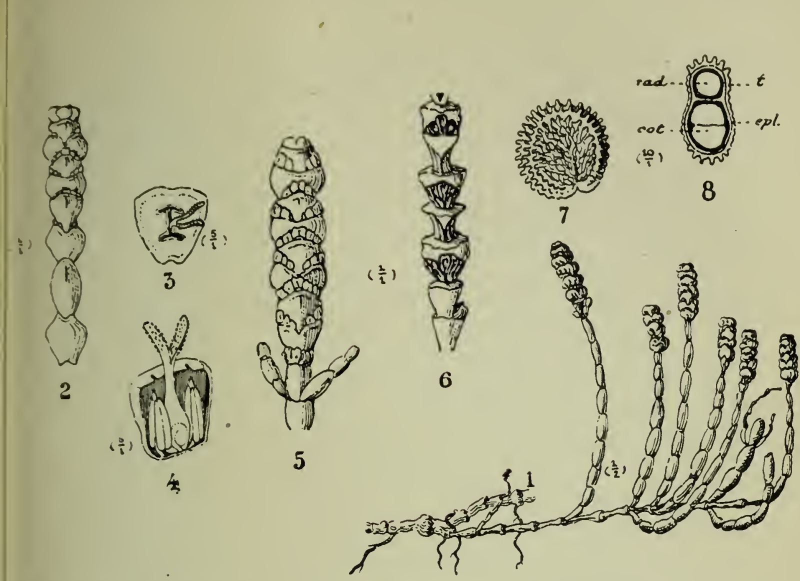
Cephalipterum Drummondii, A. Gray. 1, outer flower (of the large headed typical form; drawn from a specimen collected by A. Oldfield at Champion Bay, W.A., and lent to me by Mr. Tovey, officer in charge of the Victorian National Herbarium); *sq*, the scale, or "outer pappus." 2, a ripe achene, viewed from above and showing the thickened, obsolescent scale *(sq)* of the smaller form. 3, one of the "coiled hairs" (really 2 hairs coiled spirally round each other). 4, one of the long, flexuose, barbed hairs. 5, outer involucral bract. 6, inner spreading involucral bract. The complete plant and all the other figures except No. 1 represent the small-headed form *(forma minor* of Diels and Pritzel).

Plate III.

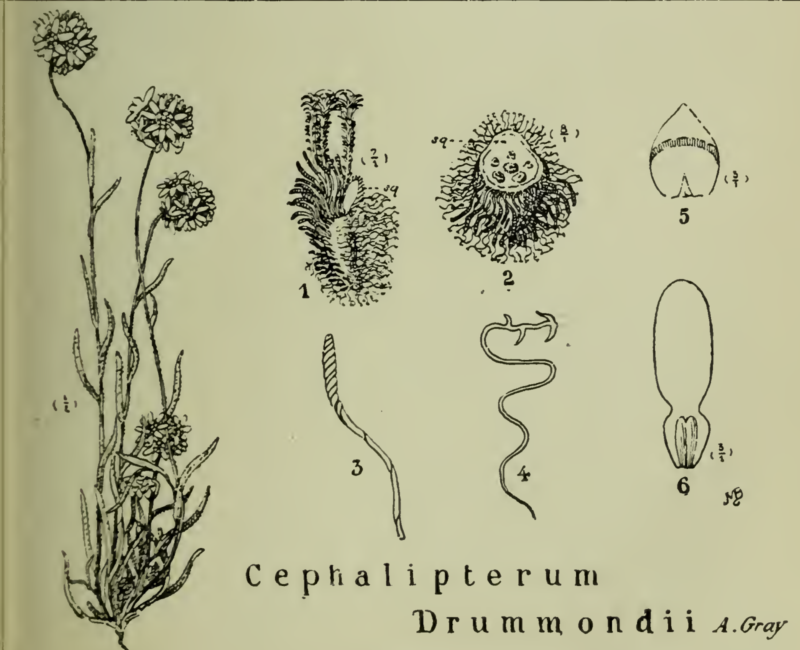
Calandrinia disperma, n. sp. 1, a flowering and fruiting branchlet. 2, calyx spread open. 3, corolla spread open. 4, pistil. 5, ovary spread open. 6, vertical section of capsule. 7, embryo and albumen within the membranous endopleura; *e*, embryo; *alb*, albumen. 8, embryo; *rad*, radicle; *cot*, cotyledons.

Plate IV.

Calotis ancyrocarpa, n. sp. 1, ray flower. 2, disk flower. 3, ripe achene. 4, 5, 6, ripe achenes of *C. pterosperma*, R. Br., *C. multicaulis*, (Turcz.) J. M. Black, and *C. porphyroglossa*, F. v. M., respectively.

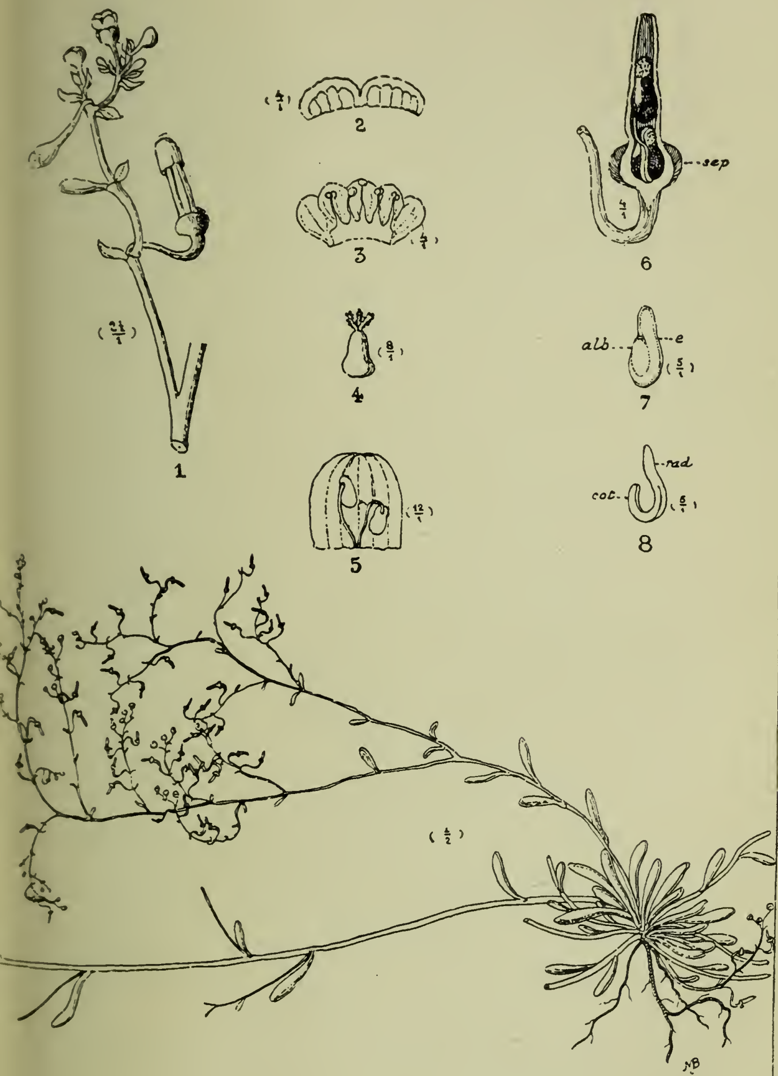


Salicornia pachystachya *n. sp.*



Cephalipterum Drummondii *A. Gray*

Gillingham, Swann & Co. Ltd., Printers, Adelaide.



Calandrinia disperma *n. sp.*

Gillingham, Swann & Co. Ltd., Printers, Adelaide.

Calotis ancyrocarpa *n.sp.*

Gillingham, Swann & Co. Ltd., Printers, Adelaide.

Geological Memoranda (Second Contribution).

By Professor Walter Howchin, F.G.S.

Subjects:

I. Miniature Serpuline "Atolls."

II. Pseudo-Cryptozoön Structure.

III. A Prehistoric Alluvial Fan of Exceptional Character at the Mouth of the Glen Osmond Gorge.

IV. The Occurrence of Scoriaceous Boulders in the Ancient Gravels of the River Torrens.

[Read May 12, 1921.]

Plates V. to VII.

I. Miniature Serpuline "Atolls."

Pl. v.

Professor L. V. Pirsson, in the Text Book of Geology by Pirsson and Schuchert, has figured and briefly described [*loc. cit.*, Part I., p. 180, fig. 152] some small atoll-like formations that occur on the coasts of the Bermudas. The explanation given of the figure is as follows:—"Serpuline Atolls, Bermudas Islands. These structures, formed in shallow waters, may be a number of feet or yards in diameter and are locally called 'boilers.' "

Interesting examples of a similar kind occur on the coast, at Encounter Bay, South Australia. The littoral zone, at the locality mentioned, is very shallow and takes the form of a marine platform which extends a considerable distance seawards. This submerged shelf has been cut out by the waves in the Permo-carboniferous glacial till, while large erratics, washed out from the latter, are strewn along the beach and occur abundantly in shallow water of the sea margin.(1) The bay is largely land-locked, being sheltered by the outlying islets of Granite Island, Seal Rock, and Wright Island, as well as by the promonteries of Victor Harbour, at the north-east angle, and Rosetta Head, at the south-west.

(1) Howchin, "The Glacial (Permo-Carb.) Moraines of Rosetta Head and King Point," Roy. Soc. S. Austr., vol. xxxiv. (1910), pls. vii. and viii.

On account of this protected position the tidal currents are very weak and are scarcely noticeable within the limits of the bay, while the fluctuations of the sea are largely controlled by the direction and force of the wind, the rise and fall of the sea at any time being limited to a few inches. These conditions are very favourable for the development of a littoral fauna, among which *Serpulae* make a prominent feature, forming a kind of miniature fringing reef, composed chiefly of the calcareous tubes of these annelids, with a tendency to assume circular outlines.

Professor Pirsson offers no explanation as to the reason why the serpuline growths on the Bermudas coast take a circular form of growth, but, so far as the Encounter Bay examples are concerned, I think an explanation is possible.

The Permo-carboniferous till, which forms the cliffs and marine platform at Encounter Bay, consists chiefly of an argillaceous sand-rock that is easily acted upon by the sea, and yet is sufficiently coherent to form a definite floor. It extends inland throughout the Inman and Hindmarsh Valleys, across the Bald Hills watershed to the shores of Gulf St. Vincent, yielding, in many places, excellent sections. Within the body of this argillo-arenaceous till, in many places, there has been a segregation by some cementing agent that has taken the form of a thin layer, or shell, having a spherical outline. In weathering, this layer, being somewhat more resistent to change than the rest of the stone, protects the included portions, which thereby stand out in relief as rounded objects. They can be seen in the cliffs of the River Inman, nearly opposite the 8-mile post, and are known, locally, as the "pots and boilers," having the same popular name as the serpuline forms in the Bermudas. They also occur in the washouts, caused by small streams, in the sea cliffs between Port Elliot and Victor Harbour, where they were pointed out to me as "fossil pumpkins."

There is scarcely an appreciable difference in the composition of the material contained within the spherical shell as compared with the general matrix of the till. The nature of the cementing material which gives rise to this thin spherical crust was not critically examined, but it is probably of a ferro-siliceous kind, such as is often developed in concentric lines and as "iron balls" in argillaceous sediments. So far as observed, the size of these so-called "boilers" varies from about a foot to two feet in diameter.

There is little doubt that the serpulite rings that occur in the shallow water of the coast at Encounter Bay take their rise from this spherical structure which is developed in the local till beds. Inland, where these objects are seen in section in the cliff faces, they exhibit a ring in relief. At Encounter Bay, the waves in cutting their way through the sandy till have truncated these spherical bodies, and as the outer and inner portions of the matrix are softer than the spherical crust, the former are denuded, leaving the indurated investment as a circle in relief.

This gives us the explanation desired. The hard and raised circles give better holding-support to the *Serpulae* than the softer ground around, the annelids become attached to the stony circles, and from such a foundation build up their colonies, the calcareous ring offering a certain likeness, in a small way, to the coralline atolls, while the water, filling the depressed centres, gives the similitude to the central lagoon in such islands.

II. Pseudo-Cryptozoön Structure.

Ref. Howchin, "The Occurrence of the Genus *Cryptozoön* in the (?) Cambrian of Australia," Trans. Roy. Soc. S. Austr., vol. xxxviii., 1914, pp. 1-10, pls. 1-5.

At the Ordinary Meeting of the Society, held on April 11, 1918, some rock specimens were exhibited by Mr. L. K. Ward, Government Geologist, that had been collected by Mr. Winton from the New Burra Mine.(2) The specimens were obtained in limestone and contained certain wavy and concentric structures that have, in some instances, a close resemblance to those of the supposed fossil known as *Cryptozoön*. I have recently visited the locality and now offer a few remarks on the nature of the specimens and the geological conditions under which they occur.

The journey was made down the Burra Creek which takes its rise about a mile above Kooringa, but the proper watershed is in the ranges to the north of the township. The creek flows in a south-easterly direction and finds its outlet, when heavy rains occur, in the River Murray, at the Nor'-west Bend. The creek below Kooringa follows a moderately straight course and is heavily charged with alluvial sediments. A course was followed down the creek for nine miles. A series of whale-back limestone ridges follow the western side of the creek, with the main ranges visible beyond. The limestone belongs to the Brighton Series, while the eastern side of the creek consists of the underlying Tapley Hill banded slates. The strike of the beds is roughly parallel with the Burra Creek. At about nine miles from Kooringa, the

(2) Trans. Roy. Soc. S. Austr., vol. xlii., 1918, p. 297.

beds are thrown to a position transversely to the former strike, causing the limestone to cross the creek, and it then follows the top of the range on the eastern side, in a return direction. The beds are, apparently, faulted and repeated along the strike.

At the main angle of disturbance there is a great intrusion of quartz dykes and veins, and the limestone, which follows the eastern ridge, is extensively penetrated with a dark-coloured chert. The chert sometimes occurs in bands several inches in thickness, but, for the most part, in fine laminae, and follows the grain of the limestone, producing a finely-laminated cherty-calcareous rock.

In the north-western angle of Section 3 (Hundred of Kooringa), the New East Burra Mine (late Utica) is situated. The lode occurs in the limestone and carries copper sulphides and carbonates thinly distributed through a gangue of calcite and barytes. On the western side of these workings the infiltration of silica, in the form of chert, follows the planes of bedding in a fine lamination, which is locally much contorted and is sometimes concentric in form, suggestive of *Cryptozoön* structure. A careful examination of the ground, however, leaves no room to doubt that this structure is of inorganic origin. The effects of the siliceous infiltration can be traced over a very wide area, from its occurrence in the form of parallel and straight lines; gradually passing, first into a wavy modification of these lines, and then, in places, to a cyclical and concentric structure. These features occur both along, and for many yards across, the strike.

In the case of *Cryptozoön*, the supposed organic structure is quite distinct from the matrix, while in the case under review, the wavy structure is a feature of the rock-mass as a whole and can be explained by a process of metasomatism in which the limestone, along certain layers, has become altered to chert. The immediate cause of such a change can be explained as a consequence of the powerful local strains to which the bedding has been subjected by earth movements, and the introduction of silicated waters.

At the Burra the same limestone shows laminated and imperfect concentric structures, but without the introduction of silica and with a less resemblance to *Cryptozoön*. Cherty inclusions are first noticed in the limestone, along the strike, about a mile to the south-eastward of Kooringa. (See Howchin, "Autoclastic, Intraformational, Enterolithic, and Desiccation Breccias and Conglomerates," Roy. Soc. S. Austr., vol. xliv., pls. 17 and 18.)

III. A Prehistoric Alluvial Fan of Exceptional Character at the Mouth of the Glen Osmond Gorge.

Pls. vi. and vii.

The piedmonts on the western side of the Mount Lofty Ranges are deeply incised by numerous short streams that are in a juvenile stage of development. These streams are mostly working on rather steep grades, and although the gathering ground is limited they exert considerable hydraulic force when in flood. The Adelaide Plains, which extend from the foot-hills to the sea, have been built up by alluviation brought down by these streams from the hills, and within a few miles from the base of the hills this transported material has a thickness of 400 ft. Numerous bores on the plains show that the sediments vary from a fine unctuous clay to gravel of moderate size. At the exits of the numerous gullies alluvial fans spread out to a greater or less extent and are extended seawards along the principal channels formed by flood waters. These channels are very absorbent and the greater number of the streams finally disappear on the plains at a lower level.

The Glen Osmond Gorge, which opens on to the plains at a distance of three and a half miles to the south-east of Adelaide, has been cut through a compact quartzite, 100 ft. in thickness, with slaty rocks both above and below it. The stream which is responsible for the excavation of the gorge takes its rise on the scarp face of the foot-hills and is one of the minor creeks that drain the western side of the ranges. It follows a line of faulting, with a downthrow on its left bank, and is confined for some distance in a narrow channel by the side of the main road. After skirting the old Glen Osmond quarries near the foot of the hills, it diverges from the road and follows its natural course within banks from 15 ft. to 20 ft. in depth. It crosses the "Cross Roads" near Glen Osmond; passes through the western portion of the public reserve (Ridge Park); crosses the Fullarton Road on the north side of Fisher Street; and continues, confined by small culverts, through Unley, Goodwood, and by a covered channel through the new Agricultural Show Grounds at Keswick. It is dry during most of the year and is simply a channel for flood waters after heavy rains. The present size of the creek is out of all proportion to the nature of the alluvial fan about to be described.

The ground has a gentle slope, in the direction of the creek, from the mouth of the gorge to the Fullarton Road, a distance of about a mile. Within a restricted breadth, the land adjoining the creek is more or less strewn with angular stones, varying in size from a few inches up to several feet in diameter. Near Glen Osmond, large villa residences and highly cultivated grounds have obscured the natural features, but wherever the ground exists in its natural condition large stones can be noted at the surface, usually strongly embedded in the ground. The distribution of large stones follows, in the main, the direction of the creek channel, sometimes best developed on the one side and sometimes on the other. In the Ridge Park, at Glen Osmond, on the western side of the park, there is a conspicuous group of about thirty examples, situated on the right bank of the creek, the largest stone measuring 3 ft. 6 in. in length. They can be seen on a newly laid out road, on the opposite side of the creek, and in paddocks towards Fullarton.

The most important assemblage of these transported blocks occurs on the eastern side of the Fullarton Road, a little south of Fisher Street, fully a mile from their source. They occur in great numbers, some of extraordinary size, on the grounds of Mr. Thomas Baulderstone and adjoining properties. The largest of these transported blocks measured 9 ft. 6 in. long by 3 ft. 6 in. broad, and 2 ft. 9 in. above the ground. This stone probably weighs not less than six tons. Near the above is a large tabular mass giving the measurements 5 ft. 6 in. by 7 ft. embedded almost level with the surface of the ground. Another measured 5 ft. long, 4 ft. 6 in. wide, and 1 ft. 9 in. out of the ground. Another, irregular in shape, measured 4 ft. 10 in. long, by 3 ft. 5 in. at greatest width, and 2 ft. 10 in. out of the ground. In one part of Mr. Baulderstone's paddock there is a group of eight quartzites, close together, each of which Mr. Baulderstone calculated would weigh something like five tons, and there are scores of quartzite blocks that equal 2 ft. or more in length. To relieve the ground of these obstructions to cultivation a hundred, or more, have been dragged to the side of the paddock and form a conspicuous line at the fence. (See plate vii.) From the stones of this paddock Mr. Baulderstone has built his house, outhouses, and enclosing walls, which exhibit stones of unusual size used for such purposes. When this ground was open for selection, no one wanted it, as it was regarded as a quartzite outcrop, and was actually offered for sale as a possible quarry. The circumstances which gave rise to the distribution of such a large number of angular blocks of stone are evidently abnormal and require some geological explanation to account for their presence. Under certain circumstances ice agency might be credited with the transportation of such large stones, but such a view is not supported by any collateral evidences.

In reaching a conclusion the following facts have to be considered:—

(1) The deposit is not an alluvial fan in the ordinary acceptation of the term. A normal fan is built up by a succession of flood deposits of corresponding features as to strength of current and alluvial sediments, forming a succession of fine and coarse sediments; but the Glen Osmond alluviation, now under description, was unique, there was nothing like it before or since in the geological history of the creek. The sections exposed in the banks of the creek exhibit the normal red clay, with occasional beds of sand or fine gravel, typical of the Adelaide Plains, and in no case do large angular blocks of stone show in these sections. This is confirmed by well sinkings in the neighbourhood. Mr. Baulderstone sunk a well on the ground where the stones occur in great numbers, the first 60 ft. was in bluish and reddish clays followed by 10 ft. of sand and gravel; no large stones were met with in sinking, nor was bed-rock reached. A well on the adjoining property gave a like result.

(2) The stones consist of quartzites and slates, chiefly the former, and can be definitely identified with beds of a like character that outcrop in the Glen Osmond Gorge.

(3) All the large stones are angular in outline and of indefinite shape, often partly broken on the bedding plane as though wrenched from their bed by strong force.

(4) The stones lie in every possible position and are confusedly mixed. Sometimes a large mass of slate is seen wedged in between two quartzites.

(5) The trail can be traced back from the Fullarton Road, following the general direction of the creek to the mouth of the gorge. Near the Fullarton Road it is about six chains wide.

The only explanation that can be given, consistently with the evidence, is that of a torrential wash of extraordinary force. To carry such a body of stone, including many rocks of from three to six tons in weight, over a low gradient for a mile, seems an almost impossible task for such a small watercourse. The gathering ground is so limited, the rocks are of the hardest kind, and the stream must have spread out far beyond its ordinary banks. We must assume that a cloud-burst, of local extent, but of exceptional intensity, must have acted as the quarrying and transporting agent.

It is self-evident that no such storm has occurred in our neighbourhood since its occupation by Europeans. Whilst this occurrence must be regarded as geologically "recent," it must be referred to a time far anterior to all historical records. The quartzites show a deeply weathered and incised surface quite equal to the exposed outcrops seen *in situ*, and are covered by lichens, and splitting by the action of the weather. Further, the wash now occupies a slight rise in the ground, the land sloping on either side, which would imply that the interval has been sufficiently long to permit of a lateral denudation that has brought the original water level above the surrounding ground.

* * *

Since the above was written I have received a letter from Mr. Baulderstone, under date April 29, 1921, to the following effect:—"I am writing you these few lines to let you know that my next door neighbour (Mr. Tonken) is having that stony paddock, adjoining mine, grubbed of stone ready for cultivation. His men are blasting all day and are smashing up all the largest stones, but enough can be seen to make a very interesting exhibit to a geologist. They will probably finish turning the stones up to-day, so if you could come along, say to-day or to-morrow, you would be able to get a full view of about half an acre of the up-turned stones."

I am glad that Mr. Baulderstone has a due appreciation of the scientific interest which attaches to these remarkable stones, so that whilst he has planted the area in which they occur with trees, he takes pains that none of the larger examples are disturbed.

[*Note.*—It has been suggested that the transport of these large stones might be due to a land-slide in the gully which dammed the water back and was followed by a break-away. This might be taken as a plausible alternative in accounting for their presence, but it has its difficulties. The rocks forming the sides of the gully are solid and stable. To effectively block the channel would require sufficient material not only to cover the floor of the valley, but to make an embankment on the opposite side. There is no evidence of such an occurrence as having taken place either as a slide on the face of the cliffs, or remnants of the talus at lower levels.—W. H.]

IV. The Occurrence of Scoriaceous Boulders in the Ancient Gravels of the River Torrens.

Many years ago my attention was called to a clay pit situated between Mile End and Hindmarsh on account of some unusual features that had developed in working the pit. The clay had been used for brickmaking for a number of years and had been worked down to a floor 20 ft. below the surface of the ground. At this depth the clay ceased and a bed of sand and gravel was met with which varied in thickness from 4 ft. to 9 ft. On looking over the gravel I discovered a boulder, about 5 in. in length, which had an open vesicular structure, very similar to scoriaceous lava. Its presence under such circumstances seemed unaccountable, so the specimen was laid aside with the hope that at some future time some evidence might be obtained that would throw light on its true nature and origin.

My interest in the subject was revived when, in 1914, Mr. F. R. Zietz placed in my hands a similar water-worn stone which he and Mr. Ridgway had obtained from the extensive gravel deposits at Findon, adjacent to the Grange Road, about four and a half miles from Adelaide. Subsequently, Mr. Ridgway, who takes much interest in these gravels and their incidental contents, was successful in obtaining several additional examples of a like kind, the largest of which is a subglobular mass, rounded irregularly by river attrition, and measures 32 in. round the longer diameter and 25 in. round the lesser. In each instance the contemporaneity of these vesicular stones with the rest of the pebbles in the bed was evidenced by portions of the adjacent sand and small stones having become cemented to the exterior surface.

The first impression was that these scoriaceous-looking stones were of volcanic origin, as in their general appearance they can scarcely be distinguished from such vesicular lava as occurs in volcanoes of the Mount Gambier and Mount Schank type. The latter localities are, however, too distant to give any probability of these stones having come from such a source. It seemed equally improbable that extrusions of lava existed in the hill regions that formed the hydrographic basin of the River Torrens.

In pursuance of these enquiries it then became necessary to make thin sections for examination by the microscope, and also to submit the stones to chemical analysis. The microscope showed that fusion had taken place and that the vesicular structure arose from this cause, but whilst mineral glass was present, there was an absence of any further evidence of volcanic action of an incidental kind. There could also be detected in the transparent section minute grains of quartz (sand) which had not undergone fusion. Further, when the largest fragment obtained is examined by the naked sight, small pockets can be noted in the mass which are quite distinct from the gas vesicles, and some of these contain earthy matter which must be regarded as portions of the original material which had not undergone fusion.

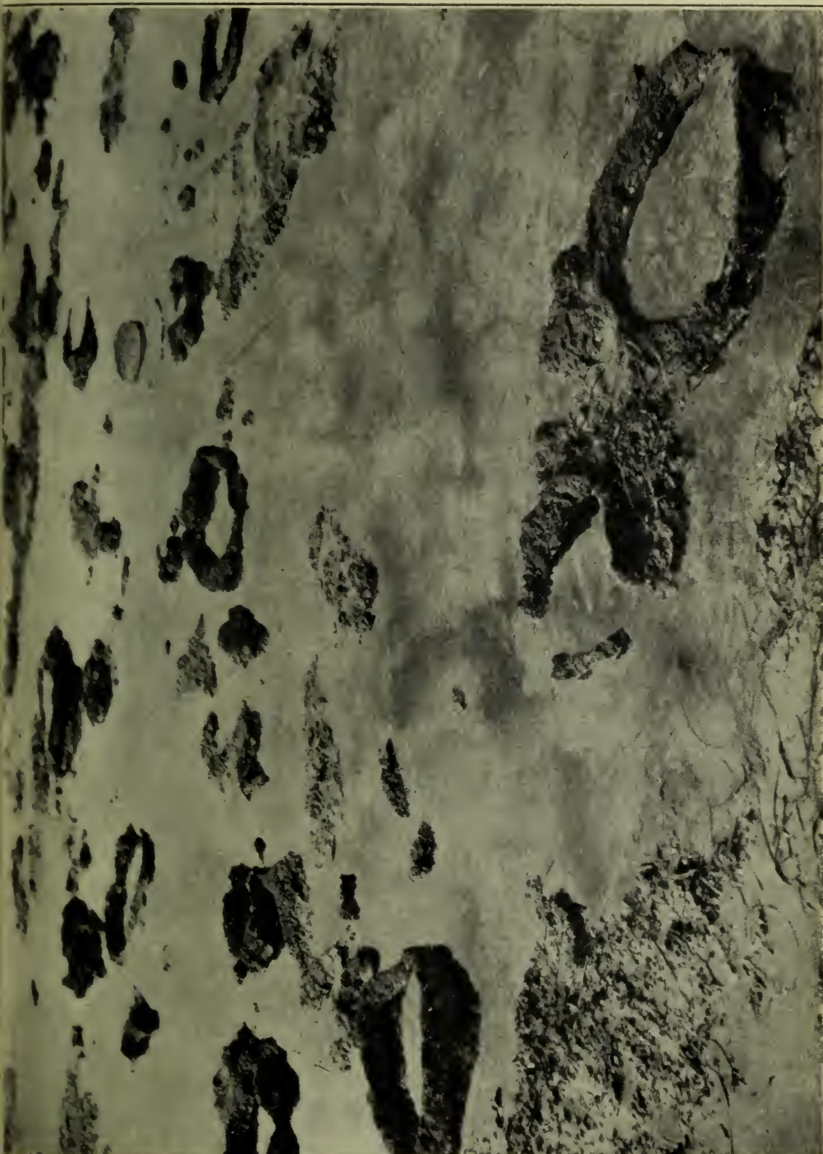
As the chemical composition of the scoriaceous material was likely to afford some evidences that might be useful for determination, a typical sample was placed in the hands of Mr. W. T. Chapman, Analyst and Assayer at the Adelaide School of Mines and Industries, who kindly undertook to analyse the specimen. The following is the result:—

SiO_2	71·48
Al_2O_3	12·17
Fe_2O_3	1·73
FeO	3·32
MgO	2·02
CaO	3·12
Na_2O	1·06
K_2O	·92
Water at 100° C.	1·45
Water over 100° C.	2·07
TiO_2	·52
MnO	present
	99·86

A vesicular rock, such as those found in the Findon gravels, if of volcanic origin, would probably represent an extrusive lava of basic composition, such as are commonly known as basalts, or allied forms. The chemical analysis, however, as shown above, does not suggest such a relationship. There is an excess of silica as compared with the basaltic group, as well as a low proportion of the ferro-magnesian elements, and also a low percentage of lime. This discordance in chemical composition, as well as the very high probability that there are no extrusive lavas in the country within hundreds of miles of the place where the stones were found, practically negatives the idea of their volcanic origin.

I venture to suggest that these scoriaceous stones have had their origin in bush fires. Some large tree stumps have been known to smoulder for weeks after a bush fire. A little alkaline material in the soil would assist the fusion of mineral substances, and the presence of organic matter in combustion, under superincumbent pressure, might yield the gas necessary for the formation of a vesicular structure. A termite's nest in the soil at the base of a large tree, or within a hollow stump, might be favourable for the formation of stones of this kind.

Other Localities.—Specimens of a simliar kind have turned up from other localities. Many years ago I received a stone of an open and cindery structure sent down from Central Australia, the sender being under the impression that it was a meteorite. Mr. A. Canning, late school teacher



Miniature Serpuline "Atolls."

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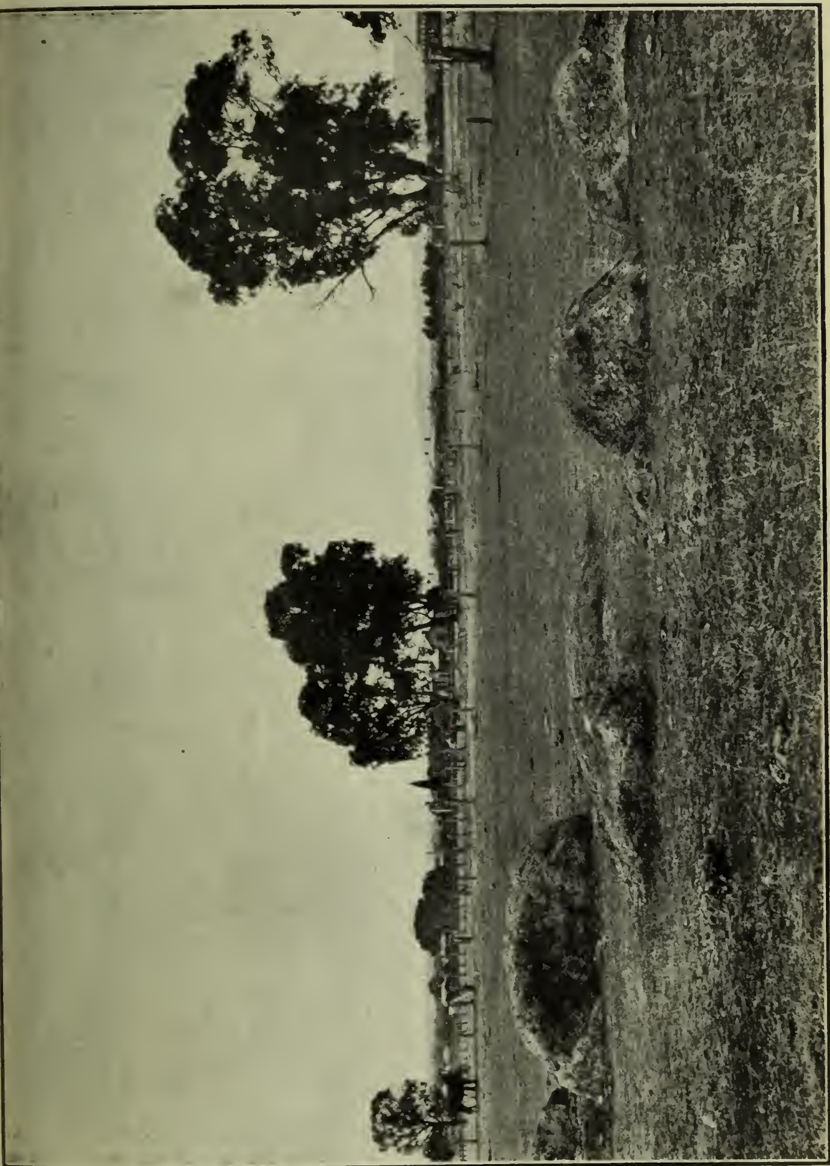

Group of large transported Stones, set in alluvium, looking North.

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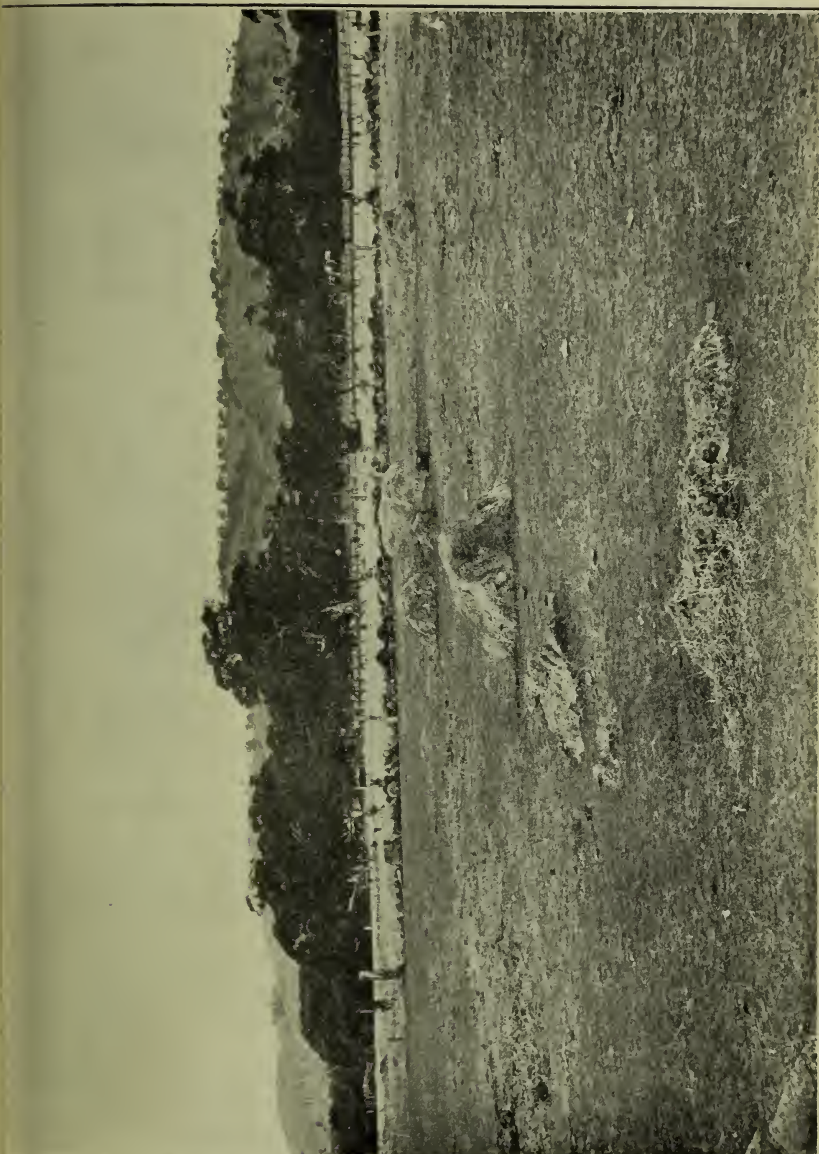

Group of large transported Stones, set in alluvium, looking East.

Gillingham, Swann & Co. Ltd., Printers, Adelaide.

at Paskeville, sent me a collection of stones for determination, gathered from the locality, among which was one of a similar vesicular structure. Still more recently Mr. A. N. Mackenzie sent down from Cooper Creek to the Adelaide Museum a large mass of fused earth, half a square yard in extent, which possessed the same characteristics as those obtained from the Findon gravel pits, but it possesses a more open texture and will float in water. The specimen was obtained at Kopperamanna Lake, in the Cooper Creek region.

DESCRIPTION OF PLATES.

Plate V.

Photograph of a group of small "atoll"-like circles formed by *Serpulae*, Encounter Bay, South Australia.

Plate VI.

View of a group of large transported stones, set in alluvium. Mr. Baulderstone's paddock, near Fullarton Road, looking north.

Plate VII.

View of another group, in linear position, looking east. Observe the numerous assemblage of somewhat smaller stones that have been dragged to the boundary fence in middle distance. Mr. Baulderstone's paddock, near Fullarton Road.

Note.—The photographs, now reproduced, were taken before the planting of the ground as an orchard.

The External Characters of Pouch Embryos of Marsupials.

No. 2.—*Notoryctes typhlops.*

By F. Wood Jones, D.Sc., F.Z.S.,
Professor of Anatomy in the University of Adelaide.

[Read June 9, 1921.]

For the specimen described here I am greatly indebted to the authorities of the Perth Museum. Unfortunately no details of its provenance are obtainable. In the Perth

Fig. 1.
Notoryctes typhlops.
Right lateral view of embryo of 10 mm.

Museum, Mr. Glauert informs me, there are three examples of *Notoryctes*. All are females. Two belong to the recently described Western Australian form *N. caurinus* (Thos.), whilst the third is the typical *N. typhlops* (Stirling), from Central Australia. It appears certain that the embryo could not have belonged to either of the Western Australian specimens, but beyond that it seems impossible to determine its origin.

The state of preservation of the specimen is not very good, and subsequent microscopical work would not appear to hold out very great promise, but considering the great rarity of embryos of *Notoryctes* it is well to place on record the external characters of even a single embryo, and one, moreover, which lacks a history.

The embryo measures 10 mm. from the vertex to the most distal point of the flexed caudal extremity.

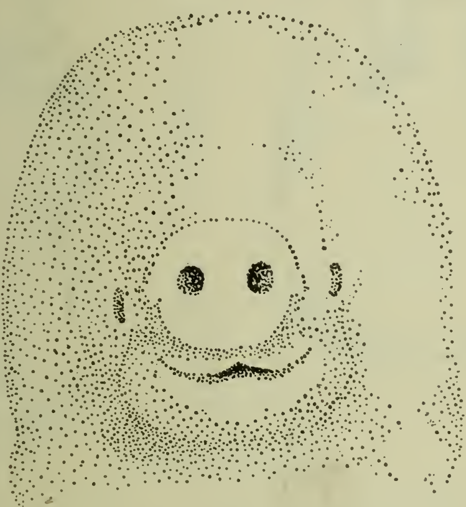

Fig. 2.
Notoryctes typhlops.
Front view of the head to show the features of the rhinarium.

The head is but little flexed on the trunk, but the caudal extremity is flexed in the pelvic, and, again, in the sacral region, so that the tip of the tail is brought beneath the chin.

No trace of hair can be detected, nor are there any skin elevations or sensory papillae present. The eye is well marked as a conspicuous patch of black pigment which shows clearly beneath the covering epitrichium; no trace of eyelids or accessory structures are visible.

The external auditory meatus is situated somewhat far back, behind and below the eye spot; it is surrounded by a definite raised margin which obviously represents the aborted structures involved in the formation of the pinna.

The rhinarium consists of a blunt and pig-like snout at the extremity of which are two rounded narial apertures. The nostrils are situated somewhat wide apart, and their circular orifices open immediately forwards. The narial margins are complete, there being no lateral incisura. The thickening and slight prominence of the dorsal surface of the

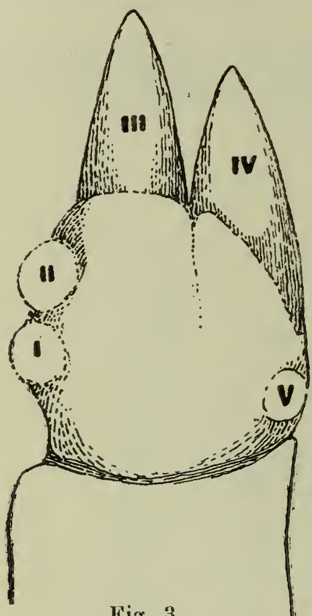

Fig. 3.
Notoryctes typhlops.
Palmar aspect of left manus.

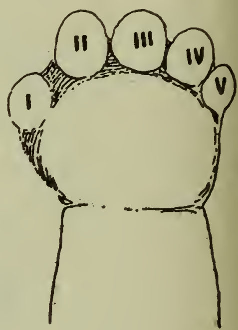

Fig. 4.
Notoryctes typhlops.
Plantar aspect of left pes.

rhinarium is doubtless the commencing formation of the rhinal shield of the adult.

The mouth is elongated and slit-like. The margins of the lips are separated over a considerable portion of their length. There are in the specimen in its present condition no evidences of the adaptation of the mouth to a nipple. The limbs are short and stout, the free portion of the fore limb being considerably longer than the corresponding portion of the hind limb.

The manus and pes are of peculiar interest.

In the manus the enormous, and early, specialization of digits 3 and 4 is remarkable. It is to be noted that, although the digital specialization has proceeded so far, the manus has not undergone the adult folding which makes the determination of the different elements a matter of some little difficulty. It is well known that in his original communication (1891) Sir Edward Stirling designated the specialized digits as 4th and 5th, and assumed that the small digits were the 1st, 2nd, and 3rd. In the extended description published in the same year this error was noted and corrected, and correct figures were published. Despite this, Lucas and Le Souef (1909) speak of "the edge of the large triangular nail of the fifth digit" being used for digging.

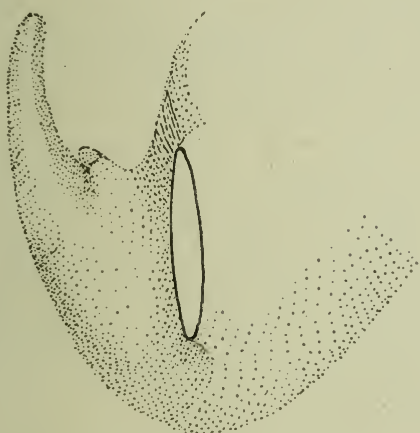

Fig. 5.
Notoryctes typhlops.
Left lateral view of the caudal region.

In the embryo the 1st, 2nd, and 5th digits of the manus are represented by mere tubercles. It is a very remarkable thing that the manus should attain one of its greatest peculiarities by what is essentially an opposition of the 1st and 2nd digits to the 3rd, 4th, and 5th, such as exists, for instance, in *Phascolarctos*.

The pes is short and spade-like, the digits ranged in very primitive fashion, save that the 2nd is very slightly in advance of the 3rd.

The tail, so far, presents none of its adult peculiarities. The external genitalia reveal to external examination only a raised cloacal margin from which protrudes a genital tubercle. No trace of a pouch rudiment, nor of an umbilical site are visible externally.

Notes on Some Western Australian Chitons (Polyplacophora), with Additions to the Fauna and the Description of a New Species of *Rhyssoplax*.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read May 12, 1921.]

Plate VIII.

Visiting Western Australia in connection with the Congress of the Royal Australian Ornithologists' Union, in October, 1920, I determined to take the opportunity of visiting Ellensbrook, in the south-west corner of that State, during the series of low tides at the end of the month.

Dr. W. G. Torr had done some excellent collecting at that locality at the end of December, 1910, obtaining single examples of two striking and new forms which he described under the names of *Ischnochiton verconis* and *Tonicia hullianus*. It was in the hope of refinding these, and possibly adding further species to the fauna of the State, that we arranged this visit. Unfortunately a heavy westerly gale was blowing during the two days spent at Yallingup, and still heavier seas were coming in during the three days spent at Ellensbrook, entirely precluding any effective work being done at the latter locality.

The work of the two days spent at Yallingup was carried out under great difficulties, and while the number of specimens taken was in consequence very limited, several forms of exceptional interest were secured, and amongst them the second known specimen of Dr. Torr's *Tonicia hullianus*. The rocks are granitic and suited to the habits of chitons.

My warmest thanks are also due to my colleague, Mr. R. Wilson, of Eden Hills, but for whose able assistance the results would have been much poorer. My stay in that State was prolonged till the next series of low tides, and Geraldton, 306 miles, by rail, north of Perth, and Dongarra, 40 miles to the south of that place, were both visited and the reefs examined for chitons. Unfortunately the rocks in both localities are composed of solid limestone reefs, with rough surfaces, unsuited to the habits of this group of mollusca, consequently very few species were secured, but amongst them, fortunately, were two specimens of a new *Rhyssoplax* which I propose to name *R. Geraldtonensis*, after the locality where it was found.

As a result of the total collecting several species are added to the Western Australian fauna, the range of others greatly extended, and several outstanding problems solved. Altogether nineteen species were collected.

My acknowledgments are due to Dr. Torr for the opportunity of examining his types and the data attached thereto, and to Mr. L. Glauert, of the Western Australian Museum, for the loan of the type of *Lucilina delecta*, Thiele, and other specimens.

Callochiton platessa, Gld.—One small specimen was secured at Yallingup. I have collected this shell in New South Wales, and from there to Western Australia, including Tasmania, and also have specimens from New Zealand, so probably it has the widest range of any of our chitons. The specimen under consideration was adhering to a rock covered with pink calcareous algae; evidently a case of colour protection.

Stenochiton posidonialis, Ashby.—One specimen was taken at Dongarra, living on a stronger form of *Posidonia* than is met with in South Australia. It grew in a fairly sheltered situation inside the reef. The first record of the occurrence of this and the following species in the waters of the Western State is contained in my paper (Jour. and Proc. Roy. Soc. W. Austr., vol. vi., 1920). The present discovery extends its range for nearly 300 miles northwards.

Stenochiton cymodocealis, Ashby.—One specimen was taken on a very fine form of *Cymodocea*, growing in a sheltered situation close to the harbour at Geraldton, thus extending its range for more than 300 miles northwards.

Ischnochiton torri, Ire. and May.—One taken at Yallingup; Torr also recorded it from the same locality.

Ischnochiton virgatus, Reeve.—I found this charming little *Ischnochiton* fairly numerous at Ellensbrook; this is the first published record of its occurrence on the west coast of this State.

Ischnochiton (Haploplax) resplendens, Bed. and Mat.—A nice series of this handsome chiton was obtained on the smooth granitic rocks at Yallingup. Although all were darker in colour than is typical they show the same minute sculpture and highly ornamental markings, consisting of blue spots and varied streaking, that is characteristic of the South Australian shell. They are evidently a larger race, measuring up to 30 × 17 mm.

Ischnochiton (Heterozona) cariosus, Pils.—I found it numerous on the granite rocks at Ellensbrook and Yallingup, and also collected it on the limestone rocks at Rottnest, Dongara, and Geraldton. Heretofore it has not been recorded further north than Rottnest Island. The northern specimens are much lighter in colour than those from Yallingup, the ground-colour of both being pale "Ochraceous-Buff" (Ridgway's Colour Standards, pl. xv.), slightly flecked with darker streaks. The more southern shells are much more extensively thus flecked, which gives them a greyish look. The reddish form so common in South Australian waters is quite absent. The girdle is banded in a varying degree. The sculpture differs slightly from the eastern shells, the longitudinal ribbing of the pleural area is less regular, and the nodules of the lateral area are coarser and suggest often two nodulose, radiating ribs. Should it be desired to distinguish this western variety, I suggest that it be known as var. *occidentalis.*

Callistochiton meridionalis, Ashby.—This shell was fairly numerous at Yallingup. It was taken by Torr, in 1910, at the same spot, and recorded by him under the name of *C. antiquus*, Reeve (Trans. Roy. Soc. S. Austr., xxxv., 1911, p, 98).

Plaxiphora albida, Blain.—I collected these on limestone rocks both at Cottesloe and Dongarra, in positions exposed to the full force of the waves. Dr. Thiele (Faun. Sudwest Austr., III., 1911, p. 402) records the same shell from Cottesloe under the name of *P. albida*, and I saw in the Western Australian Museum a specimen from that locality so labelled by Dr. Thiele. This form is not the heavily wrinkled one that used to be known by Australian collectors as *P. petholata*, Sow., but in most cases it corresponds with the non-wrinkled shell we used to recognize as *P. glauca*, Quoy and Gaim.

Dr. Torr (in *loc. cit.*, p. 99) identifies this shell as *P. costata*, Blain., and writes as follows:—"Mr. Iredale says, 'Blainville's *costatus* is easily recognizable as the species I have noted as *glauca*, Q. et G.' He agrees with Dr. Thiele, in his Revision des Systems der Chitonen, in placing *P. petholata*, Sow., as *albida* of Blainville, and *P. glauca*, Q. et G., as *costatus*, Blain."

Up to the present I have with some misgivings been following the course adopted by Dr. Torr. I now have a translation of Dr. Thiele's work before me. In it he says, referring to Blainville's type of *Chiton costatus*, which he had before him, that it is "probably the one named *Plaxiphora petholata* by Sowerby (1840); as Blainville's names were published in 1825, *P. costata* is certainly older." He then describes the sculpture as follows:—"The central areas have at both sides a radial rib above which more or less vertical zig-zag striae are visible." He adds that Blainville's shell "is said to have come from King George Sound." He goes on to give the result of his examination of the type of *Chiton albidus*, Blain., "which originated from King Island, south of Australia." His reference to the sculpture is as follows:— "A definite radial rib is not in evidence, only a blunt ridge, having at one place, in the front, a few zig-zag indentations," and adds, "I was unable to examine the original of *Plaxiphora glauca*, Quoy and Gaim., from Tasmania; according to the drawings it would be possible to class it with the last-named species, though the colour is somewhat different." Without going into the question as to how the mistake occurred, it is quite evident that the words quoted from Dr. Torr's paper transpose Dr. Thiele's statement, and the shell that has been referred to by Torr and quoted by Hedley (in Jour. Roy. Soc. W. Austr., vol. i., 1914-15, p. 23) as *P. costata*, Blain., must in future be designated *P. albida*, Blain.

The shells collected by myself at Cottesloe and Dongarra vary considerably; all but one show a single diagonal rib and some are quite free from wrinkling or notching, but others show a slight wrinkling, and one, if held in a certain light, shows distinct raising of the posterior margin of the central valves, suggesting a second diagonal rib so common in the strongly sculptured specimens of *P. petholata*, Sow., which equals *P. costata*, Blain.

The limit of the present paper prevents the discussion being carried further. Either we have been confusing three species and one sub-species under the name of *P. petholata*, Sow., and *P. glauca*, Quoy and Gaim., or these three forms are referable to one very variable species and possibly one sub-species, *viz.*, *P. conspersa*, Ad. and Ang.

Kopionella matthewsi, Ire.—Three specimens of this interesting shell were found at Yallingup. All show similar "oar-headed spicules" to the South Australian form which was fully described in my paper (Trans. Roy. Soc. S. Austr., vol. xliii., 1919), and a like slight cleft in the girdle behind the tail valve.

The writer has now found members of this genus from eastern Tasmania to the west coast of Western Australia, and in every specimen the strange "oar-headed spicules" are present. All specimens I have collected, even when separated by more than a thousand miles, are invariably furnished with these spicules.

No. 1 specimen, measuring 9×6 mm., is similar in method of sculpture to the shells from Marino, in South Australia, and shows the coarsely pustulose radial ribs in the lateral areas, which is so marked a feature in that form.

The tail valve, although thickened at its posterior margin, is not as distinctly upturned.

Nos. 2 and 3 are quite distinct in sculpture; they measure, respectively, 14×9 and $13{\cdot}5 \times 6$ mm. The last-named, it will be seen, is long and narrow; quite an unusual form for members of this genus.

The lateral areas in these two are almost smooth, with the exception of the second valve, which in specimen No. 2 gives some evidence of diagonal ribs; in No. 3 a few large nodules are present.

These two specimens suggested affinities with Torr's *Plaxiphora hedleyi*, and so I took the earliest opportunity of visiting the Doctor, who, with his usual kindness, allowed me to make careful examination of his types. I find that the shells I have called 2 and 3 are undoubtedly his species, designated under the name *Plaxiphora hedleyi* (Trans. Roy. Soc. S. Austr., vol. xxxv., 1911, p. 103). I also find that Dr. Torr's *Plaxiphora zebra*, described in the same paper (p. 106) from a single median valve, is similar in sculpture to my specimen No. 1, and corresponds with the South Australian shell known as *K. matthewsi*, Ire. Prior to 1910 Australian collectors used to refer to this shell as *Plaxiphora conspersa*, Ad. and Ang. In June of that year Iredale described it under the name of *P. matthewsi*.

Seeing that Dr. Torr's paper was read in October, 1911, his *P. zebra* becomes a synonym of Iredale's shell. Although it is possible that there is only one very variable species in the waters of South Australia and Western Australia, which the finding of these three shells, above described, in the same hole at the same time, rather supports, I prefer for the present to retain Torr's name as *hedleyi*, as a sub-species of *Kopionella matthewsi*, Ire., and represented by the forms I have herein described as Nos. 2 and 3, with almost smooth lateral areas. The delicate and remarkable "oar-head spicules," which suggested to me the name of the genus, were no doubt removed from Torr's specimen in rough handling in the cleaning.

The tail valve, as shown in Torr's fig. 2E, is a little misleading, the part of that valve behind the mucro is really the thickened edge of the upturned portion; neither is the slight indentation of the girdle behind the mucro indicated in his fig. 2A.

Acanthochiton kimberi, Torr.—I am glad to be able to add this somewhat rare *Acanthochiton* to the fauna of Western Australia. Two specimens in an excellent state of preservation were secured at Yallingup; they show none of the erosion which so often mars the shells of this species. The nearest locality from which this species has heretofore been taken is St. Francis Island, in South Australia, so that the extension of its range to the west coast of Western Australia is very interesting.

Acanthochiton (Notoplax) sub-viridis, Torr.—This interesting shell was described by Torr *(loc. cit.)* from specimens taken by himself at Albany, on the south coast. We have now taken it on the west coast, at Yallingup; the onlv previous specimens known were those taken by Torr at Albany.

Rhyssoplax torrianus, Hed. and Hull.—A nice series were taken at Yallingup, where Dr. Torr also took it in 1910.

Onithochiton scholvieni, Thiele.—This large *Onithochiton* was common on the face of the exposed reef at Dongarra, making it difficult to get with the surf breaking over them; it adhered very tightly to the hollows in the fretted limestone reef. I believe it has not before been recorded further north than the neighbourhood of Perth.

Liolophura georgiana, Quoy and Gaim.—This species was very common on the rocks that were fully exposed at low tide at Ellensbrook, Yallingup, Cottesloe, and Dongarra. The larger specimens were always more or less eroded. Small specimens, on the other hand, are beautifully sculptured.

On examining Torr's type of *Plaxiphora pustulosa*, described from one median valve only *(loc. cit.*, p. 107), the presence of "eyes" in the lateral areas was at once apparent, and suggested its true nature. On comparing it with a well-preserved example of similar age of *L. georgiana*, its identity with it was evident; Torr's example is probably valve No. 5 of that species.

Had Dr. Torr seen the whole shell the mistake, of course, would never have occurred. The accident is not without its compensating features, for I believe no recent first-class figure exists of this shell, so Torr's excellent drawing of the median valve *(loc. cit.*, pl. xxv., fig. 7) under the name *Plaxiphora pustulosa* will always be of use to collectors.

Crytoplax striatus, Lamark.—One specimen only from the east side of Rottnest Island. The only other record of this common eastern species is that given by Dr. Torr, who took it at Hopetoun and Yallingup.

Cryptoplax hartmeyeri, Thiele.—One specimen taken at Yallingup and measuring 12 mm. long was quite new to me. It does not fully agree with Dr. Thiele's figure accompanying his description of the foregoing species (Faun. Sudwest Austr., III., 1911, p. 405, pl. 6, f. 11-17, Shark Bay). The sculpture is more bead-like and the spicules on the girdle are widely spaced and short and thick, quite different from the thickly-set, hair-like spicules of *C. gunni*, Reeve, or the massed, coarse, curved spicules of *C. striatus*, Lamark. As Dr. Thiele's specimen was fully three times the size, the bead-like character may have been somewhat impaired. The examination of more material may alter this determination, but, for the present, I propose to refer the species under review to Dr. Thiele's species.

Tonicia hulliana, Torr.—This very distinct species has heretofore only been represented by the type specimen, a well-preserved adult shell, collected by Dr. Torr, at Ellensbrook, and described by him (*loc. cit.*, p. 104, pl. 25, f. 4). It was my fortune to find a single specimen of this hitherto unique chiton, measuring, dry, 6·5 × barely 4 mm. It was quite new to me, being apparently smooth and of a delicate pink colour; a few eyes were then noticed in the lateral areas and end valves, and I, at first, thought it must be referred to Dr. Torr's shell, but on turning up the description and figure I found that the sculptural characters figured and described by him were absent, and that almost the only feature present in mine was quite distinct from his, and concluded that, while it certainly was a *Tonicia*, or rather that division thereof known as *Lucilina*, with posterior mucro, it must be an undescribed form. Later Dr. Torr, with his usual kindness, forwarded me his type of *(Tonicia) Lucilina hulliana*, when I discovered that he had overlooked the juvenile features, which consist of a number of pits in the pleural area immediately abutting on the anterior margin of the lateral areas, high up on the back. The type has about seven of these clearly visible on most of the valves, if held at the right angle of light. Both specimens are carinated, and I think the statement in the description, "Back rounded, side slopes curved," may therefore be a little misleading. The sculpture of the adult form, correctly described by Torr as "concentric growth-lines running from lateral into pleural and dorsal areas," and the "5 or 6 irregular flattened ribs" in the lateral areas, are absent in the juvenile form, although there is a suggestion that these forms of sculpture are about to commence. We have therefore in this species a very excellent example of the wide difference that exists between the sculpture of juvenile chitons and their adult form, a fact I have pointed out in several of my papers. In this case the juvenile method of sculpture is dropped immediately the adult characters begin to appear.

Lucilina delecta, Thiele (Faun. Sudwest Austr., III., 1911, p. 397).—While I did not myself take a specimen of this shell, through the kindness of Mr. L. Glauert, of the Western Australian Museum, I have had the opportunity of comparing specimens "obtained on pearl-shell" from Shark Bay with Dr. Thiele's type, which is in the Western Australian Museum, and I find them the same species. As Dr. Thiele does not figure the shell, I include one in the plate accompanying this paper.

I am indebted to Mr. Nils. H. J. Odhner for a specimen of the shell collected by Dr. E. Mjoberg, of the Swedish Scientific Expedition, 1910-1913, and identified and recorded in Kun. Sve. Vet. Hand. Band. 52, No. 16, p. 12, as *Tonicia truncata*, Sow., from Broome. I find this shell agrees with Dr. Thiele's species. I have been unable to see compared specimens of Sowerby's shell or of Reeves' *T. picta*, now *Lucilina shirleyi*, Ire., but Pilsbry's drawing of this latter shows decided differences between that and Thiele's shell; on the other hand, Pilsbry's drawing of Sowerby's *T. truncata* will fit equally the Broome and the Shark Bay shells—in both the girdle encroaches on the valves, which is said not to be the case in *T. picta*, Reeve.

For the present I am not able to decide the question as to whether Dr. Thiele's *L. délecta* is the same as Sowerby's *T. truncata*, or whether the identification of the shell obtained by Dr. Mjoberg, at Broome, as such, is incorrect; it is quite certain that one or the other name must be withdrawn from our Australian list.

Rhyssoplax geraldtonensis, n. sp.

Two specimens, one adult and the other juvenile, were obtained on the reef, Back Beach, Geraldton, November 7, 1920.

General appearance.—Shell strongly carinated, side slopes steep, slightly rounded, lateral areas much raised and bi-ribbed, pleural areas longitudinally grooved, general colour dirty ivory-white mottled with pale brown, polished surface, girdle banded.

Anterior valve.—The apex and nearly half the valve smooth, the rest radially ribbed, which ribs are broken with concentric grooving. I counted eighteen ribs.

Posterior valve.—Mucro slightly posterior and much raised, dorsal area broad and smooth, anterior portion longitudinally ribbed, similarly to the pleural areas in the median valves. Posterior portion of valve margined by a raised, nodulose rib, the portion of valve immediately behind the mucro smooth, posterior portion decorated by radial ribs broken into two or three nodules by deep concentric sulci, the posterior portion of valve slightly recurved.

Median valve.—Dorsal area slightly beaked, broad and smooth, lateral areas much raised, composed of two rather flattened, nodulose ribs separated by a broad groove; in valve 2 there is slight evidence of two of these grooves. Pleural area broken into flat, longitudinal ribs, separated by deep grooves, those next the dorsal area only traversing part of the area. I counted ten of these grooves in some valves.

Girdle.—Clothed with highly-polished, flattish, pebble-like scales, with rounded apices. There is no sign of fluting or ribbing on these scales, but under a high power there is some evidence of parallel scratching.

Measurements.—The dry specimen measures 20×11 mm.

Habitat.—On the underside of loose limestones buried deeply in sand, in holes in the solid limestone reef at Geraldton.

Juvenile shell.—Measuring 9×5 mm., three longitudinal grooves are present in the pleural area, the nodulose character of the lateral areas is only in evidence in the outer half. A juvenile shell of half this size will therefore have unsculptured pleural and lateral areas, but the latter area will be distinctly raised. The anterior valve is practically without sculpture, with the exception of the very fine decussate pattern that covers the whole shell, probably due to the megalopores.

Comparisons.—While at first sight this shell, with its polished ivory-like appearance, seems very different from *R. tricostalis*, Pils., its method of sculpture approaches that form. The ribs in the pleural area are less raised and further apart than is the case in that species, and suggest weather-boarding rather than the narrow well-raised ribs, separated bv deep grooves of *R. tricostalis*. The lateral areas are divided into two ribs, instead of three, and the nodules are more rounded and flatter. The scales, both in shape and lack of grooving, are of a different character. *R. verconis*, Torr and Ashby, which is somewhat kindred in sculpture, has erect, pointed scales, of the same type as *R. jacksonensis*, Ashby. Then, again, the habit of this species in adhering to the underside of limestone rocks buried deeply in sand is very distinct from

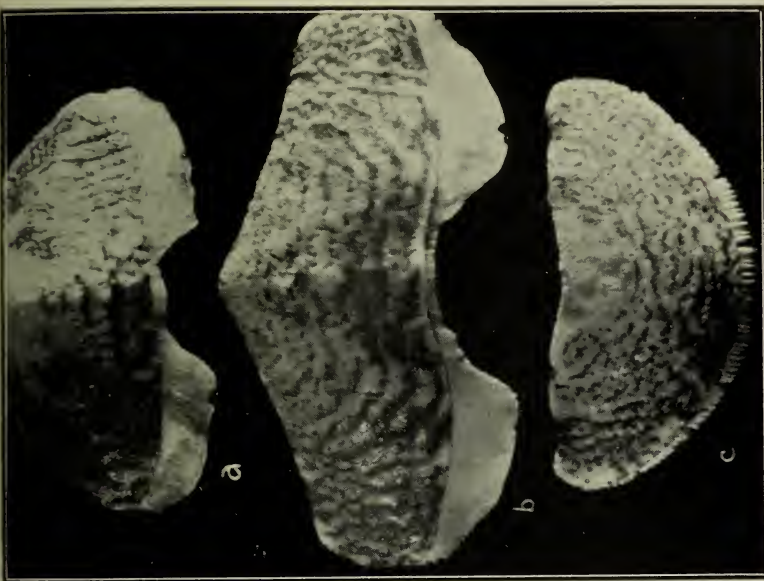

Fig. 2.

Fig. 1.

Gillingham, Swann & Co. Ltd., Printers, Adelaide.

R. tricostalis, which loves the exposed sides of clean hard rocks.

In conclusion.—It will be seen by the foregoing that the following must be added to the Western Australian fauna:—*Acanthochiton kimberi*, Torr; *Kopionella matthewsi*, Ire.; and *Rhyssoplax geraldtonensis*, Ashby. That the following must be removed from that list, *viz.*:—*Plaxiphora hedleyi*, Torr, which become a subspecies of *Kopionella matthewsi*, Ire.; *Plaxiphora zebra*, Torr, becomes a synonym of the same species; and *Plaxiphora pustulosa*, Torr, becomes a synonym of *Liolophura georgiana*, Quoy and Gaim. *Plaxiphora costata*, Blain., is replaced by *Plaxiphora albida*, Blain.; *Lucilina delecta*, Thiele, either is replaced by *Tonicia truncata*, Sow., or the record of the occurrence of that shell at Broome, quoted in my paper (Trans. Roy. Soc. S. Austr., vol. xliv., 1920, p. 291), collected by Dr. Mjoberg, must be altered to *Lucilina delecta*, Thiele.

One other correction must be made. Dr. Torr (*loc. cit.*, p. 98) records the occurrence of *Chiton exoptanda*, Bednall, on the strength of "one anterior valve and one median valve, were taken from 20 fathoms in Geographe Bay."

Through the kindness of Dr. Torr I have had the opportunity of examining these valves, and find that the anterior valve has "eyes" and is possibly a worn valve of *Lucilina hulliana*, Torr, and the median valve cannot be identified with *C. exoptanda;* the most that can be said is, that if the characteristic sculptural features of that shell were ever present they have been so worn off as to make determination impossible. The colour approximates very closely to *exoptanda*.

DESCRIPTION OF PLATE VIII.

Fig. 1. *Rhyssoplax geraldtonensis*, Ashby, ×5½.
,, 2*a*. *Tonicia (Lucilina) delecta*, Thiele, posterior valve, ×6.
,, 2*b*. ,, ,, ,, ,, median valve, ×6.
,, 2*c*. ,, ,, ,, ,, anterior valve, ×6.

On Australian Coleoptera of the Family Malacodermidae.

By Arthur M. Lea, F.E.S.

(*Contribution from the South Australian Museum.*)

[Read June 9, 1921.]

The Malacodermidae of Australia were revised by me in 1909,[1] since when comparatively few species have been named; but great attention having recently been paid to the family, and the Blackburn collection containing many novelties, many more species can now be added.

Metriorrhynchus rhipidius, W. S. Macl.

A specimen, from the Victorian Alps, may represent another variety of this species, its rostrum is long, although rather less than the average length of the species; but its prothorax appears to be five-areolate in an unusual way: from the central areolet three costae connect with the apex (the two side ones are not very distinct from above, but are distinct from the sides), so that there are two small medio-frontal areolets, a fairly large central one, and a very large one on each side; each of the lateral ones has a feeble transverse elevation across part of its middle, but, as it is not in the form of a distinct costa joined to the others, the prothorax cannot be regarded as seven-areolate. In all undoubted specimens of *M. rhipidius* that I have examined the prothorax is distinctly seven-areolate. The specimen may be an individual aberration, of which so many occur in the genus.

Metriorrhynchus foliatus, Macl.

There were two specimens standing in the Macleay Museum as types of this species, and they agree exactly in colour, but only one agrees in structure with the description; it is a male. The other is a female, but certainly not of the same species, its rostrum being much longer and thinner, and prothorax of a very different shape; I have described it as *M. insignicornis*.

Metriorrhynchus serraticornis, Macl.

Two females, from Cairns, probably belong to this species, but have the hind femora, tibiae and tarsi, middle tibiae,

(1) Lea, Trans. Ent. Soc. Lond., 1909, pp. 45-251.

tarsi, and half of the femora blackish, and the scutellum infuscated.

METRIORRHYNCHUS FUMOSUS, Macl.

Seven specimens, from Cairns, agree with the types of this species, they are opaque-black, to the naked eye (owing to pubescence) appearing a smoky-brown, the antennae are strongly serrated in both sexes, and the scutellum is somewhat narrowed posteriorly, with its end truncated; the length varies from 5 to 9 mm. The female differs from *M. opacus*, of which only a female is known, in the more strongly serrated antennae, prothorax almost parallel-sided and shorter, and in the scutellum, that of *opacus* being emarginate at the apex, with the ends conspicuously produced.

METRIORRHYNCHUS CENTRALIS, Macl.

The types of this species are females; in general appearance they are extremely close to the types of *M. elongatus*, but differ in the central areolet of the prothorax; on *M. centralis* it is terminated fully one-third from the apex of the prothorax, on *elongatus* it extends much nearer to the apex. Two males, from Cairns, that probably belong to *centralis*, differ from the types in being somewhat smaller and narrower, antennae and legs longer, the former more strongly serrated, the prothorax less transverse, and in the abdomen.

METRIORRHYNCHUS GRACILIS, Lea.

On this species the front margin of the prothorax is thickened, with a row of punctures almost dividing it into two parallel parts. A second specimen agrees with the type in having the four front areolets of the prothorax ill-defined; but on two males they are sharply defined, their connecting costae being distinct to the hind part of the apical thickening; one of these males has the black tips to the elytra rather larger than on the others, although they are still rather small and oblique.

METRIORRHYNCHUS ATRICORNIS, Lea.

A specimen, from Cairns, probably belongs to this species, but has the scutellum black, and extreme base of elytra flavous; the sides of its prothorax near the base are suddenly incurved, but the angles themselves are much as on the typical form; the difference is probably due to contraction in drying. In my table,[2] owing to the elytra not being entirely dark, it would be associated with *M. ampliatus*, but that species has the pale basal portion larger (distinct to the naked eye), and prothorax with five, instead of three, areolets.

(2) Lea, Trans. Ent. Soc. Lond., 1909, p. 51.

Metriorrhynchus heterodoxus, Lea.

A specimen, from the Dividing Range in Victoria, appears to represent a variety of this species, its elytra have more of the tips red than on the type, but the pale parts of the sides are narrower and terminate before the base, instead of being somewhat dilated on the shoulders, the sides of the prothorax are narrowed in the middle, the true second joint of the antennae is concealed from above, and the third is even shorter than on the type. In the original description by a misprint, the first joint of the antennae was made to read "as long as wide *and* almost concealed"; the reading should have been "*2nd* almost concealed."

Metriorrhynchus occidentalis, Blackb.

M. disconiger, Lea, var.

The type and only specimen of this species known to Blackburn is now in the British Museum, but several specimens, from the Mallee District of Victoria, agree perfectly with the description.

Two males, from Hobart, appear to represent a variety of it, they have the black mark of the elytra at its widest almost extending to the middle of each elytron, and continued from the scutellum to slightly nearer the apex than on the typical form; these specimens agree with the description of *M. disconiger*, consequently the latter name must be regarded as a varietal one only.

Metriorrhynchus eremitus, Blackb.

Three specimens, from Eden (New South Wales), differ from the typical form of this species in having the pale portion of the elytra confined to the tips, and of the prothorax to the sides.

Metriorrhynchus melaspis, Bourg.

This species was described as 8-9 mm. in length, with the abdomen (3) and tibiae entirely pale, and the apex of the labrum and the palpi black. There are numerous specimens in the Museum from the Northern Territory (Mary River and Darwin) that appear to belong to the species, but have the labrum entirely pale, and palpi either entirely pale, or partly infuscated; they measure 8-10 mm. in length. The antennae are strongly serrated in the male, with some of the joints subpectinate; in the female they are less strongly serrated.

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(3) By a clerical error in my table the abdomen was noted as "partly" pallid.

Some specimens, from Queensland (Coen River and Cooktown) and North-western Australia (King Sound), are considerably larger (up to 15 mm.), and have the tips of the tibiae, labrum (wholly or in part) and palpi blackish, with the knees infuscated or not.

Metriorrhynchus cancellatus, Lea.

A female of this species, from Gosford (New South Wales), has the antennae much less strongly serrated than in the male, and the third joint of antennae no longer than the fourth.

Metriorrhynchus diminutivus, Lea.

Two females, from Cairns, probably belong to this species, they differ from the description in having the dark parts black instead of blackish-brown, the scutellum no paler than the elytra, and the antennae, except the minute second joint, entirely dark.

Metriorrhynchus ramosus, Lea.

Two males, from Mount Tambourine, probably belong to this species, but differ from the type in having the antennal rami shorter, and rather less of the elytra black.

Metriorrhynchus parvoniger, n. sp.

♂. Sooty-black.

Head irregularly concave between eyes, muzzle very short. Antennae rather long and feebly serrated, third joint the length of fifth and slightly wider, but at apex no narrower than fourth, slightly longer than the apical width, the others all distinctly longer than wide, after the sixth decreasing in width, and after the eighth in length also, but eleventh slightly longer than tenth. *Prothorax* small, seven-areolate, apical costae sharply defined and rather long, front angles almost rectangular, hind ones acutely produced, sides angularly diminishing to middle. *Scutellum* obtusely bilobed at apex. *Elytra* with single rows of large, transversely-oblong punctures, close to base a few doubled. Length (♂, ♀), 5·5-6 mm.

♀. Differs in having antennae shorter, thinner, and even more feebly serrated, and in the abdomen.

Hab.—Queensland: Cairns district (E. Allen and A. M. Lea). Type, I. 11810.

On each elytron almost throughout there are but five rows of punctures, about the tips they are less angular than elsewhere, and close to the base a few of the punctures in the second and third rows are doubled. The female, taken *in cop.* with the type, has the sides of the prothorax obscurely diluted with red. The variation in colour of the prothorax would distribute the specimens, in my table; the female with it bicolorous would go with *M. coenosus*, which has the elytral margins pale, and the others with *M. insignipennis*, which is a consistently larger Tasmanian species, with somewhat different antennae, and shining elytra. At first glance it resembles *M. fumosus* and *T. ater*, the former has elytral punctures in double series, the latter differs in generic features.

Var. (?) A female, also from Cairns, possibly belongs to this species, but has the third to tenth joints of antennae strongly serrated (subpectinate), its colours are as in the type female, except that each shoulder is obscurely diluted with red. Probably, however, it represents a new species.

Metriorrhynchus mimicus, n. sp.

♂. Black, tips of elytra brick-red.

Head with muzzle very short. Antennae rather long, third to tenth joints feebly serrated, third to sixth joints about the same width at apex, the others decreasing in width, eleventh about two-thirds the width of tenth, and slightly longer. *Prothorax* conspicuously seven-areolate, strongly narrowed to middle, hind angles produced but tips rounded off. *Scutellum* almost truncate at apex. *Elytra* narrow, slightly dilated posteriorly; with single rows of large, quadrangular punctures, becoming double for a short distance at base and about tips. Length, 7 mm.

Hab.—Victoria: Belgrave (F. E. Wilson). Type (unique), I. 12271.

In general appearance strikingly close to the variety *haemorrhoidalis* of *M. rufipennis*, but the elytral punctures in single series (except for a very small part of the base and of the apex); *M. paradoxus* is somewhat larger, with the sides and more of the apex of elytra reddish, the punctures larger, and the interstices not alternately more strongly elevated, as the third and fifth are on this species.

Metriorrhynchus minutus, n. sp.

♀. Black, basal three-fifths of elytra reddish, base and sides of prothorax narrowly and obscurely reddish.

Head with muzzle short. Antennae rather short, wide, and moderately serrated, most of the joints slightly shorter than their greatest width. *Prothorax* small, distinctly seven-areolate, slightly longer than apical width, apex slightly produced in middle, front angles rectangular, hind ones produced, but not very actue. *Elytra* rather thin; with single rows of punctures, except on basal fifth, where they are doubled. Length, 5 mm.

Hab.—Queensland: Port Denison (Aug. Simson). Type (unique), I. 11814.

A minute species which, in my table, would be placed with *M. coenosus*, which has tips and sides of elytra pale, and somewhat different antennae; besides the bicoloured prothorax it differs from *M. basalis* in having much smaller elytral punctures, with costae evenly elevated, and antennae somewhat wider.

METRIORRHYNCHUS MARGINICOLLIS, n. sp.

♀. Black, elytra and sides of prothorax brick-red.

Head with muzzle very short. Antennae not very long, moderately wide, third to tenth joints feebly serrated, third distinctly longer than fourth, eleventh scarcely perceptibly longer than tenth. *Prothorax* slightly longer than apical width, conspicuously seven-areolate, sides almost parallel on apical half, then angularly dilated to base, where the angles are acute. *Elytra* thin; with single rows of large, quadrangular punctures. Length, 5·5 mm.

Hab.—Queensland: Mount Tambourine (A. M. Lea). Type (unique), I. 11813.

Rather narrower than *M. uniseriatus*, and antennae very different from those of its female, and the sides of the prothorax pale; the antennae are more like those of *M. minor*, but the elytral punctures and costae are regular to the base, and the sides of the prothorax are pale; it is also close to *M. minutus*, but the elytra are entirely pale, with larger punctures and alternate interstices slightly elevated above the others; in my table would be placed with *M. coenosus*, but the antennae are different, and the elytra entirely pale.

METRIORRHYNCHUS FULIGINEUS, n. sp.

♀. Sooty-black.

Head with very short muzzle. Antennae rather long and moderately wide, third to tenth joints serrated, third longer than fourth, and eleventh longer than tenth. *Prothorax* triareolate; median areolet rather narrow in its middle (where it is widest), and continuous from base to apex, sides strongly elevated and evenly curved, front angles rounded off, hind ones produced and sharply acute. *Elytra* slightly wider near apex than base; with double rows of punctures becoming irregular about tips; alternate interstices distinctly elevated. Length, 6 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type (unique), I. 11819.

Allied to *M. kingensis*, but with apex of prothorax not notched in middle. I have previously given [4] two short

[4] Lea, Trans. Ent. Soc. Lond., 1909, pp. 62, 63.

tables of species of Lycides almost identical in colours, but separated by profound structural differences, and one of entirely black species may be of interest:—

Prothorax not divided into conspicuous areolets	*D. melancholica*, Lea
Prothorax with conspicuous areolets.	
Subsutural costa trifurcate near base	*T. ater*, Macl.
Subsutural costa simple.	
Elytral punctures in single series.	
Elytra opaque	*M. parvoniger*, Lea
Elytra shining	*M. insignipennis*, Blackb.
Elytral punctures in double series.	
Prothorax three-areolate.	
Apex of prothorax deeply notched in middle	*M. kingensis*, Lea
Apex not notched	*M. fuligineus*, Lea
Prothorax seven-areolate.	
Antennae of male ramose ...	*M. funestus*,(5) Lea
Antennae of male not ramose	*M. rufipennis*, Fab., var.

METRIORRHYNCHUS INSIGNICORNIS, n. sp.

♂. Black; prothorax (except for a large blackish discal blotch) and elytra brick-red.

Head with rostrum unusually long and thin. Antennae long, the first six joints with long and fairly dense hairs on the under-surface, first joint small, second minute, third long and thin (about four times as long as wide), fourth about two-thirds the length of third, and slightly longer than fifth, the latter feebly produced on one side at apex, sixth the length of fifth but strongly produced at apex, seventh to tenth shorter and pectinate, eleventh thin. *Prothorax* moderately transverse, seven-areolate, apex produced in middle, sides incurved to middle, base trisinuate, the hind angles moderately acute. *Scutellum* with two rather acute tips. *Elytra* thin and parallel-sided, with regular double rows of punctures, the alternate interstices elevated. Subapical segment of *abdomen* notched in middle almost to base. Front and middle *trochanters* each with an acute spine, hind pair largely produced and truncated; front femora flat and unarmed, middle femora with a small tooth at basal third; hind pair much stouter than the others, obtusely dentate about middle, largely excavated on one side of base, and clothed on under-surface with long hairs as on antennae; hind tibiae thicker

(5) An allied species (probably undescribed) occurs in the Madang district of New Guinea.

than the others, and with hairs as on femora. Length (♂, ♀), 9-10 mm.

♀. Differs in having antennae shorter, without long hairs, the joints after the fifth serrated but not pectinated, legs unarmed, hind femora no stouter than the others, and without special clothing, and abdomen not notched.

Hab.—Queensland: Gordonvale (Dr. J. F. Illingworth), Cairns (Macleay Museum). Type, I. 11820.

At first glance strikingly close to *M. lateralis* and similarly coloured species, but the remarkable antennae and legs readily distinguish the male from all previously named males of the genus. One of the females was placed with the type of *M. foliatus* in the Macleay Museum, but it is certainly not that species, from which it differs in having the rostrum much longer, and sides and apex of prothorax very different. The rostrum is distinctly longer than the prothorax in both sexes; the black of the prothorax touches the base, except in middle, but not the sides or apex.

METRIORRHYNCHUS PALLIDOMINOR, n. sp.

♂. Flavous; tips of elytra, six apical joints of antennae and parts of two preceding ones, palpi and tarsi (except claw-joint) black or infuscated.

Head with rostrum of moderate length. Antennae rather long, third to tenth joints oblong, third about one half longer than fourth, eleventh one half longer than tenth. *Prothorax* slightly longer than wide; conspicuously seven-areolate; apex obtusely produced in middle, sides gently incurved to middle, hind angles slightly rounded, the front ones strongly. *Elytra* thin and parallel-sided; with regular double rows of punctures, alternate interstices slightly elevated. Length (♂, ♀), 5-6 mm.

♀. Differs in having somewhat shorter antennae and wider abdomen, with the subapical segment not notched.

Hab.—Northern Territory: thirty miles east of Darwin (G. F. Hill). Type, I. 12265.

A small, thin, pale species, not very close to any other known to me; the blackish tips to the elytra are about one-eighth of their length; the antennae might fairly be regarded as nonserrated; the frontal areolets of the prothorax are longer than usual. The length of the rostrum (including the mandibles) is somewhat less than the basal width, and not half the length of the prothorax: regarding it as of moderate length, in my table it would be placed with *M. rufirostris;* regarding it as short, with *M. fallax;* each of which species is considerably larger, with black under-surface and legs.

Metriorrhynchus funestus, n. sp.

♂. Sooty-black.

Head with very short rostrum. Antennae rather long, third to tenth joints ramose, eleventh more than twice the length of the non-ramose portion of tenth. *Prothorax* moderately transverse; conspicuously seven-areolate; front angles slightly obtuse, hind ones produced and acute, sides almost parallel to near base. *Elytra* parallel-sided; with somewhat irregular double rows of punctures, the alternate interstices distinctly elevated. Length, 5·5-6·5 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type, I. 11825.

Readily distinguished from all previously named black species by the long antennal rami; *M. opacus*, of which only the female is known, has very different prothorax; the ramus of the third joint commences near the middle of the inner side, on the others it is gradually advanced till on the tenth it commences near the tip, on the third and tenth joints it is almost twice the length of the supporting portion, on each of the intervening joints it is more than twice the length of its supporting portion. Of the median areolets of the prothorax the front ones are about two-thirds the length of the hind one. The short costae dividing off the elytral punctures are often transversely Y-shaped, and from some directions the rows in places appear to be in single instead of double series; but when the elytra are so placed that the thinner parts appear semitransparent, the punctures appear to be in quite regular double rows.

Metriorrhynchus rufomarginatus, n. sp.

♂. Black; tips of elytra, each lateral costa, and part of suture bright red.

Head with rostrum very short. Antennae moderately long, third to tenth joints strongly serrated or subpectinated. *Prothorax* moderately transverse, apex obtusely produced in middle, sides moderately dilated and rather strongly elevated from middle to base, front angles obtuse, hind ones (except for a slight rounding off) almost square; conspicuously seven-areolate, the median areolet produced in front to about the middle of the medio-frontal areolets. Tips of *scutellum* produced. *Elytra* slightly dilated posteriorly; with irregular double series of large punctures, alternate interstices slightly elevated. Length (♂, ♀), 13-17 mm.

♀. Differs in having the antennae shorter and less strongly serrated (not subpectinated), abdomen wider, the subapical segment not notched, and legs slightly shorter.

Hab.—Victoria: Lorne (F. E. Wilson). Type, I. 12273.

The red tips to the elytra extend for from three to seven punctures in length; on the male the suture is red for almost half its length, on the female for scarcely one-fourth; on the male the middle of the apex of the prothorax is slightly notched, on the female more conspicuously so, but the character is probably not dependable. In my table would be placed with *M. rufipennis*, and in fact the types look like large specimens of the variety *goryi* of that species, but they differ in having the prothorax more transverse, its sides more feebly incurved about middle, the antennal serrations different, and the tibiae thinner.

METRIORRHYNCHUS MODICUS, n. sp.

♂. Black; sides of prothorax and tips of elytra flavous.

Head with rostrum short (distinctly wider than long). Antennae moderately long, third to tenth joints strongly serrated. *Prothorax* moderately transverse; conspicuously seven-areolate; apex produced in middle, sides strongly elevated, especially behind middle; front and hind angles rounded off. *Elytra* slightly dilated posteriorly; with double rows of irregular punctures; alternate interstices moderately elevated. Length (♂, ♀), 8-10·5 mm.

♀. Differs in having somewhat shorter and less strongly serrated antennae, and subapical segment of abdomen not notched.

Hab.—New South Wales: Eden, in October (Dr. E. W. Ferguson and H. J. Carter). Type, I. 12274.

In some respects close to *M. eremitus*, with which it would be associated in my table, but elytra more dilated posteriorly, and with only about one-sixth pale at the tips; the pale portion, however, is slightly advanced on the sutural and lateral costae, the prothorax also is pale only on the sides.

METRIORRHYNCHUS COMPOSITUS, n. sp.

♂. Black; prothorax, scutellum, and three-fifths of base of elytra of a rather dingy flavous.

Head with rostrum very short. Antennae moderately long, acutely serrated. *Prothorax* along middle (owing to the obtusely produced apex) almost as long as wide, conspicuously seven-areolate, front angles obtuse, hind ones produced and acute, median areolet produced to beyond middle of medio-apical ones, these much smaller than latero-apical ones. *Elytra* thin and parallel-sided; with regular double rows of punctures, except about tips, the alternate interstices distinctly elevated. Length, 8·5 mm.

Hab.—Queensland: Coen River (H. J. Carter from H. Hacker). Type (unique) I. 11850.

On the type there is an infuscated stain at the inner corner of each of the latero-basal areolets, and the scutellum is also infuscated towards the base. In my table would be placed with *M. posticalis*, but the frontal areolets are very different, and the antennae are non-ramose; regarding the dark parts of the prothorax as more than stains it would be placed with *M. marginipennis* and *M. eremitus*, whose pale elytral markings are longitudinal.

Metriorrhynchus crassipes, n. sp.

♂. Black and flavous.

Head with very short rostrum. Antennae rather short and wide, third joint distinctly longer than fourth, and each feebly serrated, the others to tenth more strongly serrated and gradually decreasing in width, eleventh about one-half longer than tenth. *Prothorax* moderately transverse; conspicuously seven-areolate; apex obtusely produced in middle, sides narrowed to middle, front angles obtusely rounded, hind ones slightly rounded. *Elytra* rather thin; with double rows of somewhat irregular punctures, alternate interstices distinctly elevated. *Legs* rather stouter than usual. Length, 7-7·5 mm.

Hab.—North-western Australia: Forrest River, in February (J. Clark from W. Crawshaw); Northern Territory: Stapleton, in February (G. F. Hill, No. 54). Type, I. 11832.

The flavous parts are the prothorax, scutellum, elytra (except for rather more than the apical fourth), abdomen (three or four of the basal segments deeply infuscated or black), coxae and base of femora (more of the middle than of the hind ones, and less than of the front ones). In my table would be placed with *M. posticalis*, but the male of that species has flabellate antennae; in appearance the type is somewhat like a small specimen of *M. apicalis*, *M. abdominalis*, or *M. melaspis*, but its rostrum is short; many species of *Trichalus* are similarly coloured.

Var. (?) Another male, from the Forrest River, may belong to this species, but it differs from the others in having the prothorax with the sides almost parallel, its front margin semidouble (approaching that of *M. gracilis*), more than one-third of the elytra black on the sides, but the flavous part triangularly advanced at the suture, more of the hind femora pale, and the abdomen entirely black.

Metriorrhynchus eucerus, n. sp.

♂. Flavous, head (partly or entirely), antennae (basal joints sometimes obscurely paler), palpi and apical fourth or fifth of elytra black, tarsi and metasternum more or less deeply infuscated.

Head with very short rostrum. Antennae with long rami. *Prothorax* moderately transverse; conspicuously seven-areolate; apex obtusely produced in middle, sides narrowed to middle, front angles obtuse, hind ones produced and acute, median areolet large, produced fairly close to apex. *Elytra* rather thin and parallel-sided; with double rows of regular punctures to near apex, the alternate interstices moderately elevated, but the same as the others on the dark portion. Length, 7-9 mm.

Hab.—Northern Territory: Darwin and Daly River (H. Wesselman). Type, I. 11828.

The ramus on the third joint of the antennae is about twice the length of its supporting portion, on the following ones, to tenth, it is longer (up to thrice the length of its support), the eleventh joint is about thrice the length of the non-ramose portion of the tenth; the lengths of the rami, however, vary slightly on the six specimens taken. In my table the species would be placed with *M. posticalis*, *M. gracilis*, and *M. fallax;* of these *gracilis* was described as having more of the under-surface and legs dark, and less of the elytra, and with very different prothoracic areolets, on the present species they are all well defined, and the central one is not confined to the basal half; *posticalis* has more of elytra and of under-surface dark, and the areolets different; *fallax* (of which I only know the females) has less of elytra and more of under-surface dark, and the areolets different.

Metriorrhynchus trichocerus, n. sp.

♂. Flavous; head, antennae, palpi, apical third (or more) of elytra, abdomen, tarsi, and parts of tibiae black.

Head with rostrum very short. Antennae with long rami on third to tenth joints, the rami with moderately dense and rather long hairs, eleventh joint more than twice the length of the non-ramose part of tenth. *Prothorax* moderately transverse; conspicuously seven-areolate, apex obtusely produced, sides narrowed to middle; front angles obtuse, hind ones slightly produced and subacute, central areolet slightly produced between bases of medio-apical ones. *Elytra* thin and parallel-sided; with regular double rows of punctures, the alternate interstices moderately elevated. Length, 6-7·5 mm.

Hab.—Northern Territory: Melville Island (W. D. Dodd). Type, I. 11820.

All the rami are long, the shortest (on the third joint) being almost twice as long as its support. The species is allied to the preceding one, but the rami have conspicuous clothing, the abdomen is dark, and the metasternum pale (there are six of the preceding species and three of the present before me, and the differences noted are constant); in my table would be placed with *M. posticalis*, which has darker legs and under-surface, median areolet of prothorax longer, etc.

A female, from Stapleton (G. F. Hill), probably belongs to this species, its colours are as in the type, except that the basal joint of the antennae is obscurely pale (as it is also on one of the males); its antennae are shorter, rather wide, and the fourth to tenth joints are moderately serrated, the eleventh joint is almost twice the length of the tenth, the abdomen is wider, its subapical segment is not notched and the legs are shorter.

TRICHALUS INFAUSTUS, n. sp.

♂. Sooty-black; prothorax, and rather more than basal half of elytra of a dingy flavous.

Antennae moderately long, third to tenth joints strongly serrated. *Prothorax* slightly longer than apical width, sides considerably elevated near base, and somewhat sinuous, front angles rounded off, hind ones acute, central areolet continued to apical fifth and connected with apex by a short costa. *Elytra* rather thin, slightly narrowed in middle, subsutural costa trifurcate at basal fourth. Length, 9·5-10·5 mm.

Hab.—Queensland: Cairns district (A. M. Lea), Atherton (Dr. E. Mjoberg). Type, I. 12277.

In my table[6] would be placed with *T. flavopictus*, which is a larger species, with wider prothorax, elytra more dilated posteriorly, and less of apex dark; the dark part is not sharply limited, but is continued almost to the middle as an infuscation; on both specimens before me there is an infuscated stain on the disc of the prothorax, and the scutellum is dark.

TRICHALUS QUADRICAVUS, n. sp.

♀. Black; prothorax, scutellum, basal four-fifths of elytra, front and middle coxae, and trochanters flavous.

Antennae rather long, third joint about twice as long as its apical width, and slightly longer than fourth, the others to tenth slightly decreasing in length and width but none transverse, eleventh about half as long again as tenth. *Prothorax* about as long as the apical width, front angles obtuse, hind ones acute; central areolet divided into two parts. *Elytra* parallel-sided to near apex, alternate interstices distinctly elevated, the subsutural one trifurcate at basal third. Length, 8 mm.

(6) Lea, Trans. Ent. Soc. Lond., 1909, p. 90.

Hab.—Queensland: Cairns district (A. M. Lea). Type (unique), I. 11839.

One side of the prothorax of the type is gently incurved to the middle, but the other is slightly dilated there, this appears to be due to post-mortem contractions. The dark part of the elytra is slightly dilated on the sides. At first glance the type appears to be a specimen of *T. froggatti*, with more of the apex of elytra black than usual; but the doubling of the central areolet associates it with *T. insignis*, which is a much larger species, with part of the prothorax black, and the black markings of elytra longitudinal instead of apical; the basal portion of the central areolet is half the length of the segment, then there is a portion half its size, and a carina connects this with the apex.

Dumbrellia pilosicornis, Lea.

Two males, from Melville Island, appear to belong to this species, but differ from the type in having more of the apex of the elytra black: on one specimen occupying about one-fourth of the elytra, on the other less about the suture, but as much near the sides; the prosternum and mesosternum are flavous, and the head is moderately infuscated instead of black; on one of them the head is flat between the eyes, on the other there is a depression there, although not as deep as on the type; the differences are probably due to contractions on drying.

Dumbrellia melancholica, n. sp.

♀. Sooty-black; head and prothorax somewhat shining.

Head with a rather feeble median line, but ending in front in a small, deep fovea. Antennae rather long and thin, most of the joints cylindrical, second very small, third wider than fourth, but somewhat shorter, the following ones to tenth feebly decreasing in width, eleventh slightly longer than tenth. *Prothorax* about twice as wide as long, apex gently produced in middle, sides feebly increasing in width to base, front angles obtuse, hind ones produced and acute, a narrow deep transverse impression on each side of base, but isolated from a small medio-basal impression; with rather large submarginal punctures at sides and apex. *Elytra* thin and parallel-sided; with almost regular rows of rather large, rounded punctures. Length, 5·25 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type (unique), I. 11843.

Readily distinguished from the two previously described species by its entirely dark upper-surface; the deep median line of the prothorax of these species is represented on the present one by a basal fovea only.

Calochromus guerini, Macl.

Two specimens, from Cairns, differ from the typical form of this species in having the prothorax red, except for a narrow dark median line; another, from Dorrigo, has the prothorax normally coloured, but the elytra entirely red.

Calochromus insidiator, Fairm.

A male, from the Tasmanian Lakes, and three others, from Ulverstone, have a blackish triangle about the scutellum, and so, at first glance, appear to belong to *C. scutellaris*, but the head is unarmed.

Calochromus amabilis, Lea.

Three males, without exact locality labels, from the Blackburn collection, probably belong to this species; they have the punctures about the tips of the elytra decidedly coarser than elsewhere, and similarly thick antennae to those of the types, the apical marking, however, is briefly transversely-elliptic, instead of slightly advanced along the suture, and concave between the suture and each side. The antennae are decidedly shorter and thicker than those of the male of *C. basalis*, but the elytral interstices are intermediate between those of that species and *amabilis*.

Calochromus denticulatus, n. sp.

♂. Blackish-purple; prothorax, scutellum, and elytra (except apical sixth) lemon-yellow.

Head with a flange-like process overhanging and concealing labrum; a narrow median line at base, ending between antennae in a small, deep fovea. Antennae long and thin, first joint stout, second very small, third wider and shorter than fourth, the others to tenth subequal in length, and very feebly decreasing in width, eleventh slightly longer than tenth. *Prothorax* almost twice as wide as long, a large sinuous depression near each side, and a narrow one along middle. *Elytra* almost parallel-sided; punctate-striate, punctures partially concealed by pubescence, but becoming more distinct about apex, where the striae vanish; alternate interstices somewhat elevated above their fellows. Front *femora* rather stout; with two rows (two or three in each row) of small teeth, or acute granules, on under-surface near apex; front tibiae denticulate on lower-surface. Length, 12 mm.

Hab.—Queensland: Coen River (W. D. Dodd). Type, I. 11840.

The head has a curious process that projects in front so that the labrum is concealed from above, its front angles are rectangular, but the middle is slightly produced, from the sides it resembles a thin flange, it is not an acute process such as in *C. scutellaris*, so I regard the head as unarmed, and so regarding it the species would be associated with *C. guerini*, in which the process is ridged along the middle in the male; the antennae are slightly longer (13 mm.) than the body. It belongs to Waterhouse's second section of the genus.

A specimen from New South Wales (Wentworth Falls, H. J. Carter), possibly belongs to this species, but has the dark part of the elytra advanced to the basal fourth, the front femora with more numerous teeth (seven on one of the rows), and the dentition of the front tibiae inconspicuous. Another specimen, from the Madang district of New Guinea, possibly also belongs to the species, but the dark part of the elytra has a deep metallic-green gloss, and leaves only the basal fifth pale, the denticulation of its front legs is as on the Wentworth Falls specimen.

Luciola cowleyi, Blackb.

Some years ago I received from the late Rev. T. Blackburn a specimen bearing his name—label "*Luciola cowleyi*, Blackb.," but without a locality label; this specimen agrees well with the description, except that parts of two abdominal segments are white; whereas in the description only the penultimate segment was noted as white; on some specimens with the apical segment contracted, however, its white part is scarcely distinct from that of the preceding segment, so that possibly he was misled, or the type may have been a female (unknown to me) with really only one segment white. There are numerous males in the Museum, from the Northern Territory, that agree with the specimen above noted, and all of them have the white of the abdomen confined to the lower-surface; the dark parts of the elytra vary somewhat in intensity of colour, and on some specimens only a small part of the base of each could be regarded as blackish.

Luciola flavicollis, Macl.

A specimen, from Normanton, possibly represents a variety of this species; it is larger (6·5 mm.) than usual, and the suture is as widely pale as the sides, but the black covers the whole of the tips; three apical segments of the abdomen are pale, but the two apical ones are more flavous than the other, which is almost white, the apex of the subapical segment is gently but distinctly incurved to the middle, much as in females of *L. humilis*, and *A. lychnus*, but less strongly than in the females of *L. platygaster*, and *L. complicata*, and the femora are entirely pale. The apex of its prothorax is feebly produced as on females of other species, and the head is only feebly concave. On normal specimens of *flavicollis* the third segment from the apex of the abdomen is entirely white on both sexes, the two apical ones are dark on the female, and the subapical one has a large, white, medio-basal patch on the male.

Luciola dejeani, Gemm.

L. apicalis, Boi., n. pr.

♂. Flavous; head, antennae, palpi, a spot at apex of each elytron, part of third segment of abdomen, tarsi, and tips of tibiae, black or infuscated; two apical segments of abdomen white.

Head concave, shining, and with small punctures between eyes. Antennae with third joint slightly longer than fourth. *Prothorax* about twice as wide as long, depressed near margins, median line distinct; punctures dense. *Elytra* subparallel-sided to near apex, with feeble remnants of discal costae; punctures small and crowded, but sharply defined. Length, 8 mm.

Hab.—Probably Northern Territory.

The abdomen appears to be composed of two pale segments, then an infuscated one, then a white one similar in shape to the third, then a long white one with its tip rounded (it is possible, however, that there is a very small white one, inconspicuously attached to the tip of the fifth, and obscured by pubescence).

There are before me two species, either of which may be *dejeani* (or possibly neither), the original description is "Lutea, capite nigro; elytris apice nigris; subtus lutea." With a translation into French. The locality was New Holland. But of these two species the one described above (without locality label but probably from Darwin) bears Blackburn's name-label "Luciola dejeani Gemming," and as less of its under-surface is dark than on the other (described below) I shall presume that it is correctly identified [7]; it is somewhat smaller and narrower than the specimen in the Australian Museum identified by Olliff as *dejeani*, but appears to belong to the same species.

Luciola costata, n. sp.

♂. Flavous; head, antennae, palpi, about one-fourth of apex of elytra (less on suture and sides), two segments of

[7] The type is probably in the Paris Museum.

abdomen, tarsi and tibiae (except at base), black or blackish; two apical segments of abdomen white.

Head concave and with dense punctures. Antennae with third joint slightly longer than fourth. *Prothorax* about twice as wide as long, with irregular submarginal depressions, median line distinct; punctures of moderate size, crowded, and somewhat asperate. *Elytra* rather wide, subparallel-sided to near apex; each with four discal costae, of which the inner two are conspicuous, commence at the base and terminate on the black portion, the other two are feeble, commence at the basal third, and terminate just inside the black portion; punctures dense and sharply defined, but rather small. Length, 8·5-9 mm.

Hab.—Northern Territory: Flora River (Prof. Baldwin Spencer). Type, in National Museum; cotype, I. 12280, in South Australian Museum.

Of the abdominal segments the first is scarcely darker than the sterna, the second is deeply infuscated, third black, fourth white and slightly shorter than third, fifth white and almost thrice as long as fourth, owing to an obtuse extension of its apex. On the type the apex of the prothorax is produced in the form of a distinct (although very wide) triangle, on a second specimen it is scarcely produced there; the difference is probably due to post-mortem contractions. This species can hardly be the one identified by Olliff as probably *L. dejeani*, as each elytron has four discal costae of which the inner two are very distinct (quite as distinct as the sutural thickening), the tibiae are pale only at the base, and two of the abdominal segments are dark, whereas on the preceding species (assumed to be *dejeani*), the discal costae are all very feeble, tibiae dark only at apex, and only one segment of abdomen dark.

Luciola complicata, n. sp.

♂. Blackish; prothorax, scutellum, suture for a short distance near base, sterna, abdomen (except for two white segments), and legs (tarsi, front and middle tibiae infuscated) flavous.

Head concave, shining, and with minute punctures. Antennae with third joint produced on one side, and distinctly shorter than fourth. *Prothorax* almost twice as wide as long, depressed near margins, median line sharply defined; with fairly dense and sharply defined punctures. *Elytra* parallel-sided to near apex, with vague remnants of discal costae; punctures crowded and rather small, but sharply defined. Hind *femora* stouter than the others and somewhat curved; hind tibiae curved at base and stouter than the others. Length (♂, ♀), 5·5-7 mm.

♀. Differs in having smaller and less concave head, eyes smaller, third joint of antennae scarcely shorter than fourth and of the same shape, hind legs thinner and less curved, and in the abdomen.

Hab.—Queensland: Coen River (W. D. Dodd). Type, I. 11844.

On two males the basal segments of abdomen are small and shrivelled, the two following ones are large and entirely white, the second of these has its tip sinuous and a flavous subconical process on each side, beyond this the segments are depressed, with a large circular cavity on each side, bounded posteriorly by a shining ring-like elevation; the tip is deeply notched, with a small conical lobe (probably the tip of the sixth or seventh segment) in the notch; on the female only one segment is white, the next one is flavous, and rather widely incurved to the middle of the apex, with the following segment moderately long and also flavous. It is allied to *L. platygaster*, but the male with curious circles below the second phosphorescent segment, and this with conical processes at the sides; the male is distinguished from the female of that species by its pale legs.

Atyphella flammans, Oll.

A male, from Kuranda, differs from the typical form in having the dark parts of each elytron reduced to a medio-basal patch between the first and third discal costae, and a still smaller apical one.

Telephorus pulchellus, W. S. Macl.

Mr. H. J. Carter and I saw a dwarf form of this species in abundance on flowers on Cradle Mountain, and Mr. L. Rodway took similar specimens on the summit of Ben Lomond in Tasmania.

Telephorus viridipennis, Macl.

Many specimens of this species have the prothorax immaculate, on others there is a spot varying from hardly more than a small infuscated stain to large, sharply defined and black, with a greenish gloss.

Telephorus rufiventris, Macl.

T. tepperi, Blackb.

The type and a co-type of *T. tepperi* are but slight varieties of *T. rufiventris*, and similarly coloured specimens occur in Queensland.

TELEPHORUS GRACILIPICTUS, Lea.

The female of this species differs from the male in having the head narrower across the eyes, less of the muzzle flavous, and the antennae and legs shorter.

TELEPHORUS APICICOLLIS, n. sp.

♂. Flavous, most of elytra and of abdomen black or infuscated. Rather densely clothed with short, ashen pubescence.

Head rather wide and flat, clypeus notched in middle; with very minute punctures, dense in places. Eyes rather large. Antennae long and thin, third joint slightly shorter and wider than fourth. *Prothorax* distinctly longer than wide, apex produced in an even curve over prothorax, and with distinct asperate punctures, elsewhere with very minute punctures; a large depression on each side near apex, and a shallow one in middle of base. *Elytra* long, thin, and almost parallel-sided; with dense and minute punctures, interspersed with numerous larger (but still small) asperate ones, sparser about base than elsewhere; with very feeble remnants of discal costae. Apical segment of *abdomen* deeply notched. *Legs* long and rather thin. Length, 8·5-9 mm.

Hab.—Northern Territory: Melville Island (W. D. Dodd and G. F. Hill), Bathurst Island (Hill). Type, I. 11855.

Allied to *T. macrops*,[8] but prothorax decidedly longer, and elytra, except for a small basal portion, deeply infuscated or black; in my table[9] it would be associated with *T. immaturus*, and *T. nigroterminalis*, to which, however, it is not very close. The produced part of the prothorax has a thin apical fringe, but it appears to be easily abraded. The flavous portion of the elytra is from about half to three-fourths the length of the prothorax; on the type it is narrowly continued along the sides and suture for a short distance; on a second specimen it is very narrowly continued almost to the apex; on a third specimen it is sharply limited near the base; the infuscation of the abdomen is less pronounced than that of the elytra.

SELENURUS ANNULATUS, Macl.

There are two forms of this species before me. On the first and evidently the typical one (as the flavous portion extends backwards along the suture, on several specimens in

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(8) In the original description two figures (157 and 173) were quoted for this species in error.

(9) Lea, Trans. Ent. Soc. Lond., 1909, p. 113.

fact narrowly connected with the apex) the black basal marking on the elytra is completely isolated, as the flavous subbasal part is continued to the extreme margins. On the second form the subbasal flavous part is larger, but is not continued along the suture, and does not touch the sides near the base, although from above it appears to do so.

Selenurus tenuis, n. sp.

♂. Black; elytra with an obscure bluish or greenish gloss; prothorax flavous, with a small discal infuscation, parts of muzzle and tips of abdominal segments obscurely flavous. Clothed with short, ashen pubescence, and some longer, dark hairs.

Head rather elongate. Antennae moderately long and thin, third joint about half the length of the fourth. *Prothorax* subcylindrical, distinctly longer than wide, surface slightly uneven. *Elytra* slightly wider than prothorax, narrowed posteriorly, terminated long before apex of abdomen; granulate punctate, or with coarsely rugose punctures. *Legs* long and thin. Length (♂, ♀), 5-6 mm.

♀. Differs in having somewhat smaller head and shorter legs.

Hab.—South Australia: Lucindale (F. Secker). Type, I. 11853.

Allied to *S. sydneyanus*, but prothorax decidedly longer, elytra shorter and more coarsely sculptured, and antennae thicker; the prothorax is much the shape of that of *Telephorus kershawi*, but that species is without flight wings, whereas on this species they are present. The discal spot is at about the apical third and occupies about one-fourth the length of the prothorax, on one of the males, and on the two females before me; on a second male it is represented by two minute dots. The abdomen is badly shrivelled on all of them.

Selenurus tenuicornis, n. sp.

♂. Black; elytra with an obscure olive-green gloss; part of muzzle, prothorax (except for a large discal blotch), scutellum, much of sterna, tips of most of the abdominal segments, coxae, basal half of femora, and base of tibiae flavous. With short, ashen pubescence.

Head rather wide; with large prominent eyes; sides thence strongly narrowed to base; with minute punctures. Antennae long and thin, third joint about half the length of fourth. *Prothorax* longer than wide, sides almost parallel, apex obtusely produced in middle, disc uneven. *Elytra* much wider than prothorax, much shorter than abdomen, strongly narrowed posteriorly, with a feeble and rather short discal costa on each; with dense and minute, rugulose punctures or shagreened. *Legs* long and thin. Length (♂, ♀), 6-9 mm.

♀. Differs in having somewhat smaller, but still very prominent eyes, and somewhat shorter antennae and legs.

Hab.—Queensland: Coen River (W. D. Dodd). Type, I. 12253.

Close to *S. sydneyanus*, but larger, antennae longer, elytra much less coarsely shagreened, scutellum flavous (instead of black), more of the legs flavous, and prothoracic blotch of different shape; the blotch is of irregular shape, slightly dilated in front and behind, and narrowly touches each side about the middle. The under-surface of several of the basal joints of antennae are obscurely pale. The types are fastened together, as they were taken *in cop.*, and their abdomens are greatly shrivelled.

Selenurus flavoinclusus, n. sp.

♂. Black and flavous. Densely clothed with short pubescence, varying in colour with the derm.

Head rather wide across eyes, strongly narrowed to base; with dense and minute punctures. Antennae long and thin, third joint about half the length of fourth. *Prothorax* considerably longer than wide, disc uneven, sides and suture thickened, apex produced over base of head; punctures very minute. *Elytra* much wider than prothorax, long, thin, and regularly decreasing in width posteriorly, with tips diverging from suture; with dense and fine rugulose punctures or shagreened. Subapical segment of *abdomen* semicircularly incised. *Legs* long and thin. Length, 10-13 mm.

Hab.—Queensland: Cairns district (E. Allen and F. P. Dodd). Type, I. 11852.

The pale parts are portion of the muzzle, prothorax, scutellum, elytra (base suture and sides narrowly black, but tips entirely pale), parts of sterna, tips of abdominal segments, basal half of femora, and extreme base of tibiae. The pale tips of the elytra associate the species with *S. annulatus*, from which it differs in being larger, elytra longer, with the flavous portion of each considerably longer, only just interrupted before the apex, instead of separated from the tips by a wide black band, the suture also is dark from the base to just before the tips, so that the flavous portion is separately enclosed on each elytron; on *annulatus* the larger flavous portion is continuous across the suture;

more of the legs are dark and the prothorax is immaculate. On two of the specimens the abdominal notch is double, but this appears to be due to post-mortem contraction.

Heteromastix.

The species of this genus usually have the elytra black, prothorax flavous, and head, legs, and antennae varying from partly to entirely black or flavous; the females as a rule are difficult to distinguish, *inter se*, and those of many species have not been described; but the males usually have distinctive antennae, the eleventh joint being often of remarkable shape, the tenth also is frequently peculiar. It is probable that the genus *Astychina* (10) will be found to be closely allied to, if not actually forming a section of it, the two apical joints of the antennae of *A. flavicollis*, *A. moerens*, and *A. funebris* differ quite as much from each other as do some species of *Heteromastix* with those joints distorted. So many species have been added since my table of the genus was published (11) that the following grouping should be of use:—

Antennae with third to fifth joints distorted in male.

DISTORTUS, Lea
INFLATUS, Lea

Antennae with ninth joint conspicuously dilated in male.

FUSICORNIS, Blackb.
INSIGNICORNIS, Lea
MACLEAYI, Lea
MCDONALDI, Lea
NONARIUS, Lea

Antennae with eleventh joint (and usually the tenth) distorted in male.

BICOLOR, Bohem.
BISPINICORNIS, Lea
BRYANTI, Lea
CASTOR, Lea
CRASSICORNIS, Lea
DECIPIENS, Lea
DIORYCERUS, Lea
FLAVIFRONS, Lea
FLAVOTERMINALIS, Lea
FRATER, Lea
GAGATICEPS, Lea
GALEATUS, Blackb.
IMITATOR, Lea
LATICOLLIS, Lea
LONGICORNIS, Lea
LURIDICOLLIS, Macl.
MAJOR, Lea
MEDIOFUSCUS, Lea
MELANOCEPHALUS, Lea
MINOR, Lea
MIRABILIS, Lea
MIRUS, Lea
OBSCURIPES, Lea
OBSCURUS, Lea
PALLIPES, Lea
POLLUX, Lea
SCUTELLARIS, Lea
SPINICORNIS, Lea
TASMANIENSIS, Lea

(10) Westwood, Trans. Ent. Soc. Lond., 1876, p. 494.
(11) Lea, *l.c.*, 1909, pp. 130-132.

Antennae with many joints distorted in male.

MIROCERUS, Lea

Antennae simple in both sexes.

A. Prothorax partly or entirely dark.

APICIFLAVUS, Lea
CRIBRIPENNIS, Lea
DISCOFLAVUS, Lea
FRAGILIS, Lea
GLABER, Lea
NIGER, Lea .
PULCHRIPENNIS, Lea
TENUIS, Lea

B. Prothorax entirely pale.

a. Elytra partly or entirely pale.

DENTICOLLIS, Lea
DOLICOCEPHALUS, Lea
FLAVIPENNIS, Lea
NIGRICEPS, Lea
NIGRIVENTRIS, Lea
TIBIALIS, Lea

b. Elytra entirely dark.

AMABILIS, Lea
ANGUSTUS, Lea
ANTICUS, Blackb.
CASTIGATUS, Lea
COLLARIS, Lea
COMPAR, Lea
GENICULATUS, Lea
LATUS, Lea
MEGALOPS, Lea
NIGRIPES, Lea
OCCIDENTALIS, Lea
PAUXILLUS, Blackb.
PERABUNDANS, Lea
PUNCTICORNIS, Lea
PUSILLIOR, Lea
PUSILLUS, Bohem.
SERRATICORNIS, Lea
SIMPLEX, Lea
TARSALIS, Lea
TRICOLOR, Lea
VICTORIENSIS, Blackb.

HETEROMASTIX PUSILLUS, Bohem.

A specimen of this species, from Lucindale (South Australia) has a large, double, infuscate spot on the base of the prothorax.

HETEROMASTIX VICTORIENSIS, Blackb.

On the male of this species the ninth joint of the antennae is slightly longer and thicker than the eighth or tenth, and has a small fovea near its apex; Blackburn did not specially mention the ninth joint, and in fact its distinctive features could be easily overlooked, but they appear to connect the species with those having that joint conspicuously inflated (as in *H. mcdonaldi* and allied species) with those in which the antennae are simple in both sexes. Tasmanian specimens differ from mainland ones in having the knees no paler than the adjacent parts.

Heteromastix tenuis, Lea.

The female differs from the male in being somewhat shorter, antennae decidedly shorter, prothorax without a small subbasal notch on each side, and abdomen simple.

Heteromastix mirabilis, Lea.

The female differs from the male in being somewhat smaller, antennae thinner and simple, legs shorter, and in the abdomen; it is in fact scarcely distinguishable from the females of many other species of the genus, although the male is one of the most distinct.

Heteromastix macleayi, Lea.

Three males from Northern Queensland (Innisfail and Cairns) appear to belong to this species, but differ somewhat from each other and from the description of the type. One in size and colour is like the type except that the four apical joints of its antennae are infuscated; the second is larger, 3 mm., and has the joints after the second infuscated, becoming almost black after the eighth, its elytra have the basal fifth flavous and sharply defined from the black; the third is still larger, 3·75 mm., and has the joints of the antennae, after the second, still darker, and slightly more of the elytra pale. A female, mounted with the second male, agrees well with it in colour and size, but has the antennae shorter (the three apical joints only about half the length of those in the male), with the ninth joint and the abdomen simple.

Heteromastix dolicocephalus, Lea.

On the male of this species the subapical segment of the abdomen is gently emarginate, the emargination becoming slightly stronger in the middle, not suddenly as in most males of the genus; the antennae are decidedly longer than in the female.

Heteromastix amabilis, Lea.

Prior to being published this species was given the manuscript name of *elegans*, and was so noted in the table(12): afterwards the name was changed to *amabilis*, and unfortunately the necessary alteration was not made in the table.

Heteromastix bryanti, Lea. Figs. 1-3.

As the terminal joints of the antennae were not figured at the time of the description of this species, views of them, from different directions, are given for comparison with those of other species.

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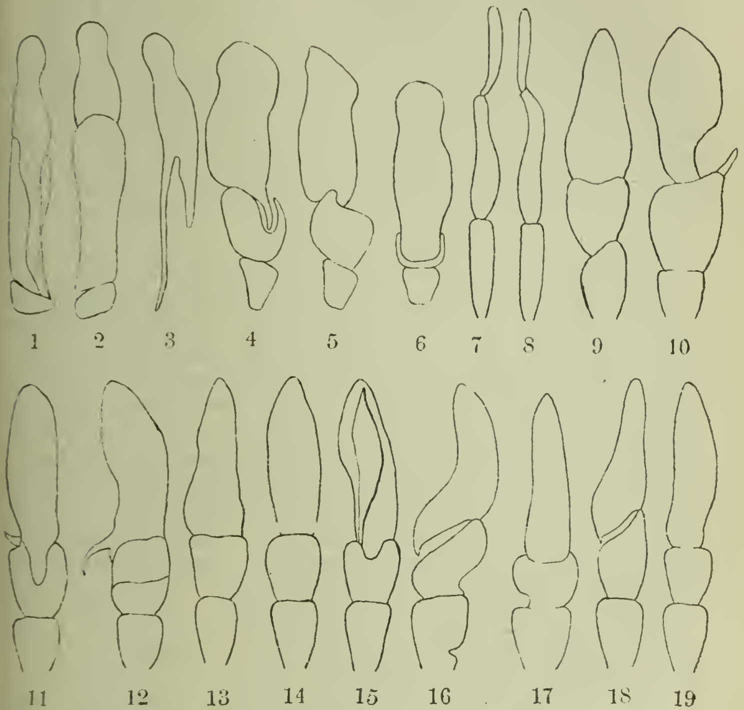
(12) Lea, Trans. Ent. Soc. Lond., 1909, p. 132.

HETEROMASTIX FLAVOTERMINALIS, Lea. Figs. 4-6.

Three figures of the terminal joints of antennae given for the same reason as those of the preceding species.



TERMINAL JOINTS OF ANTENNAE OF SPECIES OF HETEROMASTIX. 1-3, *H. bryanti;* 4-6, *H. flavoterminalis;* 7, 8, *H. longicornis;* 9, *H. mediofuscus;* 10-12, *H. bispinicornis;* 13-15, *H. major;* 16, 17, *H. obscuripes;* 18, 19, *H. tasmaniensis.*

HETEROMASTIX NONARIUS, n. sp.

♂. Black; head, prothorax, scutellum, mesosternum, legs, and basal joints of antennae flavous. Moderately pubescent.

Head gently convex, with small prominent eyes. Basal joint of antennae about as long as second and third combined, second to fifth moderately transverse, sixth to eighth strongly so, ninth large, about as long as four preceding ones combined, evenly dilated from base but more produced on inner side of apex than on outer side (tenth and eleventh joints missing). *Prothorax* almost twice as wide as long; with a few submarginal punctures. *Elytra* parallel-sided to near apex; with dense and small, but sharply defined punctures. Length, 3 mm.

Hab.—Northern Queensland (Blackburn's collection). Type (unique), I. 11859.

In my table would be associated with *H. fusiformis*, from which it differs in being smaller, legs entirely pale, antennae with third to eighth joints decidedly transverse, and the ninth larger and of different shape; it is also close to *H. insignicornis*, but the seventh and eighth joints of antennae are at least twice as wide as long, instead of slighty transverse, the third joint also is no larger than the second.

HETEROMASTIX LONGICORNIS, n. sp. Figs. 7, 8.

♂. Black and flavous. With dense, short pubescence. *Head* gently convex, with two feeble interocular impressions. Antennae long and thin, fourth joint the length of first, slightly longer than third, and twice the length of second, the others somewhat longer, tenth and eleventh distorted. *Prothorax* twice as wide as long, margined throughout, the lateral margins slightly dilated and thickened near apex; with fairly large, submarginal punctures. *Elytra* long, thin, and almost parallel-sided to near apex; with dense and small punctures, many of which are sharply defined, but others transversely confluent. Subapical segment of *abdomen* triangularly notched in middle. *Legs* thin, but not very long Length, 3·5 mm.

Hab.—New South Wales: Dorrigo (W. Heron), Gosford (H. J. Carter). Type, I. 11863.

The antennae extend to the tips of the elytra, the distortion of the apical joints is very different from that of all other known species, the tenth is distinctly longer than the ninth and eleventh, and slightly thicker, from one direction it appears somewhat lopsided and from another sinuous, on top near the apex there is a shallow groove, as if for the partial reception of the eleventh; the latter is slightly longer than the ninth and strongly curved at the base. The pale parts are the head, prothorax, scutellum, a small part of base of elytra, and the sides to near apex (but the two colours not sharply limited), legs (parts of tarsi infuscated), and basal joints of antennae.

Two females, from Dorrigo, probably belong to this species, they differ from the males in having the head black, except for a variable portion of the muzzle, the scutellum black, the black of the elytra advanced to the base, except at the sides, where it is continued almost to the tips, antennae shorter, thinner, with simple joints, and abdomen not notched; on one of them its tip is flavous.

HETEROMASTIX MEDIOFUSCUS, n. sp. Fig. 9.

♂. Black; muzzle, prothorax, legs, two basal, and three apical joints of antennae flavous. With short and moderately dense pubescence.

Head shining, and with two feeble interocular depressions. Antennae moderately long, fifth and seventh joints slightly dilated on upper side, the sixth conspicuously dilated there, ninth joint longer than eighth, tenth and eleventh distorted, closely applied together, and about equal to the combined length of the seventh to ninth. *Prothorax* about twice as wide as long, sides slightly dilated and slightly thickened near apex. *Elytra* parallel-sided to near apex; with dense and small, but sharply defined punctures. Length, 3·5 mm.

Hab.—Queensland: Mount Tambourine (A. M. Lea). Type (unique), I. 11864.

Apart from the antennae I cannot distinguish this species from *H. bicolor*, but the sixth joint is conspicuously produced on one side, although from some directions it appears even smaller than the adjacent ones; in colour it also approaches *H. mirocerus*, but the fourth to sixth joints of antennae of that species are very different. The third to sixth joints are pale on the under-parts, and infuscated above, the three following joints are almost black, the eleventh is so closely applied to the tenth that it is difficult to distinguish its junction with that joint; it appears to be somewhat helmet-shaped, although not much like that of *H. gagaticeps*.

HETEROMASTIX BISPINICORNIS, n. sp. Figs. 10-12.

♂. Black; prothorax, parts of under-surface of head, legs (tarsi infuscated), and two or three basal joints of antennae flavous. With very short pubescence.

Head feebly impressed between eyes. Antennae moderately long, two apical joints distorted. *Prothorax* almost twice as wide as long, margined throughout, sides slightly dilated to near apex. *Elytra* parallel-sided to near apex; with dense and small, rugose punctures. Length (♂, ♀), 4-4·5 mm.

♀. Differs in having the head smaller, antennae shorter, thinner, and simple, and abdomen not notched.

Hab.—Queensland: Mount Tambourine (A. M. Lea). Type, I. 11865.

The tenth joint of antennae of the male is rather large, and grooved on one side for the partial reception of the eleventh, from one direction it appears to be divided into two, so that the antennae seem to be twelve-jointed; the eleventh is about the length of the three preceding combined, fairly stout on the apical half, and strongly narrowed (on one side) to the base, near the base there are two spines, a rather short outer one directed outwards and forwards (from some directions this appears to belong to the tenth joint), and a longer one on the lower side, directed downwards and backwards. The colours are as on many other species, but the armature of the eleventh joint distinguishes from them all.

Heteromastix major, n. sp. Figs. 13-15.

♂. Black; prothorax, scutellum, labrum, parts of under-surface of head, and of three basal joints of antennae, knees and front coxae flavous. With very short pubescence.

Head shallowly depressed in front. Antennae rather long and not very thin, two apical joints distorted. *Prothorax* twice as wide as long, margined throughout, wider near apex than at base. *Elytra* parallel-sided to near apex; with dense and small, rugose punctures, coarser in middle than elsewhere. Subapical segment of *abdomen* deeply triangularly notched. Length, 6·5 mm.

Hab.—New South Wales (R. J. Burton). Type (unique), I. 12254.

The tenth joint of antennae is slightly shorter than the ninth, slightly wider at apex, somewhat lopsided, and with a notch at the apex on the under-surface; the eleventh is irregularly curved on one side, appears widest at base, and from another narrower than the tenth, and on its under-surface there is a long irregular groove; it has also a small basal spine invisible from most directions, and from some appearing to be attached to the tenth. Except for the labrum the upper-surface of the head is entirely black, and this with the pale scutellum associate the species in my table with *H. pallipes*, and *H. laticollis*, the former has legs almost entirely pale, and the latter with a greater portion dark, they have also different terminal joints; it is larger than any other species, having the elytra entirely dark and terminal joints distorted.

Heteromastix obscuripes, n. sp. Figs. 16, 17.

♂. Black; prothorax and parts of three basal joints of antennae flavous. With short, ashen pubescence.

Head with two small but distinct interocular impressions. Antennae moderately long and not very thin, three apical joints distorted. *Prothorax* about twice as wide as long, distinctly margined throughout. *Elytra* parallel-sided to near apex; with dense and small, but sharply defined punctures, becoming somewhat larger about middle. Length, 4 mm.

Hab.—Victoria: Dividing Range (Blackburn's collection). Type (unique), I. 11868.

The seventh and eighth joints of antennae are slightly incurved on one side, and outcurved on the other, the ninth has a narrow notch near the base (invisible from most directions, but very distinct from others), the tenth has its apical portion hollow, and conspicuously produced on one side, and a subbasal notch somewhat larger than on the ninth, the eleventh is about as long as the two preceding combined, with a spine on one side of base, and the middle strongly incurved on one side. There are two small, round foveae, on the disc of the pronotum of the type; they are quite symmetrical, but their presence is possibly due to post-mortem contractions. No parts of the legs (except a small portion of the front coxae) are flavous, even the tibiae being deeply infuscated. In my table would be placed with *H. gagaticeps*, which has conspicuously bicoloured legs and very different antennae; it is closer to *H. laticollis* than to any other described species, but the scutellum is dark, the apical joint of the antennae is less strongly curved than on that species, but in much the same way.

HETEROMASTIX TASMANIENSIS, n. sp. Figs. 18, 19,

♂. Black; prothorax flavous, parts of three basal joints of antennae obscurely flavous. With rather dense pubescence.

Head with scarcely traceable frontal impressions. Antennae moderately long, third joint stouter than the others, tenth and eleventh distorted. *Prothorax* twice as wide as long, margined throughout. *Elytra* parallel-sided to near apex; with dense and small, sharply defined punctures, becoming larger about middle. Length, 3·25-3·5 mm.

Hab.—Tasmania: Cradle Mountain (H. J. Carter and A. M. Lea). Type, I. 12209.

The tenth joint of antennae on one side is slightly longer than the ninth, but on the other is conspicuously shorter, the eleventh has one side incurved towards the base, with the base itself on that side produced over the shorter side of the tenth, and with a small spine there. The abdominal notch is larger than usual. In my table would be placed with *H.*

gagaticeps, from which it differs in being smaller, legs entirely dark, darker basal joints of antennae, with apical joints different, and elytral punctures coarser; from the preceding species it differs also in being smaller, ninth and tenth joints not notched near base, the tenth longer on one side than the other, but not conspicuously produced there, and the eleventh less strongly incurved on one side. It is the only species known from Tasmania with the apical joints distorted.

HETEROMASTIX NIGRICEPS, n. sp.

♂. Black and flavous. With short, pale pubescence.

Head with two faint interocular impressions. Antennae rather long and thin. *Prothorax* about twice as wide as long, margined throughout, lateral margins somewhat wider and distinctly thickened near apex. *Elytra* parallel-sided to near apex; with dense and small, but sharply defined punctures, becoming very small at tips and base. Length (♂, ♀), 3·5-4 mm.

♀. Differs in having the head smaller, with smaller and less prominent eyes, and shorter antennae.

Hab.—Northern Queensland (Blackburn's collection), Cairns (Dr. E. W. Ferguson). Type, I. 12257.

The black parts are the head (except mentum), mesosternum, metasternum, and abdomen; on some specimens some of the antennal and tarsal joints, and the coxae, are rather lightly infuscated, on others the legs and antennae are entirely pale. On both sexes (there are two pairs taken *in cop.* before me) the abdomen is notched, but the notch is much larger on the male than on the female. In my table would be associated with *H. flavipennis*, but is a much smaller species, with finer punctures and prothoracic margins much as in *H. pusillus*, to which it is structurally closer.

HETEROMASTIX DENTICOLLIS, n. sp.

♂. Flavous; head, metasternum, and abdomen blackish, antennae (except some of the basal joints) deeply infuscated, middle and hind coxae, parts of femora and of tarsi rather lightly infuscated. With short, pale pubescence.

Head with two vague interocular impressions. Antennae long and thin. *Prothorax* at widest more than twice as wide as long, with fine margins, but each side suddenly and strongly dilated and thickened towards apex. *Elytra* long, thin, and almost parallel-sided to near apex; with dense and small, but sharply defined punctures. Length, 3-3·25 mm.

Hab.—Northern Queensland (Blackburn's collection). Type, I. 12261.

A narrow, fragile species, in many respects close to the preceding one, but at once distinguished by the lateral margins of the prothorax; these are suddenly and strongly dilated somewhat nearer the apex than base, so as to appear like a large obtuse tooth on each side; on the preceding species the margins are somewhat dilated near apex and thickened there, but the increase is neither sudden nor strong. A second specimen differs from the type in having the dark parts of the femora almost black.

HETEROMASTIX PULCHRIPENNIS, n. sp.

♂. Black; elytra deep purple. With short, dark pubescence.

Head with two small, transverse, interocular impressions. Antennae moderately thin, extending to about middle of elytra, second joint more than half the length of third, eleventh distinctly longer than tenth. *Prothorax* almost twice as wide as long, sides and base distinctly margined, the former almost parallel. *Elytra* parallel-sided to near apex; with dense and sharply defined punctures of moderate size. Length, 3 mm.

Hab.—Queensland: Coen River (W. D. Dodd). Type (unique), I. 11869.

In my table would be placed with *H. niger*, but the elytra are purple, prothorax more parallel-sided, and antennae no longer than in its female.

HETEROMASTIX FRAGILIS, n. sp.

♂. Dark piceous-brown, elytra, under-surface of head, legs, and three basal joints of antennae obscurely pale. With short, ashen pubescence.

Head vaguely impressed between eyes. *Antennae* long and thin, third joint twice the length of second, and slightly stouter than the following ones. *Prothorax* about twice as wide as long, hind angles widely rounded, sides slightly dilated to near apex, and somewhat thickened at widest part. *Elytra* long and thin; with dense, small, and somewhat rugulose punctures. Length, 2 mm.

Hab.—Northern Queensland (Blackburn's collection). Type, I. 11873.

A minute, dingy, fragile species. Its prothoracic margins are slightly paler than the disc, and so the species could hardly be referred to B or BB of my table, but regarding it as belonging to BBB of that table, it would be distinguished from the species placed there by its minute size; it is in fact smaller than any species noted in that table, but there are others equally small now before me.

HETEROMASTIX NIGRIVENTRIS, n. sp.

♂. Flavous; apical three-fifths of elytra, abdomen, and eight or nine apical joints of antennae black. With rather short, pale pubescence.

Head feebly impressed between eyes. Antennae moderately long and thin, third joint slightly stouter than the following ones. *Prothorax* about twice as wide as long, margined throughout, sides slightly dilated to near apex, and somewhat thickened near apex. *Elytra* slightly dilated beyond the middle; with dense and small, but sharply defined punctures. Length (♂, ♀), 2·5-3 mm.

♀. Differs in having the head smaller, eyes less prominent, antennae shorter, and in the abdomen.

Hab.—Northern Queensland (Blackburn's collection), Cairns (Dr. E. W. Ferguson). Type, I. 11871.

The black part of the elytra is somewhat rounded in front, so that the flavous portion is advanced along the sides to beyond the middle; on some specimens some of the antennal joints beyond the third are hardly more than infuscated. In my table the entirely pale prothorax and bicolorous elytra readily distinguish it from all species having simple antennae; structurally it approaches *H. pusillus;* the simple front legs readily distinguish it from *H. tibialis.*

HETEROMASTIX COMPAR, n. sp.

♂. Black; head, prothorax, scutellum, mesosternum, two basal joints of antennae, and knees flavous, rest of legs more or less deeply infuscated. With short, ashen pubescence.

Head with a narrow, oblique impression, on each side of middle in front. Antennae rather long and thin, tenth joint partly shining, and with a small fovea near apex. *Prothorax* less than twice as wide as long, margins rather wide at base and sides, and narrow across apex, sides widest but not thickened near apex; with distinct, submarginal punctures. *Elytra* parallel-sided to near apex; with dense and sharply defined punctures of moderate size. Length, 2·75-3 mm.

Hab.—Northern Queensland (Blackburn's collection), Kuranda (F. P. Dodd). Type, I. 11874.

The tenth joint of the antennae, on three males before me, has a small subapical fovea or puncture on a small shining place, on the type the joint itself is slightly longer and thicker than the eleventh; on the other males it is no thicker, and is slightly shorter than the eleventh; on two of them (including the type) the cephalic impressions are almost conjoined in front to form a V, on the other they are much less distinct. In my table would be placed with *H. anticus*, and *H. geniculatus*, from which it is readily distinguished by the tenth joint; from the former it is also distinguished by its smaller size and less conspicuously bicoloured legs, and from the latter also by only having two basal joints of antennae pale.

A female, mounted with one of the males by Mr. Blackburn, possibly belongs to the species, but has the head black, and differs in other (probably sexual) characters.

Heteromastix angustus, n. sp.

♂. Flavous; elytra, metasternum, abdomen, and antennae (three or four basal joints excepted) deeply infuscated. With short, ashen pubescence.

Head with two feeble interocular impressions. Antennae long and thin. *Prothorax* about twice as wide as long, base and apex finely margined, sides suddenly and strongly dilated, or obtusely dentate, rather nearer apex than base. *Elytra* long and thin; with small and crowded, somewhat rugose punctures. Length, 2·25-2·5 mm.

Hab.—Northern Queensland: Blackburn's collection. Type, I. 11879.

A thin, dingy species, structurally close to *H. denticollis*, but head and prothorax flavous; the sides of the prothorax are an exaggeration of those of *H. pusillus*, but the antennae are decidedly longer than in that species, the eyes are slightly larger, and the whole insect is smaller It is the smallest and thinnest of all the species having entirely dark elytra and pale head.

Heteromastix collaris, n. sp.

♂. Black; prothorax, part of under-surface of head, and front coxae flavous. Densely clothed with short pubescence.

Head gently depressed between eyes, with a slight longitudinal elevation near each antenna. Antennae long and rather thin, third joint stouter than the following ones. *Prothorax* less than twice as wide as long, margined throughout, sides slightly but regularly increasing in width from base to near apex, and then strongly rounded to apex itself, which is not quite as wide as base. *Elytra* almost parallel-sided to near apex; with crowded and small punctures (almost shagreened). Length (♂, ♀), 6-7 mm.

♀. Differs in having the head smaller, antennae about one-third shorter, and in the abdomen.

Hab.—Victoria: Dividing Range (Blackburn's collection), South Wandin (H. H. D. Griffith from E. Jarvis). Type, I. 12259.

The sides of the prothorax are much as those of *H. geniculatus;* but the head and knees are black; the sides are intermediate between those of the species of the *pauxillus* (F) and *pusillus* (FF) groups of my table, in *H. amabilis* the angulation is slightly more pronounced, the third and fourth joints of its antennae are thinner, and the knees are pale; *H. simplex* is smaller, with much shorter antennae, more distinct elytral punctures and pale knees; *H. pauxillus*, which it closely resembles in size and colour, has decidedly thinner antennae, and sides and front angles of prothorax different; there are a few submarginal punctures on the prothorax, but they are much less distinct than on *H. victoriensis*, which also has the sides of the prothorax evenly rounded, knees (on the typical form) paler than the adjacent parts, and elytral punctures much more sharply defined.

Heteromastix serraticornis, n. sp.

♂. Black; prothorax, part of under-surface of head, two basal joints of antennae, and part of the third, and legs (tarsi and parts of tibiae infuscated) flavous. With short pubescence.

Head gently depressed in front. Antennae moderately long, rather thin, third to tenth joints slightly serrated on one side. *Prothorax* less than twice as wide as long, margined throughout, lateral margins slightly and evenly rounded and slightly thickened near apex; with submarginal punctures. *Elytra* slightly wider near apex than at base; with crowded and small rugose punctures. Length (♂, ♀), 4·5-6 mm.

♀. Differs in having the head smaller, antennae about one-third shorter and not serrated, prothorax with margins nowhere thickened, and in the abdomen.

Hab.—New South Wales: Brindabella (Blackburn's collection), Jindabyne, in January, and Sydney (H. J. Carter). Type, I. 11876.

On each of three males and five females the tips of the front tibiae, half of the middle and three-fourths of the hind ones are infuscated; on one of the males the base of the hind femora and hind coxae are infuscated, and on two of the females the middle and hind femora are deeply infuscated in parts. The serration of the antennae of the male is slight, but quite distinct from some directions; in *H. pauxillus* they are not serrated, on the female of the present species they are also not serrated, but they are scarcely half the length of those of that species, which is also narrower and with darker legs; *H. simplex* has shorter and non-serrated antennae, elytral punctures more distinct, and more of legs dark, the antennae of its female, however, are very similar. In appearance it is closest to *H. latus*, but is somewhat narrower, antennae longer and more strongly serrated in male, the terminal joint not constricted in middle, and more of the legs and less of the head pale.

LAIUS SINUS, Lea.

A specimen, from Gosford, the locality of the type, is evidently a female of this species, its apparent second joint (really the third) of antennae is much larger than is usual in females (but in this it resembles the female of *L. flavonotatus)* but much smaller than in the male and simple, from the male also it differs in having the following joint reddish, less of the muzzle reddish, the head with very small punctures, and the front tarsi and abdomen simple.

LAIUS FLAVIFRONS, Lea.

Two males, from Parachilna (South Australia), differ from the type in having two narrow dark lines extended in front from the dark interocular space, parts of the undersurface of the two basal joints of antennae (in error in the original description [13] the second joint was referred to as the "basal" one) and the legs entirely dark; the dark subapical markings of the elytra are also connected across the suture. One of the specimens has a black blotch, with a greenish gloss, occupying rather more than the median third of the prothorax, touching its base but not apex; this specimen at first glance somewhat resembles *L. nidicola*, *L. intermedius*, and *L. villosus*, all of which have much larger punctures on the elytra, and very different antennae.

LAIUS PALLIDUS, Lea.

A male, from Parachilna, with antennae identical with those of the type, has the dark part of the elytra not in the form of sharply limited spots, but more like a deep stain, irregularly occupying most of the basal two-thirds, with a whitish spot, completely isolated at the basal third, on each elytron; its scutellum is black.

LAIUS VERTICALIS, W. S. Macl.

A male of this species, from Wyndham (North-western Australia), is somewhat smaller than the females before me; the basal joint of its antennae is large, and with a process obliquely placed, so that from some directions the process itself appears narrow, parallel, and elevated at right angles from the mass of the joint, from other directions it appears

[13] Trans. Roy. Soc. S. Austr., 1917, p. 138, fourth line.

to be subtriangular, with its hind part vertical, and front part curving to the apex, from other directions the whole joint appears like a thick, barbless hook; the apparent second joint is large, convex on the lower-surface, and irregularly concave on the upper; the second joint of its front tarsi is stout, and longer than the two following ones, which from some directions it entirely conceals, it is also tipped with black. It is certainly close to the male of *L. tarsalis*, but the head is without the interrupted ridge between the eyes which causes the head of that species, when viewed from behind, to appear conspicuously notched in the middle; the head of the present species, when so viewed, appears to have a gently even incurvature between the eyes.

Laius cinctus, Redt.

A male, from Townsville, is much below the average size of this species, has shorter antennae (the three apical joints are notably stouter than on the typical form), and front femora pallid, but as the distorted joints of the antennae are almost exactly the same, and the front femora are foveate, it should probably be regarded only as a variety of the species.

Laius armicollis, Lea.

A male of this species, from Sea Lake (Victoria), in Mr. Goudie's collection, has the pale parts almost scarlet, no doubt the normal colour of living specimens. Two females, from Leigh Creek (South Australia), evidently belong to the species; they differ from the male in having the head green, except for the flavous muzzle, and without excavations, the prothorax unarmed and immaculate, and the second joint of the front tarsi normal.

Laius effeminatus, n. sp.

♂. Metallic purplish-blue, prothorax, three spots on elytra, under-surface of basal joints of antennae, and part of abdomen reddish. With rather dense, erect, blackish hairs.

Head gently convex, with two feeble depressions in front; punctures small and sparse. Antennae obtusely serrated, apparent second joint simple, almost as long as two following combined. *Prothorax* widely transverse, sides strongly rounded, base feebly bilobed; with fairly large, scattered punctures, becoming numerous on sides. *Elytra* slightly dilated to near apex, sides and suture thickened; with crowded, rugose punctures, becoming sparser (but still dense) and more sharply defined near scutellum, and at apex. Front *femora* simple; second joint of front tarsi large, lopsided, partially concealing third and fourth, and with a black outer comb. Length (♂, ♀), 4-5·5 mm.

♀. Differs in having the head smoother in front, antennae slightly shorter and thinner, elytra more dilated posteriorly, and second joint of front tarsi similar to the third.

Hab.—Victoria: Melbourne, in September (F. E. Wilson); Geelong (H. W. Davey). Type, I. 12215.

One of the few species of the genus with antennae practically identical in the sexes. The pale markings of the elytra consist of a fairly large spot, common to both, at the apex, and a narrow spot on the middle of each side, varying from one-third to one-fifth the length of the elytra; but on one female the lateral spots are absent. The antennae, scutellum, under-surface, and legs are less blue than the head and elytra; they might be regarded as black, with a bluish gloss; on some specimens parts of the elytra have a slight greenish gloss. On each of the nine specimens examined the elytra do not quite cover the abdomen; on the male the tip of the latter is deeply notched, on the female it is but feebly notched.

Laius janthinipennis, n. sp.

♂. Black with a purplish gloss, elytra deep purple, prothorax and parts of basal joints of antennae flavous. With sparse, ashen pubescence, and erect, dark hairs.

Head with a narrow curved line connecting bases of eyes, front shallowly depressed and subtriangular; with minute punctures. Antennae with first joint large, its inner apex produced into a truncated lamina, apparent second joint large, its lower-surface gently convex and irregularly four-sided, upper-surface irregularly concave and deeply notched to receive lamina of first joint, the following joints feebly serrated. *Prothorax* strongly transverse, sides strongly rounded, base gently bilobed, a wide shallow depression near base; sides with fairly numerous punctures, sparse elsewhere. *Elytra* parallel-sided to near apex, sides and suture thickened; basal sixth and apical third shining and with sparse punctures, the intervening space subopaque, and with crowded, rugose punctures. Second joint of front *tarsi* rather large and lopsided. Length, 3 mm.

Hab.—Queensland: Roma (Dr. E. W. Ferguson). Type, I. 12216.

A very distinct species of medium size, and the only one known to me having prothorax entirely pale, and elytra entirely dark. In some respects it is close to the description of *L. asperipennis*, but is smaller, prothorax immaculate, two joints of each antennae partly pale, and muzzle dark.

LAIUS INTRICATUS, n. sp.

♂. Black, in parts with a greenish or bluish gloss; elytra bright red, with purple markings, suture black, all margins of prothorax, parts of muzzle, and parts of basal joints of antennae reddish. With sparse, ashen pubescence, and erect, brownish hairs.

Head densely granulate-punctate. Antennae with first joint dilated and irregular at apex, apparent second large, lower-surface gently convex and lopsided, upper-surface with a large excavation near base, and a semi-double one near apex, following joints more or less distinctly serrated, apical one almost twice as long as the preceding one. *Prothorax* almost twice as wide as long, sides evenly rounded, irregularly depressed near base; margins with irregular punctures, small and sparse elsewhere. *Elytra* almost parallel-sided to near apex, sides and suture thickened; with crowded but sharply defined punctures in middle, becoming sparser about base and apex. Second joint of front *tarsi* rather large, lopsided, with a black outer comb. Length (♂, ♀), 4·5-5 mm.

♀. Differs in having the head smaller, with smaller punctures, basal joints of antennae entirely pale, the first about as long as in the male but only about half as thick at apex, the apparent second simple, about as long as two following combined, and second joint of front tarsi much the same as third.

Hab.—South Australia: Port Broughton (A. M. Lea), Fowler Bay (C. French). Type male, I. 11881, in South Australian Museum; type female, in National Museum.

A curiously marked species. The red of the elytra is brighter but otherwise almost as in *Novius cardinalis;* the purple part on each elytron is directed backwards from the shoulder, on the inner side curves round to the suture at the basal third, from the main portion is continued and at the apical third is directed on one side to the margin, along which it continues for a short distance, on the other side it turns round to meet a large, somewhat diamond-shaped mark on the suture, as a result (combined with the black suture) there are four isolated red patches on each elytron: a round one near the scutellum, an irregularly four-sided medio-sutural one, a large irregular apical one, and a narrow lateral strip on the basal half; the large dark part of the pronotum is gently incurved to the middle in front, dilated on each side, and bilobed at base.

LAIUS TRIFOVEICORNIS, n. sp.

♂. Dark purple, some parts blackish; prothorax, apex of elytra, basal joints of antennae, and most of legs flavous. With sparse, ashen pubescence, and long, dark hairs.

Head gently concave in front; with dense and small punctures. Antennae with first joint dilated at apex, apparent second very large, lower-surface gently convex, upper-surface with three irregular excavations. *Prothorax* strongly transverse, sides strongly rounded; with fairly dense punctures on sides, sparse elsewhere. *Elytra* almost parallel-sided to near apex, sides and suture slightly thickened, apex base and sides with rather small and rugose punctures, denser, larger, and more rugose elsewhere. Second joint of front *tarsi* lopsided, with a black outer comb. Length (♂, ♀), 2·75-3 mm.

♀. Differs in having the head smaller, apparent second joint of antennae simple, and second joint of front tarsi similar to the third.

Hab.—Australia (old collection); South Australia: Moonta (Blackburn's collection). Type, I. 7582.

The elytra are coloured almost as in *L. mirocerus*, but the two species have little else in common, from some directions they appear to be multigranulate. The pale apical portion occupies about one-fourth of the length at the suture, where it is longest, and then curves round to each side so as to resemble the figure 3, but it is very narrowly continued along each side almost to the base; the antennal joints, after the apparent second, are more or less infuscated.

LAIUS ALBOMACULATUS, n. sp.

♂. Black; parts of basal joints of antennae flavous, four large spots, and parts of extreme base of elytra, almost white. With fairly numerous, erect, dark hairs.

Head gently convex, with a small fovea in middle and two feeble depressions in front; with dense and sharply defined punctures. Antennae with first joint moderately long, the apparent second much larger, gently convex on lower-surface, irregularly concave on upper-surface, the outer front angle conspicuously produced, many of the following joints transverse. *Prothorax* widely transverse, apex much wider than base, a shallow depression near base; with dense and sharply defined punctures on sides, sparser elsewhere. *Elytra* with sides slightly dilated to near apex, sides and suture thickened; with dense and sharply defined punctures on most of the dark parts, sparser and smaller on the pale parts. Second joint of front *tarsi* lopsided, with a black outer comb. Length, 2·5 mm.

Hab.—South Australia: Tarcoola (A. M. Lea). Type (unique), I. 12217.

A small, very distinct, black and white species, in some respects like *L. flavonotatus*, but antennae of different shape and elytral spots and punctures very different. The pale basal parts of the elytra are normally concealed by the prothorax; two of the spots are at the basal third, and appear as parts of a fascia widely interrupted at the suture, and not touching the sides; the other spots are apical, and very narrowly separated by the suture.

LAIUS INCONSTANS, n. sp.

♂. Flavous and black or infuscated. Clothed with sparse, ashen pubescence, and a few longer hairs.

Head wide and gently convex; with dense sharply defined punctures. Antennae with basal joint fairly large, the apparent second much larger, gently convex on lower-surface, upper-surface with a curved ridge bounding two large unequal excavations, apical corners somewhat produced, many of the following joints slightly transverse. *Prothorax* about twice as wide as long, sides strongly rounded, a shallow depression near base; with fairly dense and rather sharply defined punctures on sides, sparse elsewhere. *Elytra* almost parallel-sided to near apex, sides and suture thickened; densely and irregularly granulate-punctate, the punctures smaller and sparser about base and tips than elsewhere. Second joint of front *tarsi* large, lopsided, and with a black outer comb. Length (♂, ♀), 2-2·75 mm.

♀. Differs in having the head smaller, the apparent second joint of antennae simple, and about as long as the two following combined, prothorax less transverse, and second joint of front tarsi simple.

Hab.—South Australia: Barton (A. M. Lea), Murray River (A. H. Elston and R. F. Kemp). Type, I. 12218.

In general appearance approaches the variety of *L. pallidus* described from Parachilna, but the antennae very different. Of the four specimens before me no two are exactly alike in colours. The type male has the head flavous, with the basal half slightly infuscated, the prothorax is almost black, with all the margins narrowly flavous, the scutellum is black, the elytra at the extreme base (normally concealed by the prothorax) are flavous, then there is a fairly wide blackish fascia touching the suture but not the sides, then a fairly wide, almost white one, touching the sides but not the suture, then a wider blackish one touching the sides, and narrowly interrupted at the suture, and then about the apical fourth is flavous; the tarsi and tip of antennae are also infuscated. A second male has the head entirely pale, the prothorax pale except for a large infuscated spot on each side, the dark parts of the elytra less blackish, and the pale fascia at the median third larger; most of the antennae and of the tibiae are also infuscated. The type female has the head, prothorax, scutellum, antennae (except the extreme tips), and legs flavous, with the dark basal fascia not much darker than the pale one following it, and the postmedian one hardly infuscated. On the second female the base of the head and part of the prothorax are vaguely infuscated, and the elytral markings are very obscurely defined, the infuscation of the legs is also slight. As with other males of the genus the apparent second joint of the antennae appears of different shape from almost every point of view.

Hypattalus punctulatus, Blackb.

Although *Hypattalus* was proposed by Blackburn on species that differed in their tarsi from typical species of the genus *Attalus*, and the male tarsi of the latter were commented upon, he did not denote the sex of either *H. punctulatus*, or *H. elegans* (described on the same page), and there were no particulars given (the legs, except as to their colour, were not mentioned in either description) that can be relied upon to determine the sex. When the major portion of his collection was acquired by the South Australian Museum there was one cotype of *punctulatus* in it, this specimen is a female. Two males, from Adelaide and Mount Lofty, belong to the species, and differ from the female in having part of the muzzle pale, the antennae longer and strongly serrated, and the hind tibiae thickened, and foveate in the middle of the outer side, with part of the foveated portion red. In the male of *H. elegans* the distorted portion is slightly nearer the base, and is not foveate externally. The two species are certainly distinct, but they both have decidedly blue elytra. Another male, from Victoria, however, has the elytra of such a deep purple as to be almost black.

Hypattalus sordidus, Lea.

Of two specimens taken by Mr. F. E. Wilson, in Victoria, one has a dark median line on the prothorax and more of its sides dark than usual; the other has the prothorax entirely pale.

Hypattalus alphabeticus, Lea.

Two specimens, sexes, from Parachilna (South Australia) probably belong to this species, but differ from the type in being considerably larger (♂, 2·75: ♀, 3 mm.), the dark parts of the elytra metallic-blue instead of violet, with the subapical spots more nearly circular, and touching the suture, the pale portion the same shade as the prothorax, instead of paler, the punctures across the middle fairly coarse, and the antennae (except the under-surface of some of the basal joints) deep black. The female differs from the type (also a female) in having the antennae decidedly shorter and stouter, the legs darker, with the hind ones black. The male has decidedly longer antennae than in the Parachilna female, of the same proportionate length as those of the type, but the serrations are stronger; its hind legs are missing, but the front and middle femora and tibiae are pale; the front femora are simple.

Hypattalus insularis, Lea.

A specimen, from the Dividing Range (Victoria), evidently belongs to this species, but has tibiae entirely dark; the prothorax is flavous with a large infuscate discal blotch, and its punctures are less distinct than on the types; the elytra have vague remnants of striation (as on the types). A specimen, from Sydney, has legs as in the type, but the prothorax entirely flavous.

Hypattalus flavoapicalis, n. sp.

♂. Black; tip of elytra, apical segment of abdomen, parts of under-surface of antennae, and of under-surface of muzzle, trochanters, and parts of coxae flavous. With sparse, short, ashen pubescence, and rather numerous erect, dark hairs.

Head moderately convex between eyes, with two shallow conjoined depressions in front; punctures rather sparse and minute, becoming denser at base. Antennae rather long, feebly serrated, seventh joint slightly longer than the adjacent ones, and the length of eleventh. *Prothorax* strongly transverse, sides (except in front) and base obliquely margined; with a few scattered punctures. *Elytra* parallel-sided to near apex, sides and suture slightly thickened, the apex more strongly so; with rather large, crowded, and sharply defined punctures. Apical segment of *abdomen* rather large. Hind *tibiae* moderately curved. Length (♂, ♀), 4-4·5 mm.

♀. Differs in having the head smaller, with shallower frontal depressions, antennae shorter and thinner, legs shorter, and apical segment of abdomen softer.

Hab.—Tasmania: Cradle Mountain (H. J. Carter and A. M. Lea), Waratah (Lea). Type, I. 12248.

In my table of the genus [14] would be associated with

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[14] Lea, Trans. Ent. Soc. Lond., 1909, p. 169.

H. exilis and *H. montanus*, but differs from each in the pale markings of elytra being confined to the apex. On the male the elytra have a faint greenish gloss; the apical segment of its abdomen is smooth and appears to be hard (as in the male of *H. apiciventris*); on the female, although similarly coloured, it is irregularly wrinkled, as a result of post-mortem contractions. A single specimen was taken at each locality.

Hypattalus tricolor, n. sp.

♂. Black; elytra violet-blue, their tips, prothorax, scutellum, and abdomen flavous; parts of legs and of basal joints of antennae obscurely diluted with red. Upper-surface almost glabrous.

Head with very feeble depressions in front; with sparse and minute punctures. Antennae moderately long, not very thin, obtusely serrated. *Prothorax* strongly transverse, sides and base thinly margined; almost impunctate. *Elytra* parallel-sided to near apex, sides and suture thickened, the apex still more so; with rather minute but sharply defined punctures, nowhere crowded, but in places rather numerous. Front *femora* moderately curved and edentate, but trochanter long, thin, and truncated, hind tibiae rather long and strongly curved. Length, 2·5 mm.

Hab.—Northern Queensland (Blackburn's collection). Type (unique), I. 11885.

The curvature of the front femora, with the very conspicuous front trochanters, associate this species with *H. australis* and its allies; the only one of these having similarly coloured elytra is *H. apicipennis*, which has elytral punctures crowded (although sharply defined) on most of its surface, very different to those on the present species, which also has the abdomen pale. There are several somewhat similarly coloured species (*H. viridis* and *H. violaceus*), but with normal front legs in the male.

A female, from New South Wales (Blackburn's collection), probably belongs to this species, but has slightly larger elytral punctures (although nowhere crowded), its colours are exactly as in the type, from which it differs also in having antennae shorter, and front legs simple.

Hypattalus inconspicuus, n. sp.

♂. Black, prothorax flavous; parts of four or five basal joints of antennae, trochanters, parts of coxae and parts of front and of middle tibiae obscurely flavous. With sparse, ashen pubescence.

Head with shallow depressions in front, and with rather sparse punctures. Antennae moderately long and obtusely serrated. *Prothorax* strongly transverse, sides and base with thin margins; sides with fairly distinct punctures, sparse elsewhere. *Elytra* with sides feebly dilated from near base to beyond the middle, sides and suture slightly thickened; with sharply defined and dense, but not crowded, punctures. *Legs* long and thin, hind tibiae rather strongly curved. Length, 1·75-2 mm.

♀. Differs in having the head slightly smaller, with thinner antennae, elytra slightly wider, legs slightly shorter, and in the tip of the abdomen.

Hab.—New South Wales: Blue Mountains (Dr. E. W. Ferguson). Type, I. 12220.

In appearance like small specimens of *H. calcaratus*, from which it differs in the thinner antennae, and hind tibiae of female not spurred; *H. abdominalis* is somewhat larger, elytra with smaller punctures, and antennae much shorter and distinctly serrated.

HYPATTALUS MINUTUS, n. sp.

Black; a small part of muzzle, basal parts of legs, and parts of basal joints of antennae obscurely testaceous. Upper-surface almost glabrous.

Head almost impunctate, an oblique depression each side in front. Antennae moderately long, thin, and obtusely serrated. *Prothorax* strongly transverse, sides and base finely margined; almost impunctate. *Elytra* rather distinctly dilated to near apex; with minute, rugulose punctures. *Legs* long and thin. Length, 1 mm.

Hab.—South Australia: Kangaroo Island (A. H. Elston). Type, I. 12219.

The smallest Australian species of the Malachiides, being only about half the bulk of *H. parvoniger*, its nearest ally. The tarsi are narrower than is usual in the genus, and the exoskeleton seems to be unusually soft; as a result the five specimens taken by Mr. Elston all differ in apparent shape, owing to post-mortem contractions.

CARPHURUS and BALANOPHORUS.

Owing to the fact that the females, as well as the males, of *Balanophorus* have a comb on the basal joint of the front tarsi, and that in *Carphurus* it is the males only that have such a comb, I was led astray, and described as male *Carphuri* specimens that were really female *Balanophori*. In my table (15) the species that need reconsideration in this

(15) Lea, Trans. Ent. Soc. Lond., 1909, pp. 188-191; in the table the top line of page 190 should have been *kk* not *nn* (to mate with *k* on page 189).

respect are those referred to "G. Antennae subpectinate or very strongly serrate." Upon these the following comments are offered:—

elegans, Lea. The comb on the front tarsus of each of the types is unusually long, and as the serrations of the antennae are rather less pronounced than in females of *Balanophorus* it was probably correctly referred to *Carphurus*.

longipes, Lea. The type is in the Macleay Museum, and I have not re-examined it.

variipennis, Lea. The type female is without combs, and so is a *Carphurus*, the serrations of the antennae of the male are very pronounced. A male in Mr. Carter's collection, from Stradbroke Island, has the middle femora entirely pale, and the hind ones dark only at the apical third; a female, in the Queensland Museum, has the elytra entirely pale.

lepidus, Lea. The type has combs and in appearance is very similar to a female of *B. scapulatus*, but its elytral punctures are denser and sharply defined, and hence it is probabaly a *Carphurus*.

maculiventris, Lea. The type is a female without combs, and so is a *Carphurus*.

apiciventris, Lea. The type of the species and a specimen of the variety *dubius* have combs, but until both sexes are known it is desirable to leave the species in *Carphurus*.

bifoveatus, Lea. Although in general appearance very close to *B. janthinipennis* the female is without combs and so is a *Carphurus*.

triimpressus, Lea. See note as *Balanophorus triimpressus*.

pictipes, Lea. Two females are combless, and so belong to *Carphurus*.

rhagonychinus, Fairm. See note as *B. rhagonychinus*.

simulator, Lea. The type has combs and is probably a female *Balanophorus*, as structurally it is very close to a female of *B. rhagonychinus*.

Balanophorus brevipennis, Germ.

Two specimens, sexes, of this species in Mr. F. E. Wilson's collection, from Gisborne (Victoria), have the head entirely red.

Balanophorus pictus, Lea.

A male, from Melville Island, in the National Museum, has the greater portion of the legs black, but otherwise agrees well with a cotype of this species. A specimen from the Forrest River (North Western Australia) is evidently a female of the species, its colours are much as in the male, except that the tip of the abdomen is black, that parts of the tibiae are infuscated, and that the blue of the elytra occupies more of the surface; the antennae are strongly serrated only.

Balanophorus triimpressus, Lea (formerly Carphurus).

Deceived by its tarsal combs I described the type of this species as a male *Carphurus*, but Mr. F. E. Wilson has recently taken, at Ringwood in Victoria, a true male of the species, and it is a *Balanophorus*, with long rami on the antennae after the third joint. It has denser and smaller, but more sharply defined punctures on the elytra than on *B. janthinipennis*, from which, as also from *B. victoriensis*, it may be distinguished by the eyes being much larger; on the female they are as large as on the males of those species, and on the male about twice as large, being almost as large as on the male of *B. scapulatus*.

Balanophorus rhagonychinus, Fairm. (formerly Carphurus).

This species is also a *Balanophorus*, its male having flabellate antennae much as in the above species, and in *B. scapulatus;* its eyes are much as in the latter species. In both sexes the femora and tibiae vary from entirely pale to entirely dark; on the female the femora are often infuscated in the middle, on one female the only dark part of the head is a conspicuous fascia connecting the eyes. Specimens before me are from Sydney, Blue Mountains, Eden, Kangaroo Valley, and Mittagong, in New South Wales; and near Brisbane, in Queensland.

Balanophorus janthinipennis, Fairm.

Two specimens, sexes, from Galston, differ from the typical form of this species in having the abdomen dark, except for the sides of the three basal segments, the elytra blackish-purple, and the second joint of antennae entirely pale; the elytral punctures are also smaller, although much more distinct than on *B. victoriensis*.

Balanophorus concinnus, n. sp.

♂. Flavous; elytra (except extreme base), and apical two-thirds of hind femora black, part of metasternum, eight apical joints of antennae, tarsi, and hind tibiae more or less deeply infuscated. With blackish hairs, denser on elytra, and longer on sides of abdomen, than elsewhere.

Head rather wide, a shallow depression each side in front; base punctate and transversely strigose. Each eye less than half the width of the inter-ocular space. Antennae with third joint acutely produced on one side, each of the seven following joints with a long ramus. *Prothorax* slightly longer than wide, sides gently rounded, a shallow depression near base. *Elytra* about twice as long as wide; with dense, small and distinct, but not very sharply defined punctures. Basal joint of front *tarsi* large, lopsided, partly concealing second joint, with a black comb from base to apex on inner side. Length, 6 mm.

Hab.—Queensland: Cairns district (F. P. Dodd). Type (unique), I. 11954.

About the size of the typical form of *B. scapulatus*, but with much smaller eyes than the male of that species, being only the size of those of its female (this character also distinguishes it from the description of *B. megalops*). In my table[16] it would be associated with *B. mastersi* and *B. pictus*, but is is much smaller and otherwise different from those species. The head and prothorax have a somewhat redder tone than the other pale parts; the pale portion of the elytra occupies hardly more than the slope adjacent to the prothorax.

Carphurus armipennis, Fairm.

A male of this species, from Port Denison, has a wide space along the suture pale, and an obscurely pale latero-apical spot.

Carphurus pallidifrons, Lea.

A female, from Aspendale (Victoria), in Dr. Ferguson's collection, has the front tibiae and the tips of all the femora flavous. A male, from the Victorian Alps, in the National Museum, probably belongs to the species, but has a conspicuous curved red mark connecting the eyes.

Carphurus longicollis, Lea.

A male, from Cairns, has the abdomen and tibiae entirely reddish.

Carphurus frenchi, Lea.

A female, from the Blue Mountains, in Dr. Ferguson's collection, has the pale basal markings of the elytra larger than usual, and the prothorax with an irregular, infuscate blotch.

Carphurus punctatus, Lea.

A specimen, from Launceston, has the prothorax with a large black spot on each side, much as on some varieties of *C. elongatus*, but the two species are otherwise very distinct.

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(16) Lea, Trans. Ent. Soc. Lond., 1909, p. 180.

Carphurus invenustus, Lea.

A male, from Illawarra, has parts of the elytra obscurely diluted with red.

Carphurus alterniventris, Fairm.

Two females, from Cairns, in Dr. Ferguson's collection, have the legs almost entirely black and the head black, with an almost round, red spot, half-way between the base and apex. A male, from Gayndah, has a pale vitta on the side of each elytron, from the base to near the middle, touching the side at the base, but not at the middle; a female mounted with it (and a similar one from Cairns) has the vitta reduced to an isolated spot near the side, its head has a large circular red space, rendered rather conspicuous by the adjacent surface being infuscated.

Carphurus cristatifrons, Fairm.

A female, from Mount Tambourine, has a longitudinal black spot on the disc of the pronotum.

Carphurus elongatus, Macl.

Of two males, from Aspendale (Victoria), in Dr. Ferguson's collection, one has the apical three-fifths of elytra black, except that the inner angle of each is obscurely diluted with red; its prothoracic spots are normal; the other has the prothorax immaculate, and the inner angles of the elytra no paler than the adjacent parts.

Carphurus gallinaceus, n. sp.

♂. Flavous; abdomen reddish-flavous; base of head, scutellum, mesosternum, metasternum, and coxae black; seven apical joints of antennae infuscated or black; labrum slightly infuscated. With sparse and very short pubescence in parts, and with long, straggling, dark hairs.

Head with a wide, semidouble excavation between eyes, and a smaller (but large one) on each side, each of the latter bounded inwards by a strong, curved elevation, the two elevations connected in front; base punctate and transversely strigose. Antennae moderately long, third to ninth joints serrated. *Prothorax* slightly longer than greatest width (near apex), sides evenly rounded, a wide shallow depression near base, and a shallower one near apex. *Elytra* about twice the length of prothorax and much wider than its base, each side near apex with a conspicuous notch, the margins of the notch thickened, its anterior end obtusely pointed, the posterior end armed with a flat, acute spine, directed forwards and outwards, each elytron near apex outwardly curved at suture; with dense and rather small, but sharply defined punctures. Basal joint of front *tarsi* with a small, black, inner comb. Length, 5 mm.

Hab.—Queensland: Bribie Island (A. M. Lea). Type (unique), I. 11941.

The crest on the head is even larger than on *C. cristatifrons*, and the ridges composing it curve round at the base, with the excavation behind them bisinuate, instead of single; the excavation at the side of each eye terminates before the posterior end of the eye, in *cristatifrons* (as viewed from the side) it is seen to slightly pass the eye; on the present species also there is a slight infuscation on each elytron near the suture, but the derm near the armature is immaculate.

Carphurus excisus, n. sp.

♂. Black; head, except at base, prothorax, elytra about armature and on extreme sides, thence to base, but not to apex, tips and sides of abdominal segments, three basal joints of antennae, and parts of tibiae reddish-flavous. With long, dark hairs, and in parts with sparse, white pubescence.

Head with three rather large excavations: one in middle bounded on each side by a narrow ridge, and one on each side bounded by an eye; with irregularly distributed punctures, base transversely strigose. Antennae moderately long, third to tenth joints moderately serrated. *Prothorax* slightly longer than the greatest width (near middle), sides evenly rounded, a wide shallow depression near base; with a few scattered punctures. *Elytra* about twice the length of prothorax, each side near apex strongly notched, the part bounding the notch strongly thickened, its posterior end with a flat blunt-tipped process, directed outwards and forwards; with dense and rather sharply defined punctures, except on tips, which are strongly, separately rounded. Basal joint of front *tarsi* with a small, black, inner comb. Length, 4·25 mm.

Hab.—Victoria: Fern Tree Gully (F. E. Wilson). Type (unique), I. 11942.

Structurally close to *C. gallinaceus*, but crest of the head with its sides less distant at base, the excavation behind it not bisinuate, and the elytra, abdomen, and legs very differently coloured. The sculpture in general is near that of *C. cristatifrons*, but the inner part of the crest is different, and the elytra, etc., are differently coloured.

Carphurus balteatus, n. sp.

♂. Flavous; elytra blackish, with a wide flavous fascia near base, and with an obtuse extension along suture, apical half or more of antennae and metasternum infuscated or black. With rather long, dark hairs, elytra with short, whitish pubescence.

Head with a large excavation between eyes, in its middle a ridge crowned by a golden fascicle diverging to each side; in front of the excavation a slightly hairy ridge, interrupted in middle, a large and rather shallow depression in front; with irregularly distributed punctures, base densely transversely strigose. Antennae moderately long, most of the joints serrated. *Prothorax* slightly longer than the greatest width, a wide shallow depression near base; with a few scattered punctures. *Elytra* about twice the length of prothorax, each side at basal third with an obtusely triangular projection; with dense and sharply defined punctures, becoming sparser on tips. Basal joint of front *tarsi* with a small, black, inner comb. Length, 6-7 mm.

Hab.—Northern Territory: Darwin (N. Davies and F. P. Dodd). Type, I. 11940.

The head when viewed from behind appears to have two tubercles, but these are less distinct than on *C. purpureipennis*, and the ridges giving rise to them are differently placed, the median fascicles are not black, as on *C. fasciculatus* and *C. uncinatus*, which also have the head differently sculptured. The head, when viewed from certain directions, appears to have a ridge from each side, not quite meeting in the middle, the point where they would have joined being overhung by the fascicles; in the male of *C. armipennis* the lateral ridges meet at the central one, which is not fasciculate in front, but some varieties of that species have a large part of the base of elytra pale. On one of the specimens the abdomen is entirely pale, and of a more reddish tone than the other, some of whose basal segments are slightly infuscated.

Carphurus micropterus, n. sp.

♂. Black, elytra and legs piceous-black. With sparse, whitish pubescence, and long, straggling, dark hairs.

Head wide; with dense and moderately coarse punctures. Antennae not very long, basal joint rather large and swollen at apex, second subglobular, third to ninth about as long as second, but becoming acutely triangular on one side, tenth and eleventh narrower, the eleventh scarcely longer than tenth. *Prothorax* distinctly transverse, sides rather strongly rounded, a narrowly impressed subbasal line; with numerous sharply defined, but not very large punctures. *Elytra* short, strongly narrowed posteriorly; with fairly dense asperate punctures. Tip of *abdomen* with a wide process on each side. Basal joint of front *tarsi* with a small comb on inner edge. Length, 3 mm.

Hab.—South Australia: Adelaide (Blackburn's collection). Type (unique), I. 11946.

A curious species that in some respects seems nearer *Helcogaster* than *Carphurus*, and for which possibly a new genus should have been proposed; the elytra are shorter than in any other species of the allied genera, being shorter than the head and prothorax combined, and shorter than their own basal width; the tip of the abdomen also is peculiar, in addition to the process on each side there is a pointed median one on the type (probably the tip of an oedeagus); most of the antennal joints have numerous rather long hairs.

Carphurus cribratus, n. sp.

♂. Black; front half of head, four basal joints of antennae, prothorax (except for a wide subapical fascia), basal two-fifths of elytra, tips and sides of subapical segment of abdomen distinctly, and of some of the others inconspicuously flavous; tibiae and most of tarsi flavous, or testaceo-flavous. With sparse, whitish pubescence, and long, dark hairs.

Head with small tubercles and depressions on front half; with small, dense punctures. Antennae rather long and thin. *Prothorax* about as long as the greatest width (near apex), an inconspicuous depression across base; with dense punctures, in places transversely confluent. *Elytra* more than twice the length of prothorax; with dense and sharply defined punctures, but some of them confluent. Basal joint of front *tarsi* with a black comb at inner apex. Length (♂, ♀), 3-3·5 mm.

♀. Differs in having the head smaller, less uneven, and with more distinct punctures in front, eyes smaller, antennae shorter, abdomen much wider, and front tarsi combless.

Hab.—Queensland: Bundaberg (Blackburn's collection). Type, I. 11948.

In my table[17] would be associated with *C. elongatus*, from which it differs in its coarser elytral punctures and sculpture of head. The fine pubescence on the prothorax, from some directions, causes the punctures to appear like strigae. On the male there is a scarcely traceable infuscation about the scutellum, but on the female it is more pronounced; the black prothoracic fascia is nearer the apex than base, but it varies in extent on the three specimens before me.

[17] Lea, Trans. Ent. Soc. Lond., 1909, p. 188.

Carphurus interocularis, n. sp.

♂. Flavous; elytra dark metallic-green; scutellum, metasternum, a basal portion of each segment of abdomen except the apical one (which is entirely pale), and hind trochanters black. With rather sparse, dark hairs, and in parts with sparse, whitish pubescence.

Head large; with a wide and deep inter-ocular excavation, its posterior end curved; a conspicuous inter-antennary tubercle projecting triangularly backwards into the middle of its anterior end; a deep oblique impression on each side close behind it; punctures irregularly distributed. Antennae long and rather thin, scarcely serrated, none of the joints transverse. *Prothorax* distinctly transverse, sides and base strongly rounded; with a few scattered punctures. *Elytra* more than twice the length of prothorax; with dense and, for the genus, rather large punctures, in places confluent. Basal joint of front *tarsi* lopsided, a black inner comb from base to apex. Length, 5 mm.

Hab.—South Australia. Type (unique), I. 11943.

In general appearance close to *C. cyaneipennis*, and with entirely pale antennae (the four basal joints are paler than the others, but these are not infuscated), but basal joint much thinner than on the male of that species, and the head strongly sculptured; its sculpture at once distinguishes the species from the males of *C. telephoroides*, *C. latipennis*, *C. cervicalis*, and other similarly coloured species. In my table it would be associated with *C. basiventris*, which has partly dark antennae and legs, differently coloured elytra, etc.

Carphurus tricolor, n. sp.

♂. Black; head, four basal joints of antennae (except upper-surface of first), prothorax, and front femora flavous; elytra deep blue. With very sparse, pale pubescence, and moderately long, dark hairs.

Head with a somewhat circular depression, in the middle of which is a slight elevation; with rather dense and distinct punctures, the base transversely strigose. Antennae rather long and thin, only the second joint transverse. *Prothorax* longer than wide, base much narrower than apex, a wide depression near base; sides with dense punctures, sparse elsewhere. *Elytra* more than twice the length of prothorax; with dense and sharply defined punctures, even at apex. Length, 4-4·25 mm.

Hab.—Queensland: Cairns district (A. M. Lea). Type, I. 11945.

A beautiful little species; the type has the front femora pale, so in my table would be associated with *C. facialis*, from which it differs in the sharply defined punctures of elytra and in many details of colour, in particular the blue elytra and red head; regarding a second specimen (having somewhat infuscated front femora) as having entirely dark legs, it might be associated with *C. pallidifrons* (although the elytra are not metallic), from which it differs in its entirely pale head, sharper elytral punctures, etc. From the description of *C. azureipennis* it differs in the entirely black abdomen, black scutellum, front legs partly pale, and pale basal joints of antennae.

Carphurus semirufus, n. sp.

♀. Black; head (except for a vague infuscation behind each eye), four basal joints of antennae, prothorax, tibiae, and tarsi reddish. With long, dark hairs, and sparse, pale pubescence.

Head gently convex between eyes, a shallow transverse impression in front; with minute punctures, becoming larger near eyes, base transversely strigose. Antennae moderately long, third to tenth joints rather strongly serrated, eleventh almost twice the length of tenth. *Prothorax* slightly transverse, sides strongly rounded, apex slightly wider than base; with a few scattered punctures. *Elytra* short, scarcely twice the length of prothorax; with fairly dense and rather sharply defined, but small punctures, becoming still smaller posteriorly. Length, 4 mm.

Hab.—Northern Territory: Melville Island (G. F. Hill, No. 351). Type (unique), I. 12201.

At first glance the type appears to be a *Helcogaster*, but the sharply defined elytral punctures, and serrations of antennae, should exclude it from that genus. Regarding the species as belonging to G of my table of *Carphurus*, it would be associated with *C. triimpressus*, which, with others of G, have been transferred to *Balanophorus* (the type has combless front tarsi so cannot belong to that genus); but regarding it as belonging to GG, it would go with *C. facialis*, which has elytra longer, more metallic, and with larger punctures, part of head black, etc.; the elytra are shorter and with less conspicuous punctures than in *C. basiventris*, the head is wider, and abdomen entirely black.

Carphurus compsus, n. sp.

♂. Flavous; six apical joints of antennae and part of the preceding one, and a large blotch on elytra blackish. With fairly numerous dark hairs, and in places with very sparse, ashen pubescence.

Head moderately long, gently convex between eyes, a rather large shallow depression in front; with fairly distinct but irregularly distributed punctures, base transversely strigose. Antennae rather long, third to tenth joints strongly serrated, eleventh distinctly longer than tenth. *Prothorax* distinctly longer than wide, sides from near apex narrowed to base, a wide shallow depression near base; punctures sparsely distributed. *Elytra* more than twice the length of prothorax; with dense, small, and mostly rugulose punctures. Basal joint of front *tarsi* lopsided, with a narrow, black, inner comb. Length, 6 mm.

Hab.—Northern Queensland (Blackburn's collection). Type, I. 11952.

The dark blotch on the elytra is sharply defined, it commences on each elytron at the basal third, from the suture it is directed obliquely towards the shoulder for a short distance, is then directed backwards to slightly beyond the middle, and from there straight to the side, the derm thence being entirely dark. At first glance it looks like some of the varieties of *C. longus*, but the antennae are strongly serrated; the male of *C. elegans* has the basal joint of the front tarsi more than twice as long as in this species, abdomen tipped with black, etc.

A female, from Cairns (A. M. Lea), that possibly belongs to this species, differs from the type in having the head smaller, with two feeble depressions in front, antennae shorter, thinner, feebly serrated and entirely pale, elytra with the dark portion more diffused, and covering rather more than the apical half as an infuscation, with more sharply defined punctures, and legs shorter, with front tarsi combless.

Carphurus macrops, n. sp.

♂. Flavous; five apical joints of antennae, apical half of elytra, and most of abdomen infuscated. With straggling, dark hairs, and sparse, ashen pubescence.

Head gently convex between eyes, a feeble depression each side in front; with rather sparse punctures, becoming denser behind eyes, but base transversely confluent. Eyes large and prominent. Antennae rather long, third to tenth joints strongly serrated, eleventh about once and one-half the length of tenth. *Prothorax* longer than wide, sides diminishing from near apex to base, a wide shallow depression near base; a few punctures scattered about. *Elytra* scarcely twice the length of prothorax; with dense and small, but fairly sharply defined punctures. Basal joint of front *tarsi* with a narrow, black, inner comb, from base to apex. Length (♂, ♀), 4-4·5 mm.

♀. Differs in having the head smaller, with smaller (but still large) eyes, antennae shorter and thinner, and legs shorter, with simple tarsi.

Hab.—Queensland: Cairns district (A. M. Lea). Type, I. 11950.

The dark part of the elytra, although distinct, is not very sharply limited; on the two females taken, but not on the male, it is narrowly continued along the sides to the base, on one female the abdomen is entirely pale. In the male the combined width of the eyes is rather more than the space between them, in the female it is about three-fourths of that space; their length is slightly more than that of the two basal joints of antennae; they are as large as in *C. vigilans*, but the head is very differently sculptured. The antennae are rather strongly serrated, and so the species might be referred to G of my table, and there associated with the pale-headed form of *C. lepidus*, from which it differs in its much larger eyes, less defined elytral punctures, etc.; referring it to GG it would be associated with *C. atricapillis*, which is a considerably larger species, with very different antennae.

Carphurus latus, n. sp.

♂. Flavous; elytra deep purple, except at base and for a short distance along suture; eight apical joints of antennae, metasternum, parts of both surfaces of three basal segments of abdomen, middle coxae and femora, and most of hind legs, black or blackish. With long, straggling, blackish hairs, and sparse, ashen pubescence.

Head wide, somewhat uneven in front; with dense punctures near eyes. Antennae rather short and stout, third to tenth joints strongly serrated. *Prothorax* slightly longer than its greatest width (across apical third), a wide shallow depression near base; with small and very sparse punctures. *Elytra* about twice the length of prothorax, wide at base, sides suddenly dilated before the middle, and then feebly narrowed to apex; with fairly dense but uneven punctures. Basal joint of front *tarsi* lopsided, but not very large, with a small, black comb on inner edge. Length, 6·5 mm.

Hab.—North-western Australia: Wyndham, in March (J. Clark from W. Crawshaw). Type (unique), I. 11951.

An unusually wide species, at first glance appearing to belong to *Helcogaster;* but the elytra with distinct punctures, head not largely excavated and antennae serrate, are evidence that it should be referred to *Carphurus:* the appendix to each claw is larger than is usual in the allied genera. The eyes are large, and, when viewed from the side, appear to have no part of the head above them. The elytral punctures are often sharply defined, but are mostly rugose, some of them are so shallow as to be scarcely traceable, especially about the tips. The antennae are not subpectinate, so regarding the species as belonging to GG of my table it would be associated with *C. atricapillis*, from which it differs in most details of shape; if it were referred to *Helcogaster*, it would be associated with *H. punctipennis*, with which it has also few details in common.

Neocarphurus costipennis, n. sp.

♀. Black; antennae, except some of the apical joints, and extreme base of prothorax flavous. A few dark hairs scattered about.

Head opaque and with rather dense punctures, a shallow depression each side in front, and a shallow median line. Antennae moderately long, none of the joints transverse. *Prothorax* slightly longer than greatest width, which is at apex, sides rounded and strongly narrowed to near base, and then almost parallel to base, which is feebly bilobed, a deep, transverse, open depression near base. *Elytra* almost twice the length of prothorax, and twice as wide as its base, opaque and shagreened except about base, a fine costa extending obliquely inwards from each shoulder. Length, 2·5-2·75 mm.

Hab.—Northern Queensland (Blackburn's collection), Cairns (Dr. E. W. Ferguson). Type, I. 10948.

The opacity of the elytra appears to be due principally to very minute pubescence, but the species may be readily known from *N. pilosipennis*, *N. angustibasis*, and all others of the genus, by the costa running inwards from each shoulder for about one-third the length of the elytron. On the type the three apical joints of the antennae, and the upper-surface of the first, are infuscated; on a second specimen only the two apical joints are infuscated.

Neocarphurus semiflavus, n. sp.

Flavous; metasternum and abdomen black; apical three-fifths of elytra, parts of hind legs, of middle and of front tibiae and tarsi, and two apical joints of antennae, more or less deeply infuscated. With a few straggling hairs.

Head with a wide depression between eyes, and a large, obtuse, inter-antennary tubercle. Antennae moderately long, second to sixth joints transverse, eleventh longer than tenth. *Prothorax* longer than wide, sides rounded and strongly narrowed to near base, and then subparallel to base, which is feebly bilobed and about half the width of apex. *Elytra* about once and one-half the length of prothorax, and much wider than its base, the dark part opaque and very minutely pubescent. Front *tarsi* rather short, basal joint with an inner black comb. Length, 3 mm.

Hab.—New South Wales: Rydalmere (Dr. E. W. Ferguson). Type (unique), I. 11955.

The dark part of the elytra is opaque; on *N. coatesi* and *N. impunctatus* it is just as highly polished as the pale part. The eyes of the type are still of a vivid green.

Helcogaster.

A table of this genus, containing less than half of the now known species, was given in the 1909 revision of the family,[18] but the features by which the species are distinguished are so often on the head, and do not lend themselves readily to be condensed into brief tabular characters, that a grouping is now given, and only males are included, as it appears to be impossible to identify many of the females with certainty from descriptions. Some of the species, with the head comparatively simple in the male, might be regarded as belonging to *Carphurus*, but all such doubtful species have very minute rugulose punctures on the elytra, and the antennae feebly serrated at most. An asterisk (*) denotes that the species has been placed in its group by the published characters: —

1. Antennae with basal joints distinctive.

FOVEICORNIS, Lea	INSIGNICORNIS, Lea

2. Prothorax not simple near, or at, apex.

CAVICEPS, Lea	MEDIOAPICALIS, Lea
IMPERATOR, Lea	NIGRIVENTRIS, Lea
INCISICOLLIS, Lea	SPINICOLLIS, Lea

3. Basal joints of antennae not distinctive, and prothorax simple near, and at, apex.

A. Prothorax partly or entirely dark.

a. Elytra entirely dark.

ATER, Lea	HOPLOCEPHALUS, Lea
ATERRIMUS, Lea	LITORALIS, Lea
BASIRUFUS, Lea	MELAS, Lea
CANALICULATUS, Lea	NIGER, Lea (typical)
CAPSULIFER, Lea	OBLIQUICEPS, Lea
COELOCEPHALUS, Lea	PARALLELUS, Lea
EFFEMINATUS, Lea	PULCHRIPES, Lea (variety)
EXCAVIFRONS, Lea	PUNCTICEPS, Lea
GAGATINUS, Lea	RUFICORNIS, Lea
GENICULATUS, Lea	TRIANGULIFER, Lea (typical)

[18] Lea, Trans. Ent. Soc. Lond., 1909, p. 215.

b. Elytra not entirely dark.

BASICOLLIS, Lea	LATEROFUSCUS, Lea
BREVICORNIS, Lea	MACULICEPS, Lea (variety)
CRIBRICEPS, Lea	MARGINICOLLIS, Lea
FASCIATUS, Lea (Note 1)	MEDIOFLAVUS, Lea
FLAVIPENNIS, Lea	OPACICEPS, Lea
INFLATUS, Lea	

B. Prothorax entirely pale.

c. Elytra entirely dark.

APICICORNIS, Lea	MACROCEPHALUS, Lea
ATRICEPS, Lea	MAJOR, Lea
BRACHYPTERUS, Bohem.	NIGER, Lea (variety)
CARINATICEPS, Lea	*NIGRICEPS, Lea
CENTRALIS, Lea	OXYTELOIDES, Lea
CERATICEPS, Lea	PULCHRIPES, Lea (typical)
CONCAVICEPS, Lea	STRIGICEPS, Lea
DECIPIENS, Lea	TRIANGULIFER, Lea (variety)
FOVEICEPS, Lea (Note 2)	TROPICUS, Lea
HACKERI, Lea	T. TUBERCULATUS, Lea
HELMSI, Lea	VARIUS NIGRIPENNIS, Lea
INSULARIS, Lea	VENTRALIS, Lea

d. Elytra not entirely dark.

BACCHANALIS, Lea	RHYTICEPHALUS, Lea
BILOBUS, Lea	SEMINIGRIPENNIS, Lea
CONVEXICEPS, Lea	SIMPLICICEPS, Lea
FUSCITARSIS, Lea (Note 3)	SULCICEPS, Lea
HUMERALIS, Lea	THORACICUS, Lea
*IMPRESSIFRONS, Bohem.	TRIFOVEICEPS, Lea
LATICEPS, Lea	TRISINUATUS, Lea
MACULICEPS, Lea (typical)	TUBERCULIFRONS, Lea
PALLIDUS, Lea	VARIUS, Lea (typical)
PIGNERATOR, Lea (Note 4)	VARIUS FLAVOPICTUS, Lea
PUNCTILOBUS, Lea	VARIUS PALLIDIPENNIS, Lea
PUNCTIPENNIS, Lea	

Note 1. The dark part of the prothorax of the type is possibly due to staining.

Note 2. On some males the sides of the prothorax have infuscated spots.

Note 3. The shoulders are not always conspicuously pale.

Note 4. The elytra of the type, from above, appear to be entirely dark.

Three species at present standing in *Carphurus* may eventually be transferred to *Helcogaster;* if so, their positions would be as follows:—*C. atronitens* in *a*, *C. basipennis* and *C. fasciipennis* in *d*.

Helcogaster gagatinus, Lea.

A female, from Melville Island, probably belongs to this species, but has the front femora black with a pale vitta, as on some males from New South Wales.

Helcogaster insularis, Lea.

A male, from the Dividing Range (Victoria), has the projection between the basal sinuations of the head clothed with rusty red hair, resembling a short fascicle; on the types the hair there is black, and so hardly conspicuous.

Helcogaster pulchripes, Lea.

A male, from Mount Lofty, differs from the type of this species in having all the legs, except the tarsi and coxae, reddish, only the extreme tip of antennae infuscated, and the prothorax with a conspicuous blackish spot on each side.

Helcogaster tuberculifrons, Lea.

On the male of this species the basal half of the head is usually deeply infuscated; on the females the infuscation of the head is more pronounced, the tubercle is reduced to a slight swelling on each side of the front of which is a shallow impression, the antennae are thinner, and the front tarsi are simple. Two females, from Dorrigo, sent with several typical ones, are rather larger than the others, and have the head deep black and highly polished, with only the lateral parts of the muzzle pale; a similar female, from the Tweed River, is in Mr. H. J. Carter's collection.

Helcogaster tropicus, Lea.

From some directions the wide median excavation on the head of the male, of this species, seems to be bounded near each eye by a subconical tubercle. The female differs from the male in having the head almost entirely black, without a large excavation, but shallowly bifoveate in front, the neck less strongly narrowed, and the basal joint of the front tarsi combless. On both sexes the legs, except for the knees, are usually entirely black.

The typical specimens were labelled, in the Macleay Museum, as from Cairns, but probably in error, as I have seen no other specimens of the species from Queensland, and it is abundant in the Mount Lofty Ranges, near Adelaide.

Helcogaster niger, Lea.

This species occurs in abundance in South Australia (Port Lincoln, Tumby Bay, Kangaroo Island, Adelaide, Mount

Lofty, Lucindale, and Mount Gambier). The head of the male, viewed from behind, appears to have three small median tubercles and a slightly larger one near each eye.(19) The typical, but not the commonest, form of the male is black, except that some of the basal joints of antennae and the knees are obscurely reddish or testaceous.

Var. 1, ♂. Prothorax with extreme base, and sometimes the sides near base, more or less reddish.

Var. 2, ♂. Prothorax with sides (or a vitta near each side) of prothorax pale, but not to apex, the pale portion usually not continued across middle of base. On some specimens of this form there is also a short, obscure, medio-apical vitta.

Var. 3, ♂. Prothorax with dark markings reduced to a median infuscated spot (usually rather large), and generally with infuscated stains about apex, or sides. On many specimens of this variety the large spot is obscurely connected with two small apical spots, so as to resemble an irregular Y, or the Y may be sharply defined.

The varieties run into each other, but I have seen only one in which the prothorax is entirely pale. In the commonest form of the female the base and sides near base of the prothorax are pale, but the various forms have not been described, as many of them are scarcely distinguishable from females of other species, although the males, by the sculpture of the head, are abundantly distinct.

Helcogaster T-tuberculatus, Lea.

In the table (20) this was in error referred to as *tuberculatus*.

Helcogaster imperator, n. sp.

♂. Black; front half of head, prothorax, a large subtriangular portion at base of elytra (an infuscate blotch about scutellum excepted), and parts of legs and of antennae flavous, or reddish-flavous. With a few scattered dark hairs.

Head wide, with a rather shallow longitudinal impression each side in front. Antennae rather stout, second to tenth joints more or less transverse, eleventh slightly longer than wide. *Prothorax* considerably wider than long, widest close to apex, a deep transverse excavation near apex, and a shallow one near base. *Elytra* not much longer than wide, each separately rounded at apex; with sparse and inconspicuous, rugulose punctures. Basal joint of front *tarsi* with a distinct black comb. Length (♂, ♀), 2·5-4 mm.

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(19) Lea, Trans. Ent. Soc. Lond., 1909, pl. ii., fig. 9.

(20) *L.c.*, p. 216.

♀. Differs in having the head, except the labrum, entirely black, front femora, as well as the others, partly dark, antennae longer and thinner, none of the joints transverse, prothorax only slightly wider than long, apex very little wider than base, non-excavated or tuberculate, and front tarsi combless.

Hab.—South Australia: Adelaide (Blackburn's collection, H. H. D. Griffith, J. G. O. Tepper, N. B. Tindale, and A. Zietz), Mount Lofty (R. J. Burton, S. H. Curnow, A. H. Elston, A. M. Lea, and Tepper), Barossa (Elston), Quorn (Blackburn), Noarlunga (Burton). Type, I. 9185.

Some females were named as *H. basipennis* (Fairmaire) in Blackburn's collection, and in many respects they agree well with the description of that species; but it was described as from Peak Downs in Queensland, and there are so many other species from Queensland and New South Wales that the description would fit equally well, that I think this species (all the specimens of which before me are from South Australia) should not be regarded as *basipennis;* in any case the male of the present species has such a distinctive prothorax that it could hardly be confused with the male of any other species. The excavation of its prothorax varies somewhat, but it is always deep and wide, it is nearly always bounded at each end by a subconical tubercle, its front edge is often impressed in the middle, and has a feeble elevation on each side of the impression, and as all the elevations are setose the front margin, from some directions, appears quadrituberculate; the bottom of the excavation is usually infuscated or black. The impressions on the head of the male are so placed that from some directions the intervening space (appearing as a wide gentle elevation), and the lateral elevations, resemble the broad arrow. From three to five joints of his antennae are pale, on one specimen they are entirely pale; the hind femora are partly black or infuscated, and sometimes the middle ones as well; the apical joints of all the tarsi are infuscated. The true width of the elytra is very little less than that of the length, but owing to irregular contraction it often appears to be much less.

Helcogaster medioapicalis, n. sp.

♂. Black and highly polished; prothorax (except middle of apex), front coxae and femora, and base of middle femora flavous. With very sparse, dark hairs.

Head wide, largely and irregularly excavated. Antennae moderately long, joints gradually decreasing in width, eleventh about once and one-half the length of tenth. *Prothorax* about as long as its greatest width, sides almost evenly rounded, middle of apex irregular. *Elytra* dilated from near base, each separately rounded at apex; with fairly numerous and small, but (for the genus) rather distinct, rugulose punctures. *Legs* rather long and thin, basal joint of front tarsi large, lopsided, and with a comb on the inner edge. Length, 3·5 mm.

Hab.—New South Wales: Blue Mountains (Blackburn's collection). Type (unique), I. 11915.

The prothorax not simple at apex associates this species in my table with *H. incisicollis* and *H. spinicollis;* the former has the prothorax black and deeply notched, the latter has the apex spined; on the present species there is a curved impression across the median apex, behind which the surface is elevated, and from some directions appears to project slightly forwards, but it is not spinose; the irregular part is darker than the rest of the prothorax; the general appearance and elytra are much as in *H. concaviceps.* The excavation on the head is transverse, and continuous from eye to eye, its hind margin is obtusely trisinuate, and front margin more sharply so, and it has a small tubercle in its middle not elevated above the level of the eyes; from some directions it appears to have several small tubercles. On the type the front tibiae and tarsi are infuscated, so that the tarsal comb (which on the males of most species show up as a distinct black inner rim) is inconspicuous, but under the microscope it is seen to be composed of about thirty long, close-set teeth.

HELCOGASTER LITORALIS, n. sp.

♂. Black; head (except base), most of prothorax, and basal third of antennae reddish-flavous. With sparse, dark hairs, elytra glabrous or almost so.

Head shallowly impressed on each side in front, towards base with a wide triangular elevation. Antennae moderately long, second to fifth joints slightly transverse, sixth to tenth slightly longer, eleventh longer than tenth. *Prothorax* slightly longer than wide, widest near apex, with a closed depression near base. *Elytra* moderately long; with sparse inconspicuous punctures. Basal joint of front *tarsi* lopsided and with an inner comb. Length (♂, ♀), 2·25-3 mm.

♀. Differs in having the head black almost to the muzzle, and without the triangular elevation, prothorax almost or entirely black, antennae somewhat thinner, and front tarsi combless.

Hab.—Lord Howe Island (A. M. Lea). Type, I. 11906.

In my table would be associated with *H. obliquiceps* which has a very different head, in fact the head is very different from that of any other species; seen from behind its entire base appears to be triangularly elevated; it is transversely impressed at the extreme base, with the triangle overhanging it; even on the female there are traces of these. Twelve specimens were obtained on the island by the use of a sweep-net on grasses, etc., close to a beach; of these four are males, and the dark parts of the prothorax on each appear to be more of the nature of stains than regular markings, on three of them there is an irregular postmedian fascia, on the fourth there is only a small spot on each side; but the prothorax of the female is deep black, with the base usually, but not always, more or less reddish. On several specimens of each sex the knees are obscurely reddish.

Helcogaster medioflavus, n. sp.

♂. Black; middle portion of elytra obscurely pale flavous, three or four basal joints of antennae more or less flavous. A few blackish hairs scattered about.

Head with a rather shallow, inter-ocular impression; with three distinct costae in front, the median one shorter than the others. Antennae longer (passing elytra) and more distinctly serrated than usual in genus. *Prothorax* slightly transverse, sides evenly rounded, a wide transverse depression near base. *Elytra* moderately long, inconspicuously rugulose. *Abdomen* with a small medio-apical process. Basal joint of front *tarsi* lopsided, with an inner comb. Length, 2-2·5 mm.

Hab.—South Australia: Quorn (A. H. Elston), Murray Bridge (A. M. Lea). Type, I. 11899.

The bicoloured elytra and tricostate head render this species a very distinct one, and at once distinguish it from *H. obliquiceps* and *H. gagatinus*, with which it would be associated in my table. The dark parts of the elytra are a wide basal triangle, and the apical two-fifths, the pale intervening portion is distinct, but its outlines are not sharply defined. A specimen from the old collection, without exact locality, has the dark parts more brown than black, with the pale portion of the elytra more extended. There are five males before me, but I have been unable to associate any females with them.

Helcogaster opaciceps, n. sp.

♂. Black; elytra with median portion pale flavous, three basal joints of antennae, knees, front tibiae, and tarsi, more or less reddish-flavous. A few blackish hairs scattered about.

Head wide, opaque and densely punctate, a fairly large depression close to each eye, the two separated by an obtuse, shining ridge. Antennae moderately long and feebly serrated. *Prothorax* slightly transverse, sides evenly rounded, a wide transverse impression at base; a few punctures on sides. *Elytra* moderately long; with a few small, rugulose punctures. Basal joint of front *tarsi* lopsided, with a black inner comb. Length (♂, ♀), 2·75-3·25 mm.

♀. Differs in having the head narrower, the median ridge and lateral depressions much less distinct, antennae somewhat shorter and thinner, prothorax more transverse, and front tarsi combless.

Hab.—South Australia: Quorn (E. L. Savage), Tarcoola and Ooldea (A. M. Lea). Type, I. 12212.

Colours much as in the preceding species, from which it differs in being slightly wider, head opaque (except in front) and with dense punctures, instead of highly polished, and antennae somewhat shorter. On the only male before me the dark parts of the elytra are a large basal triangle, and the apical two-fifths; on one of the females the dark basal portion is extended, and the apical portion decreased; on the other female the dark parts are both somewhat extended and narrowly meet on the suture.

Helcogaster cribriceps, n. sp.

♂. Black; median portion of elytra flavous, four basal joints of antennae, tibiae and tarsi more or less reddish-flavous. With sparse dark hairs.

Head rather wide; with small and fairly dense, sharply defined punctures, becoming denser in front; a shallow depression on each side in front. Antennae fairly long, moderately stout, and obtusely serrated. *Prothorax* moderately transverse, sides gently rounded and narrower at base than at apex, base with a transverse depression. *Elytra* not very long, each separately rounded at apex; with fairly numerous small, but rather sharply defined, rugulose punctures. Basal joint of front *tarsi* with a small black comb. Length, 3 mm.

Hab.—Western Australia: Cue (H. W. Brown). Type (unique), I. 12121.

Close to *H. medioflavus*, and with similarly coloured elytra, but the head simple except for feeble lateral depressions and with, for the genus, very distinct punctures; these are sparser than on the preceding species, and are individually distinct, so that the head is shining, on that species they are so dense as to cause the head to be opaque. The pale portion of the elytra occupies rather more than the median third along the suture, it is somewhat extended on each side towards the base, but does not quite touch the sides, as a result, from above, the black basal portion of the elytra appears to be widely triangular.

Helcogaster brevicornis, n. sp.

♂. Black; head in front of eyes, front sides of prothorax, elytra (a slight infuscation about scutellum), antennae, front legs, and knees, more or less flavous. A few dark hairs scattered about.

Head rather small, a wide, feeble, median elevation in front, a shallow depression on each side of it, and a more feeble one behind its middle; a few minute scattered punctures, but becoming dense behind eyes. Antennae short, scarcely reaching base of prothorax, all the joints, except first and eleventh, transverse. *Prothorax* moderately transverse, sides gently rounded, subbasal depression very feeble and ill-defined; a few small punctures scattered about, but becoming more condensed on sides. *Elytra* scarcely twice the length of prothorax; with a few small, rugulose punctures. Basal joint of front *tarsi* large, lopsided, and with a distinct, black, inner comb. Length, 3·5 mm.

Hab.—Western Australia: Coolgardie (Blackburn's collection, from E. Meyrick). Type (unique), I. 11916.

The shallow depressions on the head are as on many females of the genus, and the head itself is rather small for a male, but the front tarsi are unmistakably masculine. On the type the base of the head is exposed and opaque, but it would probably be concealed on most specimens.

Helcogaster flavipennis, n. sp.

♂. Black; labrum, elytra (a slight infuscation about scutellum), front legs and parts of the others more or less flavous. A few blackish hairs scattered about.

Head rather wide, a feeble trisinuate impression between eyes, a feeble and short median line; a few small punctures scattered about. Antennae thin and not very long. *Prothorax* moderately transverse, sides evenly rounded, subbasal depression almost absent; almost impunctate. *Elytra* rather short, dilated posteriorly; with sparse and minute, rugulose punctures. Basal joint of front *tarsi* large, lopsided, a distinct black comb from base to apex. Length (♂, ♀), 2-3 mm.

♀. Differs in having the head smaller, median line less distinct, a shallow depression each side in front, antennae shorter, prothorax more transverse, and front tarsi combless.

Hab.—South Australia: Quorn (Blackburn's collection and A. H. Elston), Oodnadatta (Blackburn). Type, I. 11898.

In my table would be associated with *H. marginicollis*, which has cephalic armature and bicoloured prothorax; the almost simple head of the male, and pale elytra, except for a slight infuscation about scutellum, readily distinguish from *H. medioflavus;* in appearance it is much like the preceding species, but the head of the male is larger, more transverse, somewhat differently sculptured in front, less of muzzle pale, and pronotum entirely dark. The middle legs are sometimes almost entirely dark, sometimes only infuscated in parts; the hind ones usually have the base of femora obscurely pale; the antennae of the male are usually entirely pale; on the female the apical half, or more, is usually deeply infuscated; on several females the sides of the elytra are slightly infuscated posteriorly.

Helcogaster basicollis, n. sp.

♂. Black; base of prothorax, basal third of antennae and most of legs flavous; elytra obscurely piceo-flavous, blackish about base and suture. With sparse, black hairs.

Head smooth and almost impunctate between eyes, base and sides behind eyes densely punctate; two narrow and rather deep impressions in front. Antennae rather short. *Prothorax* moderately transverse, sides evenly rounded, base and apex subequal, subbasal depression scarcely traceable; a few punctures on sides. *Elytra* rather wide and not very long; with sparse, minute, rugulose punctures. Basal joint of front *tarsi* lopsided, a black comb on the inner edge. Length, 2·75-3 mm.

Hab.—South Australia: Quorn (A. H. Elston). Type, I. 11902.

Allied to the preceding species, but head more conspicuously bifoveate in front, prothorax pale at base, and elytra and legs more obscurely coloured. In my table it would be associated with *H. obliquiceps*, and *H. gagatinus;* the former has head very different and antennae longer; the latter is considerably narrower, with unicolorous prothorax. The head without large excavations and bifoveate in front, is as in many females of the genus, but the front tarsi are essentially masculine. On the two specimens taken by Mr. Elston the elytra from behind are seen to have the sides obscurely flavous, with the base and a fairly wide sutural space (narrowing posteriorly) blackish, but from above, or the sides, the two colours are not sharply defined. On both specimens parts of the tibiae and the hind femora are infuscated.

Helcogaster inflatus, n. sp.

♂. Black; apical three-fifths of elytra (more on sides), tibiae, and tarsi flavous. With very sparse, black hairs.

Head with a wide shallow depression in front, triangularly narrowed posteriorly and terminated level with hind edge of eyes; with minute scattered punctures, more numerous about eyes than elsewhere. Antennae rather short. *Prothorax* about as long as wide; a deep, transverse, subbasal depression, closed at each end. *Elytra* comparatively long, sides inflated in middle; punctures sparse, minute and rugulose. Basal joint of front *tarsi* slightly lopsided, with a small black comb. Length, 2 mm.

Hab.—South Australia: Port Lincoln (A. M. Lea). Type (unique), I. 11903.

The depression on the head, although from some directions appearing rather wide, could hardly be regarded as a large excavation, as it is rather shallow, and it is almost simple; hence in my table the species might be associated with *H. obliquiceps* and *H. gagatinus*. Regarding the head as largely excavated it would be associated with *H. marginicollis*. It is considerably narrower than *H. flavipennis*, impressions of head and prothorax different, elytra longer, and with more of its base dark; the dark portion has a somewhat rounded outline, and is rather sharply defined. The basal joints of antennae and base of prothorax are not as dark as the adjacent parts, but the different shades of colour are not at once apparent. The inflation of the sides of the elytra commences rather suddenly at the basal third.

Helcogaster melas, n. sp.

♂. Black; muzzle and three basal joints of antennae obscurely flavous. With sparse, dark hairs.

Head with a rather large, flattened elevation in front; with crowded punctures. Antennae moderately long. *Prothorax* moderately transverse, with a rather small subbasal depression. *Elytra* comparatively long; almost impunctate. Basal joint of front *tarsi* lopsided, with an inner comb. Length (♂, ♀), 2·25-3 mm.

♀. Differs in being without an elevation on head, its punctures more sharply defined in front, antennae somewhat shorter, and front tarsi combless.

Hab.—Victoria: Nelson (Blackburn's collection); South Australia: Lucindale (F. Secker). Type, I. 11895.

The elevation on the head is somewhat bottle-shaped, but the neck of the bottle is shorter than in *H. bacchanalis*, and the two species are otherwise very different. The head, when viewed from behind, appears to have a solitary median tubercle, but this is not as thin as in *H. parallelus*, and from above the head of that species is seen to be largely excavated;

on the present species there is a slight depression immediately behind the elevation. The elevation is somewhat suggestive of that of *H. litoralis*, on a greatly reduced scale, but the head otherwise, and the colours are different. In my table it would be associated with *H. obliquiceps*, which is a smaller species, with more of the head and legs pale, the head flatter between eyes, the elevation of different shape, and antennae much shorter.

HELCOGASTER PUNCTICEPS, n. sp.

♂. Black; muzzle and basal joints of antennae obscurely diluted with red. With sparse, dark hairs.

Head with a vague depression each side in front, leaving a feeble, impunctate, thin, parallel-sided elevation; elsewhere with dense punctures. Antennae rather long and thin. *Prothorax* lightly transverse, with a wide subbasal impression. *Elytra* moderately long; with small, rugulose punctures. Basal joint of front *tarsi* lopsided, with a small comb. Length, 2·25 mm.

Hab.—South Australia: Murray Bridge (A. M. Lea). Type (unique), I. 12122.

In some respects close to the preceding species, but head without a bottle-shaped elevation in front and antennae thinner; in my table it would be associated with *H. obliquiceps* and *H. gagatinus*, from which it differs in its darker head, with dense punctures; these are so dense that (except for the feeble elevation in front) the derm is rendered opaque.

Two females, from Adelaide, possibly belong to this species; they differ from the type in having the head smaller, with much sparser punctures, antennae shorter and thinner, base of prothorax obscurely reddish, and front tarsi combless.

HELCOGASTER CAPSULIFER, n. sp.

♂. Black; three or four basal joints of antennae obscurely reddish. With sparse, black hair.

Head with a flask-shaped elevation bounded by strongly impressed lines; with dense punctures, except on elevation. Antennae rather short and not very thin. *Prothorax* slightly wider than long, with a wide, closed subbasal depression. *Elytra* not very long; almost impunctate. Basal joint of front *tarsi* lopsided and rather large, with an inner comb. Length (♂, ♀), 3 mm.

♀. Differs in having head smaller, its elevation much smaller, entirely frontal, not flask-shaped, without deep bounding lines, punctures more evenly dense, antennae somewhat thinner, and front tarsi combless.

Hab.—New South Wales: Eden (H. J. Carter). Type, I. 11893.

The head has distinct impressions but it is not largely excavated, so in my table would be associated with *H. obliquiceps* and *H. gagatinus;* from which it is distinguished by the flask-shaped elevation, etc. On *H. melas* the elevation rises conspicuously above the general level of the head, on the present species it does not do this, being divided off by impressed lines, which become deep between the antennae; seen from in front, or obliquely from behind, there appears to be a deep, angular, interocular fovea, on each side of the apex of the flask; seen from directly behind there appear to be two minute tubercles near each eye.

A male from Tumby Bay, South Australia, in size, shape, colour, and sculpture of head so closely resembles the type that I think it must represent a variety of the species; its antennae are decidedly—about one-fourth—longer, and the head when viewed directly from behind does not appear to have two minute tubercles near each eye; the flask-shaped elevation, however, is of exactly the same shape.

HELCOGASTER EXCAVIFRONS, n. sp.

♂. Black; two basal joints of antennae bright red. With a few inconspicuous dark hairs.

Head wide, with a large excavation; punctures small and crowded. Antennae moderately long. *Prothorax* slightly transverse, with a rather wide subbasal depression. *Elytra* rather short and wide; almost impunctate. Basal joint of front *tarsi* lopsided, and with an inner comb. Length (♂, ♀), 2·25-2·5 mm.

♀. Differs in having the head smaller, without excavation, punctures more uniformly distributed, antennae shorter, thinner, with the basal joints less brightly coloured, and front tarsi combless.

Hab.—South Australia: Port Lincoln, Tumby Bay (Blackburn's collection). Type, I. 11901.

The cephalic excavation is of irregular depth, its sides touch the front of the eyes, and its hind outline is a gentle curve, but with a slight median impression; the interantennary space is shining; viewed from behind the head appears to have two very small median elevations in front, but to be without one at the side of each eye. In my table it would be associated with *H. niger*, from which the excavation, single at its posterior end, is distinctive.

One of the four females, associated with the two males by Mr. Blackburn, has the base of the prothorax obscurely reddish.

Helcogaster aterrimus, n. sp.

♂. Black; second and third joints of antennae and under-surface of first more or less reddish. With a few dark hairs.

Head wide, with a wide and deep excavation, its posterior end obtusely bilobed; behind the excavation with small and dense punctures. *Prothorax* near apex, slightly wider than long, with a rather wide, subbasal depression. *Elytra* moderately long; with numerous minute punctures. Basal joint of front *tarsi* lopsided, with an inner comb. Length (♂, ♀), 2-2·25 mm.

♀. Differs in having the head smaller, non-excavated, and with uniformly dense punctures, antennae shorter and thinner, and front tarsi simple.

Hab.—South Australia: Port Lincoln (A. M. Lea); Western Australia: Yilgarn (Blackburn's collection). Type, I. 11897.

At a glance apparently belonging to the preceding species, but excavation of head of different shape, although almost of the same size; when viewed from behind the head appears to have four small equi-distant conical elevations, the lateral ones slightly larger than the others, and one touching each eye, each lateral one, however, when viewed from the side is seen to be a simple semicircle around the eye: in this it differs distinctly from the following species, in which from the side there appears to be a conspicuous elevation behind the eye, and this elevation is connected by a narrow ridge with a medio-frontal one. In my table it would be associated with *H. niger*, from which it is distinguished by the different excavation and somewhat thinner antennae. On the specimen from Yilgarn the middle of the side of each elytron is pale; on the type the pale portion is scarcely traceable.

Helcogaster hoplocephalus, n. sp.

♂. Black; four basal joints of antennae, except upper-surface of first, obscurely reddish. Very sparsely pubescent.

Head wide, largely and irregularly excavated and tuberculate; with crowded punctures. Antennae comparatively short and stout. *Prothorax* slightly transverse, subbasal depression shallow and ill-defined; with fairly numerous, minute punctures. *Elytra* moderately long; with small and dense, fairly distinct punctures. Basal joint of front *tarsi* with a small comb. Length (♂, ♀), 2·5-3 mm.

♀. Differs in having the head nontuberculate, with two feeble depressions in front, and a very feeble one between eyes, antennae shorter and thinner, and front tarsi simple.

Hab.—New South Wales: Sydney (Dr. E. W. Ferguson). Type, I. 11920.

The excavation on the head of the male is obtusely bilobed posteriorly. Seen from behind the head appears quadrituberculate, the larger tubercles being adjacent to the eye, and distinct from all directions; but from oblique directions it may be seen that the tubercles represent the ends of a narrow curved ridge on each side. The elytral punctures, although small and somewhat rugulose, are much more distinct than is usual in the genus. In my table would be associated with *H. niger*, which is a larger species, with different excavation, and much longer antennae; it is about the size of *H. gagatinus*, and the females are very similar, but the male has very differently sculptured head.

Helcogaster coelocephalus, n. sp.

♂. Black; parts near eyes, and four basal joints of antennae, more or less flavous. Almost glabrous.

Head wide, with a large and irregular excavation, with small tubercles; in parts densely punctate. Antennae rather long. *Prothorax* near apex slightly wider than long, with a shallow, subbasal depression. *Elytra* moderately long; with minute punctures. Basal joint of front *tarsi* lopsided, with an inner black comb. Length, 2 mm.

Hab.—Northern Queensland (Blackburn's collection). Type (unique), I. 11896.

The excavation on the head is trisinuate posteriorly, the median sinus being bounded by an oblique elevation on each side (from some directions the elevations look like small tubercles). The head, viewed from behind, appears to have four small elevations: two black, median, widely triangular ones, and a pale one, curved inwards, at the side of each eye; from the preceding species, in which the ocular tubercles are black, it is also distinguished by the trilobed posterior end of the excavation. In my table it would be associated with *H. niger*, which has thicker antennae, and head very different, when viewed from behind.

Helcogaster triangulifer, n. sp.

♂. Black; labrum and four basal joints of antennae flavous. A few inconspicuous dark hairs on sides.

Head with a deep, irregular impression or excavation in middle. Antennae rather long and obtusely serrated. *Prothorax* slightly longer than the greatest width, base much narrower than apex; a wide subbasal depression, closed at its ends; a few punctures on sides. *Elytra* moderately long; with minute, indistinct, rugulose punctures. Basal joint of front *tarsi* lopsided, with a small black inner comb. Length, 2·25-3 mm.

Hab.—Victoria: Alps (Blackburn's collection), Lorne (F. E. Wilson), Fern Tree Gully (F. P. Spry). Type, I. 11894.

From an oblique direction the head in front of the excavation appears to have an oblique groove near each eye, then an oblique ridge, then another groove, and then a short median ridge; but from other directions the whole space between the subocular grooves appears to be a feeble semicircular elevation, and in fact its appearance varies with the point of view; the excavation has a wide triangle projecting into its middle from the base of the head, so that its posterior end is obliquely directed behind each eye. The basal portion of the head, which, however, is often concealed, is densely punctate. On the type the sides of the head adjacent to the front are obscurely diluted with red.

Two males, from the Dividing Range (Victoria), differ in being more of a piceous-brown than black, with most of the head, base, and sides near base of prothorax, knees and other parts of legs more or less flavous. Three females, mounted with them and evidently belonging to the species, are coloured as the males, except that one has the prothorax entirely pale; they differ in having the head smaller and nonexcavated, with a slight longitudinal elevation in front, and the front tarsi simple. A male, from the Blue Mountains, has the muzzle and sides of head in front of eyes, base of prothorax, and knees, more or less reddish. A male, from Illawarra, is like the preceding specimen, except that the prothorax is entirely pale. All these males agree in having a wide triangle projecting into the middle of the interocular excavation; in my table they would be associated with *H. niger* (except the one from Illawarra); from which they differ in the antennae, and in the excavation not trisinuate at base. The Illawarra male would be associated with *H. concaviceps*, but its head is of different shape, and differently sculptured, etc.

Helcogaster macrocephalus, n. sp.

♂. Black; labrum, four basal joints of antennae, prothorax, parts of middle and of hind femora, and of tarsi, and most of front legs, more or less reddish. Sides with rather numerous, blackish hairs.

Head rather large, wide, and flat; with two small oblique foveae between eyes, two very small ones in middle behind them, and a shallow longitudinal depression each side in front; with fairly numerous, asperate punctures; towards base densely, transversely strigose. Antennae rather short, third to eighth joints obtusely serrated. *Prothorax* strongly transverse, sides strongly rounded, a wide shallow depression near base; almost impunctate. *Elytra* short, feebly dilated posteriorly; with sparse rugulose punctures. *Legs* not very long, basal joint of front tarsi large, lopsided, and with a black inner comb. Length, 4·5 mm.

Hab.—South Australia: Mount Lofty Ranges (A. H. Elston). Type (unique), I. 12251.

A rather wide species, with head very differently sculptured from the many similarly coloured ones; in width it is second only to *H. major*.

HELCOGASTER OXYTELOIDES, n. sp.

♂. Black; prothorax flavous, basal joints of antennae, tibiae and tarsi, obscurely flavous. With sparse dark hairs, more numerous on sides than elsewhere.

Head rather large; a shallow depression each side in front, with a feeble median elevation between them; apical half shining and with sparse punctures, basal half opaque and with dense ones. Antennae rather long, third to ninth joints distinctly serrated. *Prothorax* moderately transverse, sides and base rounded, a vague open depression near base. *Elytra* short; almost impunctate. Basal joint of front *tarsi* large, lopsided, with a black inner comb. Length, 2·5 mm.

Hab.—Victoria: Sea Lake (J. C. Goudie's No. 829). Type, I. 12123.

The head is much the shape of that of many species of *Oxytelus*, of the Staphylinidae; the impressions on its front are quite distinct, but the head could not be regarded as largely excavated, hence in my table the species would be associated with *H. bilobus*, which has the head even less excavated, and bicolorous elytra. Many of the punctures, at the base of the head, are longitudinally confluent.

A female, mounted with the type by Mr. Goudie, and probably belonging to the species, differs from the male in being smaller (2·25 mm.), in having the pale parts of the legs and antennae more extended, and of a brighter colour, head much smaller, its shining and impunctate portion continued to nearer the base, frontal impressions smaller, antennae shorter, elytra with fairly numerous punctures (which although not sharply defined cause the surface to appear finely rugulose), and front tarsi combless.

HELCOGASTER ATRICEPS, n. sp.

♂. Black; prothorax, basal joints of antennae, and knees more or less flavous. With sparse, dark hairs.

Head rather large, with a deep transverse interocular excavation; densely punctate and opaque. Antennae comparatively long. *Prothorax* about as long as the greatest width (near apex), base much narrower than apex, near base with a wide and rather deep, closed depression. *Elytra* moderately long; with minute, rugulose punctures. Basal joint of front *tarsi* rather large, lopsided, and with a black inner comb. Length, 2 mm.

Hab.—New South Wales: Wentworth Falls (Aug. Simson), Mittagong (A. M. Lea). Type, I. 11908.

In general appearance close to the preceding species, but the head deeply transversely excavated; it is evidently close in appearance also to *H. nigriceps*, but differs from the description in being smaller, head with excavation bisinuate, instead of trisinuate, posteriorly (the sinuations although wide are feeble, and the space dividing them is very obtuse), antennae longer, four of the basal joints partly or entirely pale, and the knees pale. In my table it would be placed with *H. insularis*, which is a much larger species, with the excavation different, the part dividing the sinuations acute, antennae wider, and knees no paler than the adjacent parts. The head of the Mittagong specimen, when viewed from behind, appears to have a minute tubercle on granule close to each antenna, but on the type these are not evident.

Helcogaster pignerator, n. sp.

♂. Black; front of head and a large spot near each eye, prothorax, and part of antennae flavous. With sparse, dark hairs, more numerous on sides of abdomen than elsewhere.

Head rather large, with a wide, sinuous, interocular excavation, its posterior end trisinuate; inter-antennary space irregularly elevated; in parts with dense punctures. Antennae moderately long. *Prothorax* slightly longer than greatest width (near apex), a wide but rather shallow and open depression near base. *Elytra* rather long; minutely rugulose-punctate. Basal joint of front *tarsi* lopsided, with a black inner comb. Length, 5 mm.

Hab.—New South Wales: Sydney (A. and F. R. Zietz). Type (unique), I. 11907.

The three conspicuous spots give the head a curious appearance, the front one at first appears to be confined to the inter-antennary space, but is continued along the sides to near the eyes, and passes completely across the under-surface; the other spots are smaller, round, and sharply defined. In some lights the elytra have a faint bluish gloss, and their extreme lateral margins from the base almost to apex are whitish; two of the basal joints of antennae are decidedly flavous, the three following ones gradually become darker, the others are black; the knees and tips of tibiae are obscurely flavous. The pale inter-antennary elevation is somewhat heart-shaped, and gently concave, from behind it appears a feebly trituberculate process, from the side a curved ridge. In my table would be placed with *H. concaviceps*, which is a smaller and broader species, with head differently coloured and excavated.

Helcogaster ventralis, n. sp.

♂. Black; prothorax, each side of three basal segments of abdomen, and three basal joints of antennae flavous; knees and parts of tibiae and tarsi obscurely diluted with red. With rather sparse, blackish hairs.

Head moderately large; with minute, irregularly distributed punctures, becoming crowded at base; a small shallow depression each side in front. Antennae rather short. *Prothorax* distinctly transverse; subbasal depression shallow and ill-defined. *Elytra* rather short; with minute, rugulose punctures. Basal joint of front *tarsi* moderately large, lopsided, and with a black inner comb. Length, 3 mm.

Hab.—South Australia: Mount Lofty (A. H. Elston). Type (unique), I. 11910.

Structurally fairly close to *H. basicollis*, but frontal fovea of head much less distinct, antennae somewhat shorter, and prothorax uniformly pale. In my table it would be placed with *H. pulchripes*, from which it differs in its darker head, with somewhat different frontal impressions, darker antennae, and abdomen partly pale. The head has a distinctly feminine appearance, but the front tarsi are certainly those of a male.

Helcogaster apicicornis, n. sp.

♂. Black; prothorax, most of front and of middle legs, hind knees, and part of antennae flavous. With sparse, dark hairs.

Head highly polished, with two small but distinct foveae in front, a few minute punctures about base. Antennae rather short, second to fourth joints slightly transverse, fifth to tenth rather strongly transverse, eleventh flat, almost as long as eighth to tenth combined. *Prothorax* distinctly transverse, sides evenly rounded, base and apex equal, a vague depression near base. *Elytra* moderately long; with fairly dense and minute, rugulose punctures. Middle *femora* distinctly dentate, middle tibiae rather strongly curved at base, basal joint of front tarsi large, lopsided, with a black comb from base to apex on inner side. Length (♂, ♀), 2·5-3 mm.

♀. Differs in having the head smaller, antennae shorter and thinner, joints less strongly transverse, apical one smaller and with its tip pointed, middle legs and front tarsi simple.

Hab.—South Australia: Adelaide (Blackburn's collection and A. M. Lea), Mount Lofty (R. J. Burton, A. H. Elston, J. G. O. Tepper, and Lea), Lucindale (B. A. Feuerheerdt, F. Secker, and Lea), Myponga (Elston). Type, I. 11909.

Readily distinguished from all previously described species by the apical joint of the male antennae; its most distinctive shape is that viewed at right angles to its greatest width, when it appears rather wide and parallel-sided, with its tip slightly notched, from other directions it appears rather narrow and somewhat lopsided; the middle legs are also distinctive, the head is slightly smaller in the female than in the male, but the frontal foveae are much the same. In my table it would be placed with *H. pulchripes.* On the male the tarsi and the base of the middle femora are infuscated, the antennae after the third or fourth joint gradually become darker, but even the terminal joint never appears to be black; on the female a greater portion of the front and middle legs is dark. On fresh specimens the prothorax has a decided reddish tinge.

HELCOGASTER CENTRALIS, n. sp.

♂. Black; head (except at base), prothorax, base of antennae, and most of legs flavous.

Head rather wide, with a rounded fovea occupying one-third of the interocular space; between it and eyes flat, and with crowded punctures; an obtuse elevation in front. Antennae moderately long. *Prothorax* near apex wider than long, but rather strongly narrowed to base, near base with a wide and deep closed depression. *Elytra* rather short, dilated and rounded posteriorly; with very minute, rugulose punctures. Basal joint of front *tarsi* lopsided, with a small black comb. Length, 2 mm.

Hab.—New South Wales (Dr. E. W. Ferguson). Type (unique), I. 11923.

At first glance apparently belonging to *H. foveiceps*, but head with a large central impression, instead of one on each side, the antennae pale only at base, and prothorax of different shape; from *H. hackeri* it is still more distinct. In front of the central fovea there is an elevation which might be regarded as a large tubercle, and hence in my table the species might be placed in *i*, and of those there noted it differs from *H. helmsi*, in being much smaller, head of different shape and colour, and legs variegated; *H. tuberculifrons* has head of different shape, elytra bicolorous and legs flavous. On the type the pale parts of the legs are the apical half of femora, front tibiae and tips of the others, and basal joints of tarsi.

HELCOGASTER LATEROFUSCUS, n. sp.

♂. Head behind eyes, sides of prothorax, scutellum, prosternum, mesosternum, abdomen, seven apical joints of antennae, and parts of legs, black or blackish; elsewhere flavous. With sparse, dark hairs; and very sparse, whitish pubescence.

Head rather long, opaque, and densely punctate; a narrow curved impression on each side from near base of eye to labrum, and a faint median line. Antennae moderately long and obtusely serrated. *Prothorax* about as long as wide, apex slightly wider than base, a shallow, open, subbasal depression; punctures fairly dense on sides, but sparse in middle. *Elytra* moderately long, sides evenly dilated posteriorly; punctures very minute and rugulose. Basal joint of front *tarsi* lopsided, with a distinct black comb. Length (♂, ♀), 3·25-5 mm.

♀. Differs in being larger, head with less prominent eyes, curved impressions shorter and less distinct, median line scarcely traceable, less of the base dark, and front tarsi combless.

Hab.—New South Wales: Rydalmere (Dr. E. W. Ferguson), Gosford (H. J. Carter); Queensland: Rockhampton (Macleay Museum). Type, I. 11922.

The sides of the prothorax are rather deeply infuscated, or blackish, on each of the three specimens under examination, so the dark parts are evidently natural and not stains; hence in my table of the genus the species would be associated with *H. obliquiceps*, which has the elytra entirely dark, head somewhat different, and antennae much shorter. On the male the four hind femora are rather dark on the basal half; the front femora, the middle of the four hind tibiae, and the apical tarsal joints, are slightly infuscated. From in front the head of the male appears to have a shallow semicircular impression, marking off a feebly bilobed interocular elevation. The Rockhampton female, probably a very old one, has the head and tibiae entirely pale.

HELCOGASTER FASCIATUS, n. sp.

♂. Piceous-brown and flavous. With very sparse, white pubescence, and with a few dark hairs; a small fascicle of dark hairs near each eye.

Head wide and irregularly impressed. Antennae comparatively long. *Prothorax* distinctly transverse, base much narrower than apex, a rather deep, closed subbasal depression; punctures rather dense on sides, sparse elsewhere. *Elytra* moderately long, a vague depression on each side of suture near base; with dense, minute, rugulose punctures. Basal joint of *tarsi* with a small black apical comb. Length, 2·5 mm.

Hab.—Queensland: Cairns. Type (unique), I. 11912.

The head is entirely pale, the five basal joints of antennae are still paler, with the following ones more or less deeply infuscated, but the tip obscurely pale; the prothorax is of a dingy reddish-brown, with the front paler, but it has the appearance as of being stained; the elytra (except for a wide, median, flavous fascia), abdomen, mesosternum, and metasternum, are piceous-brown; the legs are almost white, with the femora deeply infuscated. The fascia extends from side to side and is sharply and evenly defined on its posterior end, about two-fifths from the apex; its front edge is somewhat irregular. The cephalic excavations are partly obscured by pubescence; according to the point of view they appear to be three or five in number, but apparently there is a large, shallow, median portion, dilated and bisinuate posteriorly, narrower and bisinuate apically; the two small fascicles are very distinct; the punctures on the head are dense in places, but not sharply defined. Regarding the prothorax as partly dark, the species, in my table, would be referred to D, and there associated with *H. marginicollis*, whose head is very differently sculptured; if referred to DD, it would go with *H. maculiceps* and *H. fuscitarsis*, also with different cephalic sculpture. *Carphurus fasciipennis* was described by Fairmaire as having an elytral fascia, but the description differs in many other respects.

Helcogaster laticeps, n. sp.

♂. Black and flavous. Sides with sparse, dark hairs.

Head wide, a large central fovea closed in front, but open posteriorly, the space between it and each eye flat, densely punctate, rounded posteriorly and joined in front to a small inter-antennary elevation; base with dense, minute punctures. Antennae rather long, obtusely serrated internally. *Prothorax* slightly longer than the apical width, which is distinctly greater than the basal width, a rather wide, deep, closed depression near base, and a small fovea on each side near apex; with small and dense, but unevenly distributed punctures. *Elytra* moderately long; with very minute, rugulose punctures. Basal joint of front *tarsi* lopsided, with a small, black, apical comb. Length, 2·25-2·5 mm.

Hab.—New South Wales: Grenfell (Dr. E. W. Ferguson). Type, I. 11924.

The flat space near each eye is densely punctate, but from some directions appears finely granulate; as there is a distinct fovea in the middle of the head the species might be referred to FF of my table, but the head is very different from all the species there noted; the species, however, is allied to *H. foveiceps*, but the head is differently sculptured, and elytra bicolorous. *H. centralis* has the fovea closed posteriorly, and the front of the head with a large, obtuse tubercle, its prothorax is also of different shape, and elytra of one colour. The elytra are coloured somewhat as in *H. imperator*, but the head and prothorax are very different. The flavous parts are the head (except at extreme base), prothorax, legs (except coxae and base of femora), and three or four basal joints of antennae; part of the side of each elytron is of a different shade of flavous to the prothorax, the black part commences at the base (near to but not touching the sides), is rapidly narrowed towards the suture, and then continued along it to beyond the middle, when it is suddenly dilated to cover the apical two-fifths. On the type the apical joint of antennae is almost as pale as the basal ones, on a second male the apical joint is scarcely paler than the tenth, and the middle and hind tibiae and tarsi are slightly infuscated.

Helcogaster pallidus, n. sp.

♂. Flavous; metasternum and six apical joints of antennae deeply infuscated, middle of elytra slightly infuscated. With rather sparse, pale pubescence, a few darker hairs on sides.

Head not very large, with a large obtuse median elevation; punctures dense and irregularly distributed, becoming confluent about base. Eyes rather larger than usual. Antennae long, thin, and scarcely serrated. *Prothorax* distinctly transverse, apex much wider than base, a wide and rather deep closed subbasal depression; punctures small and sparse. *Elytra* rather long; with fairly dense, minute, rugulose punctures. *Legs* long and thin, basal joint of front tarsi with a small, black, apical comb. Length (♂, ♀), 2·25-3 mm.

♀. Differs in having the head smaller, nontuberculate, two shallow impressions in front, and with sparser punctures, antennae thinner and scarcely infuscated towards apex, prothorax less dilated in front, tip of abdomen infuscated, and legs shorter, with combless tarsi.

Hab.—Queensland: Cairns. Type, I. 11953.

The elytra could hardly be regarded as fasciate, as although the apical fourth and basal third are paler than the intervening portion, this is only vaguely infuscated, especially on the female. There is a shallow depression on each side of the tubercle of the male; on its front edge there is a small fovea, and then a transverse ridge, both fovea and ridge invisible from behind. In my table would be referred to FF, but the head is very different from all the species there noted.

HELCOGASTER THORACICUS, n. sp.

♂. Flavous; apical three-fifths of elytra black, metasternum and six or seven apical joints of antennae deeply infuscated. With sparse, pale pubescence, and with some longer pale hairs.

Head moderately long, with two small frontal foveae; with fairly numerous, small, but distinct punctures. Antennae rather long and thin, second joint distinctly shorter than third. *Prothorax* slightly longer than the greatest width (near apex); a deep, narrow impression across middle, not quite extended to sides, and marking the posterior end of a large depression; a small dark fascicle before and one behind its middle; punctures small but rather sharply defined about base and apex. *Elytra* moderately long; with minute, rugulose punctures. Basal joint of front *tarsi* lopsided, with a black inner comb. Length, 3·5-4 mm.

Hab.—Northern Queensland (Blackburn's collection). Type, I. 9203.

Readily distinguished from all other described species of *Helcogaster* and of *Carphurus* by the prothorax of the male; in my table would be associated with *H. simpliciceps*. On the type the tip of the abdomen (apparently owing to a stain) is slightly infuscated, on a second specimen it is entirely pale.

HELCOGASTER HUMERALIS, n. sp.

♂. Flavous; elytra (except shoulders), metasternum, abdomen, and five apical joints of antennae black. Sparsely clothed with ashen pubescence, and with a few longer hairs.

Head with a wide and deep interocular excavation, its posterior end evenly semicircular; a large flat tubercle in front; punctures dense and small. Antennae rather long, moderately serrated. *Prothorax* about as long as the apical width, which is considerably more than that of base; with a large, transverse, closed, subbasal depression. *Elytra* moderately long; with very minute punctures. Basal joint of front *tarsi* with a small black comb. Length (♂, ♀), 2-2·25 mm.

♀. Differs in being larger, head smaller, of a dingy reddish-brown, with less prominent eyes, a vague curved depression instead of the excavation, and a moderately long obtuse ridge, instead of the frontal tubercle, antennae thinner and less serrated, prothorax narrower in front, scutellum black, elytra with less of the shoulders flavous, abdomen wider, and front tarsi combless.

Hab.—Queensland: Cairns district, a pair taken *in cop.* (A. M. Lea). Type, I. 11925.

In my table would be placed with *H. major*, which is a much larger species, with very different head, elytra entirely dark, etc. At a glance the types look like small specimens of *H. maculiceps*, but the head is without a spot, and differently sculptured.

Helcogaster seminigripennis, n. sp.

♂. Flavous; apical half of elytra, mesosternum, and metasternum black, apical joints of tarsi, and part of antennae infuscated. Sparsely clothed.

Head with a small interocular impression, or short median line, an oblique impression each side in front. *Prothorax* slightly longer than wide, apex slightly wider than base, a fairly large, transverse, closed, subbasal depression. *Elytra* moderately long; with very minute, rugulose punctures. Basal joint of front *tarsi* with a small, black comb. Length, 2 mm.

Hab.—Queensland: Cairns, obtained on sticky seeds of *Pisonia brunoniana* (F. P. Dodd). Type (unique), I. 11914.

The three apical joints of antennae are missing from the type, the three basal ones are flavous, the others infuscated. The visible parts of the head are impunctate, but the base is concealed on the type; between the frontal impressions the surface is gently convex, but it could hardly be regarded as tuberculate. In my table the species would be associated with *H. simpliciceps*, from which it is distinguished by its smoother head, with small but distinct impressions, flavous portion of elytra not produced along sides, and entirely pale abdomen. From *H. thoracicus*, it is distinguished by its smaller size and differently sculptured head and prothorax.

Dasytes corticarioides, Lea.

This species occurs in abundance in many parts of South Australia, including Price and Kangaroo Islands. Two specimens. from Swan River, are considerably larger (2·25 mm.) than usual, and rather more robust, but probably represent a variety only.

Dasytes erythroderes, n. sp.

Black; prothorax, legs (partly or entirely), and basal joints of antennae, more or less reddish or flavous. Clothed with short, ashen pubescence; the elytra, in addition, with subdepressed setae.

Head with rather dense and small punctures. Antennae rather short. *Prothorax* widely transverse, sides and base rounded, hind angles rounded off; punctures minute. *Elytra* at base slightly wider than prothorax, sides feebly dilated in middle; with dense, and rather sharply defined punctures. Length, 2-2·5 mm.

Hab.—New South Wales: Mount Kosciusko, 5,700-6,000 feet (R. Helms); Victoria: Dividing Range (Blackburn's collection), Melton, in February (F. E. Wilson); South Australia: Mount Lofty Range (R. J. Burton). Type, I. 12291.

Readily distinguished from all previously named Australian species by the reddish prothorax; of the nine specimens before me six have it entirely pale, on two the disc is slightly, and on the other deeply infuscated; four specimens (from Mount Kosciusko, slightly larger than the others, and with the prothorax entirely pale) have the femora black; one of the Victorian specimens has the tarsi infuscated, on all the others the legs are entirely pale. From above the clothing appears to be uniform pubescence, but from the sides short setae may be seen on the elytra. On one female specimen the head, from some directions, appears to have two shallow depressions in front.

Dasytes cribarius, n. sp.

Black, elytra with a slight coppery-green gloss, tibiae, tarsi, and second to sixth joints of antennae somewhat reddish. Clothed with short, ashen pubescence; in addition with numerous suberect, dark setae.

Head with crowded punctures, becoming somewhat larger and sharply defined in front; with two distinct longitudinal impressions in front. Antennae scarcely extending to base of prothorax, most of the joints transverse. *Prothorax* scarcely one-fourth wider than long, base slightly incurved at middle, hind angles rounded off; with dense and sharply defined punctures. *Elytra* wider than prothorax, parallel-sided to near apex; with dense punctures, at base slightly larger than on prothorax, becoming smaller posteriorly; with faint remnants of striation. Length, 2·75 mm.

Hab.—South Australia: Mount Lofty Ranges (J. G. O. Tepper). Type (unique), I. 12283.

Distinguished from all previously named Australian species, except *D. fuscipennis*, by the upright clothing on prothorax, in addition to the pubescence; from that species it is distinguished by its narrower and more convex form, much smaller eyes, prothorax with much denser and smaller punctures, elytra with a metallic gloss, and with smaller punctures, etc.

DASYTES HEXATRICHUS, n. sp.

Black; upper-surface with a coppery gloss. Densely clothed with short, depressed, pale pubescence; head in addition with two long hairs, and two on each side of prothorax.

Head rather wide, with small crowded punctures, with two conspicuous longitudinal impressions in front, the intervening space bronzy. Antennae rather short, some of the joints transverse. *Prothorax* almost twice as wide as long, sides and base finely margined, hind angles rounded off; with crowded and small, asperate punctures. *Elytra* distinctly wider than prothorax, parallel-sided to near apex; with crowded and small punctures, mostly separately impressed, but in places asperate and subconfluent. Length, 3·25-4 mm.

Hab.—Western Australia: Cue (H. W. Brown). Type, I. 12287.

Structurally close to *D. squiresensis*, but elytra pubescent only, and six long hairs on head and prothorax; *D. abundans*, with similar hairs, is a much smaller species, with legs and antennae partly pale, and frontal impressions much less conspicuous.

DASYTES ABDOMINALIS, n. sp.

Black. Densely clothed with ashen pubescence, the elytra in addition with numerous subdepressed setae.

Head with dense and small punctures, rather more distinct about base than elsewhere; two vague depressions in front. Antennae short, most of the joints transverse. *Prothorax* almost twice as wide as long, sides and base rounded and very finely margined, hind angles rounded off, a vague transverse depression near base; punctures minute. *Elytra* very little wider than prothorax at base, sides feeblv dilated to near apex; with dense and rather sharply defined punctures, in places slightly confluent, and becoming smaller posteriorly. Length, 2·5-3 mm.

Hab.—Western Australia: Yilgarn (Blackburn's collection, from E. Meyrick). Type, I. 12288.

Rather more robust than *D. australiae*, impression near base of prothorax fainter, and elytral clothing of two kinds;

seen from above it appears to be uniform, but from the sides there may be seen numerous short sloping setae, amongst the pubescence, in consequence, in my table,[21] the species would be associated with *D. squiresensis*, from which it differs in having the setae less erect, and in its entirely dark legs. On one sex the apical segment of the abdomen is widely concave in the middle, and with a subtuberculate swelling on each side. On a few specimens the upper-surface, or the elytra only, have a very feeble metallic gloss.

Dasytes pictipes, n. sp.

Black; parts of antennae and of legs flavous. Clothed with short, depressed, ashen pubescence.

Head with rather dense and minute punctures; two vague depressions in front. Antennae rather short. *Prothorax* widely transverse, sides and base rounded and finely margined, hind angles rounded off, a shallow transverse depression near base; with dense and small punctures, larger near base than elsewhere. *Elytra* very little wider than prothorax at base, sides slightly dilated to near apex; with dense and small, but sharply defined punctures. Length, 2-2·25 mm.

Hab.—New South Wales: Dorrigo (W. Heron). Type, I. 12286.

Of the eight specimens before me the tibiae and tarsi are pale on all, most of them have the trochanters and knees pale, and one has the entire front legs pale; the antennae are entirely pale, or with some of the apical joints infuscated; parts of the muzzle are also pale. In my table would be associated with *D. bourgeoisi* (n. pr., now *D. julesi)*, from which it differs in being smaller, and prothorax with a shallow subbasal depression; *D. australiae*, with somewhat similar depression, is slightly less robust, and with entirely dark legs and antennae.

Dasytes ellipticus, n. sp.

Black; antennae (apical half infuscated) and legs (middle and hind femora more or less deeply infuscated) flavous. Clothed with short, ashen pubescence.

Head with small and fairly numerous punctures, two feeble depressions in front, and a still more feeble one in middle. Antennae slightly passing base of prothorax, fifth joint distinctly smaller than fourth or sixth. *Prothorax* at base almost twice as wide as long, front convex in middle, strongly rounded to sides, base and sides finely margined;

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(21) Lea, Trans. Ent. Soc. Lond., 1909, p. 240.

punctures minute and inconspicuous. *Elytra* at base scarcely wider than base of prothorax, sides feebly dilated to about middle, with dense and small, but rather sharply defined punctures. Length, 2·5-2·75 mm.

Hab.—South Australia: Parachilna (E. L. Savage). Type, I. 12284.

The sides of the elytra have short, semidecumbent setae posteriorly; they are fairly numerous, but distinct only from the sides, there is also a short hair projecting outwards from each side of the base of the prothorax. Very faint remnants of a subbasal depression may be seen on each side of the prothorax. It is an elliptical species, and in my table would be associated with *D. bourgeoisi* (now *D. julesi*), from which it differs in having more of the legs pale, prothorax larger, with the base wider, elytra somewhat shorter and wider and with smaller punctures; structurally it is rather close to *D. blackburni* (*D. helmsi*, n. pr.), but the prothoracic punctures are much smaller, and the legs are partly pale.

The Rediscovery of Choriplax (= Microplax) grayi, Adams and Angas (Order Polyplacophora, with Notes on its true place in the Natural System and the Description of a New Sub-species.

By Edwin Ashby, F.L.S., M.B.O.U.

[Read July 14, 1921.]

Plate IX.

Microplax grayi, H. Ad. and Ang., P.Z.S., 1864, p. 194; *l.c.*, 1865, p. 58, t. 11, f. 16. Angas, P.Z.S., 1867, p. 224. Carpenter, MS., p. 12. Pilsbry, Man. of Con., vol. xiv., p. 21.

Choriplax grayi, H. Ad. and Ang. Pilsbry, Nautilus, vii., p. 139, 1894. Thiele, Rev. des Sys. der Chitonen. Zool., iv., 1910.

It is with pleasure that I acknowledge my indebtedness to Dr. W. G. Torr for the opportunity of examining and describing one of the most interesting chitons it has been my privilege to examine. On May 7 last I received from him a few chitons for identification, all taken by Mr. George Pattison, near Cape Banks Lighthouse. One, he said, was not only a species new to him, but also belonged to a genus he had never seen before. I saw at once that the specimen was a remarkable find, evidently related to the genus *Amicula*, a genus whose habitat is in the cold waters of the North Pacific, from the Okhotosk Sea to the Behring Sea, and in corresponding latitudes on the eastern side of the North American continent.

Genus *Microplax*, Adams and Angas, 1864. Original description:—"Insertion plates smooth and thin, present in all the valves. Sutural plates obsolete, the sinus extremely shallow. Girdle thin, horny, most minutely granulous. Valves largely concealed in the girdle, the exposed portions small and separated.

"In the present genus a small portion only of each valve is exposed, and the sutural plates and sinus are obsolete. No other chiton having unslit insertion plates approaches this remarkable group."

M. grayi, Adams and Angas. Original description:—"Shell elongated, convex, brown; exposed portion of the valves minute, wide heart-shaped, carinated, strongly granulated, the intervals between the exposed parts of the valves about as long as the latter. Lateral areas defined by a distinct rib. Girdle moderate, corneous, smooth. Length, 13; width, 5 mill. Sydney Harbour, Australia; under stones at low water."

Choriplax grayi pattisoni, n. sub-sp.

Differs from *C. grayi*, Ad. and Ang., in its greater width and in the fact that the tegmentum is proportionately smaller. The measurements of *C. grayi*, s.s., are quoted by Pilsbry (*l.c.*, pp. 21, 22), are: length, 13; width, 5 mm. Tegmentum, $1\frac{1}{2} \times 1\frac{3}{4}$ mm. Whereas the measurements of the present specimen are $18 \times 8\frac{1}{2}$ mm., and the tegmentum $1\frac{1}{2} \times 1$ mm.

An examination of the drawings made by E. A. Smith and figured by Pilsbry (*l.c.*, pl., figs 9-11) will further explain these differences.

General Appearance.—Broadly oval, the posterior valve being much larger than the anterior. The tegmentum reduced to a small, heart-shaped, raised portion at the apex of each valve, this portion being pink. The balance of the shell is olive-green, due to an extension of the epidermal layer of the girdle over the whole of each valve, with the exception of the small, raised, heart-shaped tegmentum before referred to. The epidermal skin is minutely granulose, semi-transparent, and free from scales, hairs, or spicules.

Colour.—The small, heart-shaped, exposed portions (or tegmentum) are Prussian Red with flecking of Ochre Red (Ridgway's Colour Standards, pl. xxvii.). The epidermal covering of the highly developed articulamentum portions of the shell is, in a good light, olive-lake, merging into Saccardo's olive, in the shaded or overlapping portions of the sutural laminae (*l.c.*, pl. xxix.). The girdle is warm sepia, or a little darker.

Inside of Shell.—Transparent, pearly, and very highly polished. The plates are so thin and delicate that none of them are quite unbroken on the interior margins. The anterior margin of the sutural laminae is almost straight, the suture is reduced to a mere inward bend imperceptible in several of the valves.

Anterior Valve. — The small exposed portion is semicircular; the apex, which in this species corresponds with the mucro of the tail valve, is pronounced and approximately smooth, the superficial layer semitransparent, showing subcutaneous dark and light streaks radiating from the mucro. These may easily be mistaken for grooves and ridges. This smooth area is produced anteriorly for fully one-third of the width of the tegmentum. The balance of the valve is sculptured with rather widely spaced granules. There seems no consistent arrangement of these. The mucro is anterior to the posterior margin of the tegmentum, and the posterior lobes of the articulamentum unite behind same.

Median Valves.—The small exposed tegmentum is heart-shaped, posterior margin curved, in some straight, furnished with a broad beak or mucro, the tegmentum being continued behind this. The dorsal area is distinct and broad with almost parallel sides. The portion immediately in front of the mucro is usually coarsely longitudinally ribbed, more or less broken. In some of the valves these ribs continue to the anterior margin, in others they are replaced by subcutaneous lining. In this anterior portion, irregular raised pustules also occur to a limited extent in some of the valves. Although these irregularities exist, the chief character of this part of the shell is strong, longitudinal ribbing. A strongly-raised, diagonal rib commences at the mucro and dies away about half-way across the tegmentum dividing the lateral from the pleural area. The pleural area is sculptured with irregularly-shaped, rough-looking pustules. There is a tendency for these to become confluent along lines parallel with the ribbing in the dorsal area. In the lateral areas the raised portions or granules are even more irregular in shape than is the case in the pleural area. Behind the mucro and diagonal rib the subcutaneous line-marking is radial, and very marked in some valves. As before stated, the mucro is anterior to the posterior margin, and the posterior lobes of the insertion plates unite behind the tegmentum.

Posterior Valve.—The anterior portion of the tegmentum is less pointed than is the case in the median valves, the posterior part semicircular. Mucro anterior, a number of dark subcutaneous streaks radiate from the mucro posteriorly in a fan, with a highly-polished, semitransparent surface, but it is not truly smooth; this character occupies about one-quarter of the length of the tegmentum and is fan-shaped. That part of the valve behind the mucro is sculptured fairly evenly with circular pustules placed more or less concentrically. The anterior portion is longitudinally ribbed, but, in addition, there are coarse irregular pustules. This valve is large, measuring 4×7 mm., the tegmentum placed centrally.

Girdle.—In the dry specimen is wrinkled, bearing neither scales, hairs, or spicules; has a gelatinous or horny look, is dark in colour, and, with shrinking, has curved inside the shell to a width of ·75 mm. The girdle is thickened over the marginal portion of the insertion plates, forming a dark band round the shell 1 mm. in width or with the incurved portion referred to a total girdle width, in dry specimens, of 1·75 mm.

Measurements.—Length, $18 \times 8\frac{1}{2}$ mm. The tegmentum, or exposed part, reaches a maximum width of $1\frac{1}{2}$ mm. by 1 mm. longitudinally, in one of the median valves, whereas the articulamentum in valve 6 is 3 mm., longitudinally, by 8 mm. in width.

Habitat.—The specimen under review was found near Cape Banks Lighthouse, in South Australia. The following are Mr. Pattison's own words:—"A heavy sea tore off the big kelp *(Laminaria)* outside the reef and washed it up on the beach. The chiton was amongst the kelp, on the beach, and the sea lice had probably eaten the fish out." These facts and the flat, fragile character of the shell, with its green-brown, transparent, epidermal covering, suggest the probability of its living on the stems of the kelp under which it was found. While the discovery of the host plant of the genus *Stenochiton*, as described in my monograph (Trans. Roy. Soc. S. Austr., vol. xlii., 1918), has led to their discovery in some of the other States, is it not quite feasible that a similar search on the stems of some forms of algae may reveal a race of Polyplacophora living thereon.

Remarks.—This remarkable shell presents many unique features, the extremely reduced area of the tegmentum, the modified character of the sutural laminae, the exceptional development of the insertion plates, the partial or entire absence of slits, the transparent granula epidermal covering, and the peculiar posterior lobing of the insertion plates, widely separates this from any other known form in Australian waters, and, I believe, no near ally has up to the present been discovered in the Southern Hemisphere. Perhaps the nearest relative in our southern seas is the New Zealand shell, *Cryptoconchus porosus*, Burrow; but that species cannot be said to be very closely allied, as it only possesses a few characters in common. I have quoted the original description of both genus and species as published by Dr. Pilsbry in his famous Monograph. In the main my description, which has been written without any special reference to the earlier writers, will be found very closely to correspond therewith, but there are some rather important differences. In the first place, the sutural laminae are by no means obsolete, as stated by Adams and Angas, and there is considerably more overlapping of the valves than was noticed by Carpenter, the laminae, in some valves, reaching fully two-thirds across the tegmentum. The insertion plates are abnormally developed; in fact, this species seems to have specialized in this form of development, and, in some measure, adapted the character of the tail valve to the median valves. The lateral insertion plates are joined behind the tegmentum and produced, posteriorly, in two lobes with a sinus between them, a feature that is present in a very modified form in the tail valve of some of the Acanthochitons. While in the undissected shell under examination I cannot detect any slits in any of the insertion plates, I cannot say that they do not exist in a modified form. The interior of the tail valve is radially grooved and scored, until the girdle is approached, when the grooves appear to terminate. I would suggest the probability that in the juvenile stage some evidence of slits may exist and disappear in the mature or senile form.

Classification.—While it is to be greatly regretted that the animal and radula are missing, and also that permission has not been obtained to disarticulate some of the valves, the transparency of the shell has made this latter less important than is usually the case, I have been able to note sufficient features to justify one in removing the genus *Choriplax (=Microplax)* out of its setting in our previous classification. I can see no justification for placing a species with abnormally developed insertion plates under the Lepidopleuridae. Had the animal been present and the valves disarticulated, there would have been but little difficulty in finding its true place in the Natural System or Taxis. In spite of these limitations, the characters that it has been possible to observe are sufficient to warrant our placing the genus *Choriplax*, Pils., near the genus *Amicula*, Gray. For reasons given hereunder I should place it between *Amicula* and the Subfamily *Cryptochitoninae*. The characters of the genus *Amicula*, Gray, are given by Pilsbry (in Man. Con., vol. xv., p. 43) as "Valves almost covered by the extension of the girdle over them, leaving only a small, rounded, or heart-shaped portion exposed at the apex of each; posterior borders of valves produced backwards in rounded lobes at each side, the lobes completely separated by a posterior sinus having the tegmentum at its apex. Posterior valve having a posterior sinus and one slit on each side. Girdle more or less pilose, often having pore rows. The essential features of *Amicula* are its small exposed portion or tegmentum, situated at the posterior edge, and not extending forward to the sinus, its mopaloid posterior valve, short contour, and short gills."

The species under consideration corresponds with *Amicula* in some of its most striking features, but, although like the *Amicula*, the tegmentum does not extend forward to the sinus; unlike that genus it does not extend to the posterior margin, neither have we noticed any slit, nor is the girdle pilose.

The description of the *Cryptochitoninae*, in the same work, p. 48, is: "Valves entirely concealed in the leathery girdle and lacking tegmentum; their posterior margin produced backwards in a deep lobe on each side, the lobes united across the median line, causing the apices of all valves to be removed inwards from the posterior edge, slits sub-obsolete or lacking in the intermediate valves, girdle covered with minute tufts or bristles." It will be noticed that two of the distinguishing features of the *Cryptochitoninae* are present in

Chориplax but absent in *Amicula*, namely, the sub-obsolete or lacking slits, in the median valves and the posterior lobes of the articulamentum uniting across the median line, causing the apices of all valves to be removed inwards from the posterior edge.

While Dr. J. Thiele (Rev. des Sys. der Chitonen, pt. ii., pp. 106 and 116) leaves the genus *Choriplax* under the Lepidopleuridae between *Hanleya*, Gray, and *Oldroydia*, Dall, did so evidently with considerable misgivings. I cannot follow him in placing the two genera *Katharina*, Gray, and *Amicula*, Gray, under the Mopaliidae, and think Pilsbry is right in placing them immediately before the genus *Cryptochiton*. I would also suggest the recognition of the genus *Cryptoconchus*, Blain. and Guilding, with *C. porosus*, Burrow, as type, and placing it between *Loboplax*, Pils., and *Katharina*, Gray. With its striking development of the articulamentum posteriorly, in two lobes, its reduced tegmentum, and pores often sub-obsolete, it seems a sort of "half-way house" between those genera.

Finally.—I propose that the genus *Choriplax*, Pils., be taken out of its previous setting amongst the less specialized group, the Lepidopleuridae, and be placed under the Family Acanthochitidae, Pils., following the genus *Amicula*, Gray, and preceding the genus *Cryptochiton*, Midd. and Gray. The apparent absence of slits in the insertion plates is, I suggest, probably due to modifications in a very specialized form, brought about by the peculiar habits of the chiton. The same tendency is already apparent in the genus *Cryptochiton* where the slits in the median valves have either been lost entirely or become sub-obsolete.

Revised definition of the Genus Choriplax, Pils.—Valves are almost covered by the extension of the girdle over them, the tegmentum or exposed part being reduced to a small, heart-shaped portion, exposed at the apex of each; the insertion plates highly developed, smooth and thin, extending posteriorly in a deep lobe on each side, the lobes united across the median line, causing the apices of all valves to be removed inward from the posterior edge. The sutural laminae are apparently shallow, united across the median line, and the sinus reduced thereby to a mere inward bend. Girdle thin, horny, minutely granulose.

If we are justified in placing the genus *Cryptochiton* under the Subfamily Cryptochitoninae, may we not be justified in doing likewise for this remarkable genus, retaining Adams and Angas' name under the name of a subfamily called Microplaxinae with *Choriplax grayi*, Ad. and Ang., as the type, taking the foregoing description as the definition of the subfamily, with the addition of any new features the later examination of the soft parts may reveal? So naturally does this genus seem to fit into the place I have assigned to it, that the wiser course might possibly be to place both *Choriplax* and *Cryptochiton* under the Family Acanthochitidae, Pils., and drop the Subfamily Cryptochitoninae.

Note.—In the writer's last paper on Australian Polyplacophora (Trans. Roy. Soc. S. Austr., vol. xliv., p. 286, 1920) reference is made to the race of *Callistochiton meridionalis*, Ashby, which had been previously described from a single specimen from North-west Tasmania, and to which he had attached the name of *mayi*. Since this was written several specimens from the same district have come to hand, and while some show the same backward habit of developing the typical network sculpture that was noted in the paper referred to, other specimens are almost normal. Had more material been available at the time the then unique specimen was described, the writer would have contented himself with simply noting the fact that shells from this North-west Tasmanian coast attain the adult characters more slowly than is the case with those from the type locality in South Australia. In the same paper, p. 283, *Lepidopleurus inquinatus*, should be of Reeve, and not Blainville, as printed, and *L. catenatus*, Hed. and Hull, should have been withdrawn from the Australian fauna, it being a Lord Howe Island species.

Addendum.—Since presenting the foregoing paper I have had the opportunity of reading in the Nautilus, vii., p. 139, Dr. Pilsbry's note attached to his proposed substitution of the name *Choriplax* for that of *Microplax*, which name was preoccupied, and I now quote his remarks in full:—"This is an extremely peculiar and isolated genus, and forming, I am disposed to believe, a distinct family of the Eoplacophora, or slitless chitons; that is, if the slits really prove to be completely absent, for the unique type has not been disarticulated. In some features it recalls the Acanthochitidae. The single specimen was described and illustrated from the unique type in the British Museum, in the Manual of Conchology, vol. xiv."

DESCRIPTION OF PLATE IX.

Fig. 1*a*. *Choriplax grayi pattisoni*, Ashby, upper side, × about 5. Showing small heart-shape tegmentum and enveloping epidermis with tear in valve 2 revealing smooth articulamentum underneath.

Fig. 1*b*. *Choriplax grayi pattisoni*, Ashby, interior of shell, ×5. Showing sutural laminae.

Fig. 1*c*. *Choriplax grayi pattisoni*, Ashby, upper side with strong light thrown through the shell showing *(a)* shadow of sutural laminae, *(b)* opacity of tegmentum, *(c)* the posterior lobes united across the median line, ×5.

Fig. 3.

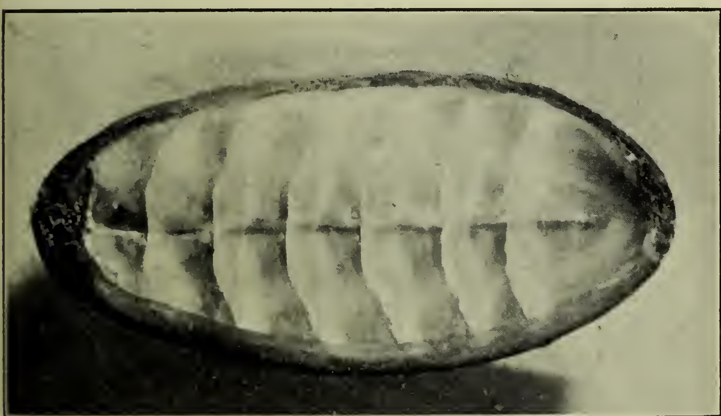

Fig. 2.

Fig. 1.

Gillingham, Swann & Co. Ltd., Printers, Adelaide

Australian Coleoptera.—Part II.

By Albert H. Elston, F.E.S.

[Read August 11, 1921.]

PSELAPHIDAE.

Ctenisophus curvipes, n. sp.

♂. Pale castaneous, with parts of elytra paler. Moderately clothed with short, white pubescence, becoming setae at apex of elytra, and absent from the middle of prothorax and elytra.

Head with a few more or less concealed subrugose punctures and two large shallow foveae between the eyes. Antennae long and moderately stout, the first two joints about twice as wide as joints three to seven, the first about as long as second and third combined, the second little more than half the length of the first, third to seventh are equal in length, each being slightly longer than half the length of the second, the eighth cylindrical, and about as long as joints three to seven combined, and as wide as the second, the ninth about two-thirds the length of the eighth and wider at apex than at base, the tenth perceptibly longer than the ninth, and the apical joint about as long as the tenth, wide near the base and obtusely pointed. *Prothorax* about as wide as long, narrower at apex than at base, with a few scattered punctures, and a moderately large subbasal fovea. *Elytra* at base distinctly wider than prothorax, the margins sloping outwards towards apex, a longitudinal furrow on each elytron, starting from about midway between the suture and humeral angle, thence to the apex, and with a short subsutural stria; with minute scattered punctures. *Metasternum* with a deep furrow starting from near the coxae of the intermediate legs and touching the coxae of the posterior ones. *Abdomen*, dorsal surface with a few small punctures arranged in transverse rows, ventral surface impunctate, the third segment large with very small and shallow round foveae. *Legs* long and moderately thin, the anterior tibiae strongly curved, the intermediate slightly curved, and the posterior ones almost straight, all are dilated towards the apex. Length (♂, ♀), 1·5 mm.

Ctenisophus curvipes, n. sp.

♀. Differs in the antennae being shorter and thinner, the eighth to tenth joints being much shorter, the apical about as long as the ninth and tenth combined, and much wider, the eyes smaller; and the abdomen somewhat larger with its ventral surface nonfoveate.

Hab.—South Australia: Murray River near Morgan, flew to lamp at night (A. H. Elston). Type, in author's collection; co-type, I. 10934, in South Australian Museum.

The four long apical joints of the male antennae associate this species with *C. longicornis*, Lea, and *C. rivularis*, Lea, but it is readily distinguished from these and all other previously described species by the strongly curved front tibiae, these being quite as strongly curved in the female as in the male.

SCAPHIDIIDAE.

Scaphisoma bryophaga, n. sp.

Ovate, shining red, towards apex of elytra and tip of abdomen diluted with flavous, antennae and tarsi testaceous, club infuscated; scantily clothed with minute bristly hairs.

Head with a few minute, scattered punctures; antennae long and slender, with three-jointed club, the first two bead-like in shape, the apical longer than the penultimate and subovate. *Prothorax* transverse, sides evenly rounded, basal angles acute, with a very faint transverse subbasal impression and a few minute, scattered punctures. *Scutellum* semi-circular in shape. *Elytra* elongate, each with a distinct, slightly curved subsutural stria, starting from near the sutural angle, becoming fainter posteriorly and vanishing before apex; slightly punctured, the punctures minute and somewhat seriate. Length, 1-1·5 mm.

Hab.—South Australia: Myponga, taken in moss (R. F. Kemp, A. H. Elston). Type, in author's collection; cotype, I. 12829, in South Australian Museum.

This species may be chiefly distinguished by its size and colour; the punctures, out of which the hairs emanate, are very feeble and barely perceptible with a simple lens.

CLERIDAE.

Phlogistus.

The generic name *Aulicus* must now be eliminated from Australian catalogues; Gorham [1] considered that the American species should be separated from the Australian, and suggested the new generic name *Phlogistus* for the latter, Spinola having considered the type of *Aulicus* to be *nero*,

[1] Gorham, Cist. Ent., vol. ii., p. 84.

not *instabilis*, as taken by Lacordaire. Blackburn [2] commented on the above, but owing to the absence of a diagnosis of *Phlogistus*, retained the name of *Aulicus*. A description of the new genus has been supplied by Schenkling.[3]

PHLOGISTUS IMPERIALIS, Gorham.

This insect was originally described from Queensland. I have now to record it from New South Wales, Victoria, South Australia, and Western Australia. As suggested by Hintz,[4] there is no doubt Blackburn failed to recognize this species, but confused it with *P. episcopalis*, Spin., which name I have seen in his handwriting attached to colour varieties of *imperialis*. The latter species is very variable in colour, and apparently Blackburn had not seen a specimen of the typical colouring, otherwise he would probably have recognized it from the description given by Gorham. This species may be readily distinguished from *episcopalis*, Spin., *inter alia*, by its deep, quadratic, and reticulate punctures; those on the latter species being more shallow, not so square, and *not* reticulate.

PHLOGISTUS CORALLIPES, Chev.

A specimen from Tasmania differs from the typical form in having dark mouth parts and legs, only the front tarsi being reddish.

PHLOGISTUS MUNDUS, Blackb.

I have taken this species in the Flinders Ranges, South Australia, together with a colour variety, which has the head and prothorax almost black, the base and apex of elytra a beautiful bright violet, the middle part bearing punctures of a coppery tint, the legs blue, with the exception of the front tarsi and the under-surface of the front tibiae, which are ochraceous.

PHLOGISTUS MODESTUS, Blackb.

Blackburn in his description of the above mentions a variety, "pedibus sordide testaceis," as being probably only an immature specimen. I have in front of me nine specimens taken in the Mount Lofty Ranges, South Australia; they all have their legs testaceous, and do not appear in any way to be immature.

PHLOGISTOMORPHA.

This genus was proposed by Hintz[5] to receive four species of *Phlogistus*, *viz.*, *blackburni*, Schenk.; *apicalis*,

(2) Blackburn, Trans. Roy Soc. S. Austr., 1900, p. 122.

(3) Schenkling, Gen. Insect., Fasc. 13, 1903, p. 56.

(4) Hintz, Deut. Ent. Zeit., 1908, p. 709.

(5) Hintz, *loc. cit.*, 1908, p. 715.

Macl.; *croesus*, Blackb.; and *mastersi*, Macl., and is easily distinguished from the preceding genus by the terminal joint of the antennae, which has an almost quadratic form, and drawn out into four points with a bay in between each two of them.

PHLOGISTOMORPHA CROESUS, Blackb.

Specimens of this beautiful insect have been taken by Mr. J. C. Clark in Western Australia. It was originally described from South Australia.

PHLOGISTOMORPHA BLACKBURNI, Schenk.

The habitat of this insect was given by its author as "Australia." I have now to record it from Victoria and South Australia.

TROGODENDRON MONSTROSUM, Gorham.

There are two specimens, a male and female, of this remarkable insect in the South Australian Museum, taken at Bowen, Queensland. The male, which has the bifid termination of the apical joint of the antennae, differs from the author's description in having the prothorax strongly, the head slightly diluted with red, the palpi and labrum reddish-yellow; the lunate-shaped fasciae behind the middle of elytra have, particularly on the posterior part, narrow reddish-brown margins, which extend nearly to the suture, the oblique guttae near the apex have likewise reddish-brown fringes which are wider than the raised ivory portion. The female differs from the male in being much smaller, not having the apical joint of antennae bifid, and the reddish-brown margins on the fasciae and guttae less conspicuous or entirely absent.

TROGODENDRON RUFIPES, n. sp.

Upper-surface black, diluted here and there with blue, palpi, antennae, and legs red; slightly raised median fasciae on elytra ivory, with wider fasciae in front of, and touching, red; somewhat scantily clothed with long dark, interspersed with pale, hairs, apical fourth of elytra densely clothed with fine, depressed, golden hairs. Under-surface black, very scantily clothed with pale hairs.

Head densely punctured, the punctures small and somewhat rugose. Antennae extending nearly to base of prothorax, second joint about as long as wide and slightly wider at apex than at base, three to eight longer than wide, nine and ten much wider and obconical in shape, the apical about half as big again as the tenth, the outside apical angle rounded and the inside one obtusely pointed. *Prothorax* about as long as wide, base much narrower than apex, somewhat globular, with a transverse impression near the apex, sides rounded and very much constricted at base, closely punctured, the punctures moderately large, deep, and in places slightly confluent. *Elytra* wider than prothorax and about thrice as long, sides slightly constricted near middle, to beyond the middle with large, deep, seriate punctures. On each elytron near the suture are two large protuberances, which have the sides almost as largely and deeply punctured as the rest of elytra, and the apices only slightly punctured. *Legs* long and slender. Length, 15 mm.

Hab.—Queensland: Bribie Island (H. Hacker). Type (unique), in Queensland Museum.

Very distinct, and not readily associated with any previously described species. The median fasciae are slightly oblique, touching the margins but not reaching the suture, the reddish patch is extended beyond the ivory one and almost touches the suture. The basal joint of the antennae is infuscated on the outside, and the second half of the apical is slightly paler than the rest of the antennae.

Trogodendron tenebricosum, n. sp.

Black; palpi, antennae, legs (femora excepted), and postmedian fasciae testaceous, upper-surface scantily clothed with moderately long, nearly upright, black hairs, except on legs which have pale hairs, and near apex of elytra with small patch of silvery hairs; under-surface very scantily clothed with grey hairs.

Head with a long transverse impression near base of antennae, closely punctured, the punctures moderately deep and rugose. Antennae stout, joints three to five a little longer than wide, six to ten obconical and gradually increasing in width, the last obtusely pointed at apex. *Prothorax* slightly longer than wide, sides rounded near middle, with a moderately deep transverse impression near apex and a deeper subbasal one; with dense punctures, larger than those on head, more or less rugose, and defining a longitudinal median carina. *Elytra* at base one and a half times as wide as middle of prothorax and more than thrice as long, humeral angles salient; to beyond the middle with large, deep, quadratic and seriate punctures, those on the fasciae a little smaller and nearly round, impunctate on humeral angles and behind fasciae. Length, 10-15 mm.

Hab.—Victoria: Melbourne (E. Fischer). Type, in author's collection.

I have before me only two specimens, sent me by Mr. F. E. Wilson, of this species, which is apparently very variable in size. The post-median fasciae touch the margins and extend somewhat obliquely upwards towards the suture, but not quite touching it. The impunctate parts of elytra are glistening; the protuberances near the scutellum are rudimentary, only a small shagreened patch being visible, the knees are sometimes diluted with red and parts of the tibiae are infuscated. Comes nearest to *T. ephippium*, Boisd., from which it can be easily distinguished, *inter alia*, by the punctures on the head and prothorax being larger, disc of prothorax without deep depression, and the absence, near base of elytra, of two protuberances bearing tufts of hair.

Zenithicola funesta, Chev.

Hab.—Stradbroke Island, Queensland, New South Wales, Victoria, South Australia, Western Australia.

Zenithicola crassa, Newm.

Hab.—Queensland and New South Wales.

Eunatalis.

Schenkling [6] stated that the genus *Natalis* of Castelnau (1836) was founded upon *N. laplacei* from Chili; to this genus were afterwards added two other Chilian and many Australian species. Subsequently (1906) for *N. punctipennis*, Germ. (from Chile), Schenkling proposed the genus *Neogyponyx*, but this must now be regarded as a synonym of *Natalis*. Klug (1842) did not recognize *Natalis* as a valid genus, but Spinola (1844) did so, incorrectly giving *porcata*, Fab., as its type; he was followed by most authors until recently. Schenkling (1909) therefore proposed that the three Chilian species should remain in *Natalis*, and the name *Eunatalis* be substituted for the Australian species.

Stigmatium ventrale, Macl.

This species is variable in size, ranging from 7 mm. to 10 mm. in length. It has now to be recorded from Queensland, Stradbroke Island, and South Australia.

Stigmatium gilberti, White.

This insect is widely distributed in Australia, and somewhat variable *inter se*. On two South Australian specimens there is a distinct dark narrow band across the reddish portion of the elytra, about midway between the base and where the black commences; the oblong subapical spots of pale hairs extend right to the apex.

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(6) Schenkling, *loc. cit.*, 1909.

Phaeocyclotomus chloropus, Kuw.[7]

This insect was originally described from New Guinea. I have now to record it from North Queensland.

Eleale.

The insects belonging to the genus *Eleale* are, with two exceptions, peculiar to Australia. I have not yet seen either *E. advena*, Chev., from Chile, or *E. pantomelas*, Boisd., from New Zealand, so am unable to speak with any degree of certainty, but believe that these two species have been incorrectly assigned to it. The members of this genus, as indeed with some of the allied genera, are very variable both in colour and size, and in compiling the following table I have endeavoured, as much as possible, to distinguish the species by their sculpture, and have only resorted to colour when there could be no danger of confusion or variability of the species. Only those species that I have been able to identify with confidence have been included in the table:—

- A. Elytra bicoloured, in parts testaceous.
  - *a*. Apex of elytra pale ... ... *lepida*, Pasc.
  - *aa*. Apex of elytra dark.
    - *b*. Apical joint of antennae distinctly emarginate ... ... *pulchra*, Newm.
    - *bb*. Apical joint of antennae not distinctly emarginate.
      - *c*. Base of elytra pale or not entirely dark.
        - *d*. Prothorax tranversely wrinkled *apicalis*, Macl.
        - *dd*. Prothorax not transversely wrinkled ... ... *pallidipennis*, n. sp.
      - *cc*. Base of elytra entirely dark.
        - *e*. Prothorax tranversely wrinkled *sellata*, Pasc.
        - *ee*. Prothorax not transversely wrinkled ... ... *fasciata*, Macl.
- AA. Elytra unicoloured, not testaceous in parts.
  - B. Punctures on disc of prothorax transversely wrinkled.
    - *f*. Apical joint of antennae emarginate.
      - *g*. Sides of prothorax straight.
        - *h*. Antennae pale, club dark ... *smaragdina*, Chev.
        - *hh*. Antennae metallic, club black *aspera*, Newm.
        - *hhh*. Antennae metallic, club reddish-brown ... ... *viridicollis*, Macl.
      - *gg*. Sides of prothorax rounded.
        - *i*. Apex of elytra lightly punctured and glistening.
          - *j*. Club of antennae black.
            - *k*. Prothorax with a strong longitudinal carina ... *carinaticollis*, n. sp.
            - *kk*. Prothorax without such a carina ... ... *reichei*, Spin.

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[7] Kuwert, Ann. Soc. Ent. Belg., 1894, p. 456.

jj. Club of antennae pale.
l. Antennae entirely pale ... *simplex*, Newm.
ll. First eight joints of antennae dark ... ... *intricata*, Klug.
ii. Apex of elytra deeply punctured and not glistening.
m. Prothorax with a longitudinal carina ... ... *illaetabilis*, n. sp.
mm. Prothorax without such a carina.
n. Apical joint of antennae lightly emarginate.
o. Prothorax with strong transverse wrinkles ... *margaritacea*, n. sp.
oo. Prothorax without such wrinkles ... ... *viridis*, Guér.
nn. Apical joint of antennae deeply emarginate ... *robusta*, n. sp.
ff. Apical joint of antennae not emarginate.
p. Colour of prothorax same as elytra ... ... *brevicornis*, Chev.
pp. Colour of prothorax not same as elytra ... ... *amoena*, n. sp.
BB. Punctures on disc of prothorax not transversely wrinkled.
C. Apical joint of antennae distinctly emarginate.
q. Prothorax with two fasciae of pale hairs ... ... *excavata*, Westw.
qq. Prothorax without such fasciae.
r. Emargination of apical joint of antennae at apex.
s. Colour emerald-green ... ... *aulicodes*, Gorh.
ss. Colour deep violet ... ... *reticulata*, n. sp.
rr. Emargination of apical joint of antennae at side.
t. Prothorax longer than wide *parallela*, n. sp.
tt. Prothorax not longer than wide ... ... *spinicornis*, n. sp.
CC. Apical joint of antennae not distinctly emarginate.
D. Parts of antennae pale.
u. Punctures on elytra comparatively large.
v. Prothorax strongly flattened on disc ... ... *angularis*, n. sp.
vv. Prothorax almost globular *globicollis*, n. sp.
uu. Punctures on elytra comparatively small.
w. Head and prothorax without median carina ... ... *latipennis*, n. sp.
ww. Head and prothorax with median carina ... ... *perplexa*, n. sp.
DD. Antennae entirely dark.
E. Prothorax with submedian fascia of pale hairs ... ... *hirticollis*, n. sp.
EE. Prothorax without such fascia *cribrata*, Schenk.

Eleale pulchra, Newm.

This is a variable species; three specimens from New South Wales differ from the typical form, two having nearly the whole of the apical nitid portion of the elytra flavous, and the other only slightly diluted with yellow at the apex; a specimen from Kangaroo Island has the antennae somewhat darker, almost red, with the tibiae reddish (in parts infuscated), and the tarsi diluted with red; there are three specimens, in the collection of Mr. Lea, from Western Australia, which have the antennae reddish, with the club dull black.

Eleale pallidipennis, n. sp.

Upper-surface of head and prothorax dark olive-green with brassy reflection, palpi, antennae, and elytra testaceous, the latter infuscated near scutellum, also on humeral angles, and at apex, legs dark blue in parts with a metallic reflection; thickly clothed with short subdepressed white hairs. Under-surface shining green with brassy reflections, and somewhat thickly clothed with moderately long, depressed white hairs.

Head comparatively small, with a small round inter-ocular depression, and with very small, round, dense punctures. Antennae reaching to middle of prothorax, club distinctly three-jointed, joints seven and eight not dilated, apical joint almost imperceptibly emarginated on the inside. *Prothorax* about as long as wide, sides evenly rounded, widest part near the middle, subapical transverse impression obsolete, subbasal one distinct; with small, round, and very dense punctures, larger than those on the head, near the apex less crowded. *Scutellum* round. *Elytra* at base a little wider and about twice as long as prothorax, sides from the base gradually narrow towards apex, with comparatively shallow and very dense punctures, which are about the same size as those on prothorax and nowhere confluent, those on the humeral angles and at apex much finer, so that these parts are more nitid than the general surface. On each elytron are to be seen three more or less distinct carinae. *Legs* comparatively long and robust, posterior femora nearly reaching apex of elytra. Length, 5-6 mm.

Hab.—South Australia: Oodnadatta (Blackburn's collection); Western Australia: Cue (H. W. Brown). Type, I. 12825, in South Australian Museum.

The dark part at the base of the elytra is in the form of an inverted triangle, the basal angles of which are situated about midway between the humeral and sutural angles and the apical one on the suture below the scutellum. This dark patch is in the nature of a stain, with here and there the testaceous colour of the elytra showing through it; on two specimens this basal stain is much lighter, and on one of them barely perceptible. The front tarsi and apex of front tibiae are sometimes diluted with yellow. Differs from *E. apicalis*, Macl., in being much smaller and more hairy, colour of elytra paler, joints seven and eight of antennae not dilated, punctures very much smaller, and those on the prothorax not transversely confluent.

ELEALE CARINATICOLLIS, n. sp.

Shining black, in parts reflecting blue; first three joints of antennae red. Upper-surface clothed with long, straggling, black hairs, thicker and more upright on the head and prothorax than on the elytra, scutellum with thick white pubescence, legs with black, interspersed with white hairs; under-surface with white hairs, thicker at the sides than elsewhere.

Head wide, with a large interocular depression; punctures on top moderately large and distinct, becoming smaller and more crowded between the eyes and forepart, and confluent in such a way as to form a more or less distinct longitudinal carina midway between the eyes, extending from the clypeal suture nearly to the vertex. Antennae with five-jointed club, joints seven to ten obconical and gradually increasing in width, the apical on the inside obliquely, but not deeply, emarginate, the apex of emargination obtuse. *Prothorax* about as wide as long, with transverse subapical and subbasal impressions, sides strongly inflated near the middle, the disc with a large moderately deep elliptical depression, divided longitudinally by a distinct carina; near apex with fine, transverse, rugose punctures, the disc and sides with large, coarse, transverse rugosities. *Scutellum* round. *Elytra* elongate, at base wider than prothorax, depressed between the humeral angles and behind scutellum, sides very slightly constricted near middle; punctures large, deep, and reticulate, smaller and more individually distinct at the base, confluent at suture and margins near the middle, and decreasing in size towards apex, at which they are almost obsolete; on each elytron are to be seen three more or less distinct carinae. Posterior *femora* comparatively slender and not reaching to the apex of elytra. Length, 10 mm.

Hab.—South Australia: Quorn (A. H. Elston). Type (unique), in author's collection.

This species is easily distinguished by the singular sculpture of its prothorax, the elliptical depression extends from the subapical to the subbasal impressions, and is truncate at its apex and base, the longitudinal carina extends the whole length of the depression, with distinct wrinkles branching from each side of it. The punctures on the humeral angles and at the apex are almost obsolete, so that these portions are more nitid than the rest of the surface. In general appearance it somewhat resembles *E. intricata*, Klug., from which it can be distinguished by having the club of the antennae black, with the apical joint more obliquely emarginate, the sculpture of the prothorax, and the punctures on the elytra more reticulate. It differs from *E. reichei*, Spin., in the shape of the apical joint of the antennae, the sculpture of the prothorax, and the punctures on the elytra being somewhat smaller.

Eleale illaetabilis, n. sp.

Upper-surface of a bronze colour with a coppery gloss, palpi and four apical joints of club of antennae dull black, legs violet with a coppery reflection; clothing moderately dense; on head, prothorax, and legs with comparatively long, on elytra short, semi-erect, black hairs; on face and legs dark hairs interspersed with pale ones, scutellum scantily clothed with white pubescence, and at apex of elytra a small fringe of white hairs. Under-surface dark shining blue with here and there a brassy reflection, and thickly clothed with long, shaggy, white hairs.

Head moderately elongate, with three small shallow depressions, one midway between the eyes, and one near the base of each antenna, with dense moderately large punctures, only here and there confluent, those at the top less crowded. Antennae long and stout, reaching back almost to base of prothorax, joints three to six slightly longer than wide, fifth and sixth feebly obconical in shape, seventh slightly flattened and obconical, eight to eleven compressed, eight to ten obconical, the apical joint only slightly larger than the tenth, and on the inside with a small, deep, and somewhat oblique emargination, the apex of which is acute. *Prothorax* distinctly longer than wide, sides almost straight to beyond the middle, where they are slightly dilated, then contracted towards base, subapical transverse impression almost obsolete, the subbasal one comparatively shallow, disc flattened, with a small shallow fovea in the middle and just in front of the subbasal impression; densely punctured, punctures not much larger than those on head and transversely confluent, those near the apex smaller and less crowded; in the middle is a longitudinal carina. *Scutellum* comparatively small and round. *Elytra* at base about one and a half times as wide, and more than three times as long as prothorax, sides straight and parallel, gently rounded off towards apex, humeral angles slightly salient, with interhumeral and post-scutellar depressions; closely punctured, the punctures larger than those on prothorax, reticulate, here and there slightly confluent, and extending right to apex, where they are smaller but nevertheless distinct, at base less crowded and smaller, only humeral angles glistening through paucity of punctures; on each elytron are to be seen three more or less distinct carinae. *Legs* comparatively slender, posterior femora only reaching about half-way to apex of elytra. Length, 9·5-12·5 mm.

Hab.—South Australia: Mount Lofty Ranges (Blackburn's collection, Rev. A. P. Burgess, A. H. Elston), Sandy Creek (J. G. O. Tepper); Victoria: Lake's Entrance, Noble Park (F. E. Wilson), Dividing Range (Blackburn's collection); Tasmania (A. Simson). Type, in author's collection; cotype, I. 12816, in South Australian Museum.

A very elongate species, and does not vary much in colour except that on some specimens the coppery gloss is a little brighter than on others. In general appearance very close to *E. aspera*, Newm., from which it can be distinguished by the shape of the prothorax, the punctures of which are larger and more individually distinct, the transverse wrinkles coarser and less crowded, and the punctures on the elytra larger, and somewhat less crowded.

Eleale margaritacea, n. sp.

Upper-surface dark green, iridescent, palpi and club of antennae black; very scantily clothed with moderately long, semi-erect, black hairs, interspersed with white ones, which are more numerous at the sides of prothorax and on legs than elsewhere, scutellum lightly clothed with white pubescence. Under-surface shining, gula bright blue, sterna and abdomen green, the sterna with metallic, the latter with glistening brassy reflections, clothed with moderately long whitish hairs, middle portion of metasternum and abdomen glabrous.

Head elongate, with a large shallow depression between the eyes, closely punctured, the punctures round, deep, here and there confluent, and defining a longitudinal carina midway between the eyes, extending from the clypeal suture to the vertex. Antennae reaching to beyond the middle of the prothorax, the first joint very large, the second almost globular, three to six longer than wide and subcylindrical, seven and eight slightly flattened and dilated at their apices, nine to eleven compressed, the ninth nearly twice the size of the eighth, the apical not much larger than the tenth, and with a small, rather shallow, oblique emargination on the inside, the apex truncate. *Prothorax* not much longer than wide, sides slightly rounded at middle, with a shallow transverse subapical impression and a deeper subbasal one; on each side near the middle is a small, shallow fovea, disc lightly flattened, the punctures dense, large, deep, and transversely rugose, those near the apex smaller, less crowded, and more individually distinct. *Scutellum* comparatively small and somewhat transverse. *Elytra* at base about one and a half times as wide, and slightly more than three times as long as the prothorax, sides straight and almost parallel, gently rounded towards apex, humeral angles barely salient, with interhumeral and post-scutellar depressions; somewhat densely punctured, the punctures moderately large, deep, and reticulate, here and there on the middle transversely confluent, near base smaller and less crowded, those near apex smaller but just as crowded and deep as on the middle; on each elytron are three more or less distinct longitudinal carinae. Posterior *femora* not reaching to apex of elytra. Length, 10·5-12 mm.

Hab.—Western Australia: Eyre Sand Patch (W. Graham). Type, I. 12828, in South Australian Museum.

Very closely resembles *E. viridis*, Guerin, from which it can be distinguished by its colour and scantier clothing, more elongate form, prothorax more transversely wrinkled, and punctures on elytra somewhat larger. In general appearance somewhat resembles the previous species, but differs in being a lighter colour, less hairy, and by not having a small fringe of white hairs at apex of elytra, sides of prothorax more rounded, prothorax more coarsely wrinkled, and punctures on elytra somewhat larger.

Eleale viridis, Guerin.

Herr Schenkling[8] considers this species to be the same as *E. aspera*, Newm.; this I believe to be incorrect, the two being quite distinct from each other. The insect I have identified as *viridis* differs from *aspera*, *inter alia*, by having the punctures much larger and coarser on the elytra and prothorax, particularly on the latter, which is also less elongate, and with the sides rounded near the middle; the colour is also of a much brighter green than any specimen I have yet seen of *aspera*.

Hab.—Western Australia.

Eleale robusta, n. sp.

Upper-surface shining green with brassy reflection, palpi, antennae, and tarsi black; head and prothorax thickly,

(8) Schenkling, Deut. Ent. Zeit., 1906, p. 288.

elytra scantily clothed with moderately long, upright, black hairs; face, scutellum, and legs lightly clothed with white hairs. Under-surface shining green with brassy reflections, and thickly clothed with long, shaggy, white hairs.

Head elongate, surface of face uneven, having a moderately large and irregularly shaped shallow depression between the eyes, and a smaller and deeper one at the base of each antenna, with comparatively small and rugose punctures, those on the vertex somewhat finer and less crowded; midway between the eyes a more or less distinct longitudinal carina. Antennae long, almost reaching back to base of prothorax; joints three to six cylindrical, seven to nine obconical and gradually increasing in width, the apical joint slightly wider than the tenth, and about one a half times as large, on the inside is a large, deep, crescent-shaped emargination. *Prothorax* only very slightly longer than wide, sides gradually widening to beyond the middle, where they reach their maximum width, then suddenly contract towards the base, with a shallow subapical transverse impression and a deeper subbasal one; on the middle of disc are two shallow foveae, one just behind the subapical and the other in front of the subbasal impressions, both foveae touching the impressions, also two shallow foveae, one on each side where the sides of prothorax attain their maximum width; transversely wrinkled, the punctures, which are about the same size as those on head, are only with difficulty to be here and there separately perceived. *Scutellum* comparatively small and round. *Elytra* at base about one and a half times as wide as the widest part of prothorax and barely three times its length, sides straight and parallel to beyond the middle then gradually rounded off towards apex, humeral angles salient, interhumeral and post-scutellar depressions moderately deep; closely punctured, the punctures large, deep, quadratic, and reticulate, in places transversely confluent, those near the base less crowded and more individually distinct, only the outside of humeral angles glistening from the paucity of punctures; on each elytron are two rather indistinct longitudinal carinae. *Femora* robust, posterior ones not reaching apex of elytra. Length, 6-7 mm.

Hab.—Queensland: Stradbroke Island (H. Hacker, H. Pottinger). Type, in author's collection; cotypes, in South Australian Museum (I. 12824) and Queensland Museum.

A robust species and apparently not variable, except that some specimens have a little stronger brassy reflection than others. Although the whole upper-surface is shining, it nowhere glistens through the paucity of punctures, except at the humeral angles; the punctures at apex of elytra, although smaller than those on disc, are nevertheless distinct and deep. It differs from *E. margaritacea*, n. sp., by having a more shining appearance, brighter colour, surface of face more uneven, joints comprising the club of antennae not compressed, the apical joint bigger and more largely and deeply excavated, transverse wrinkles on prothorax more numerous and finer, and the punctures on the elytra more confluent.

Eleale amoena, n. sp.

Upper-surface shining, head and elytra green, the latter tinged near suture with violet, prothorax brassy, base slightly tinged with violet, legs deep metallic-green with coppery gloss, antennae testaceous, club more or less infuscate; clothed with moderately long, almost upright dark hairs, shorter and more depressed on elytra, with pale hairs at sides, on scutellum and legs. Under-surface shining green with brassy reflections, and lightly clothed with moderately long white hairs.

Head elongate, with a small, round, interocular depression, closely and rugosely punctured, the punctures much fainter on part of face near clypeal suture, this part, which glistens, extends upwards in the form of a triangle, the apex being just below the depression. Antennae short, barely reaching to middle of prothorax; club distinctly three-jointed, the apical joint not emarginate. *Prothorax* slightly longer than wide, disc slightly flattened, sides parallel, but contracted suddenly near the base, with a transverse sub-basal impression, which has a small round median fovea in front of, and touching it; punctures at apex slightly smaller than those on head, and more or less individually distinct, those on the disc and sides much larger and deeper, transversely rugose, and arranged so as to define a narrow longitudinal median carina. *Scutellum* small and round. *Elytra* at base wider than prothorax, sides widest just beyond the middle, humeral callosities small and barely salient, interhumeral depression small and shallow, the post-scutellar depression somewhat larger and deeper; with moderately large, seriate and reticulate punctures, more or less quadratic and slightly confluent at suture near the middle. *Metasternum* and abdomen with a long, narrow, longitudinal furrow, extending from behind the intermediate coxae to almost the apex of the abdomen, and interrupted by the posterior coxae. *Femora* robust, posterior ones not reaching apex of elytra. Length, 5-6 mm.

Hab.—South Australia: Barossa (R. J. Burton), Murray River (A. H. Elston). Type, in author's collection; cotype, I. 12818, in South Australian Museum.

This is a very pretty little insect which varies slightly in colour, on some specimens the club of the antennae is darker than on the type, the prothorax is sometimes coppery, and the elytra almost blue, the humeral callosities are sometimes almost flat and the interhumeral depressions barely perceptible. Comes very close to *E. brevicornis*, Chev., from which it may be readily distinguished by its colour, somewhat finer punctuation, particularly on the prothorax, the sides of which are straighter, and also on the humeral angles and at apex of elytra, so that these parts are more nitid than the rest of surface. Differs from the description of *E. brevis*, Gorh., by its colour and size, head closely punctured, and sides of the prothorax straight.

Eleale aulicodes, Gorham.

Specimens from Lake Callabonna differ from the typical form in being smaller, and in colour ranging from a beautiful pale blue to a deeper blue reflecting purple.

Eleale reticulata, n. sp.

Upper-surface deep violet, in parts reflecting blue and green, club of antennae dull black, femora blue; clothed with moderately long black hairs, becoming shorter and more depressed towards apex of elytra, scutellum with thick white pubescence, sides of prothorax and base of femora with shaggy white hairs. Under-surface shining blue, in parts reflecting green, densely clothed with long, shaggy, white hairs, becoming shorter and more depressed on the abdomen.

Head elongate, with a large, shallow, interocular depression, moderately large punctures, becoming smaller, more crowded, and confluent between the eyes and on the forepart, and defining a more or less distinct longitudinal carina midway between the eyes. Antennae reaching to about the middle of prothorax, joints seven and eight only very slightly obconical and about as wide as the sixth, club wide and three-jointed, joints compressed, the apical truncate and emarginate at its apex. *Prothorax* slightly longer than wide, sides inflated near the middle, with a transverse subapical and subbasal impression, the former being almost obsolete, disc flat, punctures near apex small but distinct, elsewhere much larger and in places confluent, especially on disc, where they define a more or less distinct, thin, longitudinal median carina. *Scutellum* moderately large and round. *Elytra* elongate, at base wider than prothorax, sides subparallel, with interhumeral and post-scutellar depressions; punctures moderately large, crowded, and reticulate, those at the base and apex smaller, but nevertheless distinct. *Femora* moderately robust, the posterior ones not reaching apex of elytra. Length, 9-12 mm.

Hab.—South Australia: Karoonda (G. E. H. Wright); Western Australia: Geraldton (J. Clark), Mullewa (Miss J. F. May). Type, in author's collection; cotype, I. 12817, in South Australian Museum.

On some specimens can be seen three feeble carinae on each elytron, the elytral punctures are very crowded, but nowhere confluent, the humeral angles only glistening through paucity of punctures. Differs from *E. aulicodes*, Gorham, in having the head and prothorax more elongate, the punctures on face more crowded, the club more distinctly three-jointed, and by its colour. In general appearance it somewhat resembles *E. cribrata*, Schenk., from which it differs in being more robust and hairy, by the club of antennae, the apical joint of which is emarginate at its apex, punctures on prothorax smaller and in places confluent, punctures on elytra somewhat smaller and more crowded.

Eleale parallela, n. sp.

Upper-surface green, joints one to six of antennae metallic-green, seven to ten reddish-brown, the apical black; clothed with nearly upright, moderately long, black hairs, face, scutellum and legs with white hairs. Under-surface shining, greenish-blue, clothed with long, shaggy, white hairs, thicker at the sides than elsewhere.

Head elongate, with a small shallow depression between the eyes and a somewhat deeper one at the base of each antenna, punctures small, moderately deep and crowded, here and there confluent. Antennae long, almost reaching to base of prothorax, joints three to six cylindrical, seven and eight obconical, nine and ten wider than long and almost semicircular, apical joint nearly as large as nine and ten combined, with a large, deep, crescent-shaped emargination. *Prothorax* nearly one and a half times as long as wide, sides straight and parallel nearly to base, then slightly contracted to the base itself, disc lightly flattened, transverse subapical impression obsolete, the subbasal one almost imperceptible; punctures at apex about the same size as those on head and in places transversely confluent, those on disc and sides larger and deeper, here and there confluent, and defining an interrupted, longitudinal, median carina. *Scutellum* small and round. *Elytra* at base not much wider, and about thrice as long as prothorax, sides straight and parallel nearly to apex, then rounded off, humeral angles not salient, interhumeral depression almost obsolete, post-scutellar depression much deeper; punctures moderately large and deep, crowded, reticulate, transversely confluent near suture; at base, on humeral angles, and at apex the punctures are smaller, but not sufficiently fine to cause these parts to glisten. When viewed in a slanting direction from the front, two longitudinal carinae are to be plainly seen on the basal half of each elytron. *Legs* slender, posterior femora not reaching apex of elytra. Length, 8-10 mm.

Hab.—Queensland: Stradbroke Island (H. Hacker), Brisbane (F. E. Wilson). Type, in author's collection; cotypes, in South Australian Museum (I. 12823), and in Queensland Museum.

A very elongate and distinct species, apparently not a variable one. In general appearance somewhat resembles *E. aspera*, Newm., from which it can be readily distinguished by the apical joint of the antennae being larger and more deeply excavated, and the different sculpture of the prothorax.

Eleale spinicornis, n. sp,

Upper-surface deep blue, almost black, with here and there a metallic reflection, head paler, club of antennae testaceous; scantily clothed with rather long, semi-erect, black hairs, and thickly clothed with short, depressed, hoary hairs. Under-surface green with brassy reflections, and thickly clothed with moderately long, shaggy, white hairs.

Head with a large shallow depression between the eyes, and moderatly large punctures, not crowded, here and there confluent. Antennae long, almost reaching to base of prothorax, joints three to eight longer than wide and nearly cylindrical, club distinctly three-jointed, compressed, with the first two obconical, the apical rounded at its base, and with a large, deep, semi-oblique emargination on each side of it, that on the inner side being somewhat deeper, the apex produced into a rather long, pointed spine. *Prothorax* about as long as wide, sides evenly rounded, widest part being near the middle, subapical transverse impression entirely absent, the subbasal one very indistinct, disc very lightly flattened; punctures moderately large, but not deep, those near apex smaller, here and there confluent, with a more or less distinct longitudinal median carina. *Scutellum* small and round. *Elytra* at base little wider than widest part of prothorax and about thrice its length, sides almost straight and gently rounded towards apex; punctures smaller than those on disc of prothorax, round, shallow, and crowded, near base smaller and less crowded, only humeral angles glistening through paucity of punctures. Posterior *femora* not reaching apex of elytra. Length, 4·5-7 mm.

Hab.—South Australia: Mount Lofty Ranges (Rev. A. P. Burgess), Quorn (Blackburn's collection). Type, I. 12826, in South Australian Museum.

A very hairy species, and at once distinguished from all previously described ones by the singular formation of the apical joint of the antennae, the excavations on each side of it are deep, and extend for about half the length of the joint, so that the apical spine is about as long as the unexcavated portion; on some specimens the club is a little darker than on the type, but this may be due to age or post-mortem change. There is an entire absence of carinae on the elytra, which are closely and uniformly punctured, the inter-humeral and post-scutellar depressions are distinct and about the same size.

ELEALE ANGULARIS, n. sp.

Upper-surface shining, dark blue with metallic reflections, legs paler, antennae shining red with club dull black; scantily clothed with moderately long, semi-erect, black hairs; scutellum, sides near base of prothorax, and apex of elytra with white hairs. Under-surface dark blue with here and there metallic reflections; scantily clothed with comparatively short, depressed, white hairs, clothing much thicker at sides of pro- and mesosternum than elsewhere.

Head moderately elongate, with a large round depression between the eyes, and with small, round, rather deep, and dense punctures, here and there confluent. Antennae reaching to about middle of prothorax, joints three to five longer than wide, the third being the longest, the sixth barely longer than wide, the seventh and eighth obconical, the latter wider, the club three-jointed and compressed, the ninth and tenth obconical, the ninth about twice the size of the eighth, the apical joint about half as big again as the tenth, truncate at its apex, the inside almost imperceptibly emarginated, the inside apical angle acute, the outside one rounded. *Prothorax* not much longer than wide, sides almost straight and slightly diverging outwards to beyond the middle, then suddenly contracting towards the base, making an obtuse angle on each side; with a shallow subapical transverse impression and a deeper subbasal one, disc flattened and slightly uneven; punctures large, deep and crowded, here and there confluent, those near the apex and base smaller and less crowded; with a more or less distinct longitudinal median carina. *Scutellum* round. *Elytra* at base about one and a half times as wide, and nearly three times as long as the prothorax, sides almost straight and gently rounded off towards apex, humeral angles prominent, with interhumeral and post-scutellar depressions conspicuous; punctures somewhat crowded, large, deep, and reticulate, those at base smaller and less crowded, those on humeral angles and at apex almost obsolete, so that these parts are more nitid than rest of surface; with two more or less distinct carinae on each elytron. *Femora* robust, posterior ones not reaching apex of elytra. Length, 9·5-10·5 mm.

Hab.—South Australia: Mount Lofty Ranges (A. H. Elston); Victoria: Kiata (F. E. Wilson). Type, in author's collection; cotype, I. 12827, in South Australian Museum.

A very robust and angular species, which may be easily distinguished by the shape of prothorax and the angular appearance at base of elytra. Somewhat resembles *E. latipennis*, n. sp., from which it differs in the shape and sculpture of the prothorax, elytra proportionately longer and with larger and deeper punctures.

Eleale globicollis, n. sp.

Upper-surface bright cupreous, face, sides of prothorax, and base of elytra slightly diluted with green, large patch on middle of each elytron much paler, almost testaceous, labrum and mandibles dark brown, palpi, tibiae and tarsi testaceous, the two latter infuscate in parts, femora violet; scantily clothed with short subdepressed black, interspersed with white hairs, the latter more numerous and longer at sides of prothorax, on elytra and legs; scutellum with thick white pubescence and at apex of elytra a fringe of white hairs. Under-surface violet with brilliant coppery gloss; sides of meso- and metasternum thickly clothed with moderately long, depressed, white hairs, elsewhere much more scantily clothed.

Head with a small, round, moderately shallow, inter-ocular depression; punctures on top small and deep, confluent on the vertex and defining a small longitudinal carina, those on the face larger and somewhat obliquely confluent. Antennae barely reaching to middle of prothorax, the seventh joint almost cylindrical, the eighth slightly dilated and flattened, the club distinctly three-jointed and compressed, the ninth obconical, the tenth wider than long, the apical about as long as wide, truncate at its apex, and almost imperceptibly emarginated. *Prothorax* slightly longer than wide, sides dilated near the middle, with transverse subapical and subbasal depressions, the latter much deeper than the former, disc very lightly flattened, punctures at apex about same size as those on vertex of head and transversely confluent, on the disc and sides the punctures are much larger, deeper, and reticulate, only confluent in places near the middle, and defining an interrupted and more or less distinct longitudinal median carina. *Scutellum* round. *Elytra* at base about twice as wide as the prothorax, and a little more than twice its length, sides very slightly diminishing in width from the base to apex, which is rounded, interhumeral and post-scutellar depressions shallow; closely punctured, the punctures large, deep, reticulate, and subquadratic, here and there confluent on the middle, somewhat less crowded near base but not much smaller, on the humeral angles and at apex the punctures are almost obsolete, so that these parts are more nitid than the general surface. *Legs* moderately long, posterior femora nearly reaching apex of elytra. Length, 6-7 mm.

Hab.—Western Australia: Lake Austin (H. W. Brown); South Australia: Oodnadatta (Blackburn's collection), Murray River (A. H. Elston). Type, I. 12821, in South Australian Museum.

There are only three specimens of this species before me; the type is from Western Australia, that from Oodnadatta differs in having the club of the antennae slightly infuscated and the tibiae and tarsi darker, and the one from the Murray River is doubtfully regarded as a variety, it being more robust, its colour a bright violet with club of antennae black, but in sculpture agrees very well with the other two. In shape somewhat near *E. brevicornis*, Chev., from which it may be distinguished by its colour, the prothorax more globular, base of elytra wider, and punctures on elytra much larger.

Eleale latipennis, n. sp.

Upper-surface somewhat shining, front of head and anterior femora green, antennae red (club excepted, which is black), palpi black, remainder violet, in parts with a coppery or metallic-green gloss; clothed with moderately long, subdepressed, black hairs, interspersed with shorter and more depressed white ones, sides of prothorax, scutellum, and apex of elytra more densely clothed with white hairs. Undersurface glistening blue, with brassy reflections on abdomen, clothed with moderately dense, shaggy, white hairs.

Head comparatively small, with a shallow interocular depression, punctures small and fairly deep, crowded, and confluent in places between the eyes, but not defining a longitudinal carina. Antennae short, barely reaching to middle of prothorax, joints seven and eight scarcely flattened or dilated, club distinctly three-jointed, apical joint almost imperceptibly emarginated on the inner side with its apex pointed. *Prothorax* distinctly longer than wide, sides almost parallel to beyond the middle, then suddenly contracted towards base, which is somewhat narrower than apex, the transverse subapical depression almost obsolete, the subbasal one distinct, the disc slightly flattened; punctures at apex slightly smaller than those on head and somewhat transversely confluent, on the disc and sides much larger and deeper, and only here and there confluent. *Scutellum* comparatively large and round. *Elytra* at base nearly twice as wide as the prothorax, and about twice its length, sides almost parallel to beyond the middle, then narrowed towards apex, interhumeral and post-scutellar depressions comparatively shallow; with moderately small punctures, crowded and reticulate, only here and there confluent, those near the base and apex smaller and less crowded, and on the humeral angles they are almost absent, so that this part is more nitid than the rest of the surface. *Legs* comparatively long, posterior femora nearly reaching apex of elytra. Length, 7-9 mm.

Hab.—South Australia: Quorn (Blackburn's collection), Murray River (R. F. Kemp and A. H. Elston). Type, in author's collection; cotype, I. 12819, in South Australian Museum.

On some specimens the colour is violet with a stronger mixture of blue in it, and on one the metallic green gloss predominates over the violet. On the middle of each elytron are two more or less distinct longitudinal carinae, starting near the base and becoming obsolete behind the middle, the apices are decorated with a fringe of moderately long white hairs. The shape of the prothorax somewhat resembles that of *E. cribrata*, Schenklg., otherwise it cannot readily be associated with any other previously described species.

Eleale perplexa, n. sp.

Upper-surface of head and prothorax green, palpi and antennae testaceous, with the club of the latter and the apices of the former lightly infuscate, elytra cupreous with a brassy reflection, anterior legs green with brassy reflection, intermediate and posterior ones violet; clothed with short, subdepressed, black hairs, interspersed with shorter and more depressed white ones; scutellum covered with white pubescence. Under-surface green with brassy reflection, and densely clothed with long, shaggy, white hairs.

Head elongate, with a moderately large, shallow, inter-ocular depression, and two smaller, deeper, and more elongate ones at base of antennae; the punctures small, deep, and dense, confluent in parts, and defining a short median longitudinal carina on the vertex. Antennae reaching to middle of prothorax, joints seven and eight but slightly dilated and flattened, club distinctly three-jointed, the inside of the last joint barely emarginate, the outside apical angle rounded, the inside one acute. *Prothorax* longer than wide, base about as wide as apex, sides rounded, widest part just beyond the middle, disc flattened; punctures at apex slightly smaller and more shallow than those on head and in places confluent, those on disc and sides much larger, deeper, and reticulate, only running into each other near the middle and defining a longitudinal median carina. *Scutellum* round. *Elytra* at base wider than prothorax, and about two and a half times as long, sides parallel to about three-fourths the length, then rounded off towards apex, humeral callosities moderately salient, interhumeral and post-scutellar depressions conspicuous; punctures comparatively small, crowded and reticulate, nowhere confluent, those on base, humeral callosities, and near apex shallow and less crowded, so that these parts are more nitid than the rest of the surface; on each elytron are three feeble carinae. *Legs* long and comparatively slender, posterior femora reaching to apex of elytra. Length, 8-10 mm.

Hab.—South Australia: Oodnadatta (Blackburn's collection), Ooldea (A. M. Lea); Western Australia: Cue (H. W. Brown), Mullewa (Miss J. F. May). Type, I. 12820, in South Australian Museum.

This species is variable in colour, some specimens being lighter and others darker than the typical form, and on one specimen the elytra are almost green, strongly diluted with brownish-yellow, on some (including the type) the labrum has a distinct yellow spot, whilst on others it is entirely dark. Very close to the previous species, from which it may be distinguished by its somewhat more elongate form, antennae and palpi paler, disc of prothorax flatter, and the longitudinal carinae on head and prothorax.

Eleale hirticollis, n. sp.

Head, prothorax, and legs violet, palpi and first eight joints of antennae shining black, club dull black, base and apex of elytra blue, reflecting violet, remainder of elytra green; clothed with nearly upright black hairs, long on prothorax and base of elytra and becoming shorter towards apex of the latter, scutellum thickly covered with short, depressed, white hairs, a wide fascia across middle of prothorax, and legs (particularly at base of femora) with long, shaggy, white hairs. Under-surface shining, head and thorax violet, abdomen green; scantily clothed with moderately long, subdepressed, white hairs, which are more numerous on the forepart and sides of the metasternum than elsewhere.

Head moderately elongate, with a shallow depression between the eyes and a somewhat deeper one at the base of each antenna, punctures on top of head small, round, shallow, and slightly confluent, elsewhere much larger, deeper, and not confluent. Antennae long, nearly reaching to base of prothorax, first joint about as long as the third and twice as thick, the second is the smallest and beadlike, three to five cylindrical, seven and eight slightly, nine and ten strongly, obconical in shape; the apical joint is not emarginate, apex truncate, the outside apical angle rounded, the inside one acute. *Prothorax* about as wide as long, sides dilated near middle, anterior transverse impression almost obsolete, the sub-basal one distinct, disc with a large longitudinal, moderately deep, and elliptical depression; punctures at apex about same size as those on vertex of head and transversely confluent, elsewhere much larger and deeper, here and there confluent, and defining a distinct longitudinal carina dividing the depression in the middle. *Scutellum* round. Elytra at base about one and a half times as wide and about two and a half times as long as the prothorax, sides slightly diminishing in width towards apex, interhumeral and post-scutellar depressions moderately deep, humeral angles salient; punctures large, quadratic, reticulate, and nowhere confluent, those at base, on humeral angles, and at apex much smaller and more scattered, so that these parts are more nitid than the rest of the surface. *Legs* robust, posterior femora not reaching apex of elytra. Length, 6-13 mm.

Hab.—Western Australia: Ankertell (H. W. Brown), Beverley (F. H. du Boulay), Cue (H. W. Brown), Geraldton (J. Clark), Mullewa (Miss J. F. May), Mount Squires (Elder Expedition); South Australia: Lake Callabonna (A. Zietz). Type, in author's collection; cotype, I. 12822, in South Australian Museum.

This is a very pretty and variable species, particularly in size; on some specimens the head and prothorax are much darker in colour, a very deep blue, and on others violet tinged with green. It was this species that Blackburn doubtfully identified as *E. reichei*, Spin., from which it can be distinguished by its colour, the apical joint of antennae *not* emarginate, the punctures on prothorax more individually distinct, median fascia of white hairs on the prothorax, and the punctures on the elytra smaller, more crowded, and more reticulate. In general appearance it somewhat resembles *E. excavata*, Westw., from which it differs in being of a brighter colour, the club of the antennae composed of only three joints, and the apical one not emarginate, the disc of the prothorax depressed, only one transverse fascia of hairs on prothorax, and that extending across the middle, and the base and apex of elytra glistening.

Eleale cribrata.[9] Schenklg.

Mr. F. E. Wilson has sent me from Kiata, Victoria, several specimens which agree very well with the description of this species, except that the whole upper-surface is blue-black, with here and there a coppery reflection; four specimens with the typical colouring have been taken at Lucindale, South Australia.

Allelidea similis, n. sp.

Black; antennae (club infuscated) and parts of legs pale testaceous; elytra with two white fasciae, one basal and the other submedian; scutellum black. With sparse subdepressed white setae, longer and more numerous on sides and legs.

Head wider than prothorax, with moderately large punctures; these are separate and distinct on top of head, but are crowded together on the forepart, and running into each other in such a way as to form a more or less distinct, longitudinal carina midway between the eyes. Antennae short. *Prothorax* longer than wide, apex wider than base, inflated near the middle and very much constricted at base, with an almost obsolete, transverse impression near apex; punctures larger than those on the head, and sparsely but evenly distributed. *Elytra* at base about as wide as base of prothorax, then gradually widening to beyond the middle, when they gently contract towards apex, which is rounded; punctures moderately large, distinct, and seriate, becoming smaller and less distinct posteriorly. *Legs* long and slender. Length, 3 mm.

Hab.—Australia; probably Queensland. Type (unique), in Queensland Museum.

On the elytra the basal fasciae are not interrupted by the suture and touch the margins, the submedian fasciae touch the margins but are interrupted by a very narrow strip at the suture; both fasciae are slightly narrower at suture than at the margins. The anterior tibiae are more or less pale, and the apices of the intermediate and posterior ones are also pale. This insect very much resembles *A. brevipennis*, Pascoe, with the elytra continued to beyond the second white part, where it is cut off on that species; it also differs in having the prothorax more closely punctured on the disc. There is a resemblance in shape to a big *A. ctenostomoides*, Waterh., but having the elytra without subapical white marking; and it is also closely associated with *A. curvifasciata*, Lea, from which it differs in having the white basal markings broader and almost parallel, and the submedian fascia broader

(9) Schenkling, Deut. Ent. Mus. Mittl., 1916, p. 148.

and not shaped like a boomerang, the punctures smaller, particularly on the prothorax.

Pylus pygmaeus, Blackb.

This insect varies in the colour of prothorax and the size and shape of piceous markings on the elytra. On some specimens the prothorax is darker, and on one it is entirely piceous; on all the specimens examined by me the posterior fascia, although varying greatly in size and shape, does not extend to the extreme apex of elytra. An example from Queensland has the elytra testaceous and, in addition to the median and subapical fasciae, has the base infuscated. Widely distributed in Australia and Tasmania.

CHRYSOMELIDAE.

Cleptor goudiei, Lea.

Several specimens of this beautiful insect were taken by R. F. Kemp and myself from the foliage of the Native Pine, *Callitris robusta*, in January, near Murray Bridge, South Australia. The male, which hitherto was unknown, is much smaller than the female and of a beautiful green with a slight brassy reflection, the under-surface more brassy than the upper, abdomen with a wide longitudinal depression down the centre, the first segment with large scattered punctures, second, third, and fourth segments rather densely punctured, in other respects it agrees very well with the author's description of the female. The female varies in colour, some of the specimens taken are of the same colour as the male, others are bright copper with a greenish reflection.

The Craters and Lakes of Mount Gambier South Australia.

By Charles Fenner, D.Sc.

[Read August 11, 1921.]

Plate X.

1. Introduction.
2. Discovery and Settlement of Mount Gambier.
3. Previous Literature (with list of chief references).
4. General Description: —
   (a) The surrounding country.
   (b) Mount Gambier.
5. The Volcanic Materials: —
   (a) The lava and its extent.
   (b) The fragmentary material and its distribution.
6. Age of the Eruption: —
   (a) Relation to Victorian Newer Basalt period.
   (b) Physiographic evidence.
   (c) Fossil evidence.
7. Duration of the Eruptive and Effusive Phases.
8. The Number of Craters and the Order of Eruption: —
   (a) Previous opinions.
   (b) Contour Map.
   (c) Reconstruction of the Cinder Cones.
      (i.) Dip of tuff beds.
      (ii.) Slopes of external faces.
   (d) Section through the reconstructed cones, showing collapses, etc.
9. The Subsidences: —
   (a) Extent, cause, and time of collapse.
   (b) The Blue Lake.
   (c) The Leg of Mutton Lake.
   (d) The Valley Lake.
   (e) Crater Lake.
   (f) The Moorak Depression.
   (g) The Punch-bowl.
   (h) The Water of the Lakes.
10. Scenic and Economic Aspects.
11. Summary.

1. Introduction.

Mount Gambier is situated in the extreme south-eastern corner of South Australia. The volcanic features of that district, of which Mount Gambier is the most important, mark the western limits [1] of that great area of comparatively recent volcanic activity that affected the greater part of central and south-western Victoria.

The cinder cones of Mount Gambier were never large, nor is the area covered by the ash deposits of very great extent. The volcanic phase was accompanied or followed by extensive collapse of the greater part of the area covered by the cones of ejected material, so that only remnants of the original cones now mark the points of activity. The areas of the collapse are now occupied in part by deep lakes.

Several factors combine to make Mount Gambier of special interest. The fertile volcanic soils are of great economic importance, and because of them the town of Mount Gambier has grown up, and has become the chief business centre of that portion of South Australia. The "Mount," with its beautiful lakes, being the product of two series of catastrophic happenings, namely, a rapid volcanic up-building, with subsequent extensive collapse, presents scenic features of an exceptional nature and of great variety and beauty. From the scientific point of view, the structural features present special facilities for investigating the mode of origin of the present physiographic features.

The observations on which this paper is based were carried out in such leisure hours as were available during numerous visits to Mount Gambier, extending over the past five years. In this work the writer has received invaluable and enthusiastic assistance from Mr. H. C. Hosking, B.A., of Mount Gambier, to whom his best thanks are due. The writer is also indebted to Mr. L. Keith Ward, B.A., B.E., Director of Mines, South Australia, for his assistance and suggestions.

2. Discovery and Settlement of Mount Gambier.

On the evening of December 2, 1800, Lieut. James Grant, on a "voyage of discovery" in the "Lady Nelson," was nearing the coast in the neighbourhood of Mount Gambier. So far the navigator had not sighted Australia, but a close watch was ordered to be kept for signs of land. The first such sign

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(1) With the possible exception of the Kangaroo Island basalts (see "Enstatite Basalt from Kangaroo Island, South Australia," E. R. Stanley, Trans. Roy. Soc. S. Austr., vol. xxxiv., 1910, p. 69).

noted was the presence on board of a dragon-fly, or "horse-stinger." (2)

At 8 o'clock on the morning of December 3, Grant got his first sight of New Holland, "the part that was right ahead appearing like unconnected islands, being four in number, distant six or seven leagues." These turned out to be two capes and two high mountains a considerable distance inshore. "One of them is very like the Table Hill at the Cape of Good Hope, the other stands farther in the country. Both are covered with large trees, as is also the land, which is low and flat as far as the eye can reach. I named the first of these mountains after Captain Schank,(3) and the other Gambier's (4) Mountain." On Grant's map the two volcanic hills are drawn in outline (not merely marked in position), and are shown as covered with timber. They are quite recognizable from the drawings, and are named "Schank's Mountain" and "Gambier's Mountain." On the centenary of Grant's discovery a substantial "Centenary Tower" of red dolomite was erected on the highest point of the Mount.

Regarding the spelling of the name of Mount Schank, it may be noted that Lieut. Grant consistently uses the spelling "Schank," which has been adopted by all South Australian cartographers and surveyors. The Rev. J. E. T. Woods, throughout his "Geological Observations in South Australia" uses the spelling "Shanck." The Dictionary of National Biography, however, gives the correct spelling as "Schanck," as adopted in the name of Cape Schanck, Vict.

As would be naturally expected from the geography of the area, the Mount Gambier district was first settled from the east. It would appear that Mr. S. G. Henty, of that well-known pioneering family, was the first white man to visit Mount Gambier. Stimulated by the great inducements held out to selectors by the South Australian Government, he set out from Merino Downs (Vict.) towards the South Australian border in June, 1839.(5) He was accompanied by

(2) "The Narrative of a Voyage of Discovery performed by His Majesty's vessel, the 'Lady Nelson,' of Sixty Tons burthen," by James Grant. London, 1803.

(3) Captain John Schank (1740-1823), the "worthy and esteemed friend" of Grant. He invented the patent sliding keel with which the "Lady Nelson" was fitted.

(4) Admiral James Gambier (1756-1833), a well-known seaman, later commanded the British Fleet at Copenhagen, 1807, and was rewarded with a Peerage.

(5) "Letters from Victorian Pioneers to Governor La Trobe." Melbourne, 1899.

two men, and on the second day of their journey they arrived at Mount Gambier. He ascended a gentle slope of the Mount, probably somewhat to the west of the cemetery, and suddenly found himself confronted by the great chasm of the Blue Lake, a sight "quite beyond his powers of description." He was uncertain at the time whether Mount Gambier was in South Australia or not, and so pushed on further to the west. He afterwards formed cattle stations at the Mount. Writing in 1854 he described the district as "now thickly settled."

3. Previous Literature.

1800—Reference has already been made to the record of the original discovery, of this portion of Australia, by Lieut. James Grant.

1839—The records also exist of the first man who actually visited the area, S. G. Henty, and these have been referred to. Numerous references to the locality are to be found in the records of the early settlers and in the published accounts of the aboriginal life and legends, but in these there is nothing of special geological interest.

1846—The oldest geological notes available are those published by Thomas Burr, then (1846) "Deputy-Surveyor-General of the Province." These notes give a brief but extremely interesting account of Mount Gambier, and will be quoted from later.

1851—According to the Rev. J. E. T. Woods, Blandowski made a survey of the Mount in 1851. His observations were published in the Adelaide German paper, but his maps have been lost.

1862—In this year the Rev. J. E. T. Woods published his "Geological Observations in South Australia," of which Chapters VIII. and IX. are devoted to the volcanoes of Mounts Gambier and Schank. His observations show an extended and intimate knowledge of the area, and remain the most important account yet written.

1879—In this year Professor Ralph Tate, of the University of Adelaide, made passing reference to Mount Gambier in his Presidential Address to the Philosophical Society of Adelaide.

1884—The State Government Geologist, H. Y. L. Brown, published a short account of the area, dealing more particularly with the depth, temperature, and origin of the water in the lakes. In these notes the suggestion was first made that there had been but one crater at Mount Gambier.

1901—"Notes on the Extinct Volcanoes of Mounts Gambier and Schank" were published by Professor Howchin. In these notes were suggested special lines for further investigation, which the present writer has endeavoured to follow.

1906—J. C. Moulden published a petrographical note *re* the Mount Gambier basalt, as also had Chas. Chewings in 1894.

1907—Dr. T. S. Hall, of Melbourne, gave some account of the tuff beds, dealing more particularly with their mode of deposition.

1909—E. R. Stanley carried out detailed chemical and mineralogical examinations of the types of lava at Mount Gambier, and added to these in 1910 with special notes on the olivine bombs and nodules found in the tuff beds.

In addition numerous references are made to this area by Professor Howchin in his Geography of South Australia (1909), and in his Geology of South Australia (1918).

The following is a list of the most important books and papers dealing specially with this area. Reference is made to them throughout this paper by using the numbers attached in this list:—

1. Burr, Thomas—"Remarks on the Geology and Mineralogy of South Australia." Adelaide, 1846.
2. Woods, Rev. J. E. T.—"Geological Observations in South Australia." London, 1862.
3. Brown, H. Y. L.—"Report by Government Geologist on Lakes in Mount Gambier District." Parliamentary Papers, South Australia, 1884, No. 256.
4. Howchin, W.—"Notes on the Extinct Volcanoes of Mount Gambier and Mount Schank, South Australia." Trans. Roy. Soc. S. Austr., vol. xxv., 1901.
5. Hall, T. S.—"Note on the deposition of Bedded Tuffs." Proc. Roy. Soc. Vict., vol. xx., 1907.
6. Stanley, E. R.—"Complete Analysis of the Mount Gambier Basalt, with petrographical descriptions." Trans. Roy Soc. S. Austr., vol. xxxiii., 1909.
7. Stanley, E. R.—"Lherzolite and Olivine from Mount Gambier." Trans. Roy. Soc. S. Austr., vol. xxxiv., 1910.

4. General Description.

Mount Gambier is the best known of a series of small volcanic hills in the south-eastern corner of South Australia. These hills may be classified in three groups:—

(i.) Mount Gambier, The Bluff, Mount Muirhead, and Mount Burr.

(ii.) Mount Edwards, Mount McIntyre, and Mount Graham.

(iii.) Mount Schank.

Groups (i.) and (ii.) show a linear arrangement in a north-north-west direction, while Mount Schank stands alone to the southward. The linear direction referred to is parallel with the present coastline, with a series of past coastlines, with a rather remarkable and extensive series of consolidated dune ridges,(6) and possibly with the direction of a fault-line, running parallel to and adjoining The Bluff, Mount Muirhead, etc. This suggested fault-line has not been carefully investigated, but a casual examination suggests it as well worthy of study, from both the geological and physiographic points of view.

(a) The Surrounding Country.—The bed rock of the area consists of a series of marine tertiary limestones (Janjukian),(7) which mark the site of the ancient "Murray Gulf," and which extend over thousands of square miles to the north, west, and east of Mount Gambier. This series is, in places, from 1,800 to 2,000 ft. in depth,(8) is richly fossiliferous, and is believed to be in places underlain by the carbonaceous mudstone series of the Jurassic period; there is, however, no record of the occurrence of fragments of this formation in the ejectamenta at Mount Gambier. The limestones remain on the whole remarkably level-bedded. Their wide level surface rises gently from the sea, broken only by the series of parallel ridges referred to, by occasional low inliers of early palaeozoic and older rocks, and by one or two "breaks" which may be due to comparatively late fault-scarps.

The limestones include red and cream-coloured dolomites and a polyzoal limestone (all three used as building stones), and, in places, flints are extremely abundant. The surface is of extreme topographic youth; there is an almost complete

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(6) See reference No. 2; also referred to in various maps and reports of the Geological Survey of South Australia, *e.g.*, Bulletin No. 4, plate facing p. 25 (1915).

(7) Memoirs of the National Museum, Melbourne, No. 5, Frederick Chapman, 1914, p. 48.

(8) The Portland (Vict.) Bore penetrated these limestones to a depth of 2,265 ft. Ann. Rep. Sec. Mines, Vict., 1895, p. 60.

absence of surface streams. Swamps abound, and in the winter time these overflow and unite as broad flowing sheets of water.

The rocks are in the main very porous, with abundant caverns, collapses, and "run-away holes." The limestones contain the extensive sub-artesian fresh-water basin of the miocene "Murray Gulf," the waters of which are mainly derived from local rainfall and from the rainfall in the adjoining counties of Lowan and Follett (Victoria).(9) The average rainfall at Mount Gambier itself is 30 to 35 in. Near the coast the water-table of the sub-artesian basin is cut by the land surface, and beautiful streams of fresh water

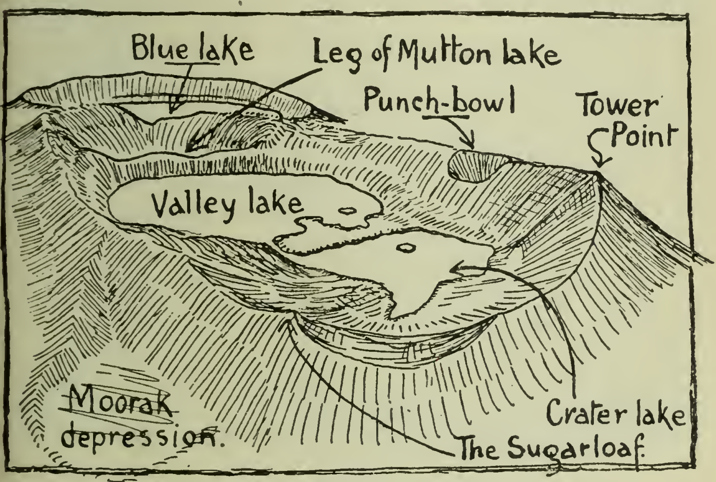

Fig. 1.
Sketch of the present-day remnants of Mount Gambier, looking E.S.E. along the line of the lakes, to show the chief features.

emerge at such places at Ewen Ponds, Dingley Dell, and the interesting miniature mound springs near Beachport. The surface of the underground water is about 70 to 80 ft. above sea level at Mount Gambier (140 ft. above sea level), and is there exposed to view in a series of four beautiful lakes.

The limestones decompose to a red clay, and the chief modifying feature of the surface soils is the peaty

(9) Maps submitted to First and Second Interstate Conference on Artesian Water (A. S. Kenyon), 1912 (p. 32 of report) and 1914.

accumulations of the extensive swamp areas and the sand of the ancient dune ridges. The most fertile areas are those where basaltic "ash" fragments have been deposited.

(b) Mount Gambier.—The immediate neighbourhood of Mount Gambier might best be described by reference to the sketch given in fig. 1, which has been drawn in part from an aerial photograph taken by Mr. Arthur, of Mount Gambier.

The present-day "Mount Gambier," which gives its name to the town that nestles on its northern side, is but a remnant of what was at one time a considerable pile of volcanic material, mainly fragmentary. The series of cinder cones extended about 180 chains in the direction of its greatest length (roughly S.E.-N.W.), and was about 80 chains in width.

A series of extensive collapses took place along the line of the cones, so that the higher portions have almost wholly disappeared, and only the outer, lower slopes remain intact. The collapsed area is in part occupied by lakes, the surfaces of which are about 70 ft. below the level of the town and the surrounding plain. The highest point, on which stands the Centenary Tower, is about 650 ft. above sea level (about 500 ft. above the level of the town).

The area of elevation and collapse, now largely clothed by native and introduced vegetation, presents features of remarkable variety from the scenic point of view. The depressions, as shown in the sketch, are six in number:—(i.) Blue Lake; (ii.) Leg of Mutton Lake; (iii.) Valley Lake (broadly connected with iv.); (iv.) Browne or Crater Lake; (v.) the Punch-bowl; (vi.) the Moorak depression.

5. The Volcanic Materials.

(a) The Lava and its Extent.—In the very early stages of the volcanic outburst there was a small lava flow. This is exposed in section in the western and eastern walls of the Blue Lake, and in the eastern wall of Valley Lake, with a thin deposit of volcanic ash separating it from the underlying limestones. These sections are beautifully clear—almost diagrammatic in outline (see fig. A, pl. x.).

The basaltic lava is locally known as the "blue rock," in distinction to the beds of stratified tuff, which latter, by a curious etymological twist, is locally known as "the lava."

The lava is thickest at exposures B and C (fig. 2), thinning towards D, and doubtless flowed in the direction from A towards D. As suggested by Professor Howchin *(Ref.* No. 4), the flow probably came from a crater situated near to and eastward of the point A. At the latter place there is an interesting development, on the inner face of the wall of the Mount, of ropy and stalactitic lava.

In all the sections shown the rapid thinning out of the lava, from the centre of the stream (50 ft. thick) towards the sides, is clearly to be seen, and suggests quite a small extension to the north and south. In well-sinking, in and near the northern slopes of the Mount, the "blue rock" is

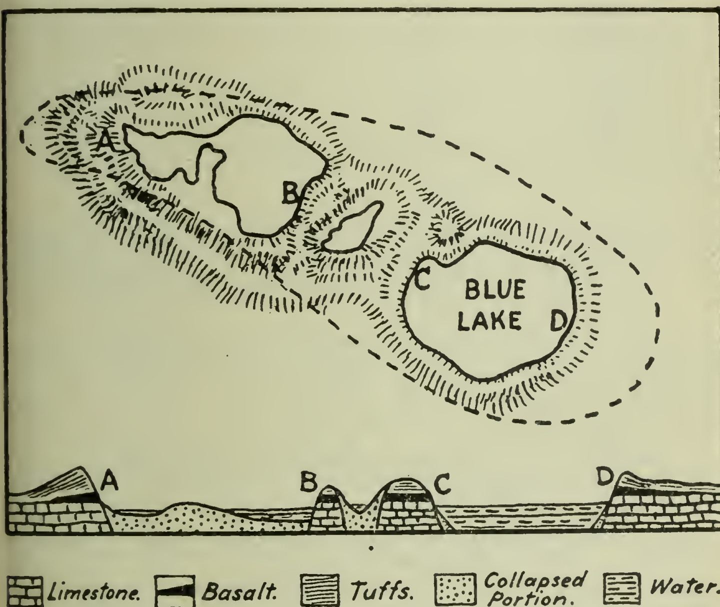

Fig. 2.
Sketch plan and section to show the probable extent of the lava flow. In the section the basalt is shown in black (not to scale).

sometimes met with. From all the evidence available, the maximum extent of this early flow is probably represented in the above sketch (fig. 2).

Mr. E. R. Stanley has carried out careful analyses and microscopic examination of the lava, and also of the olivine-bearing nodules, bombs, and fragments that occur throughout the tuff deposits *(Refs.* 6 and 7). The following table shows Mr. Stanley's analysis, compared with the average analysis of typical basalts in Victoria, and with Mr. Daly's "average basalt":—

		A.	B.	C.
SiO_2	...	48·00	48·84	46·95
Al_2O_3	...	14·11	15·90	14·37
Fe_2O_3	...	5·61	5·23	1·37
FeO	...	6·11	6·30	9·52
MgO	...	8·81	6·38	9·74
CaO	...	8·68	9·15	10·04
K_2O	...	3·01	3·05	3·49
Na_2O	...	1·25	1·46	1·53
H_2O+	...	·73	$\left\{\begin{array}{l}1·60\\ \\ \end{array}\right.$	·52
H_2O-	...	·80		·10
TiO_2	...	2·20	1·35	2·04
MnO_2	...	·13	·29	—
P_2O_5	...	·50	·45	·46
		99·94	100·00	100·13

A. Average of six basalts, Camperdown District, Victoria. "Geology of the Camperdown and Mount Elephant Districts," Mahony and Grayson, Mem. Geol. Sur. Vict., No. 9, 1910.

B. Average basalt analysis. "Igneous Rocks and their Origin," R. A. Daly, 1914, p. 315.

C. Mount Gambier vesicular olivine basalt. E. R. Stanley (*Ref.* No. 6).

Stanley also published microscopic descriptions of the slaggy and vitrophyric types of lava, found at Mount Gambier, and concludes that, on the evidence presented, the Mount Gambier lavas are closely related to those of Western Victoria. The comparison with Mahony and Grayson's analyses, and with other subsequent analyses of Victorian basalts, strongly supports this conclusion, as does other evidence later referred to.

(b) The Fragmentary Material and its Distribution. Apart from the brief effusive phase above described, the vulcanicity was wholly of the explosive type. Possibly the occurrence of the outburst in the centre of a strongly water-bearing series had some bearing on this fact. The ejectamenta of which the cinder cones were built, and of which the finer particles were widely distributed, consists of lapilli and ash with but a small representation of coarser scoriaceous material. In this respect the materials and the cones more closely resemble those of Tower Hill, in Victoria, than the more abundant scoria cones, such as Mounts Warrenheip, Buninyong, etc.

The general appearance of the stratified tuffs, in section, is quite like those of South-western Victoria and also the better known tuffs of Lake Burrumbeet, though with much less nodular basalt than the latter beds show. At Mount Gambier huge ejected blocks of limestone, dolomite, and basalt occur, with olivine bombs and blobs of ropy lava. Occasionally, also, one may find flint nodules, waterworn quartz pebbles,[10] and rare fragments of ancient rock (mica schist, etc.).

The foregoing features have been more carefully described by others, but there is no record of the exact extent of the ash deposits. With the able assistance of Mr. H. C. Hosking, the writer investigated the limits of the ash deposits, with the results shown in fig. 3. In this investigation the matter was quite easy where road and rail cuttings, quarries, and subsidences occurred; elsewhere the fertility of the soil was noted as evidence of the presence of ash, and this was corroborated by the statements of the occupiers of the land, and by shallow excavations. It is remarkable how light a layer of ash has rendered the soil fertile as compared with that of the limestone or sand-dune country, but there are also occasional areas of good land beyond the limits of the ash deposits.

On the outermost areas of the ash, the only evidence consists of small, occasional, friable, light-brown nodules that one soon becomes expert in recognizing. Such nodules were also, later, found along the railway line, to the north-west, as far as Mitchell Siding, but the deposit of ash must have been here so slight that it has not been included in the plan. Possibly one or two stiff "south-easterlies," such as occasionally occur here, would account for this light distribution to the north-west. Howchin[11] states that the ash extended seven miles in a north-easterly direction, but careful examination showed that this is not the case; the limit of the ash in a north-easterly direction is a little over two miles. The

(10) These waterworn pebbles may have been carried by aborigines, whose flint flakes are abundant on certain parts of the Mount. More likely, however, they were derived from the occasional beds of sand and gravel that occur in the tertiary beds; the records of the South Australian Department of Mines show that sands and gravels were met in several bores in the Hundred of Young, at depths between 100 and 150 ft.

(11) "The Geography of South Australia," Howchin and Gregory, 1909, p. 130. I am informed by Professor Howchin that the above statement was made on the authority of the late Professor Tate, who stated that the greater extension of ash in a north-easterly direction could be explained from the prevalence of south-westerly winds.

greatest extent of the ash is in a southern and south-easterly direction, and the total area affected is about 25 square miles.

As pointed out by Dr. T. S. Hall (*Ref.* No. 5), the stratified tuffs, away from the Mount itself, closely follow the contour of the land surface, and were undoubtedly deposited subaerially. The manner in which the beds follow the gently undulating surface of the limestones and sand-dunes

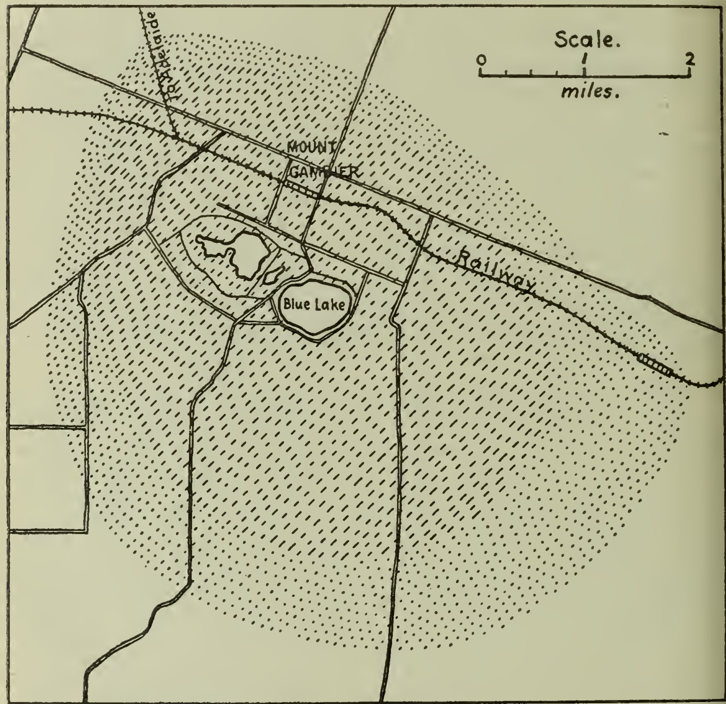

Fig. 3.

Plan showing the extent of the ash deposits surrounding Mount Gambier, covering an area of about 25 square miles.

is excellently shown in practically every cutting where such sections are available.

Since there is no doubt whatever that the whole of the ash was ejected from the two or more foci at Mount Gambier, the unsymmetrical distribution of the finer material at once suggests the influence of the prevailing winds as the chief agent of its distribution.

There is every reason for assuming that the eruptions were of so recent a period that it is quite likely that the circumstances of atmospheric circulation were at that time much as they are at present. In order to get an average of the wind direction and velocities, the details of the local records for the years 1915, 1916, and 1917 were obtained by the courtesy of Mr. E. Bromley, of the South Australian Meteorological Bureau, and of the postmaster at Mount Gambier.

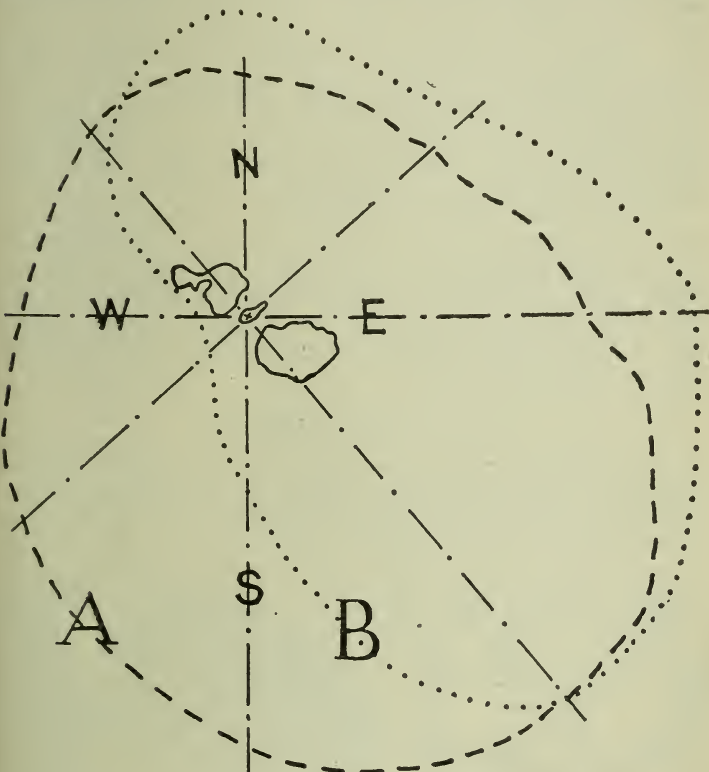

Fig. 4.

Graph showing the general outline of the ash deposits (A) compared with the present average annual wind direction and strength (B).

The direction, velocity, and continuity of these winds were graphed in various ways (by months, seasons, years, etc.), in the hope that some light might thereby be thrown on the duration of the explosive activity, or on the season of the year at which the chief eruptions took place. These efforts were not attended with any positive results, but it will be seen from fig. 4 that the average graph of the winds for the year corresponds, roughly, with the outline of the limits of the finer volcanic material, and confirms the idea that the ash distribution was governed by winds similar in direction and velocity to those of the present day.

East winds are very rare throughout the whole year, which fact corresponds with the limited distribution of the ash to the west of the craters. South-easterlies are commonest in late January and February, while north-west and west winds are strongest in September and October. The graph of the average October winds corresponds most closely with the actual distribution of the ash. The chief point of discordance is that the extent of the ash deposits to the south, towards O.B. Flat, etc., is greater than the average amount of north wind would suggest.

The question of the duration of vulcanicity is discussed later, but if it be fair to assume that the wind circulation was at that time much as it is at present, as suggested by the graph, and if it be further shown that the duration of the volcanoes' life was brief, then the foregoing results suggest that the explosive activity took place about the middle of the later half of the year.

6. Age of the Eruption.

(a) Relation to Victorian Newer Basalt Period.—Before discussing the age of the Mount Gambier vulcanicity it is desirable that its relationship should be established with the great period of eruptive and effusive vulcanicity that occurred in

Fig. 5.

Sketch map showing the area covered by Newer Basalts in South-western Victoria, and the volcanic localities of South-eastern South Australia.

Victoria in late Tertiary times, and which is known as the Newer Basalt Period. The newer basalts, with their associated scoria and cinder cones, tuffs, etc., cover thousands of square miles of Central and South-western Victoria, and extend almost to the South Australian border.

The close relation in composition between the materials of the Victorian Newer Basalt Period and those of Mount Gambier has already been established. The relationship in space of the volcanic features of the two States is quite clear from fig. 5, and strongly suggests that the South Australian foci are outlying centres of the one great area of activity.

Professor Skeats,(12) in describing the Victorian Newer Basalts, says:—"They form the Melbourne and Keilor plains, and occur . . . over thousands of square miles in the the Western District, passing over into South Australia and connecting with the recent volcanic rocks of the Mount Gambier district."

(b) Physiographic Evidence.—One of the features stressed by those who have dealt with the denudation of cinder cones is the remarkable way in which, in some cases, these very porous beds will absorb the rainfall, lessen the "run-off," and so preserve for ages an appearance of youth. While giving full consideration to this fact, the physiographic evidence (denudation, etc.) at Mounts Gambier and Schank points to a fairly recent geological period for their age. Familiarity with the volcanic features of a considerable portion of the Newer Basalt area in Victoria suggests also that the age of the cinder cones of Mounts Gambier and Schank is about equal to, or less than, that of similar Victorian features.

On those portions of the exterior of the cones that may be unquestionably accepted as unaffected by the great collapses that have taken place, the small amount of denudation is remarkable. Wherever opportunity for testing the matter arose, the general surface slope was found to be that of the dip of the stratified material.

(c) Fossil Evidence.—In the paper previously referred to, Professor Skeats discusses the age of the Victorian Newer Basalts, on the evidence of fossil leaves and fruits, etc., and believes that the volcanic activity extended throughout a considerable period, "from the Pliocene to the Recent, if not Historic periods. . . . The tuffs about Tower Hill overlie the geologically-recent dune-limestones of that district."

(12) "The Volcanic Rocks of Victoria," E. W. Skeats. Presidential address. Section C. A.A.A.S. 1909.

Mr. R. H. Walcott [13] has recently published an account of volcanic tuffs near Mount Terang (Vict.), where bones of extinct marsupials and an aboriginal implement were found below the tuff. Professor Gregory [14] has discussed the question of the historic age of the more recent volcanoes in his enquiry into the antiquity of man in Victoria. Chapman and Gabriel,[15] in 1917, published an account of a shell-bed underlying the tuffs of the Tower Hill series, near Warrnambool (Vict.), and concluded that the tuffs of the Tower Hill series were ejected between early Pleistocene and early Prehistoric times, and represent one of the last stages of the volcanic outburst in Victoria. The evidence at Tower Hill is particularly mentioned on account of the close lithological and physiographic resemblance of the materials and forms there to those at Mount Gambier.

In the "Geology of South Australia" (Howchin), p. 480, it is stated that "on the southern slopes of Mount Graham there are the remains of an ancient sea beach, about 40 ft. above the present level of the plain, consisting of perfectly loose sand and sea-worn shells. This shows that the sea must have encroached upon the locality and again receded since the volcanoes were in eruption." There is no evidence whatever of such an encroachment affecting the Mount Gambier area.

Professor Howchin, in his "Geology of South Australia," p. 134, says:—"Pliocene and Post-pliocene clays and soils underlie the ash-beds (at Mount Gambier, etc). The latter enclose impressions of trees and plants of species still growing in the neighbourhood, such as *Eucalyptus*, *Casuarina*, *Banksia*, etc., and extinct marsupials of the late Pliocene and Post-pliocene age." Mr. F. Chapman [16] mentions also the bracken fern *(Pteris aquilina)* as underlying the ash-beds, as does a *Banksia* "in every way comparable to *B. marginata*." I submitted to Professor Osborn, of the Adelaide University, a well-preserved impression in ash of the banksia leaves, and he could find no difference whatever between such leaves and those of the present-day *B. marginata*.

Following along the line of evidence, suggested by Professor J. W. Gregory, *re* the mention of active volcanoes in

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[13] The Volcanic Tuff of Perjark Marsh, Victoria, R. Henry Walcott, Proc. Roy Soc. Vict., vol. xxxii., Part I., 1919.

[14] The Antiquity of Man in Victoria, J. W. Gregory, Proc. Roy. Soc. Vict., vol. xvii., 1904.

[15] On a shell bed underlying Volcanic Tuff near Warrnambool, Chapman and Gabriel, Proc. Roy. Soc. Vict., vol. xxx., Part I., 1917.

[16] "Australasian Fossils," Frederick Chapman. 1914.

aboriginal legends, it may be mentioned, that in the recorded legends of the Mount Gambier tribes there is frequent reference to the lakes, etc., of the district, but nothing that I have read to suggest that the race had any record of an actual eruption.

Summing up this evidence, we may conclude that Mount Gambier and its associated vents represent a western marginal outburst from the great basaltic magma that gave rise to the Victorian Newer Basalts, occurring near the close of the Newer Basalt Period, and possibly dating to quite late pre-historic time.

7. Duration of the Eruptive and Effusive Phases.

As pointed out by previous observers, the preliminary phase of the Mount Gambier volcano was an explosive one, brief in duration, as evidenced by the thin layer of ash to be seen immediately overlying the Janjukian Limestones, and underlying the basalt flow.

Following this, the lava welled up and flowed for a couple of miles or so in an easterly direction. There is no evidence to suggest that the lava belonged to a later stage of activity and was forced along in its present position as a "sill." The effusive phase, like the other features of this volcano, was on a diminutive scale, and lasted probably for a few hours only.

Subsequently the volcanic activity was wholly explosive, at times with considerable violence. In the effort to discover the probable duration of the building of the cinder cones, investigation has been made of all available descriptions of cases where the duration of activity is known, either actually or approximately. The best comparison might be made with the well-known case of Monte Nuova, near the Bay of Naples, since that particular cone, though smaller, is comparable to the chief cone at Mount Gambier in height and circumference. It will be remembered that, about 400 years ago, Monte Nuova was built up before the eyes of observers in a few days.

Mount Gambier is larger and more complex in structure, but it is clearly possible that its volcanic history was very brief. As already mentioned, effort was made to discover evidence regarding the duration of activity from comparison of the graphic records of present-day wind direction with the distribution of the ash. The evidence is admittedly of no high value, but, taken for what it is worth, it suggests that the cones were built up in the later months of the year.

It has been pointed out that cinder cones, in some cases, preserve their shape in a remarkable manner. This is particularly the case when the materials have become, to some extent, set and consolidated and covered with vegetation. In the earlier period, while the material is still merely loose fragments, the erosion of a winter should leave distinct traces. At present, for instance, the loose faces of the interior wall below the Tower are being rapidly worn away.

In noting the many sections of the stratified ash, both radial and normal to the foci, watch was kept for any signs of contemporaneous erosion. In no case was there found any suggestion of a runnel or valley formed in the ash-beds during deposition. This is suggestive of the idea that no wet season occurred during the period of explosive activity.

The stratified beds are numerous, but show no consistent evidence of rhythm in deposition, though Woods (*Ref.* 2, p. 254) recognized three series of layers, varying in each series from coarser material below to finer material above. The occurrence of the numerous and varied layers is probably due to the intermittence and variation in force of the explosions, and to the shifting of the winds. Summing up the evidence as presented in the field, I would suggest as a working hypothesis that the whole period of activity at Mount Gambier was something more than, say, six weeks and less than six months.

8. The Number of Craters and the Order of Eruption.

(a) Previous Opinions.—The question of the number of craters that existed at Mount Gambier is one on which there has been considerable divergence of opinion, and while it is purely of theoretical and academic interest, very careful consideration has been given to this point. The opinions of previous observers are given below, as far as possible in their own words.

The earliest available account of the geology of South Australia was published by Thomas Burr, in 1846, when the Province was but ten years old, and seven years after Mount Gambier had been first visited by white men (see *Ref.* No. 1). The brief account there given of Mount Gambier was kindly brought under my notice by Mr. L. Keith Ward, the Director of Mines of South Australia.

Thomas Burr says, concerning the craters:—"This mountain has three craters, which lie in a direction nearly east and west. The western crater [17] is divided into two portions —that to the east contains a lake of great depth containing fresh water. The middle crater [18] is much smaller and

(17) Browne and Valley Lakes.

(18) Leg of Mutton Lake.

circular, with a small lake at the bottom. The eastern crater [19] is nearly of the same size as the western, and comprises a large lake of great depth, which cannot be visited, as there are precipitous rocks all round." This writer gives the approximate widths of the various craters, but does not mention the possibility of enlargement by subsidence. The Rev. J. E. T. Woods (see *Ref.* No. 2) believed that there were five craters:—(1) The west end of the Valley Lake (now Browne or Crater Lake); (2) The east end of the Valley Lake (now Valley Lake); (3) the Centre Lake (now Leg of Mutton Lake); (4) Blue Lake; (5) the Punch-bowl (regarding this crater he was in some doubt, and did not have the evidence now available in the bare walls of this depression). Woods gives full value to the matter of enlargement of the craters by collapse. His notes on the general history of the Mount are evidence of the careful and accurate observations made, and show a keen appreciation of the problems involved. Notwithstanding the great advance made in the knowledge of vulcanism since he wrote, no subsequent writings on Mount Gambier can properly summarize or replace the material of Chapter VIII. of his book (*Ref.* No. 2).

H. Y. L. Brown (see *Ref.* No. 3) confines his remarks mainly to the depth, temperature, and origin of the waters of the lakes. In the section accompanying his report he marks only one "undoubted crater," that near the point where the Tower stands, and he writes:—"From the contour of the Blue and Valley Lakes . . . together with the appearances in their neighbourhoods, I think that they are not craters, but merely depressions caused by subsidence of the crust, consequent on the removal from below of such vast quantities of material as it is evident that has been erupted."

Professor Howchin (see *Ref.* No. 4) supports the views of the previous writer on this point, adding:—"The quaquaversal dip points to one centre of ejectment, while the depressed areas of the Blue Lake, the Leg of Mutton Lake, and the Valley Lake are undoubtedly sunken areas, the subsidence taking place late in the period of activity, or even after the volcano ceased to eject material."

(b) Contour Map.—The writer has made repeated efforts to confirm this conclusion of Professor Howchin, but his accumulated observations of both dip and contour strongly support the conclusion of Woods that there was a very important crater situated somewhere near the centre of the collapsed area that now contains the Blue Lake. The evidence for an undoubted crater near the foot of Tower Point (Mount Gambier proper) is equally clear.

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(19) Blue Lake.

In order to properly discuss the matter it was found essential to have a contour map of the whole Mount. This

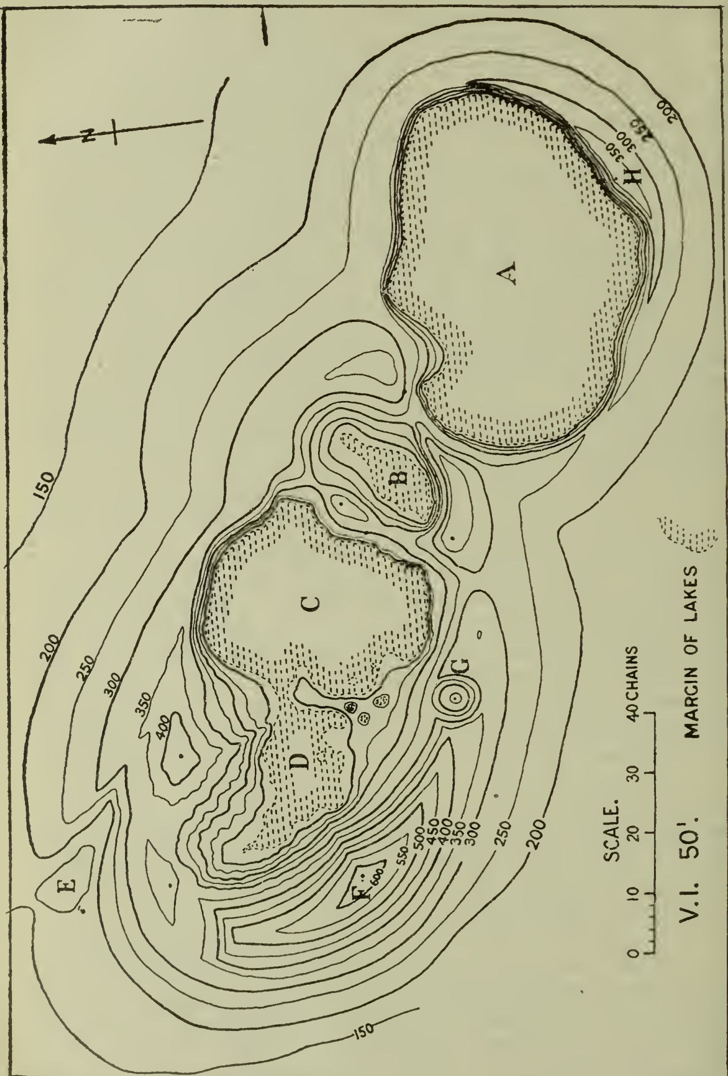

Fig. 6. Contour map of Mount Gambier, showing: A, Blue Lake; B, Leg of Mutton Lake; C, Valley Lake; D, Browne or Crater Lake; E, the Moorak depression; F, the

has therefore been prepared (see fig. 6). The hachured plan of the Mount and lakes (10 ch. = 1 in.), prepared by H.

Jacob, of the South Australian Lands Department, in 1910, was made the basis of the contour map. Numerous traverses were made around and across the area, wherever possible, taking two sets of aneroid observations by separate observers, and checking results at all intersections. The contour lines are plotted at 50-ft. intervals.

It is not claimed that this is a correct contour map of the locality, but in all essential features it is sufficiently correct for the purposes for which it was prepared. It has been found of great value in working out the reconstruction of the cones prior to subsidence.

(c) Reconstruction of the Cinder Cones.—In attempting this reconstruction, two lines of supporting evidence are available: (i.) the dip of the tuff beds where undisturbed; (ii.) the external contours where unbroken by the collapse.

It is therefore necessary to eliminate the areas disturbed by the subsidences. As already stated, these subsidences or collapses have led to the disappearance of almost the whole of the volcanic cones; they are arranged in the same linear direction as that of the Mount itself, and are shown in fig. 7, where the areas of most abrupt and definite collapse are darkly shaded and the surrounding areas affected by subsequent slumping and land slipping are lightly shaded. The portions unaffected (unshaded) are therefore those where we must obtain our evidence of dip and contour.

(i.) Dip of Tuff Beds.—Excellent exposures of dip are available at the following places:—The great faces on each side of the "buttress" that runs from the Tower to the margin of Crater Lake; the summit of the Sugarloaf (an isolated point north-west of the Tower); the northern and eastern faces of Valley Lake; practically the whole of the abrupt cliff face, averaging 250 ft. in height, that surrounds the Blue Lake; and a small section at the rear of the ornamental tower opposite Gordon's Monument.

The evidence of the dips in the western portion of the area is distinctly in favour of a centre of eruption somewhere about the centre of Crater Lake. In the eastern portion, around the cliffs of the Blue Lake, the dip is everywhere outwards from the centre of the lake, pointing to a centre of eruption there.

The evidence of dip about the central area is somewhat non-committal. Unfortunately there is no evidence of dip in the interior of the Leg of Mutton Lake, and the dips visible on the surfaces in the neighbourhood of this lake may be due either to the action of surface wash, or to light ash deposits subsequent to the formation of the present slopes. The section opposite Gordon's Monument is believed by

Professor Howchin to be due to subsidence, and this may be the case. If a true dip, it would indicate a higher cone at Blue Lake than is shown in figs. 7 and 8.

Summing up the evidence given by dip, we have a western crater (Crater Lake) and an eastern crater (Blue Lake), with a doubtful central area where an additional crater or craters may or may not have existed.

(ii.) Slopes of External Faces.—As will be seen from fig. 6, the whole of the lower outer slopes of the cones remains intact, with the exception of the depression in the north-west, and a small subsidence on the slope below the Hospital (not shown on the map). Before using the evidence of the exterior slopes to assist in reconstructing the cones it is necessary to establish two things:—1. That cones of volcanic ejectamenta are characteristically symmetrical about the centre of eruption. 2. That at Mount Gambier the present external slopes, where undisturbed, are practically coincident with the dip of the beds.

With regard to the symmetry of cinder cones, it is scarcely necessary to point out that this feature is one of the most consistent of all land forms. The neighbouring cone of Mount Schank, and the various cinder cones of related age in Victoria, are notably symmetrical. Most of the material of the Mount Gambier cones was of such a size as to be little affected by the prevalent winds, and the effect of the wind on the finer material would be no more than to somewhat flatten the eastern and south-eastern slopes; this feature is to be noted in the contour map (fig. 6). There is, therefore, every reason to assume that the cinder cones at Mount Gambier were symmetrical.

The coincidence of the slopes of the surface with the underlying stratification of the ash-beds is noticeable in all the cuttings seen. In places around the Mount, where the surface soil has been partly removed, the surface slope is found to be the same as that of the consolidated tuffs. Other observations support this idea, and it may be fairly claimed that the contour lines, where drawn in firmly in fig. 7, represent the general outline of the cones as originally built up.

The reconstruction shown in fig. 7 is based on the principles outlined in the preceding paragraphs, and on a mass of minor observations that it is not necessary to detail. The dips and contour lines preserved at the western crater (particularly Tower Point), and the eastern crater (particularly the Blue Lake Look-out), enable us to reconstruct these two cones, and the lines suggest them to have been 750 ft. and 550 ft. high respectively. The Blue Lake cone may have been higher.

We then find that there are two high ridges, partly surrounding the Leg of Mutton Lake, and composed wholly of

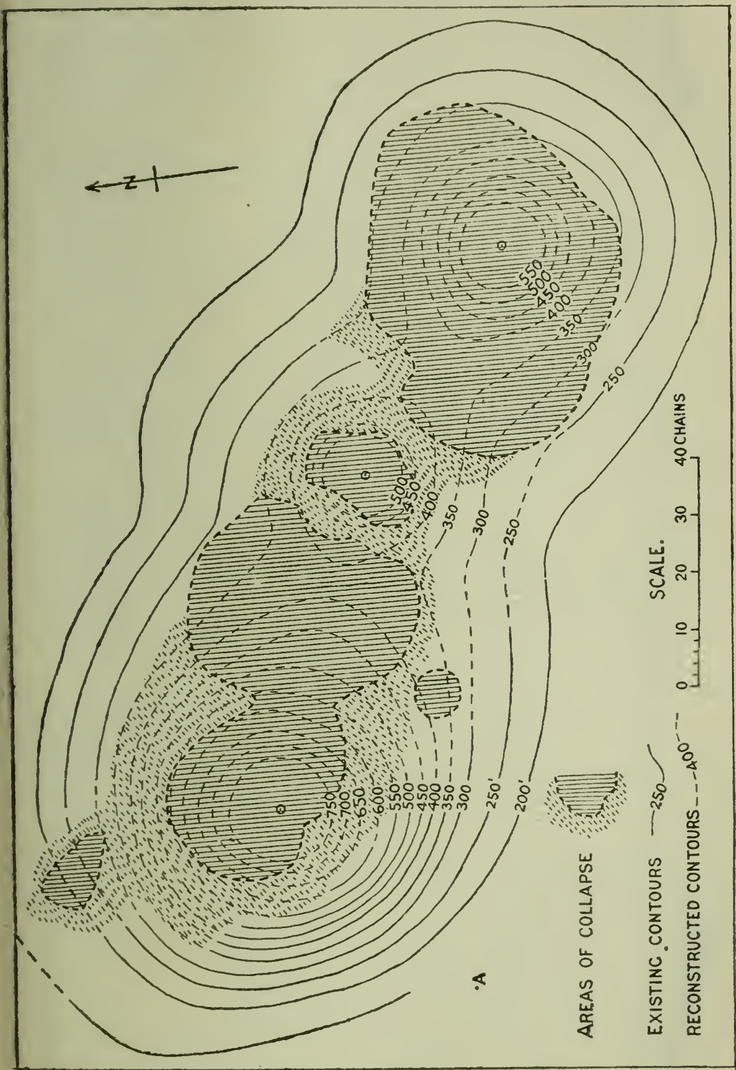

Fig. 7. Plan of Mount Gambier, showing the areas affected by subsidence, and the reconstruction of the cinder cones as originally built up.

bedded tuffs, that do not fit in with the slopes of the two cones reconstructed. Nor can these ridges be conceived as built

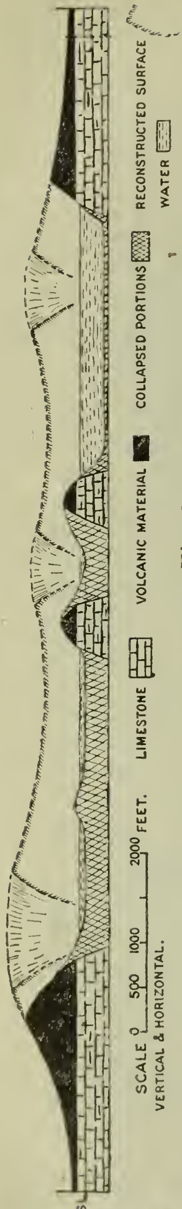

Fig. 8.

Section (vertical and horizontal scales equal) drawn through the reconstructed cones, and showing also the true shape of the present volcanic remnants, the underlying limestones, the collapses, and the lakes. The depths of the lakes are taken from the section published by Brown. (*Ref.* No. 3.)

wholly from either or both of these craters. In addition there is a re-entrant curve in the contours to the east of the point where the Bay Road approaches Blue Lake. There is also a less well-marked re-entrant curve in the same contours to the west of the Hospital.

Beyond the data of elevations and curve of contour lines, there is no evidence as to the locus of the third crater that must have existed hereabouts. On plotting the information available, one is reluctantly compelled to relinquish the attractive theory that the Valley Lake was the site of a crater, and to assume that a third and smaller crater existed in the small and deep depression now known as the Leg of Mutton Lake.

(d) Section through the Reconstructed Cones, showing Collapses, etc.—To test the truth or otherwise of the reconstruction, numerous true sections were drawn, and checked against the known facts of slope, dip, etc. The most informative of these sections is shown in fig. 8.

In this section (fig. 8), the known facts of structure detailed in previous paragraphs are embodied. The section is drawn from the point A, fig. 7, through the Tower Point to the centre of the "Mount Gambier crater," thence to the centre of the "Leg of Mutton crater," thence to the centre of the "Blue Lake crater," and thence through the highest point on the rim of the Blue Lake (the Look-out).

It would appear from the section that the ash deposits on the flanks of the Leg of Mutton (central) Lake might have been deposited from the eastern and western craters, but the section does not show the high ridges north and south of the Leg of Mutton Lake, and the other evidences detailed above, which can only be accounted for by the third (central) crater shown in the reconstruction.

Woods gives much detail regarding the order of eruption, but the writer could not discover any definite evidence on the matter. There was a brief explosive phase prior to the basalt flow, and that probably came from the western crater, as did the lava. Possibly the order of activity was:—1, an explosive outburst from the Mount Gambier crater; 2, a brief effusive phase at the same focus; 3, renewed explosive activity at that crater; 4, explosive eruption of Blue Lake crater; 5, explosive activity at Leg of Mutton crater. Still, there is no positive evidence against the idea that phases 3, 4, and 5 were contemporaneous.

9. The Subsidences.

(a) Extent, Cause, and Time of Collapse.—As pointed out in the introduction to these notes, only remnants of the original cones now exist to mark the centres of volcanic activity at Mount Gambier. The actual extent of the subsidences is clearly shown in fig. 1 (general view), fig. 7 (plan), and fig. 8 (section).

It is difficult to imagine the reason for such extensive collapses. Woods suggests the draining away to the southward of a great mass of lava that had formed an underground reservoir, at comparatively shallow depths. He quotes evidence in favour of this (p. 250), which I have not had the opportunity of investigating.

To take the case of the Blue Lake subsidence, a huge block of rock, 170 acres in extent, and comprising about 300-ft. thickness of level-bedded limestones, 20 to 50 ft. of dense basalt, and possibly an average thickness of 350 ft. of tuffs, has disappeared abruptly and precipitately downwards into the earth.

The surrounding limestone country contains many caverns and sink holes, such as those known as Umpherston's "Caves," but none of these are at all comparable in size to those of the lakes. This suggests a genetic relationship between the underground spaces into which the collapse took place and the volcanic activity itself. Both, in turn, may be related to the line of crustal weakness which is suggested by the linear arrangement both of the craters and of the subsidences.

In other areas similar great crater depressions have been formed by a violent final explosion, blowing away the whole "roof" of the volcano. If that had been the case at Mount

Gambier, one would expect to find evidence of same in an arrangement of abundant scattered blocks of limestone, basalt, and bedded tuffs around the depressions. Huge blocks of basalt and limestone certainly occur, but these are occasional only, and are situated in all cases in the proximity of one or other of the three ancient craters. The idea of accounting for the depression by explosion has not been previously put forward, and is here mentioned only in order to be dismissed for lack of evidence.

Woods believed that the subsidence was in part contemporaneous with the volcanic activity, but no evidence could be found for this, and the writer, on general appearances, prefers to agree with Professor Howchin that the subsidence may have occurred "even after the volcano ceased to eject material." It is, of course, possible that the collapses were not in all cases abrupt and precipitate, but may have occurred rather as a series of collapses, concentric to the margins of the vents.

(b) The Blue Lake.—This is the most remarkable and most fascinating of the subsided areas. Notwithstanding the fact that much of the native vegetation that clothed its precipitous sides has now disappeared (possibly since the advent of the rabbit), its beauty still deserves the enthusiastic admiration given by its discoverer and by early investigators. This is particularly so on a bright day, when the beautiful blue colour of the water is most marked.

The first person to venture on the lake was Governor Sir R. G. McDonnell (*Ref.* No. 2, p. 247). When one ventures in a boat on the lake for the first time, the unusual crystal clearness and coldness of the water, the known great depth, and a memory of its mode of origin, combined with the forbidding rampart of cliffs that everywhere surrounds the lake, quite justify the epithets of "weird," "uncanny," and "awe-inspiring" to the imaginative mind.

The average depth of the water is 250 to 280 ft.; the height of the cliffs averages 250 ft. above the water. The shape is an irregular oval, and the area is about 170 acres. The water supply of Mount Gambier town is derived from a well sunk alongside the margin of this lake, and is limited only by the capacity of the pumping plant. The high ridge north-east of the Leg of Mutton Lake is utilized as a storage reservoir, to provide the necessary "head."

If one followed the general terminology of physiographic text-books, the Blue Lake would be termed a "caldera." The typical caldera given by Professor W. M. Davis, in his "Physical Geography" (pp. 212, 216), is quite similar to the

Blue Lake depression. R. A. Daly [20] has subsequently discussed the term "caldera," shown to what varied uses it has been put by different writers, and prefers to apply the word to explosion forms only. His term "volcanic sink" hardly fits the case of Blue Lake, and it is probably best to refer to it in simple English as a "collapsed crater."

(c) The Leg of Mutton Lake.—This is a small, steep-walled depression. The sides are covered with soil and clothed with native and introduced trees, in striking contrast to the bare rock walls of the Blue Lake. One of the nurseries of the State Forestry Department nestles picturesquely at the bottom, alongside the lake. Brown's section suggests that the depth of this lake is about 70 ft., but it looks much shallower than that. Woods called this the Centre Lake; it has since received the present name from its shape. The depression is deep enough to show both the limestone and the basaltic layers, but they are apparently quite covered over with volcanic material that has slumped down or been washed down from above (see fig. B, pl. x.).

(d) Valley Lake.—This name was applied by Woods to both the present lake and the Crater Lake, which are connected by a shallow channel when the water is high, and disconnected when the water is low. The Valley Lake, as may be seen in fig. 6, is steep-walled, with good sections, on the east and north. The extent and nature of the collapse is comparable with that of the Blue Lake, and the water has the appearance of great depth. There is no definite record of the systematic sounding of any of the lakes except Blue Lake. The western wall is almost non-existent, and the southern wall is low and gently sloping. Down this southern wall a road has been constructed for tourist purposes.

On the peninsula, separating Crater Lake from Valley Lake, there are two or three funnel-shaped depressions, possibly due to small local subsidences. Woods regarded them as small craters.

The two irregular peninsula shapes that jut into this depression, partly separating the Crater and Valley Lakes, are probably due to the much greater amount of tuff that was here concerned in the subsidence (see fig. 7).

(e) Crater Lake (also called Browne Lake).—Excepting the Leg of Mutton Lake, this is the smallest, and apparently the shallowest, of the group. Mr. E. F. Crouch, of the Old Residents' Association, Mount Gambier, informs me that when his parents came to Mount Gambier, in 1841, this lake

(20) Igneous Rocks and their Origin, R. A. Daly. New York, 1914 (pp. 144-6).

was empty. If so, the lake must be very shallow, and the year referred to must have followed a succession of droughts in the main intake areas of the sub-artesian basin.

The subsidence here has been very great, but subsequent land-slipping has partly obliterated the abruptness of the slopes, except on the south, where the great buttress of Tower Point rises, now the highest point of the Mount. On this southern wall there is an excellent exposure of the stratified tuffs overlying the limestone, and along the western wall, low in the depression, there is an exposure of ropy lava previously described. The lumpy, land-slipped slopes, on the north and west, are now clothed with dense bracken fern.

North-west of Crater Lake, a single peak called the Sugarloaf, stands high above the rest of the wall. It is interesting from the regularity of its structure, in the shaping of which erosion has played but a small part. To the west, it slopes steeply down to the Moorak depression, and to the east its face is formed by the collapse of the crater area. On the other two sides, crescent-shaped depressions of the crater wall have occurred, leaving the Sugarloaf standing like a four-sided pyramid (see fig. 1).

(f) The Moorak Depression.—The most western of the subsided areas is small, but interesting. It is flat-bottomed and not deep enough to contain water. It is noted in maps, but has not been remarked by previous investigators. On the north it is bounded by a long gently-sloping ridge, and as one approaches the depression over this ridge, coming from the town, the impression of its being the remnant of a concentric outer wall of an older crater is quite distinct. Other evidence does not support this idea, but this curious depression well merits closer investigation.

The ridge which bounds this depression on the north-west is partly cut through, giving an excellent exposure of the ash-beds; these beds closely follow the contour of the ridge, and suggest that the subsidence existed prior to the conclusion of the explosive activity. There is an old well in the flat-bottomed depression, but this is now partly filled in. Possibly this is the well referred to by the late Professor Tate in his class lectures as having been sunk 40 ft. through stratified ash.

The Moorak Station homestead stands on the bank of this depression, which is therefore here referred to as the "Moorak depression." It has been utilized as a rifle range, for which purpose it is eminently suited, being sufficiently extensive, quite level-floored, safe, secluded, and picturesque.

(g) The Punch-bowl.—This symmetrical, funnel-shaped depression is in the southern wall of the Mount, south of

Valley Lake (see fig. 6). Woods regarded it as an adventitious crater, but from his description it is clear that the walls were not then as exposed and bare as they are now. The dip of the stratified beds clearly continued uninterruptedly across the area now occupied by the depression.

The shape and size of this depression have been compared to those of the greater explosion craters made on the western front during the war. Possibly the Punch-bowl was formed by an isolated explosion late in the period of activity, without any subsequent ejection of material. It seems more likely, however, that it is due purely to a small subsidence occurring a little apart from the main line of collapse (see fig. B, pl. x.).

(h) The Water of the Lakes.—As already mentioned, the water of the lakes is portion of that stored in the great sub-artesian tertiary basin of the ancient Murray Gulf, and the surface of the lakes slowly rises and falls, apparently in harmony with the rise and fall of the general water-table of the whole area. In some cases the rapid rise of the water has caused some anxiety locally. For instance, from the middle of the year 1909 the water continued to rise steadily for two years, and in December, 1910, stood 9 ft. higher than in June, 1909. Such increases in level can scarcely be appreciated in the general appearance of the deep and steep-walled lakes, such as the Blue Lake and the eastern portion of Valley Lake; but in the shallower portions of the Leg of Mutton and Crater Lakes this variation in level causes considerable alteration in their shape and appearance.

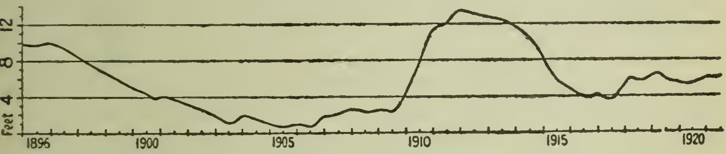

Fig. 9.

Graph showing the variations in level of the surface of the Blue Lake for the years 1896-1921, as recorded in the office of the State Hydraulic Engineer, and supplied by the courtesy of that officer.

During the past 25 years the limits in the variation of water level have been only about 14 ft. Further back in time, this variation may have been much greater. It has been mentioned that there is a local record that about 1841 and subsequent years the Crater Lake was dry. Writing in 1862, Woods says of the Leg of Mutton Lake that "the water at the bottom has only made its appearance, as I am told, within the last few years." These two lakes are to all appearances much shallower than the other lakes.

The graph shown in fig. 9 has been carefully compared with the corresponding rainfall records of the south-eastern counties of South Australia. This rainfall is approximately the same as that of the chief intake beds of the basin. There is no close correspondence to be noted at first sight between the average annual rainfall and the variation of water level, but general relations are revealed by careful examination. The two wet years of 1909-1910 were, for instance, followed by a corresponding considerable rise in water level. The consistently low water level of the years 1902-1910 corresponds with the three dry years of 1902, 1904, and 1907. The great drought of 1914 was closely followed by a distinct and rapid lowering of the lake levels. The attempt to correlate the rainfall and variation of lake levels is, however, far from satisfying.

Apart from these major movements, as revealed in the graph, the detailed weekly records of water level show a minor annual movement that is of much interest. This consists in a general rise of level in the summer (December-January) months of the year, and a general lowering of level in the winter (June-July) months. This is obviously not due either to extra local consumption of water nor to increased evaporation,[21] since the rise in level corresponds with the increase of both these factors. The area is one of winter rains, and the obvious conclusion is that the summer rise is due to the arrival along underground courses of a previous winter increment of rain received in the main intake beds. Whether it is the previous winter's rains (six months before), or those of a season prior to that, cannot be discovered without more detailed figures and further investigation. It seems clear, however, that the rise or fall of the lake levels depends on the amount of rainfall either six or eighteen months prior to such rise, and argues either of those periods as the time taken for the water to travel underground from the main intake areas to Mount Gambier.

Further Note on the Correlation of the Rainfall with the Variation in Level of the Lakes.—Since writing the foregoing note, regarding the relationship between the rainfall of the south-eastern counties of South Australia and the variation in level of the Mount Gambier lakes, the rainfall records of the County of Lowan (Vict.) have been obtained

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(21) The average evaporation per annum at Mount Gambier is 35 inches (*vide* Special Report on Lakes Leake and Edward, Ann. Rep. Govt. Geologist, S. Austr., for 1917, p. 14).

by the courtesy of the Commonwealth Meteorologist (Mr. H. A. Hunt), and further efforts have been made to discover the exact relationship that exists between the rainfall and the variation in the lake levels. The rainfall records of County Lowan (Vict.) are specially considered, because that area has been shown (by A. S. Kenyon, *loc. cit.)* to be the main gathering ground for the underground supplies of this portion of the Murray Gulf sub-artesian basin.

It has been pointed out by the Government Geologist (Mr. L. Keith Ward), in his Annual Report for 1915, that the underground water in south-eastern South Australia, although generally accepted as forming portion of the "Murray Gulf sub-artesian basin," is really of a dual character:—

(a) Sub-artesian water which is under greater pressure than that of the atmosphere, and which has travelled for some distance through the porous beds in which it is contained.

(b) Ground water derived from the downward percolation of the rainfall, occupying the pores, joints, etc., in the limestones, and being under atmospheric pressure only.

Observations made by the writer confirm the belief that the water underlying the Mount Gambier region mainly partakes of the nature of ground water, but is influenced by the annual increment of water received under pressure from the regions to the north and north-east.

For the purpose of discovering, if possible, the relationship between the rainfall and the variation in lake levels, consideration must be given to the following figures, which cover the last 26 years:—

A. The annual December levels of the Blue Lake, measured from a datum line selected by the Hydraulic Engineer's Department.

B. The annual rainfall of the south-eastern counties of South Australia, as published in the Statistical Register of that State.

C. The rainfall of County Lowan, in Victoria, as supplied by the Commonwealth Meteorologist.

		A.		B.	C.
		Ft.	In.	In.	In.
1895	...	25	10	22·03	17·47
1896	...	25	11	18·74	15·27
1897	...	24	5½	17·55	13·85
1898	...	22	7½	21·29	18·03
1899	...	21	1½	19·82	16·27

	A.		B.	C.
	Ft.	In.	In.	In.
1900 ...	19	11½	21·95	18·67
1901 ...	19	2½	19·19	16·15
1902 ...	17	11½	16·47	12·65
1903 ...	17	7½	22·98	21·21
1904 ...	17	1	18·09	17·50
1905 ...	16	10½	20·90	20·31
1906 ...	17	10	23·66	26·03
1907 ...	18	7	18·34	18·70
1908 ...	18	6	19·28	18·31
1909 ...	20	3½	25·77	22·67
1910 ...	27	3	25·08	24·31
1911 ...	29	4	19·31	18·68
1912 ...	28	8	18·50	19·82
1913 ...	27	8	17·00	17·48
1914 ...	24	1	11·48	9·76
1915 ...	20	8	19·42	19·53
1916 ...	20	1	24·14	23·08
1917 ...	21	1	25·56	22·77
1918 ...	22	1	16·87	16·66
1919 ...	21	5	15·87	14·71
1920 ...	21	10	19·91	21·03

The figures given in the foregoing lists have been graphed as shown in fig. 10.

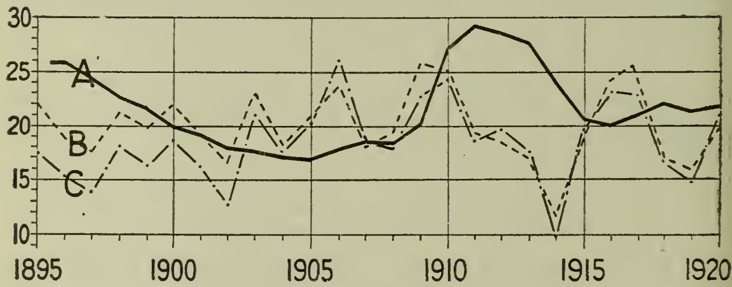

Fig. 10.

Graph showing: A, the variations in level of the Blue Lake (in feet); B, the annual rainfall of the south-eastern counties of South Australia (in inches); C, the annual rainfall of County Lowan, Victoria (in inches). From 1895 to 1920, inclusive.

It will be seen that there is no regular relationship, whatever, between the curve of the annual rainfall (which supplies both the ground water and the sub-artesian water of this area), and the curve of the annual variations in lake level. There is, however, a close relationship between the rainfall curve of County Lowan (Vict.) and that of the south-eastern counties of South Australia, the latter being throughout somewhat higher than the former (see fig. 10).

The apparent lack of correlation between the rainfall and the lake levels, as shown in the foregoing graph, was very disappointing, since the general evidence of the close relationship of these two factors is most clear. Attempts were therefore made to devise a satisfactory way of recording the rainfall so that its relation to the curve of the variation of the lake levels might be graphically demonstrated. It was realized that the most important point to be considered was the fact that the influence of the rainfall on the great reservoir of underground water in the South-East is a cumulative one.

An examination of the figures shows that when the rainfall affecting this area is from about 18 to 20 in. per annum, the level of water in the lakes remains practically stationary. From this it may be deduced that the amount of water that is added to the underground supply, from an annual rainfall of 18 to 20 in., is just about equal to the loss of water from this great underground reservoir per annum. This loss is due to some small extent to evaporation, to a very minor extent to wells and pumps, and to a considerable extent to the outlets along the southern coastline, where it constantly gushes forth in great quantities as, for instance, at the Beachport Springs, Dingley Dell Creek, Ewen Ponds, the Piccaninnie Blue Lake, etc.

If we regard the underground reservoir of the south-eastern district as a closed system, with an annual outflow of a quantity which we may call "x," and if we further accept "x" as the average annual increment of water received by this basin from an annual rainfall of 18 to 20 in., then we are in a position to construct a new graph, taking into account the cumulative effect of either a series of years wetter than the average (which is 18 to 20 in. per annum), or a series of years drier than the average.

Graphs of this nature are shown in fig. 11, and were constructed as follows:—Selecting an arbitrary point to represent the position for the year 1895 (curve B, fig. 11), the amount by which the 1896 Lowan rainfall is less than 19 in. is plotted below the level selected for 1895. Similarly the amount by which the 1897 rainfall is less than 19 in. is plotted as a further downward movement below the level shown for 1896, and so on, so that for each year the difference between the actual rainfall and 19 in. is plotted cumulatively. In fig. 11, the bottom line A represents the actual curve of the variation in the water level at Blue Lake. The line B represents the curve drawn by the above method, showing the cumulative effects of variation from the rainfall of 19 in., considering the County of Lowan (Vict.) only. The line C, which has been arbitrarily placed above that of A and B, represents a similar curve to that of B, and is based on the rainfall of the south-eastern counties of South Australia, but with $20\frac{1}{2}$ in. as the basis of calculation instead of 19 in.

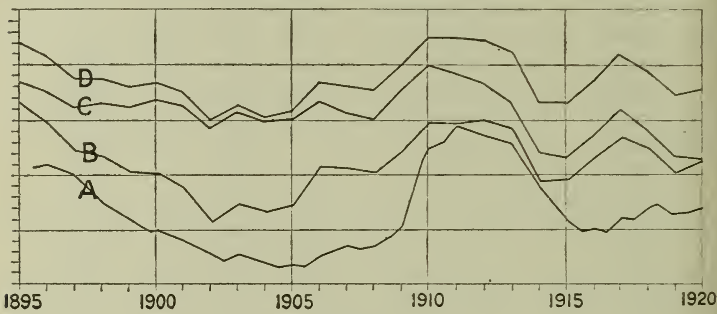

Fig. 11.

Graphs showing the relationship between the variation curve of the lake levels and the curve of the cumulative effects of the annual rainfall above or below certain selected bases. The vertical units represent 2 inches for curves B, C, and D, and 1 foot for curve A.

It will be noted that the nature of the curves coincides in a remarkable way and demonstrates the correctness of the assumptions upon which the curves are based. Various other curves have been drawn taking other annual rainfalls as providing the equivalent to "x," and these curves are, in all cases, similar to those shown in fig. 11, but bearing a less close coincidence with the curve A than the ones selected.

Mention has been previously made of the fact that the lake levels, on the whole, show a distinct rise in December as compared with June. Since this is an area of winter rains it seems clear that a proportion, at any rate, of the water of the Mount Gambier district comes from a distance, and takes about six months to make its influence felt. Further consideration of the curves in fig. 11 show that in some cases the whole effect of a high or low rainfall is not shown even within six months, but may continue to make itself felt for a year or so afterwards.

It is interesting to note that with variations from an annual rainfall measured in inches, of which only a portion soaks into the ground, we have consequent variations in the level of the underground water amounting almost to an equivalent number of feet. This is, of course, due to the fact that the ground water is only filling crevices, pore spaces, and occasional rifts and caverns in the limestone rocks. In some cases, as in the dry year of 1902, or the wet year of 1906, the effect on the level of the lakes was not proportionate to the rainfall. It is suggested that this is due to the variation in the amount of water that percolated into the ground, dependent on the distribution of such rainfall throughout the years mentioned. In 1902, for instance, the proportion of water that soaked into the ground may have been relatively greater than that of the wetter year of 1906.

In drawing the various curves it was found that those based on the rainfall of County Lowan bear the closest resemblance to that of the variation in the Mount Gambier lake levels. It seems fair to accept this as corroborative evidence of the opinion that a considerable portion of the underground water comes from the Lowan area. There must, however, be a fair percentage of percolation into these limestone beds from the general rainfall of the Mount Gambier district, so that the variation in lake levels is dependent on both factors. The curve D (fig. 11) is drawn to express this, being based on the mean of the two sets of annual rainfall figures given above.

From the evidence given in these graphs one would be fairly safe in prophesying the movement of the water level in the lakes, year by year. According as the year's rainfall, up to say October or November, varies from the average of 18 to 20 in., there would be an appreciable rise or fall in the December level, from that of the previous December, by an amount that could be calculated (approximately) from the graphs given in fig. 11.

10. Scenic and Economic Aspects.

Though the geological features of the Mount Gambier volcanoes are on so small a scale, they have had a very great influence from the economic point of view.

The fertile soils of the ash deposits, together with the visible unlimited water supply of the lakes, led to early settlement in the district, and to the rise there of a well-built and prosperous town, that has become the chief centre of the south-eastern districts of South Australia.

The history of the volcanic area having been so unusual and varied, as herein imperfectly described, the resulting scenery is equally notable for its variety, beauty, and unexpectedness. For this reason the town has become noted as a tourist resort. Practically the whole area of the Mount itself is reserved for public purposes—Botanic, Forest, or Public Park—and much has been done to add to the beauty by planting and improvement, without destruction of the unique natural features.

The well-built nature of the town is largely due to the abundant supplies of good building stones (limestones and dolomites). The basalt is used for road making [22] and the ash forms excellent footpaths. The water supply is drawn from the Blue Lake. But for the existence of the volcano, the area would doubtless consist to-day of a broad limestone plain, sparsely settled, and economically unimportant.

11. Summary.

1. The chief features of the previous literature of the Mount Gambier area have been noted, and the main items of its history described.

2. The distribution of the volcanic ash has been mapped and a contour plan of the Mount prepared.

3. General conclusions regarding the course of the later geological happenings have been arrived at, after a full discussion of the available evidence, as follows:—

4. Towards the end of the Newer Basalt period, at a time little antedating the arrival of man, volcanic outbursts occurred, subaerially, on the limestone plains of south-eastern South Australia, associated with the very extensive outbursts of Western and Central Victoria.

5. A minor explosive phase was followed by the extrusion of a small lava flow. The main crater continued its explosive activity and two other craters opened through the lava flow along a line of crustal weakness. These eruptions continued for perhaps two or three months, and then ceased, having built up three cones to an average height of 650 ft., and covered 25 square miles with ash deposits.

6. Subsequently extensive collapse took place along the line of volcanic activity, and practically the whole of the three cinder cones caved in, forming great depressions, in the deepest of which the waters of the sub-artesian basin formed lakes.

7. The origin of the water of the lakes is discussed, and also the variation in the surface level, and suggestions are put forward regarding the rate of movement of the waters in this important sub-artesian basin. The close correlation between the annual rainfall and the variation in level of the underground water supply has been graphically demonstrated.

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(22) This is brought from Mount Schank; the basalt at Mount Gambier is quite inaccessible.

Gillingham, Swann & Co. Ltd., Printers, Adelaide.

8. The special features of the up-building and subsidence of the Mount have been discussed in detail, and, finally, the economic value of each important feature has been described.

DESCRIPTION OF PLATE X.

Fig. A. Portion of the Blue Lake, looking eastward. The cliff on the far side shows clearly the level-bedded marine limestones (1), and the stratified volcanic material (2), while portion of the basalt flow separating these two series has been emphasized by a broken line to show it more clearly. A thicker development of the basalt may be seen on the left, just beyond the pumping station.

Fig. B. View of portion of Mount Gambier, showing the Leg of Mutton Lake in the foreground, Tower Point beyond on the right, with the Punch-bowl in the upper left-hand portion of the picture. The tree-clothed ridge in the centre of the picture separates the Leg of Mutton Lake from the Valley Lake, but the latter is not visible; portion of Crater Lake may be seen at the foot of the buttress that runs down from the Centenary Tower.

(Photographs kindly lent by the Director, S.A. Tourist Bureau.)

On the Occurrence of Aboriginal Stone Implements of Unusual Types in the Tableland Regions of Central Australia.

By Professor Walter Howchin, F.G.S.

[Read September 8, 1921.]

Plates XI. to XXI.

CONTENTS.

I. Introduction.

In May, 1904, the writer spent a fortnight on the Stuart Creek Cattle Station, in the Lake Eyre district. Attention was given to the occurrence of worked stones, which are usually to be found in any part of South Australia on virgin soils and in sand-drifts. In the sandhill country of Central Australia, which is mostly lowland, these Aboriginal remains are of relatively small size and carry the appearance of freshness, as though only recently made. On higher ground, in the tableland country, and amongst the "gibbers," a different type of implements is met with. These latter are commonly of larger size than those found in the sandy country. are roughly chipped, and carry the same characteristic colouring which is common to the loose stones of the uplands. A fair number of this class of implements was obtained on the Stuart Creek "run," some of which were given to a scientific friend who was on his way to England, and the remainder was presented to the Adelaide Museum, where they are on view.

In July, 1921, the writer, while on an expedition into Central Australia, had a further opportunity of pursuing these investigations. Limitations as to time and rapidity of travelling prevented extended observations of this kind, so that the locality tested for the purpose was mainly that in the vicinity of the Macumba Head Station, situated about 34 miles to the northward of Oodnadatta.

Here, as at Stuart Creek, the gibber slopes of the tableland yielded examples of the large, roughly-chipped, and ferruginously-coated implements. Some of the smaller worked implements were found mixed with the larger, but whilst the former are found generally distributed over the country, irrespective of the nature of the ground, the heavier implements appear to be restricted to the gibber or upland regions.

The country south of the MacDonnell Ranges is strongly differentiated by two well-marked physiographical features. The lowlands and wide river valleys are covered by rolling hills of sand, temporarily fixed by growing vegetation, or in a condition of drift. At a higher level, not usually exceeding 100 ft. above the normal level, are flat-topped hills that go under the name of the "tableland." These flat-topped hills represent an ancient land surface, which, by differential denudation has been dissected, and the remnants of the same are left at a higher level than the intermediate ground. The larger fragments of the tableland have the features of a "mesa," from which extend spurs and buttes with abrupt sides and terminals, like gigantic tips from smelting works.

These peculiar and picturesque features can be explained from the fact that the older land surface, represented by the tableland, consists of a capping of hard rock, underlying which is a softer layer of rock, whitish in colour, and of an argillaceous kind. The hard capping of these flat-topped hills is sometimes a true sandstone, but, more commonly, the original fragmental material, whether of sand, fine gravel, or clay, has become consolidated by the infiltration of colloid silica. The silica has penetrated the interstices of the sandstone, converting the mass into a chalcedonized rock, which, in the case of the more finely-textured varieties, possesses, more or less, a conchoidal fracture and vitreous lustre. The origin of this extensive silicification of the surface rocks in the interior of Australia can be explained from the peculiar climatic conditions of the country (see Howchin's Geology of South Australia, p. 450). Similar effects are also produced in arid regions in other parts of the world.

The great heat of the summer months and the extremes of temperature which may occur in Central Australia at any time of the year,[1] cause this highly siliceous rock to split under the stress of rapid contraction. This effect is strongly marked along the exposed edges of the table-topped hills, developing a vertical face of fractured rock at the top of the cliff, which may be from 6 ft. to 12 ft. in thickness. The fragments split off from the parent rock, in this way, follow the gravitational slope and slowly make their way to the bottom of the scarp. The distance separating these residual portions of the tableland may amount to a mile, or many miles, but the broken fragments of the hard capping, that once overspread the country, are left behind in the intervening spaces. This is one of the most characteristic features of Central Australia. The hard vertical faces of the escarpments have received the name of the Desert Sandstone, and the scattered stones derived from its waste, and which cover thousands of square miles of territory, are the so-called "gibbers."

It is seldom that such large stones, possessing a fairly good conchoidal fracture, are available for making stone implements as is the case in the Desert Sandstone country. Not only is the sandstone chalcedonized but the argillaceous beds have, in some cases, been changed to a porcellanite, which has been much used by the natives in making the cutting-stone which is invariably attached to their womerah. Implements made from this class of stone are always of small size, while the chalcedonized sandstone lends itself to the manufacture of larger implements.

II. Authenticity of the Stone Implements.

The question may be raised as to whether the chipping, in the case of the implements now under description, has been caused by natural processes rather than by human workmanship. There are no circumstances in the case that would suggest a natural origin. None, for example, such as might have been derived from subsoil pressure and differential movements or creep, as observed by Mr. S. H. Warren, in a section of the Bullhead flint-bed [xxviii.,[2] p. 238]. In the tableland country there has been, practically, neither local strain or transport. The Desert Sandstone capping is generally underlain by a soft argillaceous bed that easily yields to the weather.

(1) During a recent expedition into Central Australia undertaken by Professor Sir Edgeworth David and myself, the diurnal temperature, in July, on one occasion had an extreme range of 50° F. in the course of twenty-four hours; the day temperature, in the shade, reached 86° F., and the minimum, at night, 5 ft. from the ground, was 36° F.

(2) Numerals in small caps. refer to the Bibliographical References at the end of the paper.

As the latter wastes the harder stones on top are gradually let down to a lower level. Even in the case of the scarps, flanking the "table-tops," the slope is gradual and could give no gravitational impact that might cause a vibration equal to a cause of fracture. Again, the Desert Sandstone is coarser in the grain than the chalk-flints and does not so readily fracture by compression. In a field of gibbers one stone does not press against another, nor are they heaped together, but evenly strewn over the surface where they were left by the slow removal of the more friable bed on which they rested.

The shapes exhibited by these gibber stones have arisen from various causes. The process of silicification has often been partial in its operations, causing peculiarities of shape and differential weathering. Solar influences and rapid changes of temperature tend to the breaking up of the siliceous rocks. This may occur under two forms. On a larger scale the rocks are split, *in situ*, in a way that simulates jointing; and, in a minor way, circular depressions sometimes occur on a smooth face of rock, as though sun-flaked, and has probably been so caused. In the case of the stone implements collected from the gibber country, there are sufficient evidences of design in their workmanship to prevent any mistake being made between the sun-flaked and the man-flaked. In the former case the features are those of circular or oval depressions that occur on the face of the stone, either oddly or without any definite order, while in the worked implements, even where a naturally-shaped stone is used, there is evidence of selection in the general shape of the stone and intention in the chipping. Except in the case of oval-shaped implements, there is a thick edge, or butt, at one end, which is unchipped, suiting the tool to the hand, while the lateral edges are trimmed in such a way as never occurs with sun-flaking. This is seen in the number of chippings (amounting to scores in some examples) that have a uniform size and lineal direction along the edge, and, at times, are supplemented by a few chippings on the under-side of the edge where it was needed to secure a straight cutting edge.

III. Description of the Tableland Implements.

(*a*) general features.

1. The implements that have been secured under the circumstances already explained, can be separated into two divisions:—(1) Those that have been struck off as a fragment from a larger mass, or core, and show conchoidal fracture with a bulb of percussion. Examples belonging to this division are, usually, smaller and better finished than those mentioned in the following section. (2) Implements that have been

developed from a "gibber" stone in its natural condition. These have evidently been selected on account of their size and shape being adaptable, after modification by chipping, for certain useful purposes. It is not always an easy matter to assign some particular form to its proper place in this classification, on account of the influence of solar heat in effecting fractures in fine-grained siliceous rocks. Sun-flaked rocks sometimes show a curved and smooth face on the plane of fracture, which simulates conchoidal fracture, but is destitute of a percussion bulb. When a face of this kind occurs, it must be doubtful as to whether the flaking has been done by the workman, or whether the latter has availed himself of a fragment which had already been severed from the parent rock by solar action. The element of doubt, as to the origin of the fragment, has no bearing on the evidence of human workmanship in the subsequent treatment of the stone, which, in many cases, is beyond doubt.

2. Whether a conchoidal bulb be shown or not, there is, almost invariably, a flat face on the one side (which is the ventral or under-side), and a, more or less, raised surface on the other (which is the dorsal or upper-side). In certain prehistoric stone implements of Neolithic Age, as well as in the case of the stone implements of the existing tribes of Aborigines in Australia, this flat under-side forms a part of the manipulation and is conchoidal in character. In the tableland implements, it seems probable that some owe their flat under-sides to natural causes, either by jointing or some other form of natural fracture.

3. The chipping is, for the most part, developed on the convex or upper-side of the implement, and sometimes completely surrounds the specimen. If the curvature of the edge requires that, for the making of a straight cutting edge, the chipping should, in places, be developed on the flat, or under-side, it is chipped on that side also. This is not peculiar to the type now under description, but examples of this kind occur in the stone implements of all ages—it is an evidence of design.

4. The tableland examples are frequently of a size that is much in excess of the usual type of implements found in other parts of Australia.

5. Pointed implements are particularly common. The point is sometimes developed as a prominence between two concave scrapers and was no doubt intended for use, as well as the scrapers with which it is associated in the same implement. It is sometimes improved by a deep notch on one side, as in fig. 1, pl. xv., and pl. xvi., and is sometimes claw-shaped, as in fig. 1, pl. xii. The association of "beaks"

and concave scrapers is the chief characteristic of the most ancient types of implements, whether eolithic, palaeolithic, pygmian, or Tasmanian. The same occurs in the case of the Australian artefacts, but these are usually of smaller make than the tableland examples.

6. Hand choppers of large size also occur. Some of these have a heavy butt end and, at the other, are worked to a point, like the French form known as a *coup-de-poing*, but instead of being worked to be biconvex in transverse section, as in the case of the latter, they have a flat ventral face and are roughly worked on the dorsal side (see example described, No. 15, and figured, pl. xx.). In other examples the implement takes a reversed form, so that the pointed portion becomes the hand end, and the opposite, or broad end, is chipped to a cutting edge (pl. xix.).

7. The examples answering to the tableland type are, almost invariably, highly coloured of an ochreous or ferruginous hue, varying as reddish, yellowish-brown, or dark-brown, sometimes almost black, agreeing in all respects with the colour that is characteristic of the gibbers among which they are found. This colour is, indeed, characteristic of stony deserts in all parts of the world, and arises from the presence of iron in the soil and waters of a country existing under arid conditions.

8. All the implements of the gibber type carry more or less of a glazed surface. This glaze is frequently as fully developed on the chipped surfaces as it is on the unchipped portions. The same feature is commonly seen on genuine prehistoric stone implements in all countries, and is taken as an evidence of age and genuineness. It is as evident to the touch, in an oily and greasy feel, as it is to the eye as a glaze. This feature, often associated with a weathered surface in flints, is known as *patina* from the resemblance that it bears to the glaze of pottery, or its likeness to an oxidized coating seen on metals as the result of weathering.

9. While the chipping is very clearly defined in the examples under description, some of them possess a blunted edge which can be best explained from the wear they have suffered by use.

(*b*) DESCRIPTION OF INDIVIDUAL EXAMPLES.

1. *A claw-shaped Instrument*. Size, $5\frac{1}{4}$ in. $\times$ $4\frac{1}{4}$ in. The under-side is roughly shaped to a flattish face by a number of secondary chippings that do not show conchoidal fracture. It is ridged on both faces and has a roughly-triangular outline. The trimming has been cleverly executed (on a not very workable stone) so as to produce two sharp edges and a curved

"beak" at the apex. The base is thick and unworked. It is deeply stained to a dark-brown colour. The included sand-grains are glistening with a feebly developed glaze. *Loc.*, Stuart Creek (pl. xii., fig. 1). [For claw-shaped examples from the Red Crag, see IX., figs. 35, 36.]

2. *An Implement with the shape of an irregular isosceles triangle.* Size, $4\frac{3}{4}$ in. × 3 in. Material, a fine-grained sandstone. Under-side exhibits conchoidal fracture in one large curve. Upper-side has been formed by striking off two conchoidal flakes, leaving a dorsal ridge which is non-symmetrical. Secondary chippings on two edges, directed to a point, the termination of which is broken off. Basal portion thick and unworked. Colour, dark brown; *patina*, strong. *Loc.*, Stuart Creek (pl. xviii.).

3. *A pointed (beaked) Implement with nearly parallel sides.* Size, $3\frac{3}{4}$ in. × $2\frac{1}{2}$ in. A very fine-grained siliceous sandstone, brecciated. Under-side formed by a convex conchoidal fracture. Upper-side, chipped to an irregular cutting edge all around, terminating at apex in a distinct "beak." The ridge on the upper-side is sunken and cavernous through defective silicification. Colour, lightish-brown on under-side, darker on upper, and especially dark on the chipped edge. *Patina* well developed. *Loc.*, Stuart Creek (pl. xiv., fig. 1).

4. *Lozenge-shaped Implement.* Size, 5 in. × 4 in. In composition, a typical example of Desert Sandstone, possessing a good conchoidal fracture. Under-side is formed in one smooth surface with large percussion bulb. Upper-side is ridged inequilaterally, and a less defined ridge is seen towards the right-hand edge. On the left a portion of the original surface of the stone is preserved. The base is short and thick. Except at the base, very fine secondary chippings occur around the edge. At the apex—opposed to the base—a very prominent point, or beak, is formed, by the creation of a notch on one side. Colour, faintly reddish, darkest on the natural surface. Glaze, slight. *Loc.*, Macumba (pl. xvi.).

5. *Roughly-triangular and pointed Implement of a distinctly rostro-carinate type.* Size, $3\frac{1}{2}$ in. × 2 in. Stone, fine-grained (porcellanite). Thick. Under-side smooth, showing conchoidal fracture. Near the centre of the under-side is an oval depression, left by a flake that has been removed by solation. Upper-side is shaped by primary (coarse) and secondary (fine) chippings. Apex, pointed at termination of dorsal ridge. Basal end, thick. Reddish-brown in colour, lighter at the chipped edges. Glaze, moderate. *Loc.*, Stuart Creek (pl. xii., figs. 3 and *3a*). [Compare this implement with the following: IX., figs. 1-7; XI., pls. 23-27.]

6. *A roughly-made Implement, quadrate in outline, with a strong "beak" at one angle.* Size, 4 in. × 3 in. Under-side flat with vesicular-like depressions on what appears a natural plane of fracture. Upper-face flattish and irregularly flaked. Secondary chipping on two-thirds of the circumference, ending on one side in a strong protuberance or "beak." Colour, a very dark brown—darkest on the worked edge. *Patina* well developed, more particularly so on the chipped edge. *Loc.*, Stuart Creek (not figured). [Compare IX., figs. 27-30.]

7. *Naturally fractured Stone utilized for making Hollow Scrapers.* Size, 3½ in. × 3 in. Roughly quadrilateral in outline. Flat underneath; irregular on upper-surface. Hollow scraper ending in stumpy beak on left edge and a shallow double scraper on the right. Basal edge thick and unworked. Reddish stain; edges, where worked, are of a lighter colour. Glaze, slight. *Loc.*, Macumba (not figured).

8. *Cutting Tool and Hollow Scraper.* Size, 3 in. × 2½ in. A fine-grained siliceous rock (near porcellanite). Under-side curved and smooth but gives no evidence of "bulb." The fragment has probably been flaked off a larger mass by sun-heat. Upper-surface irregularly chipped, showing ridges bifurcating from the basal edge. Secondary chippings follow the edge in an almost complete circle, and a strongly developed hollow scraper is formed on the right edge. Colour, reddish-brown, rather lighter on the edges. *Patina* well developed. *Loc.*, Stuart Creek. This implement gives evidence of much wear, in which the divisional lines between the respective chips are almost wiped out. It has the appearance of age, and may have been worn by drifting sand (pl. xii., fig. 2). Resembles a common eolithic type.

9. *Knife and Hollow Scraper.* Size, 3½ in. × 2½ in. Constructed from a fine-grained, siliceous sandstone. Under-side smooth by conchoidal fracture but without a clearly-defined bulb. Upper, or convex, side chipped to a fairly uniform outline. The right-hand edge is very finely chipped to a straight cutting edge, and the left-hand edge is similarly chipped, forming a concavo-convex, crescentic cutting edge. To the right of the point, or beak, a hollow scraper has been formed by a deep notch. Colour, slightly reddish. Glaze, dull. *Loc.*, Stuart Creek (pl. xv., fig. 1).

10. *Implement nearly circular in outline with prominent point, or beak.* Diameter, 2½ in. On the under-side there is a very distinct bulb of percussion with conchoidal curviture. The upper-side has been formed by seven well-defined and symmetrical flakings, each of which has been struck off by a single stroke. One of these occupies the crown, and this apical fracture forms the centre around which the six other flakes

were removed, and which were of about equal size. The entire circumference is very finely worked, but the chief feature is the very cleverly manipulated point which may have been used as a borer. It is of a uniform reddish colour, with a feeble glaze. *Loc.*, Macumba (pl. xiii., fig. 1). [Compare ix., fig. 43.]

11. *Ovately formed Scraper.* Size, $3\frac{3}{4}$ in. × $2\frac{1}{2}$ in. Underside approximately flat with doubtful percussion bulb. Upperside shows the natural surface of stone, in a marginal band half around the specimen, and the crown has been reduced by flaking. Secondary chipping has been done all along the edge, which is somewhat serrated, forming an oval tool that was probably used as a scraper. Colour, reddish-brown, somewhat lighter on the chipped edge. Glaze, somewhat feeble. *Loc.*, Stuart Creek (pl. xiv., fig. 2).

12. *Adze, with cutting edge two inches in width*, forming the widest part of the implement, which is three inches in length. The material is very fine in the grain and is of the porcellanite type. The under-side is fractured along two planes that are opposed to each other at an angle of about 10°. The implement is thickest at the basal extremity, gradually thinning towards the cutting edge. The upper-surface has been worked to produce this latter effect. The cutting edge is rather roughly chipped and gives evidence of wear by use. Colour, dark red. *Patina* well developed. *Loc.*, Stuart Creek (not figured).

13. *Hand Chopper.* A large flat subtriangular stone, measuring 6 in. × $5\frac{1}{2}$ in. Appears to have been a thinnish and flattish gibber that had been fractured from the parent rock by natural causes. It is fine-grained and very siliceous. Upper and under-faces show no attempt having been made at trimming. It has been worked on one edge only, showing a cutting face $4\frac{1}{2}$ in. in length, and gives evidence of much wear. Dark red on under-side, rather lighter on the upper; chipped edge almost free of colour, but is more glazed than the rest of the tool. It is a most uncouth and rude implement that was probably used as a hand-chopper, as the thick part of the implement is on the side opposed to the cutting edge and has been rounded off to suit the hand, while the opposite end has been worked to an obtuse point. *Loc.*, Macumba (pl. xvii.).

14. *A fine example of a Hand Chopper.* Size, $6\frac{1}{2}$ in. × $4\frac{1}{2}$ in. The stone is a typical example of Desert Sandstone and has been a "gibber," which was evidently selected on account of its suitable shape. The implement is roughly triangular, and both upper- and lower-surfaces are in their native form and are almost parallel to each other. The cutting edge has been developed in a curved outline on the

base of the triangle, while, at the opposite extremity, there is a strong knob-like finish which was improved upon by the workman chipping it to a shape most convenient for gripping by the hand. The main secondary chipping, to bring up a cutting edge, has been done on the upper-surface, but there has also been complementary chipping done on the lower-surface, and as the chips struck off, in this way, were unusually large, the cutting edge has a wavy outline with a span of about an inch in each curve. The natural face of the above is a bright red, the chipped edge is rather lighter in colour, especially so on the under-side. It was evidently intended to do heavy work in cutting or splitting. The glaze on the natural surfaces is greater than that seen on the worked portions. *Loc.*, Macumba (pl. xix.). Dr. Horne has figured an example almost identical with this implement [see v., fig. 31].

15. *Thick-backed, roughly-triangular, single-edged, and pointed Implement.* Size, $5\frac{3}{4}$ in. × $3\frac{3}{4}$ in. The stone is a typical example of Desert Sandstone. Under-side is flat, having been formed by striking off a single flake but without conchoidal curves. Upper-surface shaped by coarse flaking, with an inequilateral ridge and worked to a cutting edge on one side. The point is also trimmed. Butt end, thick, and formed by the natural surface of the stone. Colour, bright red on the under-side, but the flaked upper-surface and worked edge are almost free from ferruginous colouration. Glaze, very slight. *Loc.*, Macumba (pl. xx.).

16. *Chopper or "Tomahawk."* Size, 4 in. × $2\frac{3}{4}$ in. Constructed from a very fine-grained form of Desert Sandstone, and is very siliceous. The stone, for the most part of its surface, shows numerous weathered cavities (resembling vesicular structure), which is, no doubt, the result of imperfect diffusion of the cementing agent under the process of silicification. The implement is biconvex in transverse section, and without distinction as to sides. The butt end is at right-angles to the longitudinal section and is flat. The opposite end is worked to a smooth, biconvex, crescentic edge, which is continued on one side of the implement to the butt; and, on the other, is roughly worked, so as to give a uniform outline to the implement, but was not intended for cutting. The colour is a dark-reddish-brown, with strongly developed *patina*. *Loc.*, Stuart Creek (pl. xxi.). This is, perhaps, the most interesting specimen in the collection, and, from appearances, may be the oldest. It bears a striking resemblance, in general form, to the "tomahawks" used by the Aborigines of Australia at the time of European settlement, but whilst the latter were almost invariably made from

igneous dyke rocks,[3] the present specimen is made from a siliceous sandstone. The Aboriginal "tomahawk" was ground and polished at the edge, and, sometimes, up to the middle of the implement. The Stuart Creek specimen, now under description, was carefully chipped to a cutting edge, but the edge has been rendered so smooth that it seems probable that some amount of grinding of the edge has been done to improve its cutting qualities. It must be either that, or age and weathering have reduced the prominences which marked the outlines of the individual chips struck off in its manufacture. It is certainly a unique specimen of its kind.

IV. Origin of the Implements.

(a) possible theories.

As the stone implements which occur in the tableland country of Central Australia differ, in many respects, from those commonly found elsewhere in Australia, the question naturally arises as to their age and origin. That they have a very considerable antiquity is manifest from their condition by weathering, the presence of a natural glaze seen on most of the specimens as a consequence of age, and also from the ochreous "skin" by which they are commonly coated. There are several possible explanations as to their origin.

1. They may be only local variations of the artefacts produced by the existing native tribes of the country, but possessing a considerable prehistoric antiquity.

2. They may be the earlier and cruder attempts at the making of stone implements which the existing Aboriginal people passed through before attaining the greater skill shown in later stages of their history.

3. They may be the remains of an earlier race of people, as the Tasmanians, for example, which may have occupied the ground in the far past as the true Aboriginal race, but were displaced, or exterminated, on the mainland, by the present natives of Australia, who exhibit greater virility and a more aggressive spirit than the Tasmanians possessed.

Something can be said in favour of the first of these suggested possible origins of the tableland implements. Habit in the Aborigine is, to a large extent, regulated by surrounding conditions, as happens also with the more civilized races.

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(3) In the Adelaide Museum there are a number of implements labelled "wedges" that are hatchet-shaped, resembling, but of thicker make than the common "tomahawks." They are made from a greyish-coloured quartzite, are symmetrically shaped, ground to a smooth surface throughout, and the majority have a transverse groove for hafting. All these implements were received from the River Darling country, mostly from Albemarle. The specimen, now described (No. 16), is quite distinct from these.

We may judge that the size of his tool would largely depend on the size of the raw material available for its manufacture; and, also, on the facility with which it could be manipulated. Moreover, where a suitable stone for trimming occurs in unlimited quantities and distributed over wide areas, the Aboriginal craftsman may have been prodigal of his workmanship, and his decision as to whether he should keep the freshly made implement for future use, or leave it behind when done with, would depend on the circumstances of the moment.

There are difficulties, however, in assuming that these large and uncouth implements were made by the natives now in possession of the country. These particular implements are not found outside the gibber, or tableland, country,(4) and they belong to particular types, which, so far as I am aware, have not been manufactured by the Aborigines of Australia within modern times.

(b) AN HYPOTHESIS CONCERNING THE TASMANIANS.

The possibilities of these implements having been made by an earlier race than the existing Australian natives opens up an interesting enquiry If such an earlier autochthonous people existed in Australia, it is natural to suppose that the Tasmanians were that people.

It would be beyond the bounds of our subject to review the many and conflicting theories that have been advanced as to the racial relationships of the Tasmanians and how they came to be in possession of Tasmania. That they reached Tasmania by sea seems improbable from physiographical and other reasons. With the exception of its northern coasts, Tasmania is faced by ocean deeps so profound that it is unlikely, during the human period, that there has been much more land above sea level, within a thousand miles of the island, than exists to-day. Moreover, the Tasmanian natives had not the skill to construct anything in the shape of a boat more than a very crude and temporary raft. Most writers believe that the Tasmanians reached their island home by way of the mainland of Australia. [See I., p. 49; III., p. 955; IV., p. 265; VI., p. 730; VII., p. 72; XII., *(a)* p. 30; XIV., pp. 232, 233; XXIV., pp. 85, 86. Baldwin Spencer, Federal Handbook, British Assoc., Melb., 1914, p. 34. Sir William Turner, Trans. Roy. Soc. Edinburgh, xlvi., part 2, pp. 393, 394.]

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(4) This limitation in the distribution of the specimens may be explained, in part, from the fact that the lower ground is occupied by the river plains that have been built up by flood waters dating from a remote period. These sediments (which often take the form of drifting sand) have covered and obscured much of the ancient floor of the country.

Where successive waves of migration occur the inferior races are driven by the invaders, either up into mountain recesses or to the extremities of the land. The latter fate may have happened to the first occupiers of the Australian soil, while the geological incident of the submergence of the land, at the strait, and the conversion of the Tasmanian peninsula into an island, gave the remnants of this people the chance of survival. The absence of any evidences that the dingo found its way to Tasmania, leads to the inference that the separation of Tasmania from the mainland occurred at a date prior to the arrival of this animal on the southern coasts of Victoria.

It is generally admitted that the Tasmanian natives represented one of the most primitive and generalized types of mankind. Their low development, as evidenced in the manufacture of their weapons and tools, indicates an isolation that must date back to a high antiquity. If they had a Negrito-Papuan-Melanesian origin, as appears likely from their racial characteristics,(5) they must have migrated from their ancestral home before the introduction of the bow and arrow among these peoples, as it seems very improbable that a people who once possessed this useful weapon could ever lose all knowledge of such a simple and effective contrivance.

In the event of the Tasmanian natives having reached their island home by way of Australia they must have left some evidences of their occupation of the mainland, if not in other ways, at least by their stone implements, which are practically imperishable. The question that arises is: Can there be a possible connection between these unique implements of the central tableland of Australia and the Tasmanian people? In pursuing this enquiry, the only basis for comparison that we possess is in relation to their respective artefacts in stone, the methods adopted in their manufacture, the range of differentiation in their types, and the consequent stage of culture indicated by the same.

(c) TASMANIAN STONE IMPLEMENTS.

The class of stone mainly utilized by the late Tasmanians, in the manufacture of their implements, was obtained, principally, from the shales of the Permo-carboniferous coal measures, that had been indurated and more or less metamorphosed into a cherty rock by the intrusive igneous dykes

(5) Mr. Churchward holds the view that the Pygmies of Central Africa are the nearest living representatives of Primitive Man. He says, "It was in Africa that the little Pigmy was first evolved from the *Pithecanthropus erectus*, or an anthropoid ape" [I., p. 12]. He also regards the "extinct Tasmanians as highly-developed Pygmies" [*loc. cit.*, p. 19].

that are common in the country. Less frequently, quartzite, and a jasper-like rock, formed by the decomposition of diabase, were utilized for implement-making. Although possessing an unlimited supply of such basic igneous rocks which, on the mainland, supplied the Australian natives with the raw material for the making of their polished tomahawks, the Tasmanians never got so far as to use this common stone of their own country for such a purpose. They had only a limited range, as to types, in the making of their implements, the shape appears to have been indifferent, the object aimed at was a cutting or scraping edge.

Dr. F. Noetling, in an important paper [xii., *(a)* p. 1, *(b)* p. 14] on the Tasmanians, divides their implements into two classes, as follow:—"There is a large group of implements which leaves no doubt that it was the intention, the will of their makers, to produce a certain, well-defined form. These implements bearing evidence of the intention or will to produce a certain shape may be conveniently termed: Morpholithes. The other large group represents all those numerous, shapeless implements, which bear no evidence of the maker's will or intention to produce a definite shape. This group of implements may fitly be termed: Amorpholithes" [xii., *(a)* p. 1]. It is to this latter class that Dr. Noetling refers most of the Tasmanian implements. He says, "If we examine any larger collection of implements made by the Tasmanian Aborigines, the most striking feature we notice is a bewildering mass of forms, none of which are exactly alike, and the total absence of any definite intentional or conventional shape. We may examine them over and over again; there is a sort of general likeness, a family likeness, so to speak, but each specimen constitutes an individuality of its own, different from all the others. This absolute want of any intentional shape at once fixes their position in the scale of evolution, and they must be considered as belonging to the first and lowest group of stone implements, *viz.*, the Amorpholithes." [xii., *(a)* p. 7.]

The testimony as to whether the Tasmanians, in any case, ground the edges of their cutting tools, is conflicting. Brough Smyth says, definitely, "I can state with certainty that not one has been ground, and that no attempt has been made, in any case, to give an edge by grinding." [xxiii., p. 403.]

Prof. E. B. Tylor quotes Dr. J. Barnard Davis with reference to Tasmanian works of art in his possession as follows:—"Among a few exceedingly rude stone-chippings or implements made from a dark-coloured chert . . . . I have a more finished stone implement of an oblong form with one extremity slightly sharpened by grinding, which was employed by the women, without any handle, in notching the bark of trees up which they climbed in an ingenious manner in search of the opossum." [XXVI., p. 148.]

At a later date [XXVII., pp. 339, 340] Dr. Tylor was able to trace the particular specimens on which Dr. Davis founded his statements, and has proved, definitely, that the supposed Tasmanian implement, "sharpened by grinding," was not Tasmanian in origin, but a typical "tomahawk" of Australian Aboriginal workmanship.

On the disputed question as to whether the Aborigines of Tasmania hafted their choppers, or ground the edges of their tools, the Royal Society of Tasmania instituted inquiries from all reliable sources. At a meeting of this Society held on June 10, 1873, the members, after a general discussion on the subject, recorded their conclusions in the terms, "The general belief of the Fellows present was that the stone axe with the handle attached was never used by our natives until taught by those from the neighbouring continent." [XXII., pp. 22-25; see also XXVI., p. 146.]

At the following meeting of the Society an important letter, written by Mr. Jas. Scott, was read, and was followed by the official statement, "All enquiries on the subject of the stone implements of the Tasmanian Aborigines tend to prove that no true tomahawks were known to, or fabricated by them. They merely used sharp-edged stones as knives. These were made sharp, not by grinding or polishing, but by striking off flakes by another stone till the required edge was obtained. As a general, if not invariable rule, one surface only was chipped in the process of sharpening." [XXII., p. 25.]

The confusion seems to have arisen from the fact that, about the year 1822, a number of Australian blacks were sent from New South Wales to Tasmania. The latter probably took some of their stone implements with them and, in intercourse with the Tasmanian natives, imparted to them the knowledge of improving the cutting edges of their stone implements by grinding, and also showed them the advantages of mounting their choppers in handles. Dr. Noetling has described and figured [XVI., XV.] some ground pebble-stones which he refers to Aboriginal workmanship, not designed for tools of any kind, but as "sacred" or "magic" stones. On the further point, as to the general idea that the Tasmanians trimmed their cutting tools on one side only, Dr. Noetling has shown that there were exceptions to this rule, and gives figures of several examples in which the trimming has been done on both sides of the edge; "but," he says, "this class of implement is very rare." [XIII.]

(d) THE TASMANIAN STAGE OF CULTURE.

Few, if any, people that have survived in a savage condition to historical times, have possessed so limited a range of appliances as the natives of Tasmania. The only wooden implements that they possessed were:—(a) a long stick, pointed and hardened by fire at one end, and used as a spear; and (b) a so-called "waddy," which seems to have been used chiefly in hunting game. When fighting, in addition to their wooden spears, they are said to have picked up and thrown at the enemy any loose stones that might be at hand. They had, therefore, little use for stone implements. A rough pebble, picked up on the beach, sufficed for breaking open shell-fish or crushing marrow bones. Their requirements, so far as stone implements were concerned, seem to have been, to make nicks in the bark of trees to assist in climbing; cutting down the long, slender stems of the *Melaleuca* for their spears; cicatrization; dividing up carcases; crescentic ("hollow") stone scrapers were used to scrape off the bark and give smoothness to their spears, and a stone scraper, with bevelled edge, was used in the preparation of animal skins. As prepared tools, they may be reduced to two primary types: *Cutting Tools* (which might be utilized in many incidental ways), and *Scraping Tools*, for shaping wood implements or removing fat, etc., in the curing of skins.

After eliminating the foreign elements from the Tasmanian artefacts, referred to above, what remains to the Tasmanian Aborigine is a stone-cult of the simplest and most limited character. Dr. E. B. Tylor says [xxvii., p. 340], "So far as stone-implement-making furnishes a test of culture, the Tasmanians were, undoubtedly, at a low palaeolithic stage, inferior to that of the Drift and Cave men of Europe."

For many years the oldest types of stone implements were known as "palaeoliths." They exhibited very definite types within a limited range of variation, as to form, and as they were usually found (other than in caves) in the older river drifts, implements of this particular type were generally associated with such deposits and are often spoken of as "drift" implements. In later years, worked stones that were different from the "drift" type, but still very ancient and associated with the remains of extinct mammalia, were found in England and, more particularly, on the Continent, which necessitated the subdivision of the Palaeolithic Age into several successive stages, linking the earliest palaeolithic groups with the dawn of the Neolithic Age. The chronological data, marking off these successive stages, have been worked out, principally, in relation to the prehistoric remains in France and Belgium.

At the same time, many investigators in prehistoric archaeology have claimed to have discovered still earlier examples of human workmanship which have come to be designated, "prepalaeoliths" or "eolithic" implements.

In 1889, Professor Joseph Prestwich described some remarkable prehistoric finds that had been made on the chalk plateaus of Kent [xvii.]. This paper was followed by others, by the same author, in succeeding years [xviii., xix.], and introduced what has become a considerable literature on the subject. Whilst the previously recognized palaeoliths were found in the gravels of the river valleys, this new find was obtained from certain ancient gravels that were laid down before the valleys containing the palaeolithic implements had been excavated. Of these plateau implements, Prestwich says, "They form a distinct group, characterized by their generally brown and ochreous colour, extremely rude shape, and worn appearance" [xvii., p. 286]. It is also stated that the great majority of the implements have been formed from natural fragments of flint. When design is indicated it is usually in the form of scrapers, or used for hammering, and are in all cases hand implements.

Professor B. C. A. Windle, of Birmingham University, describes this eolithic type of implements as "Roughly-hewn pebbles and nodules and naturally broken stones showing work, with thick ochreous *patina*, found on the plateaus of the chalk, and other districts, in beds unconnected with the present valley drainage" [xxix., p. 14]. The same author, when referring to the nature of the work done on these stones, says, "The trimming . . . . has generally been made on the edges of rude natural flints, taken from an old flint drift" [*loc. cit.*, p. 41]. Again, on page 43, Professor Windle says, "The stones are almost invariably stained a deep, warm, brown colour, in this respect resembling the flints of the drifts in which they are found. This colour spreads over the worked, as well as the unworked parts, though it may be lighter in shade on the former than on the latter."

Many experienced students in prehistoric archaeology are, however, sceptical in this matter and refer the chipped flints of the chalk plateau, and other places, as well as occurrences of similarly flaked flints at the base of the Pliocene "Crag," as having been caused by natural rather than by human agencies. The advocates for and against the validity of these supposed human artefacts are about evenly balanced. The Geological Society of London, on November 19, 1913, devoted an entire evening meeting to the subject. "No papers were read, but in response to the invitation issued on November 5, 18 or more exhibits were made of implements and reputed implements of Palaeolithic and earlier age, and of flints showing various types of fracture." A general discussion followed, in which the rival theories were about equally supported.

The latest attempt to discredit the so-called "eoliths," as man-made implements, is in a paper read before the Geological Society of London, by Mr. S. H. Warren, in January of the present year, on "A Natural Eolith Factory beneath the Thanet Sand." Mr. Warren made his observations on a section exposed in a chalk quarry, showing fractured flints caused by subsoil pressure arising from differential movement or creep [XXVIII.].

The point of interest in these discussions, so far as the present paper is concerned, is that several authors have drawn comparisons between the Tasmanian stone implements and the eolithic, or prepalaeolithic, implements of Europe.

Mr. J. Reid Moir has attempted to give the genesis and development of human stone-artefacts in their successive stages, as follow [XI., pp. 38, 48, abbreviated]:—

1. The most primitive implement known is a tabular piece of flint with a hollow flaked out in one of its edges.

2. The next stage is represented by a similar piece of tabular flint in which two opposing hollows have been fashioned in its edges, producing a beak-like profile at the anterior region of the implement.

3. The beak-like profile, with its central ridge or gable, develops later into the rostro-carinate implement, that is triangular in transverse section and has its cutting edge on the dorsal surface. This is especially the type of the supposed implements that occur at the base of the Red Crag (Pliocene).

4. The rostro-carinate form passes, by lateral chipping, into the early palaeolithic side-scraper in which a cutting-edge extends continuously from the anterior to the posterior region.

5. The triangular section of the pointed eolithic and rostro-carinate implements is transformed, in the earliest palaeoliths, into a section which is roughly rhomboidal. The most highly evolved palaeoliths are those with straight symmetrical cutting edges, in which the rostro-carinate profile has almost disappeared.

6. The Chellean Stage. Pointed and ovate palaeoliths of complex section. Implements large and massive.

7. The Acheulean Stage. Pointed and ovate palaeoliths, elaborately flaked and of complex section. Implements getting smaller.

8. The Mousterian Stage. Scraper points and flake-implements of simple section. A few *coup-de-poings* (hand-

choppers) of complex section, with carefully chipped points and lanceolate flakes.

9. Magdalenian Stage. Scrapers, etc., of simple section and covering a variety of forms that were well finished by chipping.

The Magdalenian implements may be taken as representing the highest order and greatest differentiation of types within the Palaeolithic succession. What follows is the Neolithic, with its highly-finished chipped and polished implements.[6]

To which of these stages in the development of stone implements can the Tasmanian artefacts be most consistently referred? Professor Sollas says, "The Tasmanians, though recent, were at the same time a Palaeolithic, or even, it has been asserted, an 'Eolithic' race . . . the most unprogressive in the world, which, in the middle of the nineteenth century, was still living in the dawn of the Palaeolithic epoch. . . . The question as regards the 'implements' is an extremely difficult one. A great number of the Tasmanian forms are so rude and uncouth that, taken alone, we should have little reason to suspect that they had been chipped by man. . . . If we judge the Tasmanian implements by the best examples, we should, in fairness, extend the same treatment to the plateau 'implements.' The best of these do, indeed, show some superficial resemblance to the Tasmanian, especially in general form, and this is particularly true of the hollow scrapers." [xxiv., pp. 70, 89-90].

It stands to reason that some crude examples of stone chipping must occur throughout the whole range of the Stone Age. Many stones, after testing, would be found unsatisfactory and be rejected without any attempt to complete the implement. Youths would have to learn the art, and their earlier attempts must account for many failures. The most expert manipulator would, sometimes, roughly edge a stone for immediate use and then discard it. Such considerations explain the commingling of roughly chipped and undefinable forms occurring in association, at times, with the most highly finished implements. The stage of culture, indicated by any particular group of artefacts, is determined by the highest and most characteristic types in the group. Thus the polished implement clearly defines the Neolithic stage, while the relative diversity of type-forms and the finish shown in the workmanship are made the basis in distinguishing the respective stages that preceded the Neolithic standard.

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(6) A succinct account of the Palaeolithic stages and their typical implements will be found in the work of Professor Sollas [xxiv.].

It is on the principle, just stated, that the Tasmanian standard of culture, in implement making, is placed at about the lowest level.

V. Points of Resemblance between the Tableland Implements and those made by the Tasmanians.

In making this comparison, the great difference between the raw material available in the tableland country and that possessed by the natives in Tasmania must be taken into account. After examining the collections as exhibited in the museums of Tasmania and elsewhere, and from descriptions given by various authors, together with the figures published in the works of Brough Smyth [xxiii.], Dr. Tylor [xxvi.], H. Ling Roth [xxi.], Dr. Noetling [xii., xiii.], and others, it is impossible not to be struck with many points of similarity which the Tasmanian stone implements bear to those found in the gibber districts of Central Australia. The general points of resemblance between these two classes of implements may be summarized as follows:—

1. The utilization of conveniently shaped stones in their natural condition, more or less trimmed by chipping.

2. Implements of large size, usually with cortical surfaces, crudely shaped by flaking.

3. A flat ventral surface, often showing conchoidal fracture. Mr. R. M. Johnstone says, "From a study of a very large number of these flints the author has observed one general character common to them all, *viz.*, that whatever lack of symmetry they present in facial outline, one of the faces is almost invariably smooth and flattish, without marks of chipping" [viii., p. 335].

4. Absence of any clearly-defined specific types, such as occur in the higher orders of stone implements. Mr. Johnstone says, "As a rule the flints have no definite form, being irregularly ovate-round, wedge-shaped, or spatulate" [viii., p. 336].

5. Tendencies towards either quadrately or triangularly shaped implements.

6. Frequent occurrence of crescentic or hollowed scrapers —a prominent point or "beak" separates the two.

7. Hand Choppers, large, and roughly chipped.

8. Generalized types, the same tool having been used for various purposes, such as, indifferently, either for cutting, scraping, or chopping.

9. Absence of grinding or hafting of tools. All implements were intended and shaped for hand-use simply. Mr. Johnstone says, "It seems to be the prevailing opinion among those who had the best opportunity for observing, that the

Tasmanian natives were not in the habit of attaching handles to their flint hatchets, or other implements, as was the case among the Australian natives'' [VIII., p. 335].

VI. Summary and Conclusions.

The tableland country of Central Australia forms a very distinct geographical province and represents a residual land surface of very ancient topographical features. So far as evidences are available the country has not been below the sea since Cretaceous times. The "tableland" probably had its origin in a previous geographical cycle. The rivers, at the present time, spread their sediments over a relatively flat country, at lower levels than the old "table-top" hills that are residual of an earlier alluviation.

With the waste of the softer beds that underlie the siliceous capping of the "tabletops," the latter is broken up and the loose stones are gently let down, by waste, to lower levels, forming the great stony deserts of the interior. On this ancient land-surface are found worked stone implements of particular types.

These implements, in their characteristic forms, do not bear any close resemblance to such as are in use by the present native tribes of Australia. Many of the stone implements used by the Australian Aborigines are crude in the extreme, and some such have even been hafted; but, in contrast to these, many have been very finely finished. Their polished axes, symmetrically chipped spear points, hafted knives, and womerah chisels, may distinguish their artefacts as Neolithic in type, although representing a stage below that of the Neolithic art seen in the prehistoric remains of the latest Stone Age in Europe.

The implements that occur among the gibber stones of the tableland are, commonly, of large size and possess certain characteristics that are described in this paper.

It is possible, that the peculiar features of the stony deserts of Central Australia, and the nature of the raw material available there, may have given rise to the use of certain stone implements, in a local way, by the present native tribes of Australia that was not represented elsewhere in the continent.

Whilst these implements do not show a close resemblance to those now, or lately, in use among the Australian Aborigines, they afford numerous analogues with the stone implements that were in use by the late Aborigines of Tasmania.

This similarity of workmanship may be taken, so far as it goes, as presumptive evidence of a relationship as to origin.

It seems most probable that the Tasmanians found their way to the extreme south of Australia by way of the mainland, before the separation of Tasmania from the larger land mass.

If the Tasmanians were the true autochthonous inhabitants of Australia, it is reasonable to suppose that they would leave behind them some memorials of their occupation. The only class of remains that would be likely to survive so long a period, since their departure, is that of their stone artefacts, and it must be conceded that the conditions that have prevailed over the tableland area for an immense period of time must have been favourable for the preservation of such remains.

The considerable age of these human relics is evidenced by their highly-coloured cortex, or skin, which the most of these implements exhibit; and, also, by the natural glaze that has been developed over the surface of the worked stones, which, in many cases, has softened the outlines of the scars left by the respective flaking and chipping.

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VIII. DESCRIPTION OF PLATES.

All figures are reproductions from photographs taken by the Author. Measurements lineal.

Plate XI.

Photographic view of "gibber" country (stony desert), with a residual "tabletop" seen in the distance. Taken near Macumba Head Station. It was from this ground that the examples from Macumba, mentioned in this paper, were gathered.

Plate XII.

Fig. 1. Claw-shaped Implement. Reduced half. Stuart Creek. See Type No. 1, p. 211. [Compare ix., p. 321, figs. 33-35.]

Fig. 2. An Eolithic type of Implement with hollow scraper and cutting edge. Natural size. Stuart Creek. See Type No. 8, p. 213.

Fig. 3. Rostro-carinate Implement. Rather less than natural size. Stuart Creek. See Type No. 5, p. 212.

Fig. 3*a*. Side view of above showing the rostro-carinal ridge and beak in section.

PLATE XIII.

The figures on this plate illustrate various forms of pointed, or "beaked," Implements with scraper features.

Fig. 1. Strongly "beaked" Scraper with uniform large chippings making an almost circular Implement. Rather under natural size. Macumba. See Type No. 10, p. 213. [Compare I., pl. 2; also XII., *(a)*, figs. 25-28.]

Fig. 2. A Tasmanian Pointed Implement introduced for comparison. The stone is a thick, dark-red jasper, with white blotches and shining lustre. A conchoidal fracture, in one plane, forms the under-side, while the upper has been roughly shaped into a subhemispherical outline. A main feature is the development of a prominent point at the distal end, bordered by a double scraper, one on either side of the point. On the right-hand side, a secondary point is also developed bordered by two hollow scrapers. The proximal end is thick. The similarity of this Implement to many of the tableland forms is self-evident. The figure is a trifle under natural size. The specimen was obtained in Tasmania by the writer and is in his possession.

Fig. 3. A flat Implement worked into points and concave (hollow) scrapers. The stone is a very fine-grained Desert Sandstone. The under-side is formed by a smooth conchoidal curve that covers half the surface, the remaining portion being chipped to reduce the face to a common level. The chief point occurs at the distal end with two carefully-chipped concave scrapers on either side. If the Implement be revolved through an arc of 90°, from right to left, another point, bordered by finely-worked scrapers, forms a feature similar to the first described. The whole edge of the Implement has been worked. The upper-surface has been chipped, apparently to reduce the thickness. The stone is of a reddish colour and has a distinct glaze. Natural size. Stuart Creek.

Fig. 4. A carefully-worked Implement consisting of points, claw, and scrapers. The under-side is formed by a single, convex, conchoidal fracture, that was formed by flaking from a previously-made, striking platform. At the distal end is a well-shaped point, bordered on either side by concave scrapers. With the exception of the proximal end, the whole edge has been worked, developing special features, including a "claw" on the left side, near the base of the tool. The upper-surface has been shaped, mainly, by two concave, smooth fractures. The stone is a very fine-grained variety of Desert Sandstone, is highly coloured—almost black on the worked edge. *Patinal* glaze strongly marked. It has the appearance of great age. Natural size. Stuart Creek.

PLATE XIV.

Fig. 1. A roughly-triangular Pointed Implement, with concave scrapers of varying sizes. Shows much fine chipping. Natural size. Stuart Creek. See Type No. 3, p. 212.

Fig. 2. An Ovately-shaped Implement with serrated edge, probably used for both cutting and scraping. Rather under natural size. Stuart Creek. See Type No. 11, p. 214. [Compare V., fig. 42; also XII., *(a)*. figs. 12, 14.]

PLATE XV.

Fig. 1. Knife and Hollow Scrapers, carefully worked. Point developed by notch. A little more than natural size. Stuart Creek. See Type No. 9, p. 213.

Fig. 2. A combination of Duck-bill and Hollow Scrapers. The stone is a light-coloured variety of Desert Sandstone, destitute of desert colouring and *patina*. The under-side has been formed by striking off a single flake, leaving a flat surface. Upper-side shaped by numerous chippings directed from a central ridge. Edge very finely worked to a symmetrical outline. This is a spatulate form of scraper which occurs as a Tasmanian type and is represented in prehistoric stone implements in many parts of the world. The specimen has a more modern appearance than most of the tableland forms. A little more than natural size. Stuart Creek. [Compare XII., *(a)*, fig. 23. For pygmy examples see I., pl. 1.]

PLATE XVI.

Lozenge-shaped Implement formed by the removal of a few large flakes, and finished off by very fine chippings on the edge. A notch has converted the remote angle into a well-defined point. Natural size. Macumba. See Type No. 4, p. 212.

PLATE XVII.

A Hand Chopper formed by utilizing a thinnish shell that exfoliated from a block of Desert Sandstone. The cutting edge is limited to one side. A slight notch at the remote angle has developed a low point. About three-fourths natural size. Macumba. See Type No. 13, p. 214.

PLATE XVIII.

A roughly-shaped Knife with cutting edges on two sides. Chipped edge mostly on dorsal surface, but, in places, is improved by chipping on the under-side. Highly coloured and glazed. Slightly enlarged. Stuart Creek. See Type No. 2, p. 212. [Compare XX., p. 13, fig. 6, figured as a "Levallois *pointe de lance*."]

PLATE XIX.

Roughly-executed Hand Chopper with cortical surfaces on both sides. The chipping done to produce a cutting edge is unusually large and has been carried out, alternately, on the upper- and lower-surfaces so as to produce a wavy cutting edge, which was evidently intentional. About three-fourths natural size. Macumba. See Type No. 14, p. 214. [Compare V., fig. 31.]

PLATE XX.

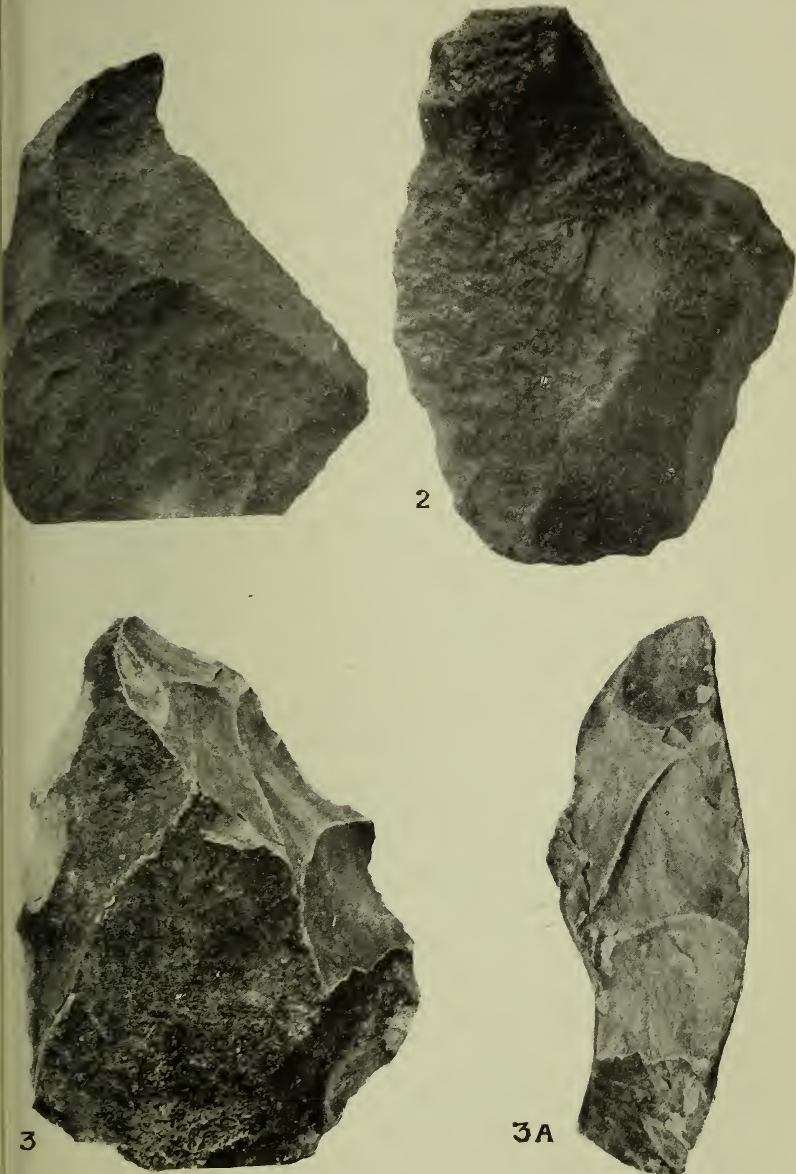
An Implement of the *coup de poing*, or "boucher," type, with a flat ventral side instead of being biconvex. The proximal end retains the cortical surface of the above, and is well formed for gripping by the hand. Rather more than three-fourths natural size. Macumba. See Type No. 15, p. 215. [Compare XXVII., pl. 11, figs. *7a*, *7b*.]

PLATE XXI.

A Hand Chopper that bears a certain resemblance to the Australian "tomahawk," but has been worked from a fragment of Desert Sandstone. The cutting edge (the upper part in the figure) is bevelled on both sides and is almost smooth, as though having been ground. If it be a ground Implement its relationship to the Australian tomahawk is self-evident. Slightly enlarged. Stuart Creek. See Type No. 16, p. 215.

"Gibber" Country (Stony Desert), Central Australia.

Gillingham, Swann & Co. Ltd., Printers, Adelaide.



Aboriginal Implements from the Tableland, Central Australia.

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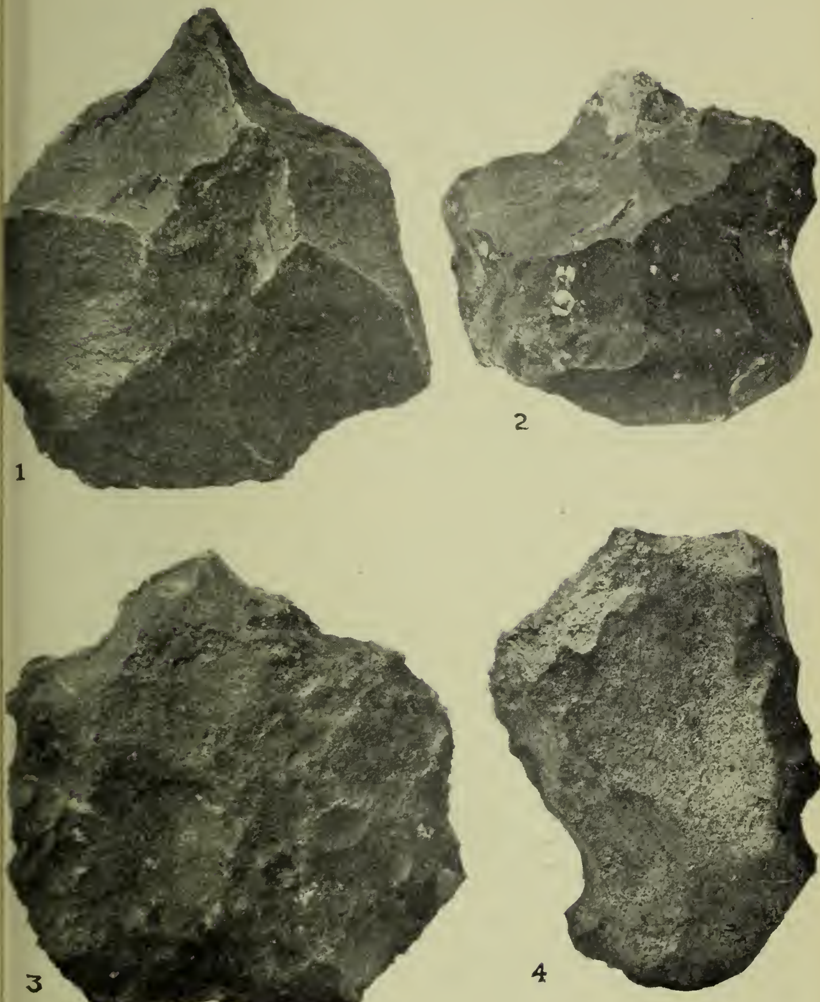

Figs. 1, 3, 4. Aboriginal Implements from the Tableland, Central Australia.
Fig. 2. Tasmanian Implement.

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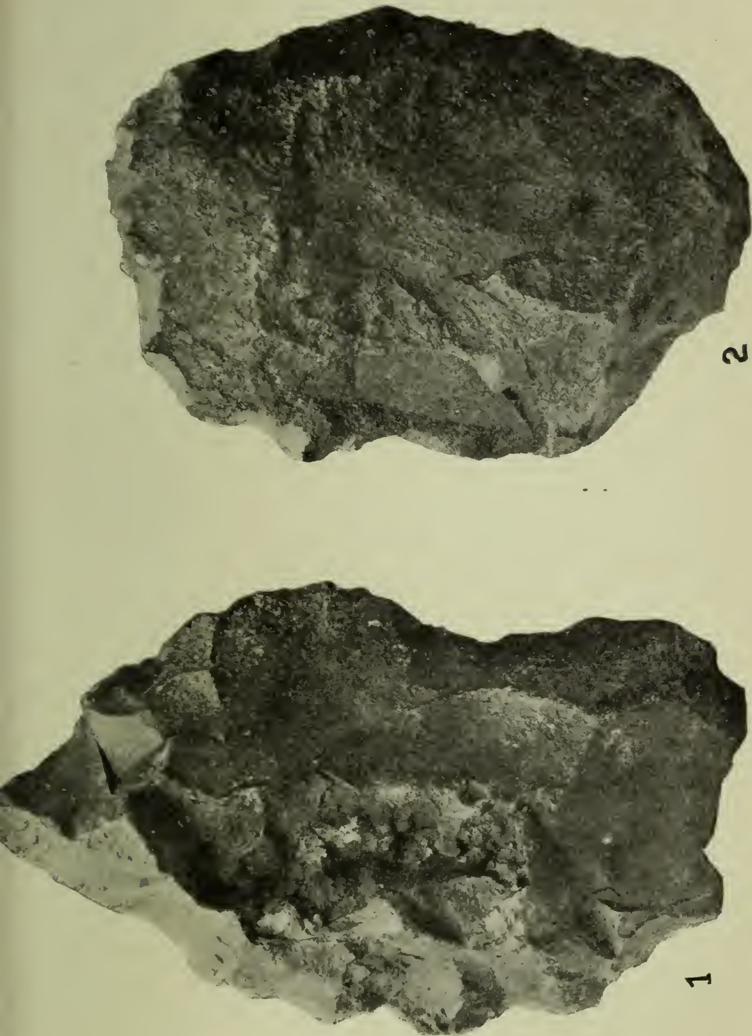

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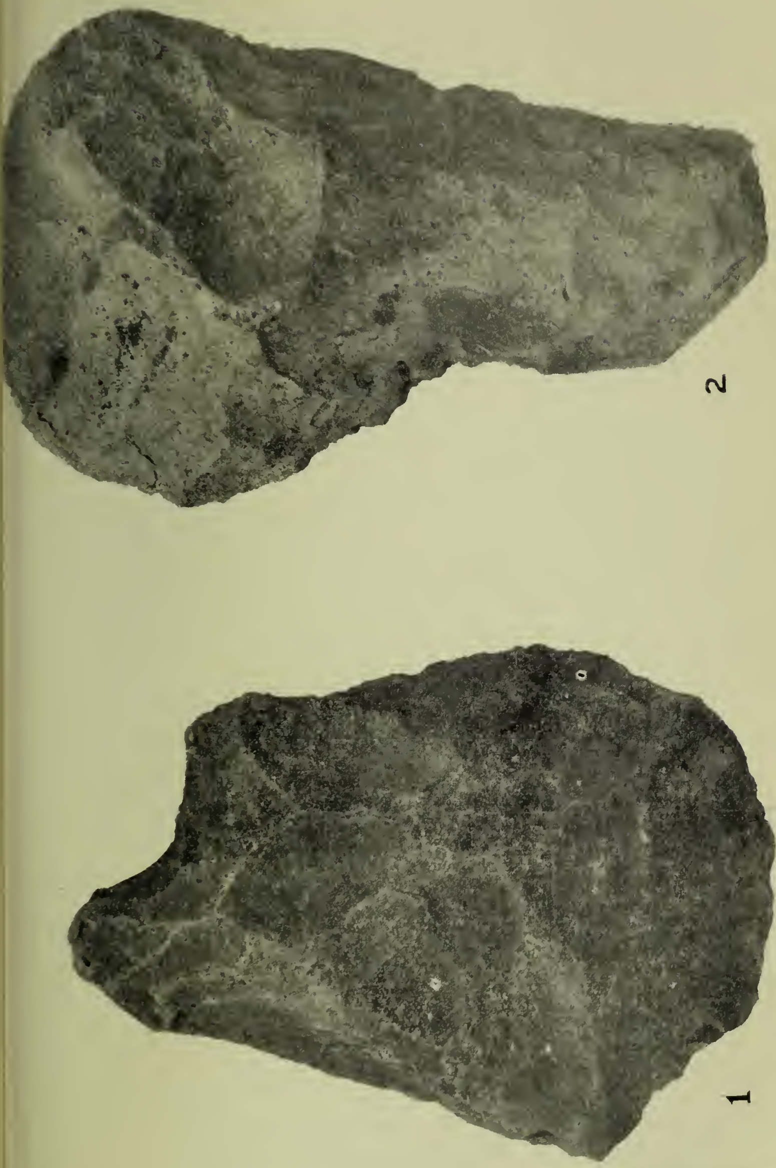

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Aboriginal Implements from the Tableland, Central Australia.

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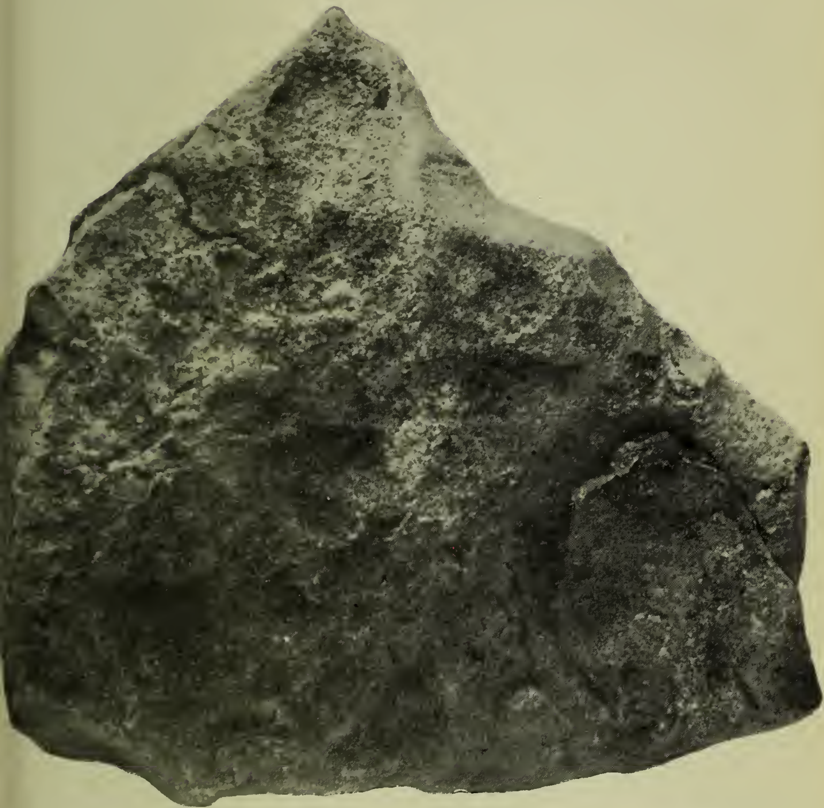

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ONCHOCERCIASIS OF QUEENSLAND CATTLE.

By PROFESSOR T. HARVEY JOHNSTON, M.A., D.Sc.,
University, Brisbane.

(Communicated by Professor Cleland, M.D.)

[Read October 13, 1921.]

In the present paper no less than three distinct species of *Onchocerca* are recorded as parasites of the connective tissues of Queensland cattle, *viz.*, *O. gibsoni*, Cleland and Johnston; *O. gutturosa*, Neumann; and *O. lienalis*, Stiles. A reference is also made to *O. fasciata*, Railliet and Henry, which infests camels.

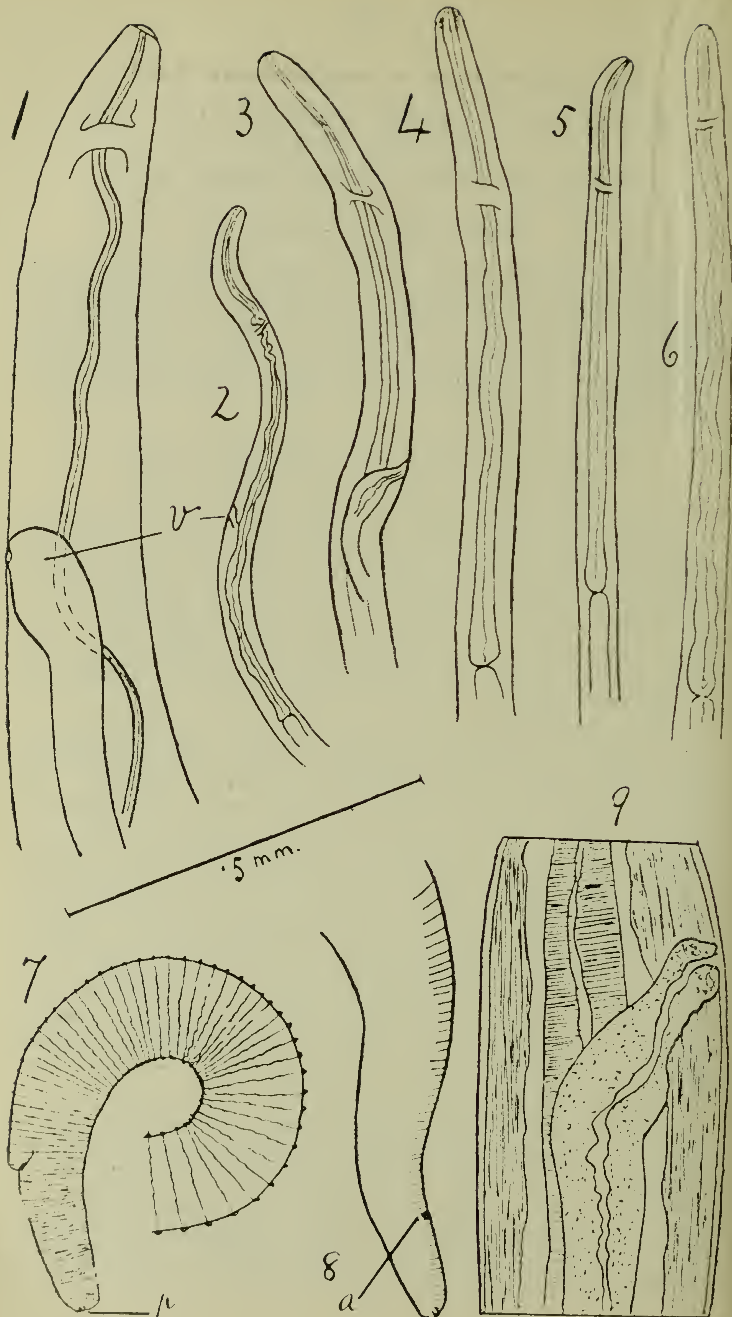
ONCHOCERCA GUTTUROSA, Neumann, 1910.

Figs. 3, 4, 7, 9, 10, 13, 16, 18, 19, 20, 25.

In a recent paper (Johnston and Bancroft, 1920a, p. 40) it was pointed out that, in addition to the well-known nodule-producing worm, *Onchocerca gibsoni*, a second species of the genus was to be met with in cattle in Queensland and New South Wales. It was provisionally identified as *O. bovis*, but shortly afterwards (J. and B., 1920b), in a summary of that paper, it was definitely labelled as belonging to Piettre's species.

In Australian cattle the parasite is to be found in the neck ligament between the first and fifth dorsal vertebrae; also at the level of the trochanter between the ends of the tendons which are attached in that region. The tendons at the stifle joint are also at times infected. Though a fibrosis is set up as a result of the presence of the parasite, yet the lesions are usually not extensive and do not assume the nodular form, so typical of *O. gibsoni* and *O. indica*. The worms occur more or less tangled lying in a fibrous tunnel, and considerable lengths of the female may be extracted from the surrounding fibrosed tissue before breaking takes place. Males lie loosely coiled or tangled in spaces adjacent to the females, or at a little distance, and can readily be obtained entire. Disintegrating worms undergoing calcification may be met with.

The writer has been informed that the parasite may be found in a very large percentage of cattle slaughtered at the Abattoirs in Brisbane and Rockhampton, so that it is, probably, very widely distributed in Queensland. It occurs, not uncommonly, in cattle slaughtered in Sydney. Mr. N. V. Brown, to whom I am indebted for specimens and information, informed me that he had not observed it in



1
3
4
5
6
2
v
·5 mm.
9
7
8
a
μ

cattle killed in the Melbourne Abattoirs. Piettre (1912) recorded the presence of *O. bovis* in 26 out of 30 cattle examined in France, and in the cervical region of 65 per cent. to 70 per cent. of Argentine animals and of 90 per cent. of Uruguayan cattle killed at the meat preserving works in those two countries (Piettre, 1916; Joan, 1917). Emery (in Neumann, 1910, p. 270) reported that *O. gutturosa* was to be found in the connective tissue of the neck ligament, principally on the inner face, and especially at the level of the second and third dorsal vertebrae in Algeria and Tunis, where, he states, nearly all adult bovines harbour the parasite. It is worthy of note that Piettre (1912) failed to find *O. bovis* in the cervical ligament of French cattle, though he recorded it from the stifle joint and from the tibio-tarsal ligament.

We have not been able to determine the length of the female worm. Joan (1917, p. 448) gives it as being over 60 centimetres in Argentine specimens. Piettre found that in French specimens the total length of fragments exceeded 26 cm., while in Argentine worms (1916) it was about 70 cm.

Males (from Queensland cattle) measured from 24 to 33 mm. in length. Piettre gives 40 to 50 mm. in the case of French material. T. Joan mentioned that one of the males studied by her measured 57·5 mm.

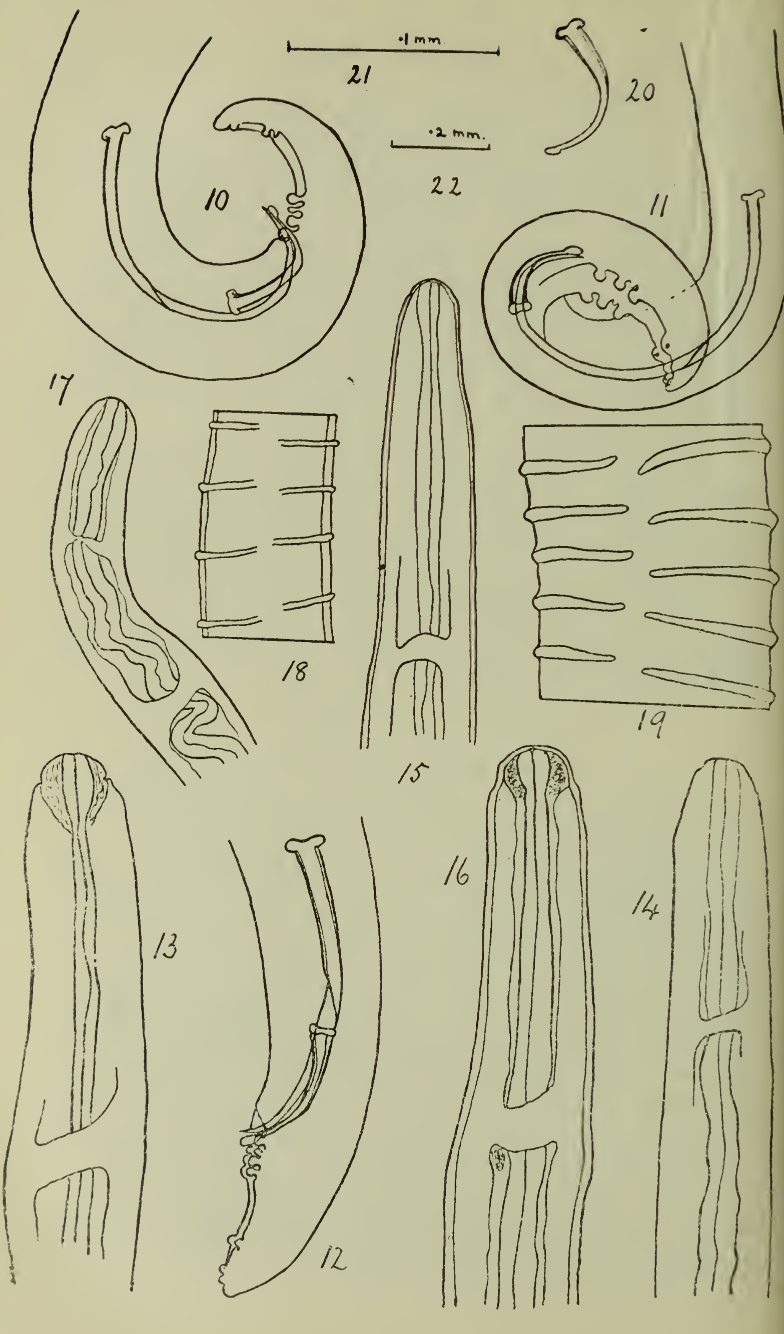
Description of Female.

Figs. 3, 7, 9, 16, 18, 19, 25.

The female body tapers gradually towards the anterior end, but rather abruptly at the posterior extremity.

The head end (figs. 3, 16) is gently rounded in front and, at least in some specimens, appears to possess a few minute papillae. The cuticle is smooth as far back as the region of the termination of the long oesophagus. The width of the body in front of the nerve ring is from ·05 to ·06 mm. In the region of the latter there is a dilatation, so that the body measures ·07 to ·075 mm. in diameter. Behind this it narrows slightly to become again somewhat dilated at the level of the vagina, where the body diameter reaches ·070 to ·085 mm. The first (cervical) dilatation is situated at from

Figs. 1 to 3, heads of females. 1, *O. gibsoni.* 2, *O. lienalis.* 3, *O. gutturosa.* 4 to 6, heads of males. 4, *O. gutturosa.* 5, *O. gibsoni.* 6, *O. lienalis.* 7 and 8, female tails. 7, *O. gutturosa.* 8, *O. lienalis* (ridges only roughly and partly indicated). 9, part of *O. gutturosa*, showing female aperture. *a*, anus; *p*, papilla; *v*, vagina. Figs. 1 to 8, drawn to the scale indicated; 9, drawn about four times that scale.


·1 mm.
21
20
·2 mm.
22
10
11
17
18
15
19
13
16
14
12

·20 to ·25 mm. from the anterior end, while the second, *i.e.*, that in the vaginal region, occurs at ·50 to ·60 mm. from the mouth. At ·15 mm. from the anterior end, *i.e.*, in the region of the termination of the oesophagus, the body diameter is ·08 mm.

The posterior extremity (fig. 7) is strongly ringed to the tip. The anus lies at about ·22 mm. from the termination of the worm, the body width there being about 0·8 mm. Immediately in front of it the diameter is about ·1 mm. Behind the anus the body gradually tapers to end in a bluntly rounded tip with a diameter of about ·05 to ·06 mm. The end of the tail possesses a tiny rounded projection at its termination and there is a pair of very minute papillae situated rather on the ventral aspect in front of it. Joan detected one pair in Argentine specimens, and Neumann figured a pair in the Algerian species.

The body, except in the anterior region, is marked by well-developed spiral cuticular ridges, which vary in their prominence and closeness of arrangement according to the body region (figs. 18, 19). They are generally from 4 to 6 micra in height, but vary in width from 6 to 15 micra. The distances between the spirals increase with the body diameter. Thus, where the latter is about ·110 mm. the ridges are about 20 μ apart; when ·115 to ·120 mm., they are 25 to 35 μ apart (figs. 19, 26); ·130 mm., 30 to 45 μ apart; ·230 to ·250 mm., about 60 to 80 μ apart (fig. 25); when ·280 mm. (the maximum diameter of the female worm), the ridges are from 95 to about 120 μ distant (occasionally as much as 140 μ) from each other (fig. 18). At 3·5 mm. from the posterior extremity, the body diameter is ·26 mm. and the low ridges are ·07 mm. apart; at one millimetre from the tip the measurements are ·13 and ·03 respectively; and at ·5 mm. they are ·12 and ·01 respectively. The ratio of the distance between ridges on the mid-body to the diameter of the mid-body is from ·33 to ·43.

The ridges have a slight wavy outline owing to the presence of tiny prominences on them and, at first sight, seem to be arranged in a simple spiral, but they are at least on a great part of the body, apparently along the lateral lines (figs. 18, 19), interrupted in a manner somewhat like that

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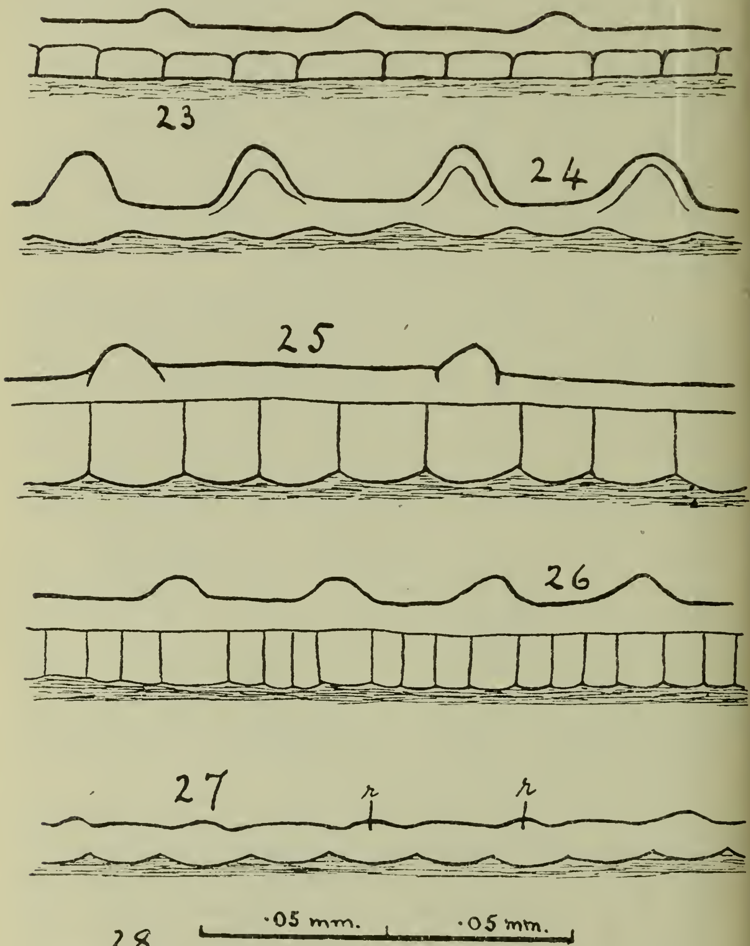
Figs. 10 to 12, tail ends of males. 10, *O. gutturosa*. 11, *O. lienalis*. 12, *O. gibsoni*. 13 to 15, heads of males. 13, *O. gutturosa*. 14, *O. lienalis*. 15, *O. gibsoni*. 16 and 17, heads of females. 16, *O. gutturosa*. 17, *O. lienalis*. 18 and 19, parts of body of female *O. gutturosa*. 18, body width, ·270 mm. 19, body width, ·120 mm. 20, small spicule of *O. gutturosa*. 21, scale to which figs. 10 to 17, 19, 20 were drawn. 22, scale for fig. 18.

figured (probably diagrammatically) by Joan for *O. bovis* (Argentine material), and exactly like that indicated by Neumann (1910, p. 275) for *O. gutturosa.* The arrangement of the ridges varies, then, according to the position from which they are viewed.



Figs. 23 to 27, views of side of females (optical section) to show thickness of cuticle, height of ridges, striae, etc.; all figs. drawn to scale indicated in fig. 28. 23, *O. fasciata* (diameter of body at place figured, ·41 mm.). 24, *O. gibsoni* (·50 mm.). 25, *O. gutturosa* (·230 mm.). 26, *O. gutturosa* (·120 mm.). 27, *O. lienalis* (·20 mm.); *r*; ridges.

The outer layer of the cuticle on the greater part of the female worm measures about 10 μ in thickness between the ridges. The underlying region is about 20 μ thick and is subdivided between each pair of ridges, usually into three (occasionally four) ring-like segments and there is one below each ridge (figs. 25, 26). From the apex of one ridge to that of the next one there are, then, three complete and two half rings of the under-cuticle, just as figured by Neumann. Thus there appear four striae between the ridges. Joan (p. 447) figures eight such secondary annulations and nine striae as occurring between the main ones, the latter being 127 μ apart and the former 15·5 μ. In our specimens the secondary rings measured from 7 to 10 μ (the main rings, *i.e.*, those below the ridges, being rather wider than those intervening), when the ridges were 45 μ apart; and about 20 μ in width when the summits of the ridges were 95 μ distant from each other.

The mouth is immediately followed by the long tubular oesophagus, about 1·52 mm. long and measuring from 12 to 18 μ in diameter in front of the nerve-ring and 22 to 25 μ behind it. Surrounding the anterior end of the oesophagus there is a mass of cells which appear to be glandular. The intestine does not call for comment.

As already stated, the position of the nerve-ring corresponds with the anterior dilatation of the body and lies at about 220 to 240 μ from the mouth. The excretory pore appears to be situated in this region. The thick-walled vagina opens at the level of the second dilatation, about ·50 to ·57 mm. from the anterior extremity of the worm (fig. 9). Uterine eggs, containing fully-developed larvae, have very thin shells and measure 32 to 37 μ in their major diameter and 23 to 30 μ in their minor axis. Larvae found free in the uteri have a length of about ·20 mm. and a breadth of 5 μ, the anterior end being bluntly rounded and the posterior pointed.

Description of the Male.

Figs. 4, 10, 13, 20.

The male worm maintains a comparatively even diameter throughout, being ·05 to ·06 mm. in front of the nerve-ring which lies at ·18 to ·20 mm. from the anterior end, gradually widening to ·08 to ·09 mm., and maintaining the latter breadth until near the posterior extremity. At the level of the anus the diameter is ·04 mm., the worm gradually tapering to the tip. The anterior dilatation in the vicinity of the nerve-ring is very slight, the diameter of the parasite there being about ·065 mm. The second dilatation of the female is not represented. A few tiny papillae appear to be present at a little distance behind the mouth. Cuticular ornamentation is hardly recognizable even under the oil immersion. The cuticle is very delicate, measuring about 2·5 to 3 μ in thickness.

The anterior end (figs. 4, 13) resembles that of the female, as also does the oesophagus, which has a similar diameter (10 to 12 μ), but the length is ·82 to 1·1 mm. The anus lies at ·075 to ·085 mm. from the tip of the spirally coiled tail.

The male papillary arrangement is usually as follows (fig. 10): four pair of perianal, of which the third pair are often rather smaller than the others; a post anal group of two, consisting of a smaller anterior papilla, lying just in front of, or beside, a larger one; and a caudal group composed of a prominent double one formed by the fusion of the pair (*i.e.*, one from each side), and there may, at times, be recognized a very small papilla on each side in front of it. The alae are rather narrow.

The longer spicule has an obliquely pointed end and measures from ·180 to ·255 μ in length, the breadth being 5 to 7 μ, while the shorter spicule is a thicker organ terminating in an enlarged rounded extremity. The shorter measures ·060 to ·080 mm. (generally about ·070) in length and 7 to 10 μ in maximum breadth (excluding the anterior expanded rim-like portion), its form tapering posteriorly so that the width is about 3 μ just in front of the widened extremity, which is about 5 μ across and 10 μ long (fig. 20).

If the information relating to this Australian species and *O. gutturosa* from Northern Africa, contained in the accompanying tables be compared, it will be noticed in regard to the males, that practically all the measurements agree except the lengths of the greater spicule, Neumann's maximum being longer than our maximum. In the case of the females the agreement is practically complete, the only marked differences being in regard to the diameters of the oesophagus and the cervical dilatation, these being of minor importance. It seems best to regard the Australian parasites as *O. gutturosa*, including under its synonymy *O. bovis*, Johnston and Bancroft, 1920 (*nec* Piettre, 1912). A specimen collected from an ox in Sydney Abattoirs and placed at our disposal through the kindness of Dr. E. W. Ferguson, Health Department, Sydney, was found to be specifically identical with the Queensland material.

The information available to the writer regarding *O. bovis*, Piettre, from French cattle is not sufficient to allow him to compare it with *O. gutturosa*. The site of infection varies, the latter being especially common in the neck ligaments, whereas the former is reported by Piettre as not invading that region. Neumann makes no reference to the presence of his species in any other location, but there is no evidence that it was looked for elsewhere. Piettre recorded *O. bovis* as occurring in the femora-tibial (stifle) joint of French cattle. The male of *O. bovis* is much longer and the female probably much shorter than those of *O. gutturosa*. The lengths of the male spicules, in the former, correspond with those of Australian specimens, but are less than those given by Neumann for *O. gutturosa*. In our earlier account it was mentioned that the female parasites were very like those of the Algerian species, but that the dimensions of the male spicules agreed with those of Piettre's species, hence our earlier determination. It must be left for some other investigator to determine whether Piettre's and Neumann's species are distinct.

The brief account (Joan, 1917) available regarding the South American parasite allows one to note certain differences from the Australian species. The males in the former are much longer and the papillae are said to be differently arranged, but in view of the difficulty sometimes experienced in detecting them, especially when the tail is closely rolled up, and in view of the variations in position (especially asymmetrical development) known to occur in the genus *Onchocerca*, further examination might reveal additional papillae. The South American female worms are recorded as being much longer than the French *O. bovis*, but agree more nearly with Neumann's account. The maximum diameter of the body and also the distance between the spirals are given as being about twice as great as in Algerian and Australian specimens. Besides, there are figured from six to nine striae between the ridges, whereas in the other cases there are from three to five. The egg is distinctly larger in both diameters, though not as large as given by Piettre for those of the French species.

It seems likely that the South American parasite is not *O. bovis*, but the available description does not allow one to synonymise it with *O. gutturosa*. The lesions and site of infection are similar to those of the Australian worm, as also are those briefly described by Ransom (1920, 1921), who reported that an *Onchocerca* occurred commonly in cattle slaughtered in Chicago. Whether the latter is *O. gutturosa* or the South American species has not been settled, though Piettre recorded as *O. bovis* parasites collected from frozen beef from Madagascar, Canada, and the United States.

Onchocerca lienalis, Stiles, 1892.

Figs. 2, 6, 8, 11, 14, 17, 27.

In the former account (Johnston and Bancroft, 1920) mention was made that "*O. bovis*" was to be met with in Queensland cattle in the gastro-splenic ligament, and it was suggested that the species was probably identical with Piettre's. Recent examination shows them to be quite distinct.

O. lienalis is extremely common in cattle in this State, especially in dairying districts in the south-eastern portion of it. It has been stated to me that nearly 100 per cent. of cows and bulls and perhaps 50 per cent. of oxen slaughtered are found to harbour this parasite whose presence in Australia had not previously been noted. In the Rockhampton district the worm is very common, but apparently less so than in the south-eastern part of the State. Mr. N. V. Brown has informed me that it is commonly met with in cattle in New South Wales.

The female nematode is readily overlooked owing to its location in the connective tissue, between the stomach and the spleen, especially adjacent to the latter, where the tunnel enclosing the parasite, if noticed, would easily be mistaken for an empty blood-vessel. The organism lives in a very delicate worm-like fibrous tunnel in the connective tissue, this tunnel showing no tendency to become thickened except occasionally at the tail end of the worm. There is then comparatively little fibrosis and no typical nodule formation as the parasite does not roll itself up in the tissues, except sometimes at the extreme posterior end, where coiling may occur and a slight local thickening of the tissue become noticeable. A female specimen, measured *in situ*, reached 316 mm., while another (also *in situ)*, whose extreme anterior end was missing, was 425 mm. long, its estimated length being 460 mm. Usually only two or three worms seem to occur in each host. Though every female examined (from about 25 different hosts) contained uterine larvae, in only one case was a male obtained.

As the worm has never been described, it seems advisable to place on record some data regarding it. Stiles named it *Filaria lienalis*, in 1892, from cattle in United States of America, but the description was lost during transit. In 1894 he referred to the parasite as *Spiroptera reticulata*. Both Leiper and Gedoelst, in 1911, placed it under *Onchocerca*.

Description of the Female.

The anterior end of the female is extremely delicate (figs. 6, 17) and it is a matter of chance whether one succeeds in obtaining the head. As only one such specimen was collected, the measurements are necessarily based on it and do not indicate any range of variation. The head end is bluntly rounded, and almost at once assumes a diameter of ·03 mm., reaching ·04 at the level of the nerve-ring (·16 mm. from the mouth). The increase in diameter is so gradual that at 40 mm. from the mouth it is only ·05 mm. Ultimately the width reaches a maximum of ·18 to ·20 mm. Towards the posterior end it tapers to about ·16 mm. (at ·6 mm. from the tip), then rather more quickly towards the tail (fig. 8). At the level of the anus (which lies at ·13 mm. from the tip) the diameter is ·065 mm. The extremity is bluntly rounded and possesses a pair of very minute papillae. *In situ* the tail end is sometimes found spirally rolled and lying in a little gland-like mass of fatty and fibrous tissue, but often occurs lying in line with the preceding part of the body.

The ridges in this species are irregularly wavy and extremely low, their greatest height being under two micra (fig. 27). In the mid-region of the worm they are fairly regularly situated at ·030 to ·040 mm. apart. In the tail region they are very low and close. At ·6 mm. from its tip they measured ·015 to ·017 mm. apart (body width ·16 mm.). Between two adjacent ridges there are two striae and, sometimes, these latter are sufficiently pronounced to make it difficult to distinguish them from the low ridges, and then that portion of the worm seems to be minutely corrugated. The ratio of the distance between adjacent ridges on the mid-body, to the mid-body diameter, is only ·2 as against ·33 to ·4 in the case of *O. gutturosa*, and about ·08 to ·10 in *O. gibsoni*, where they are especially close.

The oesophagus is ·75 mm. long, its diameter increasing from ·015 to ·02 mm. as it proceeds posteriorly. The vagina lies at ·48 mm. from the anterior extremity.

Description of the Male.

The male is a very delicate organism, apparently inhabiting serous spaces in the connective tissues, not surrounded by a tunnel—in this respect resembling the male of *O. gutturosa*. The only specimen obtained—a broken one—measures 23·8 mm. in length and possesses an even diameter (·05 mm.) for nearly the whole of its length; narrowing gradually to the spirally-wound tail, the width at the cloaca being ·03 mm. It is worthy of note that the head end has, practically, the same dimension as that of the female.

The head (figs. 6, 14) is rounded and bears at least two, probably four, tiny papillae. Lips are not recognizable.

The annulations, though very minute and closely arranged, are readily visible under the high power. The cloaca lies at ·06 mm. from the tip of the tail. The nerve-ring is situated at ·13 from the mouth. The oesophagus has a width of ·018 mm., increasing to ·025 mm.

The alae are very narrow. There are four pair of perianal papillae, the first, second, and fourth pairs being large, the third quite small and situated rather inwardly from the remainder. The postanal pair are very prominent and there seems to be a tiny pair inwardly from, and just behind, them. There is a pair of large caudal papillae, very close together. The spicules are of the usual *Onchocerca* form, measuring ·240 and ·057 mm. in length, and ·006 and ·009 mm. in width, respectively (fig. 11).

Ransom (1920, 1921) sated that *O. lienalis* is common and widely distributed in the United States. It appears to be a parasite of no economic importance.

Onchocerca gibsoni, Cleland and Johnston, 1910.

Figs. 1, 5, 12, 15, 24.

The common worm-nodule producer *O. gibsoni*, occurring in cattle in Queensland, New South Wales, and the Northern Territory, has been described so often that there is little need to do more than call attention to a few points in structure in order that they may be compared with similar parts in the other two cattle-frequenting species under review. Most of these particulars are referred to in the accompanying tables.

O. gibsoni (female) is a much stouter parasite than the other two and its spiral ridges are much more pronounced, being considerably higher and with better developed prominences along the course of the spirals. The male of *O. gibsoni* is also a rather larger parasite, its minimum equalling the maximum of *O. gutturosa*, and its cuticle is distinctly ornamented, ridges being indicated even on the tail.

The ridges in the female were found to be usually situated at from ·05 to ·08 mm. apart in the mid-body where the diameter was about ·45 mm. The maximum height was from 12 to 15 micra. Between adjacent ridges there could be seen, in favourable preparations, two fairly well-marked striae, 25 to 30 micra apart (fig. 24).

The nerve-ring in the female figured lies at ·12 to ·15 mm., and the vagina at ·7 mm. from the anterior end. Both of these organs vary somewhat in regard to their positions in relation to the anterior end.

As already pointed out by Dr. Sweet, the male may possess a large papilla situated well in front of the cloaca. In a favourable preparation, generously placed at my disposal by Dr. Ferguson, such a preanal pair is followed by three perianal pairs, a well-marked postanal, and a caudal group of three pairs—one being a large precaudal pair, followed by two smaller pairs, close to the tip of the tail—making a total of eight pairs.

The amount of fibrosis of the surrounding connective tissues of the host seems to be related to the development of ridges on the parasite, there being extremely little fibrosis surrounding *O. lienalis*, whose ridges are very low; a greater amount surrounds *O. gutturosa*, and, at times, there may be a slight indication of nodule formation, while the strongly corrugated forms, like *O. gibsoni*, *O. indica*, *O. fasciata*, and *O. volvulus*, give rise to a well-marked nodule formation.

ONCHOCERCA FASCIATA, Railliet and Henry, 1910.

Fig. 23.

Attention was drawn by Dr. Cleland and the author, in 1910, to the presence of a worm nodule-producing *Onchocerca* (identified as being perhaps *O. gibsoni)* in camels imported from India into Western Australia. In the same year Railliet and Henry (C.R. Soc. Biol., 68, 1910, p. 250) gave the species the above name, describing it as follows:—Female alone known from fragments without extremities; thickness, 400 to 475 micra; cuticle with slightly undulating ridges, repeated at every two or three striae; from a subcutaneous nodule from the head of a dromedary, Punjab. [The host was incorrectly listed by Dr. Sweet (1915, p. 31) as *Camelus bactrianus*.]

In our original account (1910, pp. 177, 178, 189) we mentioned that the anterior end and body fragments of the female specimens, examined by us, showed similar characters and measurements to those of *O. gibsoni*, and that the vulva was similarly placed.

A re-examination of some fragments, collected by Prof. Cleland from Western Australia, and now in the writer's collection, shows that the maximum body diameter is from ·40 to ·45 mm., and that the irregularly sinuous and knobbed ridges are from ·07 to ·09 mm. apart (fig. 23). Between the ridges are two to four, usually three, striae. The ridges are from 7 to 9 micra in height on the mid-body. The larval measurements resemble those of *O. gibsoni*, *viz.*, length ·18 to ·20 mm., and breadth ·003 mm.

TABLE SHOWING COMPARATIVE DATA RELATIN
The figures in parentheses are based on measurements obtaine
(relating to *O. gibsoni*) are taken from Dr. Sweet's pape

FEMALES.

	O. gutturosa. Australia.	*O. bovis,* France (Piettre).
Length of female	?	260+
Diameter ·15 mm. from anterior end ...	·08	
Diameter just in front of vulva	·07-·085	
Diameter of mid-body	·250-·280	·26-·29
Diameter at level of anus	·08-·10	
Diameter of cervical dilatation	·07-·075	
Nerve-ring from anterior end	·22-·24	
Oesophagus, length	1·52	·82-·85
Oesophagus, diameter	·012-·018	
Vulva from anterior end	·55-·60	·63-·65
Anus from posterior end	·22	
Cuticle thickness	·030	
Distance between spiral ridges on mid-body	·095-·120	
Ratio of distance between adjacent ridges on mid-body to maximum diameter of mid-body	·33-·43	
Number of striae between ridges	4	3
Height of ridges on mid-body	·004-·006	
Egg (with larva), length	·032-·037	·048-·053
Egg (with larva), breadth	·023-·030	·034-·036
Free larva, length	·20	·230-·265
Free larva, breadth	·005	·0055

MALES.

	O. gutturosa, Australia.	*O. bovis,* France (Piettre).
Length of male	24-33	40-50
Diameter ·15 mm. from anterior end ...	·05-·06	
Diameter ·5 mm. from anterior end	·05-·06	
Diameter of mid-body	·08-·09	·085-·095
Diameter of level of cloaca	·03-·04	
Diameter cervical dilatation	·065	
Nerve-ring from anterior end	·18-·22	
Oesophagus, length	1·1	·750-·800
Oesophagus, diameter	·010-·020	
Cloaca from posterior end	·075-·085	
Long spicule, length	·180-·255	·180-·210
Short spicule, length	·060-·080	·065-·075
Long spicule, diameter	·005-·007	
Short spicule, diameter	·007-·010	
Transverse ridges apart	·0015	·005-·006
Papillae (adanal, postanal, caudal)	4, 2, 1 or 2	4, 1, 2

(1) In our original short account (Agric. Gaz., N.S. Wales, 191
is a typographic

ONCHOCERCA, SPP. SIZES IN MILLIMETRES.
m the authors' drawings (Joan, Piettre), while those in brackets
15, pp. 44, 46), compiled from the work of various authors.

FEMALES.

O. bovis. Argentine (Joan and Piettre).	O. gutturosa, N. Africa.	O. lienalis, Queensland.	O. gibsoni.	O. fasciata.
600+-700+	550+	316-(460 ?)	[526-1403]	?
(·06)	(·072)-·081	·04	[·049]-·13	
(·10)	(·09)	·04	[·106-·207]	
·508	·30	·18-·20	[·37-·5]	·40-·475
(·170)	(·07)	·065	[·175-·245]	
(·030)	·09-·10	Absent	Absent	
(·27)	(·28)	·16	[·102-·188]	
1·262	1·15	·75-1·1	[·52-1·42]	
(·004)	(·036)	·015-·02	[·017-·052]	
(·60)	·55	·43-·48	[·33-1·138]	
(·30)	·20	·13	[·175-·402]	
(·023)	·035-·047	·020	[·007-·01]	·012-·015
·209	·090-·110	·040	·05-·08	·07-·09
(·24)	(·33-·37)	·2	·11-·13	·10
(6-9)	3-5	2	2	2-4 (3)
	(·006)	·002	·012-·015	(·006-·009)
·038-·042	·035-·045	·038-·040	[·04-·045]	
·031-·035	·028-·035	·028-·030	[·03-·039]	
	·170-·195	·240	[·22-·35]	·18-·23
	·004	·004	[·003-·004]	·003

MALES.

O. bovis, Argentine (Joan).	O. gutturosa, N. Africa.	O. lienalis, Queensland.	O. gibsoni.	O. fasciata.
57·5	28·3-33·8	23·8	[33-55]	Male not yet known
(·032)		·05	·038-[·066]	
	·35 (? ·035)	·05	·061-[·085]	
·09	·09-·105	·052	·12-[·196]	
(·03)	0·58	·03	[·035-·056]	
?	·08	Absent	Absent	
	(·35)	·13	[·14-·20]	
	·95	·90	[·48-1·07]	
(·01)		·018-·025	[·015-·07]	
(·057)		·060	[·048-·087]	
·216	·225-·295	·240	[·140-·220]	
·078	·075-·088	·057	[·063-·094] (1)	
(? ·005)	(·01)	·006	[·005-·014]	
(? ·005)	(·015)	·009	[·005-·008]	
	·0015-·0018	·002	[·0045-·006]	
(3 in text), 0, 2	4, 2, 1	4, 1 (? 2), 1	4, 1, 2 (3)	

e shorter spicule was reported to be ·047 mm. in length. This
ror for ·074 mm.

Acknowledgment is made to Mr. N. V. Brown, Brisbane, for his kindness in forwarding material from various parts of Queensland; and to Dr. E. W. Ferguson, Health Department, Sydney, for the loan of some mounted preparations.

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Notes on the Geology of the Moorlands (South Australia) Brown Coal Deposits.

By A. C. Broughton.

[Read October 13, 1921.]

Carbonaceous shales and lignitic material were located in a well sunk by Mr. Turner in the Hundred of Sherlock, about the year 1907, situated about 100 yards east from the Hundred of Seymour and 2,500 yards south from the Hundred of Hooper.

Several attempts were made to determine the extent of the formation, and investigations were carried out with a view to its utilization. It was not until the early part of 1920 that systematic and extensive work was undertaken to thoroughly test the locality. This is now being done by a private company—the Tailem Bend and Murray Coal Company—as well as by the South Australian Government. The results are made the subject of the present notes.

The area is being tested by bores every 300 yards, and where results justify every 150 yards, or closer. By this means very complete geological sections may be obtained. In the case of the company's bores, cores were collected every few inches from the surface to bed rock. The South Australian Department of Mines has a calyx drill working on this area, and the cores obtained by this drill are analysed by the Department. To date (September 18, 1921) the company has sunk 73 bores and the South Australian Government 20.

The following four particular bores will indicate the method of tabulating the records. The first three, *i.e.*, Bores A, B, and C, were sunk by the company, The fourth, D, shows how the coal is analysed, as the figures have been made available by the South Australian Department of Mines. The analyses were made by Mr. W. S. Chapman, of the School of Mines and Industries:—

Bore A.	Thickness. Ft.	Depth from Surface. Ft.
Surface sand	3	3
Travertine limestone	2	5
Pale-green and dull yellow-brown sand ...	3	8
Hard compact limestone	4	12
Pale-green clay, inclined to be arenaceous	$1\frac{1}{2}$	$13\frac{1}{2}$
Dull-yellow arenaceous clay, pale-green clay, yellow sandstone	$2\frac{1}{2}$	16

Bore A.	Thickness. Ft.	Depth from Surface. Ft.
Light-brown and yellow arenaceous clay	3	19
Dull-greenish sands, marine shells, sharks' teeth in this zone	3	22
Pale-yellow and grey and a little greenish arenaceous clay	8	30
Light-brown, grey, yellow, and greenish-yellow arenaceous clay with nodular ironstone, passing into carbonaceous shales of a chocolate colour at bottom	4½	34½
Brick-red and light-brown clay, yellow and grey arenaceous clay	½	35
Dark-grey arenaceous clay with reddish-brown streaks, light- and dark-yellow arenaceous shales, chocolate-coloured arenaceous shales	2½	37½
Interbanded dark bluish-grey to chocolate and dark-brown arenaceous shales, nodular pyrites, black carbonaceous shales ...	17	54½
Hard compact limestone, marine fossils, includes water-worn quartz grains and pyrites	3	57½
Grey to black carbonaceous shales with grey arenaceous shale bands	8	65½
Coal series with subfossil leaves, wood, and resin	33	98½
White talcose rotten slate, bed rock ...	3	101½

Bore B.	Thickness. Ft.	Depth from Surface. Ft.
Surface limestone	6	6
Green and yellow arenaceous clay, apparently yellow clay with thin seams of greenish sand	6	12
Small seam of black carbonaceous shale ...	½	12½
Talcose rotten slate, pink and greyish hue, bed rock	52	64½

Bore C.	Thickness. Ft.	Depth from Surface. Ft.
Surface soil	5	5
Travertine limestone	13	18
Greenish sand	6	24
Yellow clay	4	28
Light-grey and light-brown shales ...	5	33
Darker carbonaceous shales	2	35
Coal series	10	45
Carbonaceous shales	2	47
White talcose material, bed rock ...	5	52

Bore D.

The following analyses are supplied by the courtesy of the South Australian Department of Mines. Analyses by Mr. W. S. Chapman, of the School of Mines and Industries (Government number: No. 11 Bore, Moorlands [11 M.]):—

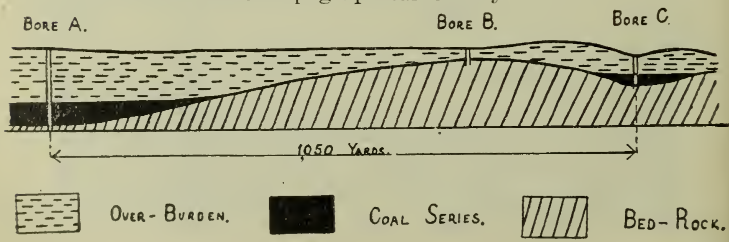
No. of Sample	Description.	Depth from Surface.	Analyses as Raised.			
			Moisture at 105° C. per cent.	Volatile Matter. per cent.	Fixed Carbon. per cent.	Ash. per cent.
1	Lignite	45′ 2″-50′ 8″	57·01	20·55	13·85	8·59
2	,,	50′ 8″-52′ 2″	50·67	21·67	15·26	12·40
3	,,	52′ 2″-55′ 2″	52·99	21·41	15·26	10·34
4	,,	55′ 2″-58′ 2″	52·75	24·00	15·80	7·45
5	,,	58′ 2″-61′ 2″	53·32	19·84	13·89	12·95
6	,,	61′ 2″-62′ 8″	54·00	22·94	13·40	9·66
7	,,	62′ 8″-65′ 8″	49·06	20·68	12·57	17·69
8	,,	65′ 8″-69′-2″	52·48	15·94	8·36	23·22
9	,,	69′ 2″-72′ 2″	48·41	20·09	11·46	20·04
10	Lignite	72′ 2″-74′ 8″	45·65	17·54	9·33	27·48
11	with clay	74′ 8″-75′ 8″	33·16	11·35	5·96	49·53

The first three bores have been chosen for description because they indicate the rapid alteration that occurs over comparatively short distances. The fourth bore has been selected because it is a typical example of the composition of the lignitic or brown coal series.

The Bores A, B, and C are in a straight line, north and south, 1,910 yards east from the boundary between the Hundreds of Sherlock and Seymour. The most northerly of these, *viz.*, Bore A,. is about 2,830 yards south from the Hundred of Hooper. The distance between this and Bore B is 750 yards; the distance between Bores B and C is 300 yards. These three together, with Bore D (a Government bore), are representative of 93 bores on the area considered.

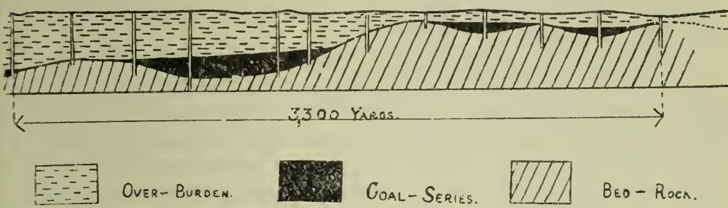
Geological Section 1.

Basin formation indicated by Bores. Vertical thickness exaggerated five times. Surface configuration according to Topographical Survey.



GEOLOGICAL SECTION 2.

Formation indicated by 12 Bores, in line, at 300 yards' interval. One Bore is 150 yards from next closest Bore. Vertical thickness exaggerated nine times. Surface configuration according to Survey.



The following table supplies particulars of Bores A, B, and C in respect to over-burden, thickness of coal series, and depth at which bed rock was struck:—

	Bore A.	Bore B.	Bore C.
Over-burden	67½ ft.	12½ ft.	35 ft.
Coal series	33 ft.	—	10 ft.
Bed rock at	100½ ft.	12½ ft.	45 ft.

From the preceding table it will be seen:—(1) The coal series occur in shallow basins; (2) a rapid variation in the thickness of the coal series; (3) old surface topography determines the coal basin occurrences.

From the log of Bore A, which is typical of 93 other bores over the area, we find that seven distinct lithological characteristics are encountered in regular order from the surface downwards:—

vii. Surface sand and travertine.

vi. Greenish and yellowish clays in which a greenish sand containing sharks' teeth occurs as a distinctive zone. Fossiliferous limestones.

v. Carbonaceous shales.

iv. Hard grey fossiliferous limestone with pyrites and quartz pebbles.

iii. Carbonaceous shales with appreciable amounts of iron sulphides.

ii. Brown coal series.

i. Rotten talcose slates, bed rock.

In places the bores have penetrated for some distance—in one place 52 ft.—into the old rock underlying the formations in which the coal series occur. Generally speaking, this old rock has been found to be a pipe-clay, if overlain by carbonaceous beds of any thickness. If the carbonaceous beds are thin, or absent, and fossiliferous limestones, arenaceous clays, clays, or sandstones immediately rest upon the bed rock, the latter is coloured in a variety of shades, such as delicate pink and silvery-grey, light green to a slate colour, intense purples, dull greens, and reds. The proximity of the carbonaceous deposits has resulted in a bleaching of the adjacent older formations.

Some bores have shown quartz or ironstone to occur in the bed rock immediately beneath the beds in which the coal series are found. When this occurs the quartz and ironstone are generally located near to the surface, indicating that such occurrences, by their greater resistance to weathering, led to elevations in the contour during the time immediately preceding the deposition of the brown coal series. Sometimes, when the quartz and ironstone have been penetrated, large lumps of undecomposed slate have been brought up in the boring tools, suggesting the presence of mineral reefs and lode breccia.

In addition to the bores, a number of shafts have been sunk in the district, several of which have penetrated the coal, and, in two places, considerable underground development gives an opportunity to examine the coal *in situ*. About 700 tons of coal have been raised, the quality of which may be gathered from particulars given of Bore D, which includes an analysis by Mr. Chapman, at the instance of the Mines Department.

Associated with the coal seam are remains of trees, still showing the original cellular structure, some with the original pith, which is grey and soft. The grain of the wood in some of these old trees is so well preserved that the timber may be splintered like deal.

These subfossil trees occur generally in a horizontal position within the enveloping carbonaceous matrix. This matrix contains small globules of a yellow resinous substance, and, occasionally, larger nodules of a darker resin, similar to yacka gum, in shape and colour, and a characteristic fossil leaf showing veination and cellular structure. This bed has the appearance of an old peaty deposit. Masses of the fossil leaves, sometimes $\frac{1}{8}$-in. in thickness, occur. In some places interbedded arenaceo-carbonaceous shales are met with in the coal deposit, indicating a local variation of conditions of deposition.

Conversion of the vegetable remains to a highly bituminous material is often observed; also the complete replacement of the original woody tissue by sulphide of iron, forming a pseudomorph in pyrites and showing the original vegetable structure. The mode of formation of these coal deposits was perhaps similar to the present-day swamps on the adjacent Murray back-waters.

From the evidences available the following order of occurrence may be suggested:—

(1) Denudation of high land immediately preceding a depression of the local area.

(2) Depression of the area which permitted swamps to form, into which were carried and retained timber and other organic material, the *débris* of floods and continental drainage.

(3) The previous dry land (Pre-Cambrian) now became basins in which newer sediments were deposited; the more elevated portions remained as islands or dry margins. Into the swamps, within the basins, highly carbonaceous muds were carried by floods; this, together with vegetation brought by flood waters and swamp plants which grew *in situ*, formed a peaty deposit.

(4) Further subsidence, preceded by local changes, caused deposition of less carbonaceous material with a corresponding increase of mineral sediments forming shales. Such subsidence permitted the sea to encroach and finally cover some, if not all, of the swamp land.

(5) Slight elevation then succeeded, and swamp conditions again eventuated, with the formation of thick carbonaceous shales.

(6) Another subsidence followed and the sea encroached. A series of fluctuations now occurred, evidenced by greenish sands (which contain sharks' teeth), sandstones, marine fossils in limestones, and clays. Finally the whole area was again elevated to dry land and our present-day conditions came into existence.

The Status of the Dingo.

By F. Wood Jones, D.Sc., F.Z.S.,
Professor of Anatomy in the University of Adelaide.

[Read October 13, 1921.]

Speculations concerning the origin of the Warrigal, or Dingo, have occupied a considerable place in Australian zoological literature, and if we accept Etheridge's 1916 Memoir as being the latest authoritative pronouncement upon the subject, we are forced to conclude that, in Australia at any rate, the question is regarded as by no means settled.

Etheridge postulates two alternatives: the Dingo may be indigenous, or it may be introduced; but he concludes his essay by saying, "which of the postulates the reader is prepared to adopt must be left to his interpretation of the facts stated." The reader will possibly be left with the impression that the author believes the animal to be indigenous, but the facts embodied in the substance of the paper are hardly sufficient for either author or reader to form a very definite opinion.

This uncertainty is, unfortunately, given currency in text-book literature, and Beddard (Mammalia, Camb. Nat. Hist., p. 421) says, "it does not seem certain whether it was tamed and brought over to Australia by the native races, or is a true and indigenous Australian species." It is owing to this apparent uncertainty concerning the animal that the present author has thought it worth while to write a paper upon a subject to the discussion of which he brings forward no new facts and no new theories.

[A] A brief survey of the literature yields the following opinions expressed, from time to time, by authorities upon Australian zoology:—

(1) The Dingo has been claimed to be an indigenous Australian mammal—an animal which originated within the confines of the Australian continent. Prof. McCoy (Prod. Paleont. Vict., Acc. vii., pp. 7-10) remarks that "the Dingo was really one of the most ancient of the indigenous mammals of the country." Again, Gerard Krefft (Mammals of Australia) says, "It must be accepted as a fact that the Dingo is indigenous."

(2) It has been claimed that the Dingo is not only an indigenous Australian mammal, but that it is, actually, the ancestor of the domestic dog. J. Douglas Ogilby (Cat. Aust.

Mamm., p. 125) states, "Until proof to the contrary is forthcoming, we shall consider the honour of being the original progenitor of our domestic favourite as due to the Australian Warrigal."

(3) It has been claimed that the Dingo is a wild, true species of *Canis* which came to Australia, unaided by and unassociated with man, by a land route which has ceased to exist. Lucas and Le Souëf (Animals of Australia, pp. 9-14) assert, "We must conclude that the Dingo reached this continent without the aid of man"; he "wandered into Australia when the land bridge existed where Torres Strait is now." The same view is expressed by Dr. R. L. Jack, who says (Geol. Pal. Q'land, 1892, p. 623), "The Dingo arrived by some chance means of conveyance without assistance, or he may have simply walked overland."

(4) It has been urged that the Dingo is a domesticated dog, which, as the companion of man (in the form of the Australian aboriginal), came to Australia from the north by a land bridge.

(5) It has been argued that the Dingo is a domesticated dog which came in with the Australian aboriginal, not by a land bridge, but by a sea route.

(6) It has been said to "owe its introduction to early Malay settlers from Asia" (Aflalo. Nat. Hist. Austr., p. 6).

(7) The Dingo has been said to be a domesticated dog introduced by Dutch navigators. Mr. J. Neil McGilp (South Australian Naturalist, vol. ii., No. 3, p. 59) states, "Most people, I believe, think that the Dingo was introduced by Dutch navigators into the Northern Territory." How widespread this belief may be I do not know.

[B] The antiquity of the Dingo in Australia has been very variously estimated:—

(1) It has been said to date from the Pliocene. McCoy *(op. cit.)* states, "Our present species, although still living in great numbers, I have no doubt dates from the Pliocene Tertiary time."

(2) It has been claimed as "one of the most ancient of the living Australian land mammals" by Lucas and Le Souëf.

(3) On the other hand, it is said to be no older than the period of the Dutch navigators.

[C] Strangely enough, although it is easy to find speculations concerning the zoological affinities of the Dingo, it is a difficult matter to discover exactly what points authors have relied on for their determinations. So far, I have been unable to trace among the writings of those who have speculated on the status of the Dingo, any indications of precise investigations into the crucial zoological characters of the animal they are dealing with: —

(1) McCoy says, "It was certain that the native dogs of Continental Asia were not clearly related, to the extent of specific identity, with the Australian one, nor could any near analogies be found elsewhere."

(2) Lucas and Le Souëf state that "in the anatomy of his teeth and skeleton he seems to be intermediate between the wild dogs of South America and the dogs and wolves of the Old World." Unfortunately the skeletal and dental characters by which this comparison was arrived at are not stated, and the particular wild dogs of South America, with which the comparison was made, are not specified.

(3) Ogilby pictured it as a wild dog which was the ancestor of all domesticated dogs, and Mr. C. M. Woodford gave it as his opinion that "the Dingo is probably the progenitor of the domestic dog of all the Pacific Islanders."

(4) Beddard assumes a non-committal attitude and calls the Dingo "an interesting and somewhat mysterious species of dog or wolf."

[D] That the Dingo is some sort of a dog is practically the only point upon which all writers have agreed. But it is one thing to agree that the Dingo is a dog, and another to agree as to what, zoologically speaking, a dog is. Before precise anatomical points were studied as the criteria for specific distinctions, a vast amount of speculative literature was woven about the problem of the origin of the dog as a domesticated animal. In Darwin's Animals and Plants under Domestication (1868) will be found a very good account of the opinions that had been put forward up to the time of writing this great work. It had been claimed that the domestic dog had his origin in the jackal, in the wolf, or in some species no longer extant. It had been claimed that the domesticated races were polyphyletic—that some had arisen from one wild stock and some from another. It had been claimed also that the origin was a mixed one, and that domestic dogs had arisen by the crossing of various wild stocks living or extinct. This uncertainty still exists in most accounts of the origin of the dog; even our best textbooks still hesitate concerning the wild progenitor of the domestic dogs, and most seek safety in hints at polyphyletism. Most of the uncertainty that prevails is due to emphasis laid upon such variable characters as coat colour, and texture, tail and ear carriage, and such other external and conspicuous but highly plastic features. Again, the relative fertility of domestic races with local feral races, or true wild species, has confused the issue.

In the genus *Canis*, as it is at present constituted, there are two main types—the true wolves and the jackalls. These two main types differ from all the other animals, formerly included in the genus, in two intrinsic anatomical features: (1) the pupil of the eye is circular when contracted, and (2) in the skull, the supra-orbital region and processes are inflated and convex. In these features the true members of the restricted genus *Canis* (which is practically the Thooid or Lupine series of Huxley) differ from the Alopecoids or Vulpine series, which have the pupil of the eye elliptical, and the supra-orbital region and process uninflated and concave.

All dogs, domestic or feral, conform to the first type and therefore belong to the restricted genus *Canis* or to the Thooids of Huxley.

Within the restricted genus *Canis*, the members have a full cynoid dentition, and in this they differ from the wild dogs of south-eastern Asia (the most probable immigrants in a "walk overland" colonization) which possess a dentition reduced by the loss of the last lower molar, and are separated into the genus *Cyno*. All domestic and feral dogs possess the full dentition, and therefore are not to be considered as descendants of the wild dogs of south-eastern Asia. The true wolves of the northern parts of the Old and New Worlds, and the jackals of southern Europe, Asia, and Africa, are, therefore, left as the possible progenitors of the domestic and feral races of dogs. The northern wolves differ from the jackals in (among other things) the form of their first upper molar tooth. In the jackals this tooth has a platform—the cingulum—running around the outer (labial) side of the crown; in the wolves the platform is reduced or wanting in the middle of its length. This condition of reduction of the cingulum must be regarded as a specialization in the northern wolves, since a complete cingulum is present in *Alopex*, *Vulpes*, and other Cynoids.

What is the condition of the cingulum of the first upper molar tooth in the feral or domesticated dog?—a Cynoid animal which has the full canine dentition, a circular pupil, and an inflated and convex supra-orbital process. Is the cingulum of the generalized Cynoid type, or is it the specialized and reduced type seen only in the true northern wolves? In every breed of domestic dog that has been examined, the specialized wolf tooth, and not the primitive jackal tooth, has been present. Mr. Gerrit Miller, of the United States National Museum, has given especial attention to this point and has declared the northern wolf origin of all races of domestic dogs (see Catalogue of the Mammals of

Western Europe). Again, in the American Journal of Mammalogy (Vol. I., No. 3, May, 1920, p. 149), Mr. Miller states, "In all specimens (of domestic dogs) that I have examined, representing very diversified breeds, the skull and teeth remain fundamentally true to the type which in wild canids is peculiar to the northern wolves. This type, particularly as regards the cheek teeth, does not represent a primitive condition which might be expected to occur in various members of the family without having any special significance. On the contrary, in respect to the development of a combined cutting and crushing type of carnassials and molars it is the most highly specialized type now in existence."

The domestic dogs are, therefore, monophyletic in so far as all are the descendants of the northern wolves; but, as Mr. Miller points out, domestic dogs will breed back with wolves, "and by this process many, possibly all, local forms of the wolf have perhaps contributed to the peculiarities of the domestic races." In other words, the domestic dogs may be claimed as polyphyletic in so far as various local races of northern wolves may have contributed to their ancestry; but monophyletic in so far as nothing but northern wolf has gone to their making.

The examination of a series of Dingo skulls can leave no doubt as to the true affinities of the Australian animal. The Dingo falls into line with all the other races of domestic dogs in being of the true northern wolf type. Moreover, in the large size of the carnassial teeth he approaches nearer to the ancestral type than do the other races of dogs of which I can obtain specimens or records.

The following table (Table I.) shows the basi-condylar length of the skull, and the length of the upper carnassial tooth, in a series of 22 genuine Dingo skulls. For permission to examine 20 of these specimens I am indebted to the authorities of the South Australian Museum (measurements are in millimetres): —

TABLE I.

No. and source of specimen.	Basi-condylar length.	Upper carnassial length.
1. S.A. Mus.	165	19·5
2. S.A. Mus.	165	20
3. S.A. Mus.	167	19
4. S.A. Mus.	169	21·5
5. S.A. Mus.	170	18
6. S.A. Mus., reared in captivity, ♀	170	16
7. S.A. Mus.	171	21
8. S.A. Mus.	174	19·5
9. S.A. Mus.	175	21
10. S.A. Mus.	176	20
11. F. W. J.	177	20

No. and source of specimen.	Basi-condylar length.	Upper carnassial length.
12. S.A. Mus.	178	20
13. S.A. Mus.	179	20·5
14. S.A. Mus.	180	21
15. S.A. Mus.	180	20
16. S.A. Mus.	181	21
17. F. W. J.	182	21
18. S.A. Mus.	184	20·5
19. S.A. Mus., reared in captivity, ♂	185	19
20. S.A. Mus.	190	20·5
21. S.A. Mus.	190	21
22. S.A. Mus.	193	22

The average of the measurements in this series shows that the Dingo, as a breed, has a basi-condylar length of 177·3 mm. and an upper carnassial length of 20 mm.

Table II. shows corresponding measurements of a series of domestic dog skulls, some of the figures being taken from the published records, and some from specimens in the South Australian Museum:—

Table II.

Breed of domestic dog.	Basi-condylar length.	Upper carnassial length.
1. Great Dane (Winge)	255	22
2. St. Bernard, S.A. Mus. ...	248	20
3. Large dog (Miller)	230	21·6
4. Mastiff, S.A. Mus.	230	22
5. St. Bernard, S.A. Mus. ...	228	22
6. Dog of the Iron Age from Denmark (Winge)	209	20
7. Average of 10 large dogs (Miller)	200+	20·5
8. Greyhound, S.A. Mus. ...	195	18
9. Greyhound, S.A. Mus. ...	185	17
10. Average of 20 Dingos (F. W. J.)	177·3	20
11. Chow dog, S.A. Mus.	170	17

It will be noticed from these tables that the Dingo, as a type, is a dog which possesses very large teeth, for the small-headed Dingo may have a condylo-basal length of only 165 mm. (No. 2, Table I.), and yet possess an upper carnassial tooth as large as that of a St. Bernard, the condylo-basal length of whose skull is as great as 248 mm. (No. 2, Table II.). It may be mentioned that the two greyhound skulls, in the South Australian Museum series, were mixed in with the 20 Dingo skulls, and although their measurements do not appear strikingly different from those of the Dingos, nevertheless, their relatively small teeth enabled them to be picked out with certainty before any measurements were taken. Of the very small series of dog skulls which I have been able to examine the Chow dog shows the greatest likeness to the Dingo in the form and proportions of the upper carnassial teeth. But large though the carnassials are in the Dingo, they do not reach the proportions of the same teeth in the wild northern wolves, for the average for the wolf tooth is 26 mm.; yet it must be remembered that the wolf skull is a large one, the condylo-basal length being constantly more than 200 mm.

It may be a mere coincidence that the two Dingos which were reared in captivity (Nos. 6 and 19, in Table I.) happen to have developed relatively smaller teeth than is normal in the race; nevertheless, the fact is suggestive of the manner in which the tooth reduction has come about in the more pampered races of the domestic dog.

It may, I think, be taken as certain that the Dingo is a domesticated and feral descendant of the true northern wolf, and that among such descendants he shows a primitive retention of his ancestors' great teeth. Physiologically, he has inherited the comparatively inoffensive smell of the wolf, and the habit of silent hunting; and in both these characters he differs widely from the jackals, the only other members of the restricted genus *Canis*. Evidence that the Dingo is a true domestic dog is to be found in the variability of his coat colour. Although it is commonly said that a pure-bred Dingo is difficult to find nowadays, proof of this statement must not be deduced from the fact that wild dogs of very varying colour are met with, for, as Mivart has pointed out, the first white men who came in contact with the Dingo remarked that both black dogs and red ones were common.

[E] Having dealt with the zoological affinities of the Dingo, a more certain basis is provided for discussing the opinions that have been put forward as to the status of the animal in the Australian mammalian fauna:—

(1) The supposition that the Dingo is indigenous, *i.e.*, that its phylogenetic story was unfolded within the confines of Australia, is absolutely untenable, and should, once and for all, be dismissed from literature having any pretence to scientific accuracy.

How the evolution of a Monodelphian Cynoid could have been accomplished in the absence of any possible ancestral forms, is a point which the advocates of the indigenous origin of the Dingo should be called upon to explain. The evolution of a modified northern wolf in an isolated portion of the Southern Hemisphere, tenanted solely by Ornithodelphians, Didelphians, and a few stray Monodelphian rodents and bats, is a thing which is zoologically inconceivable.

(2) The doctrine that the Dingo is "one of the most ancient of the living Australian land mammals," enunciated

by Lucas and LeSouëf, is ridiculous. In a land where *Ornithorhynchus* and *Myrmecobius* survive, the presence of a feral descendant of an introduced, domesticated northern wolf can merely be regarded as a relatively recent intrusion.

(3) The theory that the Dingo, as such, is the ancestor of all domesticated dogs, is absurd, and even that it was the ancestor of the dogs of the Pacific Islanders is difficult to credit. How did the Dingo spread its progeny about the world? If the introduction of the dog into Australia is a problem, what then of the infinitely greater difficulty involved in the dispersal of its progeny from Australia to the rest of the world, or even only to the Pacific Islands? A great deal of ingenuity must be expended in the planning of land bridges before the thesis can be considered as anything more than a mere random assertion.

(4) The claim that the Dingo is so ancient an inhabitant of Australia that he must have come before the earliest human arrival set foot here, must be considered from two points of view: first, the antiquity of man in Australia; and second, the possibility of the Dingo's unaided entry. Our knowledge of man's long tenure of the continent of Australia has been considerably enlarged by the finding of the Talgai skull, for though it must be admitted that "no absolutely certain evidence exists as to the exact level at which the skull was located" (Dr. S. A. Smith), the intrinsic evidence of its high antiquity is well established.

When taken in conjunction with the human molar from the breccia of the Wellington Caves, reported by Etheridge, the portions of human skeletons discovered under similar circumstances by Krefft, and the evidence collected by Dr. Fenner (South Australian Naturalist, *loc. cit.)*, we need not fear that the high antiquity of the Dingo in Australia need dissociate his advent from that of his human companion. It is safe to say that man and the Dingo were the contemporaries of some of the extinct marsupials, even if we do not venture to assign any geological name to the period of their overlap.

When we come to inquire into the possibility of the Dingo arriving in Australia unassisted by, and unassociated with, man, and when we examine the statements of those who have urged this possibility, we are forced to own that the difficulties of the problem have not always been appreciated by those who have advocated this solution. The easy assumption that the dog "simply walked overland," or that "he wandered into Australia" by a land bridge, has been a pitfall which many have failed to avoid. It need not be urged that the making of land bridges to admit individual members of an insular fauna, though a tempting business, is an extremely risky one. Above all, it is necessary in postulating a land bridge to picture one that would be effective in the admission of the species in question. For a zoologist to account for the admission of the Dingo by a former land bridge, "where Torres Strait is now," is remarkable. It is little use to make a passage from New Guinea to Australia unless a previous series of land bridges connecting New Guinea to the western Austro-Malayan islands is presupposed, and, finally, land bridges to connect the Austro-Malayan and the Indo-Malayan islands. In other words, Wallace's line must first be bridged for the benefit of the descendants of the northern wolves, and then a convenient series of land bridges must be provided for the journey, *via* the Austro-Malayan islands, into the island-continent of Australia. Despite the utter improbability of this thesis of recent land bridges for the admission of the Dingo, they have gained wide currency in Australian literature, and are urged, not only to account for the dog, but even for the admission of the aboriginal (see Howitt, etc.). How great would have been the faunal upset in Australia had land connections with the Asiatic continental masses (and nothing short of this will suffice) existed into the human period, is easy to picture, and may be imagined from a study of the very similar conditions existing in the Panama region. No land bridge that could have admitted either the Dingo or man, separately or in company, could have failed to be the high road of entry of a host of the higher placental mammals from the northern land masses. The fact that the Dingo failed to enter Tasmania, and that even Kangaroo Island was beyond his reach, should be remembered by those who do not fear to make southern land bridges within the period of the human occupation of Australia.

With Gerrit Miller's statement, that "dogs were originally domesticated somewhere within the northern area, inhabited by the true *Canis*, and that they were subsequently taken by man to most of the regions into which they have penetrated," it is impossible, in the face of all the available evidence, to disagree. The Dingo, I imagine, to be no exception to this rule. Just as man carried domesticated dogs to the Pacific Islands, where no indigenous member of the genus *Canis* exists, or has ever existed, so he carried him to Australia. And to Australia, as to the Pacific Islands, he carried him by a sea route. Some years ago, in a lecture delivered in London, I expressed the opinion that "the progenitor of the Talgai man came with his wife, he came with his dog, and with his dog's wife, and he must have done the journey in a seaworthy boat capable of traversing this unquiet portion of the ocean with his considerable cargo. Besides this living freight, and the food and water necessary for the adventure, he carried other things—he carried a knowledge of the boomerang, of the basis of a totem system, and various other cultural features, all bearing a strange suggestion of very distinctly western origin."

This statement has been regarded by some critics as being over-confident; but the examination of the cranial characters of the Dingo, and the comparison of his dental features with those of other Cynoids induces me to repeat it with added confidence.

Since the Dingo is a descendant of the northern wolves, and ranks merely as a variety of domesticated or feral dog, the name *Canis dingo*, given to the animal by Blumenbach, in 1878, cannot zoologically apply; and Australia's feral dog should be known as *Canis familiaris dingo*.

Notes on the Gynostemium in the Genus *Diuris*, and on the Pollinary Mechanism in *Phajus*.

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

[Read October 13, 1921.]

Plate XXII.

I. On the Gynostemium of the Genus Diuris.

The genus *Diuris* is peculiarly Australian, and does not extend to New Zealand or to any of the adjacent islands.

Its gynostemium is interesting, and apparently marks an important and rather primitive stage in the evolution of the Orchidaceae. The column or essential organ of the Order, in its generally accepted sense, can hardly be said to exist, as the male and female elements arise separately from the receptacle of the flower, and only enjoy a brief and adventitious union during the short period of maturity.

The anther is attached to a short filament, which arises from the posterior margin of the receptacle. It is placed vertically, and is considerably longer than the filament that bears it. It is 2-celled, each cell containing a bilobed pointed or pear-shaped pollen-mass, the pollen of which is mealy. The lines of dehiscence are vertical, and when ultimately the integuments split and retract, they leave two cusps below in which the bases of the pollinia are supported. There is no clinandrium.

Up to this point, anther and pollinia together form an entity, entirely separate from other portions of the sexual apparatus.

The stigmatic-plate carries the stigma and the rostellum on the upper part of its anterior face, and it is contracted below into a style which takes its origin in front of, but at a lower level than the filament of the anther, to which at this stage it has no sort of attachment whatever. The style is situated immediately over the cavity of the ovary, with which it communicates by means of the stigmatic-canal. The stigmatic-plate, or pistil, is approximately about the same height as the anther and, like it, is quite erect. The "disc" is at first an integral part of the rostellum, but as functional activity approaches, separation-cells are seen to be forming around it, necrosis takes place, and it is left lying loose in a slot in the apex of the rostellum.

The stigmatic-plate and the organs which it carries stand immediately in front of the anther with its bulging pollen-cells, but so far there is no connection between the two elements.

The filament of the anther is winged and the wings are produced vertically upwards into two linear structures of varying shape, which bridge the space between anther and stigma, and protect the pollinia after dehiscence against displacement and the drying influence of the air.

Dehiscence is now about to take place, and the rostellar-disc begins to secrete freely. The anther is rigidly supported behind by the fleshy curved base of the dorsal sepal. In front and at the sides, the whole of the sexual apparatus is embraced by the still erect labellum and its lateral lobes; the raised line or lines at the base of the lamina are exerting an increasing pressure against the stigmatic-plate in their progressive development, thus forcing the sexual elements of the flower more closely together. Dehiscence occurs, and for the first time union is established between the male and female elements of the plant. The apices of the pollinia become adherent to the back of the rostellar-disc. There is no caudicle. The flower expands; the insect-visitor removes the "viscid disc" together with the attached pollinia, and cross-pollination is then effected in the usual manner.

It is interesting in this connection to examine the gynostemium of *Prasophyllum*, which has reached a higher degree of specialization than that of *Diuris*. Here the filament of the anther is still retained, but it has become adnate to the base of the style, so as to form a very short column. The wings of the filament are very similar to those in *Diuris*, but in most members of the genus they have become adnate to the sides of the stigmatic-plate, so as to still further consolidate the column. The pollinia are composed of sectile pollen, and they form an attachment to the "viscid disc," not directly as in the case of *Diuris*, but through the intervention of a well-marked caudicle. The structure of the column is most easily studied in *P. elatum*, in which the flowers are relatively large. In this species the wings of the anther-filament have not yet become adnate to the stigmatic-plate.

Prasophyllum is almost exclusively an Australian genus, its only extension of range being to New Zealand.

These two genera do not appear to have developed along the usually accepted lines of evolution, which are presumably as follows:—

1. Suppression of some of the sexual parts and confluence of the rest to form a column.
2. Aggregation of the pollen into pollen-masses.
3. Formation of a rostellum.

4. Appearance of a "viscid disc" on the rostellum.

5. Development of a caudicle or its equivalent.

6. Conversion of the pollinia from mealy or granular into waxy masses.

Both are in possession of some of the more recently acquired characters of the Order, whereas in the one the column has not yet developed, and in the other it is apparently still in an early stage of evolution.

II. On the Pollinary Mechanism of Phajus.

Two species of *Phajus* indigenous to Queensland have been accepted as valid by the late R. D. Fitzgerald, F. M. Bailey, and other botanists.

Fitzgerald, indeed, prepared a beautiful plate of each of these, but did not live to complete the letter-press; consequently many important points connected with the pollinary mechanism have been left in doubt. Recently the writer has been fortunate enough to receive from Mr. C. T. White, Director of the Brisbane Botanic Gardens, a quantity of material which enables him to supply many details in regard to these Australian species which have hitherto been obscure or uncertain.

In the case of *P. grandifolius*, Lour., the material available has been ample, and has represented satisfactorily the various stages of development of the column in that species. The earliest stages were scantily represented in *P. Bernaysii*, Rowl., but the material is believed to have been sufficient on which to base trustworthy conclusions.

1. **P. grandifolius,** Lour. The structure of the column at maturity is shown in Fitzgerald's illustration. The upper part is dilated with fleshy wings. The anther is lid-like; it is attached just above the clinandrium and is situated horizontally over the stigmatic-cavity. The latter is, to a very considerable extent, shut off by the upward growth of its anterior margin, and by the inward encroachment of the lateral ones which are produced into two triangular inturned appendages. The appendages are continuous with the upper border of the stigma which is immediately below the clinandrium. There is no rostellum and no disc, so that the clinandrium, which is exceedingly shallow and oblique, merges almost insensibly into the stigma.

The stigmatic-cavity is capacious and its lower part is in free communication with the stigmatic-canal. Its surface begins to function very early and secretes copiously even before dehiscence of the anther.

In the early stage of development, the anther is placed perfectly upright on the apex of the column with its two large parallel cells bulging anteriorly. There is as yet no marginal growth to the stigma, and its surface, which is already viscid, is fully exposed as a rounded depression on the face of the column. Its appendages show as a blue dot on each side at the base of the anther-cells.

As development proceeds, the anther begins to descend and it gradually assumes an oblique position; the margins of the stigma grow upwards and inwards, so as to more readily accommodate the abundant secretion; the entrance to the stigmatic-cavity is further constricted by the growth of the appendages, whose function it is to limit the downward progress of the anther.

Dehiscence takes place in the early bud, when the anther has been brought to rest in the horizontal position by contact with the stigmatic appendages. Internally the anther is divided into two complete or primary cells, each of which is subdivided into two incomplete chambers. The four cells contain eight pollinia, arranged in an upper and a lower series of two pairs each. The former is accommodated in the upper part of the anther-cap, the points of the masses converging towards the apex of the anther and their bodies disposed radially towards the circumference. The second series, which is somewhat larger than the first, is situated immediately below, but considerably to the rear of the upper ones and overlapping their bases. Their covering membranes bulge considerably below the rim of the anther-cap.

The masses appear to be more or less embedded in a yellow granular matrix of a flocculent filamentous nature. This material is most abundant towards the apices, but it is also to be observed between the bodies of the masses as well as between the pollinia and the various septa. A careful examination of the anther before dehiscence shows that the matrix has become consolidated into linear bands or caudicles connecting together the apices of each upper and lower pair of pollinia in the dichotomous manner so beautifully illustrated by Francis Bauer,(1) more than a century ago, in Bletia Tankervilliae. These caudicles are of an unstable and fragile nature, and become broken up or pulverised after dehiscence, or even before, consequently they are only to be seen and dissected out in the early bud. Each pollen-mass is somewhat rounded or ovate with a short acute apex, and is also plano-convex, the plane surfaces of each pair being in apposition.

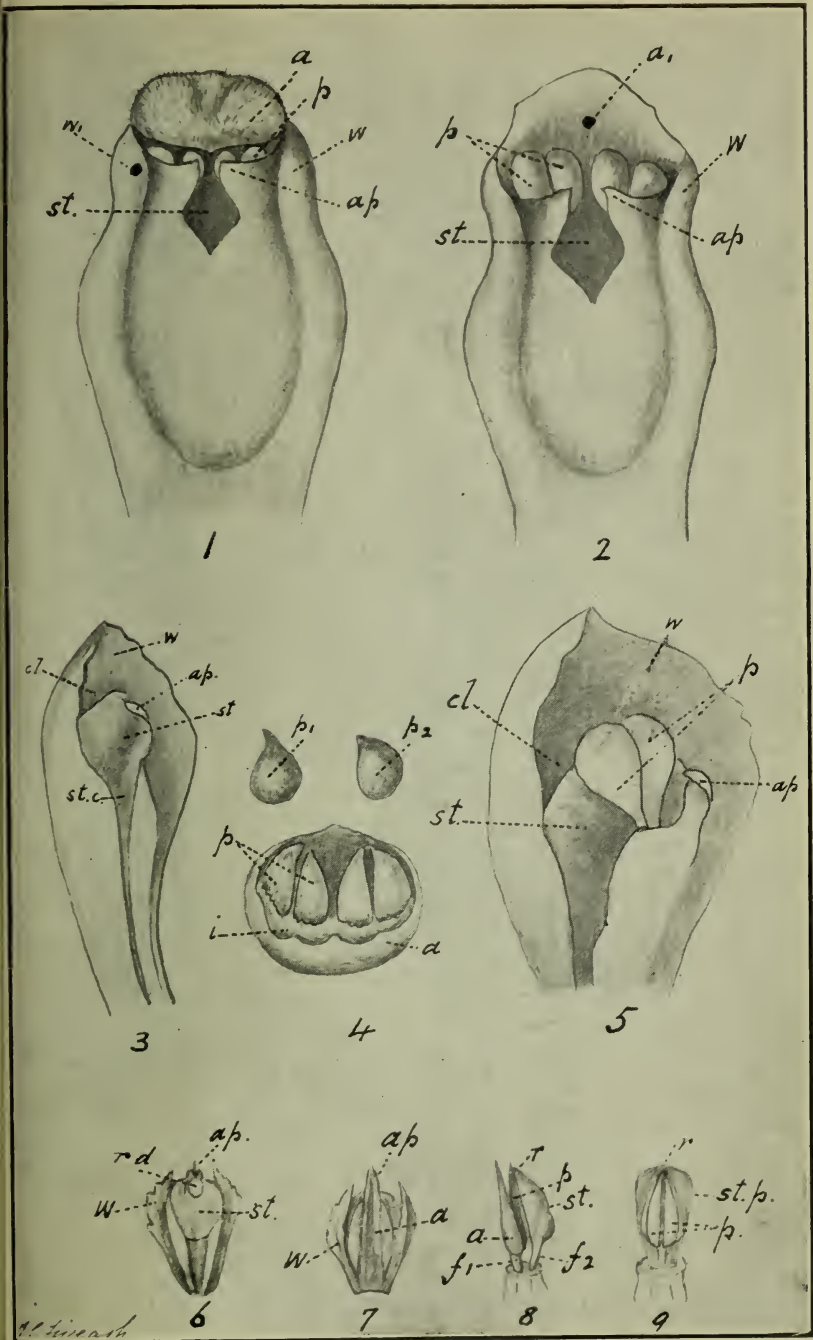
(1) Illustrations of Orchidaceous Plants, Tab. 1.

When dehiscence occurs, the covering membranes retract widely; the pollinia of the lower series are brought into contact with the stigmatic fluid, and seepage begins to take place, particularly into the two external masses. So rapidly do these latter become affected, that they rarely change their position and become quickly amalgamated with the viscid contents of the stigma. The inner pair usually slip down at the apices which are commonly to be seen protruding round the inner margins of the stigmatic appendages. Members of the upper series are subsequently liberated by retraction of the interlocular septa. The pollinia soon become cheesy under the influence of the stigmatic fluid and are then converted into a glutinous mass. Innumerable pollen-tubes are developed and may be traced as a mucoid cord down the stigmatic canal to the ovary.

Self-pollination therefore takes place in the bud, and it is inevitable that every flower should become fertilized, unless some untoward circumstance should interfere with the descent of the anther.

The only service conferred upon the plant by the expansion of the flower would appear to be the rapid drying up of the stigmatic contents and the effectual sealing of the stigmatic-canal. After expansion, the remains of the four lower masses are still to be traced as four rather dense elastic caruncles adhering to the back of the stigma.

2. **P. Bernaysii,** Rowl. This species bears a large and handsome yellow flower. Structurally the column approaches closely to that of *P. grandifolius*, but whereas the opening into the stigmatic cavity of the latter is V-shaped, in *P. Bernaysii* it is quadrilateral in form and very much smaller. The chief difference, however, is to be found in the attachment of the pollinia, which are approximately of the same size in both series so long as they are uninfluenced by the stigmatic fluid. A careful examination of the material available failed to disclose any evidence of attachment by dichotomous caudicle, even at an early stage of bud development. It was noted that at the apices of the masses, the granular material occasionally assumed a loose linear formation remotely resembling a caudicle, but in no instance did there appear to be a dichotomous connection between the individuals of a pair and between the corresponding pairs of two series, such as was found to exist in *P. grandifolius*. Dehiscence takes place very early in the bud, but pollinia are often retained, longer than would be expected from the frail nature of their attachment, some generally being found *in situ* after expansion of the flower. They also retain their



Figs. 1-5, *Phajus Bernaysii.* Figs. 6-9, *Diuris longifolia.*

Gillingham, Swann & Co. Ltd., Printers, Adelaide.

consistency and do not become agglutinated so rapidly as in the other species. As in the latter, the external members of the lower series are the first to become softened by absorption of stigmatic fluid, the others usually remaining uninfluenced and retaining their form until they are released from the matrix and fall into the stigmatic-cavity.

The tendency in the genus *Phajus* to produce supplementary anthers or staminodia is well known. Three such cases were observed in the material under examination. The staminodes took their origin from the upper shoulder of the wing and represent the suppressed lateral anthers of the inner whorl.

EXPLANATION OF PLATE XXII.

Fig. 1. Column of *P. Bernaysii* from the front, the anther is in the horizontal position; dehiscence has taken place. *a*, anther; *st*, stigma, *ap*, stigmatic appendage; *w*, wing of column; w_1, origin of staminode; *p*, pollen-mass of 2nd series showing below rim of anther.

Fig. 2. The anther has been removed together with the upper series of pollinia. Two pairs of pollinia belonging to the lower series can be seen, their bases still resting in the clinandrium. Lettering as in fig. 1, with the addition of: a_1, point of attachment of anther to back of column.

Fig. 3. A vertical mesial section of column, anther and pollinia removed; lettering as before with the addition of: *st.c*, stigmatic-canal; *cl*, clinandrium.

Fig. 4. Anther from below showing the two pairs of pollinia of the upper series. One pair is detached, showing the convex and plane surfaces of the masses and their acute apices. Lettering as in fig. 1, with the addition of: p_1, pollen-mass, showing convex surface; p_2, pollen-mass showing plane surface; *i*, retracted integuments.

Fig. 5. A vertical section through the upper part of column, the anther and upper series of pollinia removed. Dehiscence has taken place and a pair of pollinia belonging to the lower series may be seen with their bases resting in the clinandrium, their apices having slipped down against the margin of the stigmatic appendage. Lettering as in the preceding figures.

Fig. 6. Gynostemium of *Diuris longifolia* from the front showing: *ap*, anther-point; *w*, wing of anther-filament; *st*, stigma; *rd*, rostellar-disc.

Fig. 7. Same from the back. Lettering as in preceding figure, with addition of: *a*, anther.

Fig. 8. Same from the side, showing separate origins from the receptacle of anther-filament and the style of the stigmatic-plate. The wings of the filament have been removed. *a*, anther; *ap*, anther-point; f_1, anther-filament; f_2, style of the stigmatic-plate; *st*, stigma; *r*, rostellum; *p*, pollinia.

Fig. 9. Stigmatic-plate from behind with pollinia attached to viscid disc of rostellum. The anther and its wings have been removed. *st.p*, stigmatic-plate; *r*, rostellum; *p*, pollinia.

The Wing-Venation of the Leptoperlidae (Order Perlaria), with Description of a New Species of the Genus *Dinotoperla*, from Australia.

By R. J. Tillyard, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), C.M.Z.S., F.L.S., F.E.S., Entomologist and Chief of the Biological Department, Cawthron Institute, Nelson, N.Z.

(Communicated by A. M. Lea.)

[Read October 13, 1921.]

The Leptoperlidae are the dominant family in the Stonefly Fauna of the Southern Hemisphere, numerous species occurring in South America, New Zealand, Tasmania, and Australia. Owing to the fact that they are inert insects, seldom seen flying, and also because most of the species appear in the winter, or early spring, in Australia, very little is known about them here; and it is curious to note that only a single species, *Paranotoperla australica*, End., from south-western Australia, has, so far, been described from the mainland. They are, however, common on all fast mountain streams, and especially abundant in Victoria and Tasmania; while, even in so warm a climate as that of Sydney, at least two species can be taken fairly commonly from July to October.

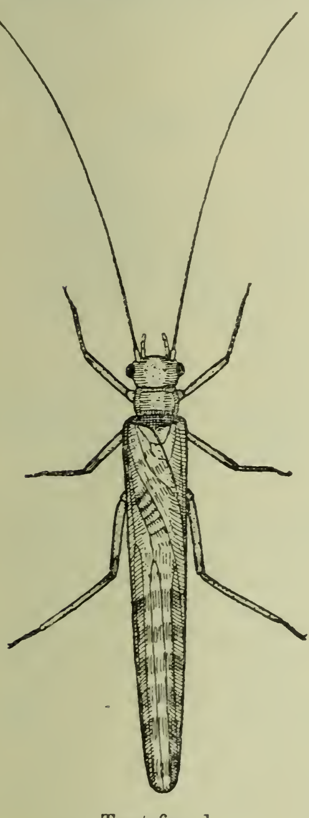
In a recent paper ("Canadian Entomologist," 1921, pp. 39, 40) I have tabulated the characters of the various families of the Order Perlaria, and have also given a dichotomic key to the same. The Leptoperlidae may be briefly defined as follows: —

Small to medium-sized stone-flies of a somewhat generalized structure, the mandibles, clypeus, and labrum normal, the palpi with short segments, the anterior coxae placed widely apart, the tarsi with segment 2 shortest, 3 longer than 1, the cerci usually long to moderately long, never reduced to 5 segments or less. In the forewing, Rs is usually either simple or once forked, very rarely three-branched; Cu_1 is simple or forked; 1A is simple; 2A is generally forked, rarely simple.(1) There is no anastomosis or transverse chord in either wing, but the distal half of the forewing, and frequently also of the hind, carries more or less numerous and irregularly placed cross-veins. A complete series of intercubital cross-veins is present in the forewing, together with

(1) It is possible that these veins are 2A and 3A respectively, and that both trachea and vein 1A have disappeared.

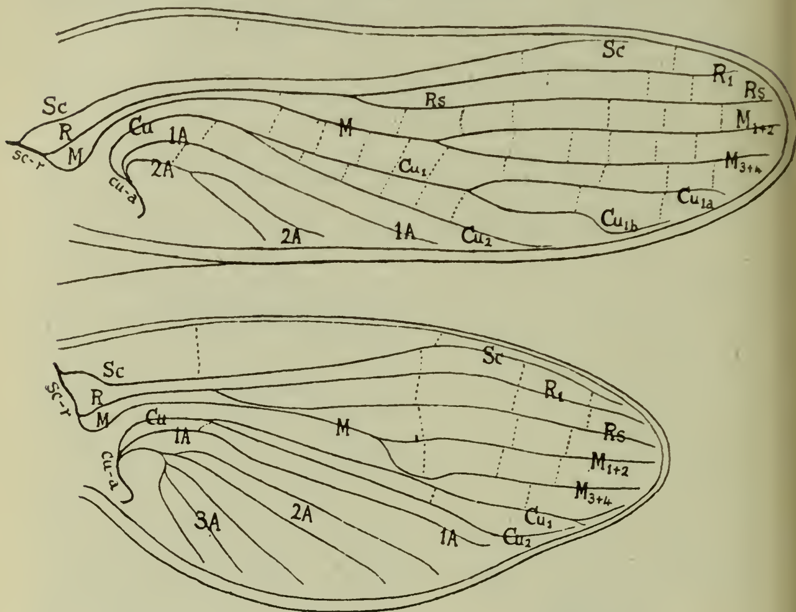
either a complete or incomplete series of medio-cubitals. In the hindwing, the anal fan is devoid of cross-veins, and there is always either a complete or incomplete fusion of the posterior branch of M with Cu_1, the basal piece of M_{3+4} descending transversely on to Cu_1 and appearing like a cross-vein. In the hindwing also, Rs and M are fused basally for some distance, as in most Perlaria.

The Leptoperlidae are all slenderly-built insects. In the position of rest, the wings are rolled round the body, the left forewing overlying the right. The larvae, none of which have so far been described, cling to rocks in running streams, and are remarkable for possessing a unique development of a rosette of gill-filaments around the anus, numbering fifty or more, which can be extruded or withdrawn as required. These gills are usually of a beautiful pink or lavender colour, more rarely whitish.



Text-fig. 1.
Dinotoperla carpenteri, n. sp. (×8).
The insect in the natural position of rest.

No study has yet been made of the tracheation of the larval wing in this family. While I was living at Hornsby, New South Wales, I discovered a small Leptoperlid larva on the rocks in one of the creeks flowing into Old Man's Valley, and succeeded in rearing the insect, which was found to be a new species of *Dinotoperla*, and will be described in this paper. A study of the wing-tracheation of this larva led to the discovery of the presence of the important specialization mentioned above for the hindwing, *viz.*, that there is always either a complete or partial fusion of M_{3+4} with Cu_1. The chief purpose of this short paper is to demonstrate this point, as a preliminary to the complete working out of the numerous undescribed genera and species of this family which exist in Australia, Tasmania, and New Zealand, and of which I possess a very large collection.



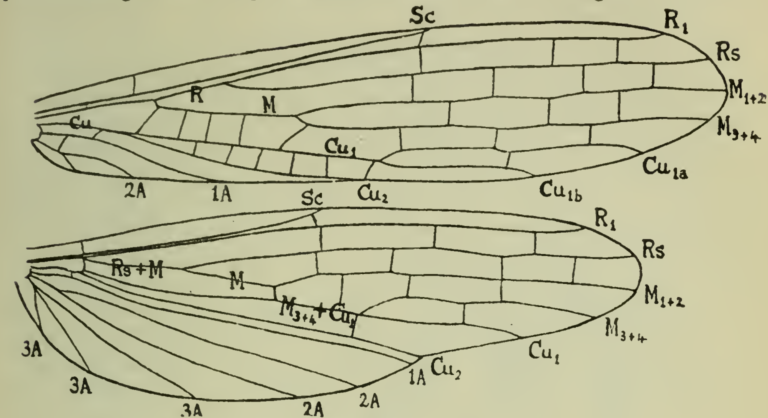
Text-fig. 2.

Dinotoperla carpenteri, n. sp. Tracheation of wings of last larval instar (×48). For lettering, see text-fig. 3, except *cu-a*, cubito-anal, and *sc-r*, subcosto-radial trunk trachea.

Text-fig. 2 shows the tracheation of the wings in the last larval instar of the Hornsby species, *Dinotoperla carpenteri*, n. sp. By comparing this with the imaginal wing-venation, shown in text-fig. 3, the manner of fusion of M_3+_4 with Cu_1 will be clearly seen. In the larval wing, trachea M_3+_4 comes off obliquely downwards from the main stem of M, runs alongside trachea Cu_1 for a short distance, and then diverges from it again, running freely to the wing margin. In the imaginal hindwing, the free basal piece of M_3+_4 takes on the appearance of a cross-vein descending on to Cu_1 at right angles, and, consequently, the free distal portion of M_3+_4, after its fusion with Cu_1, appears as if it were a true branch of this latter vein. It would, indeed, be impossible to guess the true condition of these veins without a reference to the precedent tracheation of the larval wing.

The only other genera of Leptoperlidae, so far described from Australia and Tasmania, are *Leptoperla*, Newm., and

Paranotoperla, End. In both of these, $M_{3}+_{4}$, after junctioning with Cu_1, remains fused with its right to the



Text-fig. 3.

Dinotoperla carpenteri, n. sp. Wing-venation (×10). 1A, 2A, 3A, the three anal veins; Cu, cubitus; Cu_1, first branch of cubitus, branching, in forewing only, into Cu_{1a} and Cu_{1b}; Cu_2, second branch of cubitus; M, media, branching in both wings into M_1+_2 and M_3+_4, the latter fusing partially with Cu_1 in hindwing only; R, radius; R_1, its main stem; Rs, radial sector, unbranched in both wings; Sc, subcosta.

wing margin. The three known genera may be easily separated by the following Key:—

(1) Cerci longer than abdomen; Rs in forewing, with a long fork	*Leptoperla*, Newm.
Cerci shorter than abdomen; Rs. in forewing simple	2
(2) Cu_1 in forewing, simple; in hindwing, a complete fusion between M_3+_4 and Cu_1	*Paranotoperla*, End.
Cu_1 in forewing, forked; in hindwing, the fusion between the M_3+_4 and Cu_1 is incomplete	*Dinotoperla*, Till.

Genus Dinotoperla, Till.

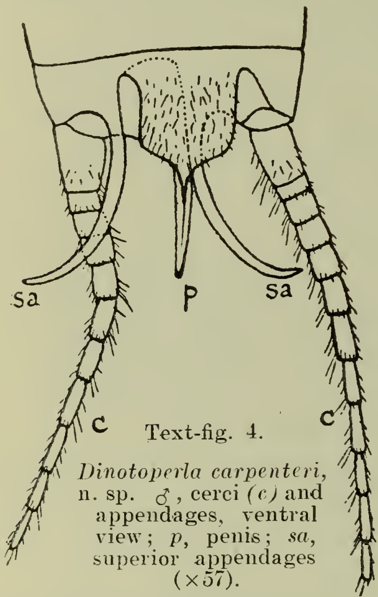
"Canadian Entomologist," 1921, p. 43, text-fig. 4*b*.

Dinotoperla carpenteri, n. sp.

Text-figs. 1, 3, 4.

Forewing, 10 mm. *Expanse*, 21·5 mm.

Head, thorax, and abdomen dull blackish, touched with dark brown behind the eyes and on notum. *Eyes* brownish-black. *Antennae* about as long as forewing, very slender, with about 50 segments, the basal one slightly enlarged. *Pronotum* rectangular, broader than long. *Legs* dull brownish, the apices of the femora and tibiae darkened; the tarsi darker, except at base of first segment. *Cerci* rather short, 10- to 11-segmented, tapering, delicately haired, the basal segment thickest and much longer than any of the next few succeeding segments. In the male, the *superior appendages* are slender, elongated, curved processes, projecting on either side of the penis, the basal portion of which is a broad plate, the distal portion slender and upcurved. The cerci and appendages of the male are figured in ventral view in text-fig. 4. In the female, the ventral plate is deeply bifid, a deep triangular median notch dividing it into two triangular pieces.



Text-fig. 4.

Dinotoperla carpenteri, n. sp. ♂, cerci (*c*) and appendages, ventral view; *p*, penis; *sa*, superior appendages (×57).

Wings: — *Forewing* medium fuscous, with irregular paler subhyaline spaces between the cross-veins; *i.e.*, each cross-vein is surrounded by a rectangle of the fuscous ground-colour, and the spaces between these rectangles are paler. As the positions and number of these cross-veins is inconstant, varying for each individual, the pattern thus produced is very irregular, and is never very conspicuous. *Hindwing* a uniform medium fuscous. When at rest, the dark and pale areas of the two wings appear to reinforce one another, giving the insect a distinctly banded appearance, as shown in text-fig. 1.

Dedicated to F. W. Carpenter, M.A., late science master at Sydney Grammar School, in memory of many happy days spent in the field together studying aquatic insects.

Locality:—Hornsby, near Sydney, N.S.W. Bred from larvae found on rocks in a small stream in Old Man's Valley; also found sitting about on the stems of reeds and grass near the stream. July to October.

Types:—Holotype (Hornsby, Sept. 14, 1917, R. J. T.) and series of para-types in Tillyard Collection, Cawthron Institute, Nelson, N.Z.

The set specimens have the abdomens so shrivelled that it is impossible to determine the sex or study the sexual appendages. The descriptions of these organs given above were made from slides prepared from specimens of the para-type series.

MISCELLANEA.

Obituary Notices.

Remarks by the President.

During the month one has passed away who, for a quarter of a century was an active Fellow of our Society, Mr. A. H. C. Zietz. He was elected in 1886. As one of the officers in the Adelaide Museum he had opportunities for study of much of our South Australian fauna, both land and marine. His first paper, read in April, 1887, was entitled "Descriptions of New Species of South Australian Crustaceans." He created a new genus for one *Gryllopagurus* and specified the type as *lithodomus*. It was discovered in Gulf St. Vincent by a born naturalist, a young public school teacher named G. W. McDougall, who unfortunately died early in life. Doubtless some of the Fellows have seen the interesting little animal, which lives in a vertical burrow in soft stone, and so folds up it's front parts as to form a remarkable flat stopper. The second crustacean was the *Dromia bicavernosa*, a medium-sized crab with a strange kidney-shaped cavity outside each eye hole, with a red margin, the use of which he could not divine. This was the first of a dozen papers from his pen on birds, fish, snakes, crustaceans, kangaroos, wallabies, whales, dolphins, and fossils. In collaboration with Dr. E. C. Stirling he wrote two papers on the *Genyornis newtoni*, and one on the *Phascolonus gigas* of Owen. He was largely responsible for the reproduction of the gigantic wombat, *Diprotodon australis*, whose skeleton is erected in the Australian section of the Adelaide Museum, building up its bones from the friable fossil remains found at Lake Callabonna. The recognition of his scientific work and his friendliness are indelibly commemorated in a dozen or more species named after him by various authors, among whom I am pleased to number myself. Mr. Blackburn went further and created an insect genus of *Zietzia*. He accompanied me on some of my marine excursions in search of mollusca, and always proved himself an indefatigable collector, an intelligent scientist, and a very easy and agreeable companion.

We have also to record the death of Mr. G. G. Mayo, who had been a Fellow from 1874 till 1919, a period of 46 years, and who is now represented on our register by two of his children, Dr. Helen Mayo and Mr. Herbert Mayo, LL.B. A short tribute to his useful relationship to our Society was rendered last year when he resigned his Fellowship and may be found in Vol. XLIV.

J. C. Verco.

Evening Meeting, September 8, 1921.

A Tholeiitic Basalt from Eastern Kangaroo Island.

(Communicated by Professor Walter Howchin.)

The evidence of igneous action of Tertiary date in the Kangaroo Island area has, so far, been indicated only in the neighbourhood of Kingscote, and to the west.

The rock, which is shortly described in this note, represents a further member of the Tertiary suite—developed in the vicinity of Cape Willoughby. Through the kindness of Professor Howchin, the writer has been able to study this rock, collected by him from a dyke cutting the older Palaeozoic or Proterozoic schists near Cuttle Fish Bay, Hundred of Dudley (Trans. Roy. Soc. S. Austr., vol. xxvii., 1903, pt. I., p. 82).

The hand specimen is a grey-black, fine-grained rock containing phenocrysts of felspar, visible with a low-power lens. There are also present a number of small spherical masses of brown colour which represent infilled amygdales. These do not exceed one-sixteenth of an inch in diameter.

Viewed in thin sections, the rock has the mineralogical composition and texture of a basalt. The phenocrysts consist of plagioclase and augite set in a ground-mass of hypocrystalline nature. The constituents of the ground-mass are augite, plagioclase, magnetite, brown glass, and the amygdale minerals, opal, and an undetermined zeolite.

The augite phenocrysts are usually subidiomorphic and reach in size $1\frac{1}{2}$ mm. They are elongated parallel to the vertical axis. In convergent light they are seen to be of two types, a dominant one, biaxal, and in less amount an enstatite augite of uniaxial character. They are both colourless to greyish with well-developed prismatic cleavages, and commonly show twinning on 100. The plagioclase phenocrysts reach a similar dimension but are usually smaller. They show twinning after the Carlsbad and Albite laws, and less commonly the pericline. The composition approximates that of bytownite, with a refractive index of 1·57. A glomeroporphyritic texture is often apparent.

The ground-mass of augite, plagioclase, and glass has the typical intercertal fabric, the brown glass occurring as angular patches between the plagioclase laths. The felspar is a plagioclase of labradorite composition, with a lath-shaped habit, and the augite granules still preserve a tendency towards elongation parallel to the vertical axis. Grains of magnetite are uniformly distributed through the base. The amygdales of spherical shape are filled with a very low refracting substance, partly isotropic, and partly birefringent.

The isotropic material usually borders the vesicle, and the central part is filled with a birefringent mass of radiating zeolite fibres. Both these substances have a refractive index less than 1·51. The isotropic material shows irregular cracks, and has the properties of opal. Its reflective index is considerably below that of the brown glass. These zeolitic patches are developed quite irregularly between the constituents of the ground-mass.

In some cases the vesicles were formed prior to the final consolidation of the rock as they are surrounded, externally, by the ground-mass felspar laths arranged tangentially to the spherical surface of the vesicle.

This rock is thus distinctly related to the tholeiite type of basalt, but shows some affinities with the innimmorites, in the presence of a uniaxial augite, and the presence of opal in the vesicle substances indicates an acidity more comparable with the latter. The rock bears no relation petrographically with the Palaeozoic dyke rocks of the Blinman and Victor Harbour districts, and there can be no question of its relation to the Tertiary igneous rocks of the Kingscote area. The basalts of Kingscote have been shown by Stanley (Trans. Roy. Soc. S. Austr., vol. xxxiv., 1910, pp. 69-74) to be enstatite types of comparative high acidity (53% SiO_2). By the presence of the enstatite molecule in the monoclinic pyroxene, this tholeiitic basalt is petrographically linked with the enstatite basalts, and it is probable that they represent terms in a common differentiation series.

C. E. Tilley.

Evening Meeting, April 14, 1921.

Loranthus and Its Hosts.

Dr. J. B. Cleland exhibited specimens of *Loranthus* showing the remarkable resemblance each bore to the general appearance of the particular hosts. Thus *Loranthus exocarpi* on the cultivated olive (and oleander): *L. miraculosus* on *Myoporum platycarpum*; *L.* sp. near *L. gibberulus* on *Casuarina* and *L. linophyllus* on *Acacia Burkitti*, were in some instances almost indistinguishable when growing from the trees or bushes on which they were parasitic. Why this resemblance?

(1) The suggestion that the resemblance is a protective device of advantage to the mistletoe can at once be dismissed. The mistletoe, being spread by birds feeding on its fruits, is more likely to court observation than otherwise.

(2) May the resemblance be due to some hormone developed in the host reaching the parasite by means of the sap and thus modifying and controlling the development of the

parasite in the same way that it may influence the host's tissues? This view is ruled out of court by an examination of the specimens exhibited, amongst which we find examples in which the leaves of the mistletoe resemble (1) the leaves of the host, (2) the phyllodes of the host, and (3) the branchlets of the host. In other words, the hormone if present would be modifying in some instances different structures in the parasite to those in the host.

(3) The following, it is suggested, is the real explanation. The successful establishment of the parasite is probably due to its accommodating itself reasonably well to the normal supplies of food and water available from the host. If it required, owing to greater evaporation, more water than the host was capable of distributing, then the parasite would presumably die out just as a plant in the earth succumbs in drought. The water supply of the host will depend partly on the evaporation from the leaves or leaf substitutes. If these are protected from rapid loss (*e.g.*, are glazed, terete, etc.), then the mistletoe to survive must modify its leaves so as to let the escape of water by their means be relatively equivalent to that from a corresponding branch of the host. Otherwise, if the loss be much greater, the available water travelling up the host will be soon exhausted. Hence only those species of Loranth can develop on particular hosts whose leaves function similarly to the leaves or leaf substitutes of the host.

John B. Cleland.

Evening Meeting, April 14, 1921.

Old Native Camps at Commodore Point, Encounter Bay.

The native camps referred to in these notes are at the back of Commodore Point, in Sections 2311 and 2285. I visited them in January, 1921, and this is intended to record their condition at that date.

Commodore Point is a granite outcrop backed by sandhills. In these there are masses of travertine which were largely used by the natives for hearth-stones and, in the blown sand, these masses of blackened travertine often stand out as little hillocks. On digging into these, carbonized matter is found mixed with remains of food materials. Although one finds these ancient hearths scattered all through the sandhills at the sides and back of the Point, the main camp is just to the west of the Frenchman Rock.

This camp is about 300 yards long and 100 yards wide. The whole area is thickly covered with shells of *Donax epidermia* from the adjacent Middleton beach, and this cockle evidently formed the main food supply of the camp. The valves are present in countless millions. Mixed with these, sparingly, are shells of *Turbo undulatus*, *Fasciolaria*, *Fusus*, and a few other species. The surface is uneven and there are mounds rising as high as 10 ft., in places. Hearths, formed of circular collections of blackened travertine, are scattered everywhere. Amongst these are burial mounds, many of which have recently been exposed, and long bones, ribs, and hand and foot bones are plentiful. Owing to the burials being in a sitting position the skulls have been first exposed and generally carried away. On digging down the lower jaw is generally the first bone met with. The bones are in a well-preserved condition and are evidently those of primary burials; that is to say, they are not interments of bones from tree burials such as one often finds in *tumuli* on the lower Murray. In these the hand and foot bones are frequently partly or wholly missing. The camp is of very old date, and the extensive sand movements have sifted out the shells and stones so that successive strata are probably mixed and now rest on the hard pan.

The main object of the visit was to see what stone remains could be gathered. The stone implements of the Encounter Bay natives were of a most primitive kind, made to use in the camps and left there and not carried about. Those exhibited show the principal forms met with. The most common are the flat oval hammer stones which appear to have been used for cracking cockles. In form they are light and easily handled, and their edges show the marks of frequent percussion. More rarely, one finds stout circular stones with a well-marked depression on which cockles and Turbos were placed to be cracked. Then there are rough hand axes, or choppers, made by knocking flakes off a pebble of suitable size. These are similar to those found in camps on the Victorian coast, and of which I have specimens from Point Cook, near Melbourne, where there is a similar extensive camp.

Flat masses of granite are scattered about, brought from the adjacent beach, and are always polished with use on the upper-surface, while the lower is in the natural rough condition. These, probably, were used for grinding ochre, of which masses of the yellow and red varieties are met with. Small highly-polished stones were probably used to grind with. The search revealed no small chipped implements, but flakes of quartz are everywhere. These are of such a size and shape that they make excellent tools for opening the *Donax*, and I suggest that this was the use they were put to. The quartz must have been brought from some distant part, and Rosetta Head seems to be the nearest place where it occurs in quantity. High up on the saddle of Rosetta Head is a place which was very likely the source of this material, and chips are scattered about over a large area. The extreme hardness and fine edge of this material rendered the chips fit for their intended use without any secondary working. Chips of other material are less common, and some of them are pointed in form and may have been used as borers or gravers. No large millstones are met with apart from the granite masses which may have been used as such, but one fragment with a concave surface is shown which is evidently of this nature.

Apart from the mollusca the only food remains are the otoliths of the mullowan, or butter fish, which occur in considerable numbers all over the camp, and this fish evidently largely contributed to the aboriginal food supplies.

R. H. Pulleine.

Evening Meeting, May 12, 1921.

On the Methods Adopted by the Aborigines of Australia in the Making of Stone Implements, based on Actual Observation.

In my late visit to Central Australia I came into contact with some aboriginals that still used their native weapons. Two of these, one quite destitute of clothing, were met with near the River Finke. They were carrying about half a dozen rabbits each, which they had killed by means of their wooden barbed-spears and throwing sticks, or womerahs. The womerahs had, as is usual, at the opposite end to the prong, a carefully-chipped stone implement, in the form of a gouge, which is used for shaping most of the wooden tools and weapons of the natives. From these men I obtained useful information as to the methods adopted by them in making their stone implements, whether by flaking, chipping, or otherwise. The information thus obtained throws important light on certain features that could not previously be explained.

It is well known that the stone commonly used by the aborigines as a braying stone, or hammer, was a naturally-formed, oval-shaped, waterworn stone, very fine in the grain. These so-called "hammer" stones are among the most common and widely distributed of aboriginal implements, and are frequently found on the sites of their old camping grounds. They give evidence of having been used by the abrasion or roughened appearance that occurs on some parts of the surface. It has been a little perplexing to find that some of these hammer stones show an abraded surface at one or both ends of the stone in its longer diameter, while others show the abrasion, not at the end, but at a little distance from the end, and on one or more of the lateral faces. In some cases the tool shows signs of use both at the ends and on the sides of the pebble.

The reason for this was explained by my native instructors. When a flake has to be struck from the core, the end of the hammer is used and a sharp blow is directed at a point near the edge of the previously prepared flat surface of the core. By this means a flake, possibly several inches in length, is struck off and shows a conchoidal fracture concentric to the point where the impact was made. To obtain this effect the striking tool must be used vertically and with considerable force. To work up a fine cutting edge by secondary chipping a different method is adopted. During the day on which I met the two aboriginals at the Finke I happened to have picked up a quartzite flake, that was chipped to some extent on one side, and also a round pebble that had been used as a hammer stone. I produced these from my pocket and showed them to the two natives. With respect to the quartzite flake, they said, "Him no good." I then said to them, "Show me how you make him." One of the natives then took the quartzite in his left hand and the round stone, or hammer, in his right, holding the flake with its flat, or conchoidal side, uppermost. Then, instead of using the hammer, end on, as is done when removing flakes from the core, he struck the edge of the flake by a sideways blow from the hammer, which produced a bevelled surface along the edge of the convex side of the flake. The object, in this case, was to make a womerah stone, but, as the native stated, the stone (a quartzite) was not a good kind of stone for this purpose. Womerah gouges are usually made from a very fine-grained porcelain-like stone, and are often an article of barter between the tribes.

This object-lesson explains not only the use of the smooth, oval-shaped pebbles (which might be more appropriately called *fabricators* rather than hammers), but also the origin of the two kinds of abrasion seen on these stones, as referred to above. I also ascertained that in the use of the stone gouges, or other cutting instruments, the stone knife is not directed away from the workman, as in the case of European usage in cutting with a steel knife, but is directed towards the workman.

The information obtained from the natives at the Finke was confirmed and still further illustrated by the natives met with on the Macumba Station.

WALTER HOWCHIN.

Evening Meeting, September 8, 1921.

ABSTRACT OF PROCEEDINGS

OF THE

Royal Society of South Australia

(Incorporated)

FOR THE YEAR, NOVEMBER 1, 1920, TO OCTOBER 31, 1921.

ORDINARY MEETING, NOVEMBER 11, 1920.

THE PRESIDENT (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

ELECTION.—John Neil McGilp a Fellow.

TREASURERSHIP.—The resignation of W. B. Poole as Hon. Treasurer was accepted with regret, and expressions of appreciation of his services were spoken; B. S. Roach was elected to the vacant position.

The HON. SECRETARY reported that the Council had handed to the Archives Department of the Public Library, for safe custody, certain old documents referring to the origin and early history of the Society, which would be catalogued and always available for reference.

RESOLVED: That the Society endorses the following two resolutions passed by the Section of Public Health and State Medicine of the Australasian Medical Congress, held this year in Brisbane, *viz.*:—

"8. That this Congress is of opinion that the time has arrived when a campaign of Preventive Medicine should be made real and effective, and that with the object of carrying out such an undertaking, and of fully utilizing existing agencies, the Commonwealth Government be approached and requested to appoint a Royal Commission to fully consider and report.

"That the *personnel* of such a Commission should contain a considerable percentage of unofficial medical practitioners, and also representatives of local governing bodies.

"9. That this Congress recognizes the importance of preventing the extinction of wild life in Australia, both on grounds of scientific interest and of public health. It urges on the various State Governments the advisability of making reservations, biological areas in which the protection of the remarkable Australian animals may be adequate."

In this connection it was pointed out that this Society, after a campaign of thirteen years, had succeeded in getting passed through Parliament the "Flinders Chase Act," establishing such a reserve in the western portion of Kangaroo Island under the control of a Board on which this Society and the University of Adelaide are represented.

The President reported that the Council had made to Mr. F. R. Marston a grant in aid of research into the possibility of obtaining from azine precipitates samples of the pure proteolytic enzymes.

Exhibits.—Dr. Pulleine, *pro* Mr. C. E. May, exhibited from near Pine Creek, Northern Territory, native copper in the form of large shot; gypsum crystals with inclusion resembling moss and also included bubbles; and from Darwin a rare shell (*Voluta bednalli*). Dr. J. B. Cleland exhibited a specimen of *Loranthus exocarpi*, Behr., parasitic on *Loranthus pendulus*, Sieber, the latter growing on *Eucalyptus odorata*, F. v. M., in Beaumont Common. The latter Loranth has been growing for twenty years or more, but has only recently been infected by the first-named. The first-named has, however, been growing on an oleander near by for very many years, and from this source, probably, has been distributed to a number of cultivated olive trees. A second instance of *Loranthus linophyllus* growing on *L. pendulus* has been seen near Clarendon. Also a bird's nest, decorated with wild flowers which had been worked into the lining and especially the entrance. The flowers, consisting of three spider orchids (*Caladenia dilatata*, R. Br.), a number of white everlastings (*Helichrysum Baxteri*, F. v. M.), and several heads of a brownish rush-like plant (*Luzula campestris*, Dec.) were quite fresh when the nest was found, having obviously been gathered that morning or the evening before. The birds had evidently exercised selection in their choice of material, having chosen the spider-like yellow-brown and purple orchids and the brownish rush-like heads, though these plants were not nearly so abundant as some others, for example a striking blue orchid. The nest was found at Clarendon on October 13, being empty of contents. Its original builder was *Pomatorhinus superciliosus*, Vig. and Horsf., but the old nest had been taken possession of, Dr. Morgan suggests, by the finch *Stagonopleura guttata* (Shaw). Prof. Cleland was indebted to Mr. J. M. Black and Dr. Rogers for the identification of the species referred to. Capt. S. A. White exhibited a native skeleton recently ploughed up at the Reedbeds, showing mended fractures of leg and arm bones; also the pear-shaped fruit of a Western Australian Hakea, and the curious black "kangaroo paw" flower. Mr. A. M. Lea exhibited a collection of insects made by Mr. F. Parsons in the north-east corner of the State, and another by Mr. H. M. Hale in the

Flinders Ranges. Both collections contained several species new to science. He also exhibited roots of an apricot tree dying from the attacks of weevils, and apricot leaves and fruits destroyed by another species of weevil *(Desiantha nociva).* Mr. A. R. Riddle discussed an apparently unrecorded phenomenon occurring in the electron type of X-ray tube, by means of which a brilliant blue light was produced.

Ordinary Meeting, April 14, 1921.

The President (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

Nomination.—R. J. Burton was nominated as Fellow.

Papers.—"Additions to the Flora of South Australia, No. 19," by J. M. Black; "Crinoids from the Cretaceous beds of Australia, with Description of a New Species," by Professor Walter Howchin, F.G.S.; "A Tholeiitic Basalt from Eastern Kangaroo Island," by C. E. Tilley (communicated by Professor Howchin).

The President reported that the Council had made a grant to Professor Wood Jones in aid of research into the Fauna and Flora of Nuyt Archipelago.

Exhibits. — Dr. Pulleine exhibited palaeolithic stone implements from South Bruni Island, Tasmania, at the Easter encampment of the Tasmanian Field Naturalists, and made some remarks upon Tasmanian implements generally. Capt. S. A. White exhibited the following birds:—*Tyto novaehollandiae* (Chestnut-faced Owl), from the blowhole on Nullarbor Plain, with *Tyto delicatula* for comparison; *Coracina robusta mentalis* (Southern Cuckoo Shrike), from South Australia, with *Coracina melanops* (Black-faced Cuckoo Shrike) from New South Wales and South Australia, and *Pteropodocys maxima* (Eastern Ground Cuckoo Shrike) from New South Wales for comparison; also specimen prints of Cayley's "Birds of Australia." Professor J. B. Cleland exhibited specimens of *Loranthus*, showing their resemblance to their respective hosts [*vide* Miscellanea]; also portion of a branch of a sugar-gum *(Eucalyptus cladocalyx)* over 2 in. in diameter which broke off spontaneously at its juncture with the stem at 12.30 p.m. on February 19, 1921, the day being warm and muggy and the maximum shade temperature 91° F. During this month, in the neighbourhood of Adelaide, numerous large fallen branches were seen lying under these trees. Mr. J. H. Maiden, to whom the matter was referred, stated that owing to the liability of the branches of this species to fall in this way, its cultivation had largely gone out. The wood of the branch examined was very sappy. Also a number of portions of the roots of a mallee *(Eucalyptus* *oleosa*, F. v. M.) removed from a well, sunk beside the tree, at a depth of 50 ft. The roots are up to ½ in. or more in diameter and very porous, the opening of the tubes being just visible to the naked eye. The tree was growing about 70 miles north of Renmark in a slight depression. Being of rather luxuriant growth, a bore was put down beside it in search of water. At 115 ft., a portion of the mallee-root came up; at 124 ft. water was tapped. The well was now being sunk to reach this water, and when visited had reached 50 ft. Professor Wood Jones showed a melanistic variety of the common opossum (*Trichosurus vulpecula*) which was taken when young from the pouch of a normally-coloured female; also a series of otoliths from South Australian fish. Mr. E. R. Waite, on behalf of the South Australian Museum, showed a series of all the sea-horses known in South Australia, seventeen in number, including five new species. Mr. A. M. Lea exhibited some red mites, found in immense numbers on apricot trees, at Angaston; also pumpkins, in various stages, attacked by the squash-tip disease, a fungus that has destroyed more than half the past season's crop of pumpkins, melons, and marrows in South Australia.

Ordinary Meeting, May 12, 1921.

The Vice-President (R. H. Pulleine, M.B.) in the chair.

Election.—R. J. Burton was elected a Fellow.

Nomination.—Gilbert Henry Dutton, B.Sc., F.G.S., was nominated as Fellow.

Notice of Motion by A. G. Edquist *re* planting of Morialta Reserve.

Papers.—"Notes on some Western Australian Chitons (Polyplacophora) with Additions to the Fauna, and the Description of a New Species of *Rhyssoplax*," by Edwin Ashby, F.L.S., M.B.O.U.; "Geological Memoranda (second contribution). Subjects: I., Miniature Serpuline 'Atolls'; II., Pseudo-Cryptozoön Structure; III., A Pre-historic Alluvial Fan at the Mouth of the Glen Osmond Gorge; IV., The Occurrence of Scoriaceous Boulders in the ancient gravels of the River Torrens," by Professor Walter Howchin, F.G.S.; "Notes on Old Native Camps at Commodore Point, Encounter Bay," by R. H. Pulleine, M.B.

Ordinary Meeting, June 9, 1921.

The Vice-President (R. H. Pulleine, M.B.) in the chair.

Election.—Gilbert Henry Dutton, B.Sc., F.G.S., was elected a Fellow.

Resolved, on the motion of A. G. Edquist, seconded by Professor Osborn—"That this Society interest itself in the future planting of Morialta Reserve, and recommend that the Flora of the Reserve be kept typically Australian by the exclusion of exotic trees and shrubs."

Resolved—"That a copy of this resolution be presented to the Minister controlling the Reserve, by a deputation consisting of the President, Dr. Pulleine (V.P.), the Hon. Secretary, Professor Osborn, Professor Cleland, and Dr. Rogers."

Papers.—"The External Characters of Pouch Embryos of Marsupials, No. 2, *Notoryctes typhlops*," by Professor Wood Jones, D.Sc., F.Z.S.; "Australian Coleoptera of the Family Malacodermidae," by A. M. Lea, F.E.S.

Exhibits.—Professor Howchin drew attention to the variation in the present outline of the Morialta Fall from that shown in the coloured illustration of the same (then known as Glen Stuart) in George French Angas' book published in 1845, proving that there had been a slight recession in the falls since that date. Mr. Edwin Ashby exhibited some specimens of great historic interest, shells collected by the famous naturalists, Péron and Lesueur, of the ship "Le Géographe," under the command of Capt. Nicholas Baudin, who, in 1802, sailing round from eastern Australia, met Capt. Flinders in the "Investigator." The naturalists made some very valuable collections at the various places visited, especially at King Island, in Bass Strait. The specimens shown by Mr. Ashby are some of those collected while Baudin lay off King Island, and which, on the arrival of the explorers in Paris, were named by the famous French savant, De Blainville, in 1825. The name he gave to them was that of *Chiton lineolatus*. It is a rather interesting coincidence that the final recognition of De Blainville's shell Chiton, now *Ischnochiton lineolatus*, was only established by one of Mr. Ashby's papers published in the Royal Society's Transactions of last year. This result was made possible through information supplied by a Belgian specialist in this group of mollusca named Commandant Paul Dupius. In August last year, after a long silence due to grave illness, Mr. Ashby received a letter from him in which he says, "I shall have no time again to study further my Polyplacophora. The Museum offered to me £100 to get my collection (less than it has cost me), but I do not like to put my collection where nobody will do any work about it. I prefer to give the whole lot to somebody interested with the matter, so I decided to send you my collection parcel by parcel." He then mentions some of the very valuable types and cotypes the collection contains, and concludes with the words, "No need to thank me at all; the whole pleasure I feel in sending my collection to the best man able to possess it is quite enough." Three parcels have already been received containing much valuable material, and these are to be followed by others from time to time. One of the shells shown still has the words "Ile King" written on the inside of the shell, no doubt in the handwriting of one or other of the famous naturalists Péron and Lesueur, adding thereby special interest to that particular specimen. Mr. Ashby also showed *Choriplax grayi*, H. Adams and Angas, 1864. The specimen shown had been found by a Mr. George Pattison near Cape Banks Lighthouse, who sent it to Dr. W. G. Torr, by whom it was placed in Mr. Ashby's hands for description. Professor OSBORN showed a rust fungus *(Uromycladium tepperianum)* on various Acacias, with *U. simplex* for comparison; also downy mildew on vines *(Plasmopora viticola)*, a pest recently appearing in South Australia, which could only be controlled by spraying. Professor CLELAND showed a large mass of "spinifex" *(Triodia*, sp.) gum from the Roebourne district, north-western Australia. This is used by the natives for fixing barbs on their spears. Also fresh specimens and a water-colour sketch by Miss Fiveash of the stone-making fungus, *Polyporus basilapiloides*, McAlp. and Tepper, for which they proposed the generic name *Laccocephalum*. The fungus belongs to the section *ovinus* of *Polyporus*. It proves to be developed from a deep-buried heavy true sclerotium, on top of which a false sclerotium appears which has hitherto been the part found by collectors. The cap is coloured brown. It is not always reticulated. Also specimens of some rare or unusual puff-balls from Monarto South, *viz.*, *Secotium melanospermum*, Berk., the first finding since Drummond discovered the species in Western Australia over seventy years ago; *Phellorina strobilina*, only found twice before; a large *Tylostoma;* and *Battarea phalloides*, var. *Stevenii*. These fungi would be further discussed in a later paper. Mr. A. M. LEA exhibited two drawers of insects from the very fine and extensive collection recently given to the South Australian Museum by Mr. William White, of Fulham; many of the showy moths and grasshoppers, although taken fifty years ago, preserved their natural colours, but sometimes trimmed and stiffened by pasting strip of paper on underside of wings, and sometimes painted natural colour.

ORDINARY MEETING, JULY 14, 1921.

THE PRESIDENT (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

The President reported that the resolution, *re* Morialta Reserve, passed at the last meeting, had been presented to the Hon. Minister of Education, and that the deputation had received a favourable reply. He also reported the death of our Fellow, the Rev. D. T. Whalley.

National Parks, etc.—A letter was received from the Naturalists' Section and the Fauna and Flora Protection Committee, *re* proposed public meeting to urge the reservation of large areas for our native Fauna and Flora, and asking for the appointment of two delegates to a committee to make arrangements for same. Messrs. Edwin Ashby (Vice-President) and Walter Rutt (Hon. Secretary) were appointed.

Paper.—"The Rediscovery of *Choriplax grayi*, etc.," by Edwin Ashby, F.L.S., M.B.O.U.

Exhibits.—Mr. Edwin Ashby exhibited fossil *Loricella sculpta*, Ashby, from Table Cape, Tasmania. Five species of Western Australian parrots, *viz.*, *Barnardius semitorquatus*, Quoy. and Gaim., from Ellensbrook, in the south-west of the State, and from 20 miles west of Moora; *B. zonarius connectens*, Mat., from Moora, and from Watheroo; *Platycercus icterotis*, Kuhl., from Ellensbrook; *Purpureicephalus pileatus*, Vig., from Ellensbrook; *Psephotus multicolor*, Kuhl., from Watheroo. Professor J. B. Cleland exhibited water-colour drawings of two curious fungi—the beef-steak fungus recently introduced from Europe, and a fruiting portion of native bread. Dr. C. Fenner (for Dr. Johnson) exhibited sections of recent borings in Adelaide streets; fossil-bearing limestones from various localities; igneous rocks from Houghton; and belemnites from Central Australia. Mr. A. M. Lea exhibited three Cypress *Lambertiana* trees that had been killed by jewel beetles (*Diadoxus scalaris*). The beetles lay their eggs on the trees near the ground and the larvae practically ringbark the tree and many of the roots, usually killing the trees and causing unsightly gaps in hedges. Mr. A. G. Edquist exhibited specimens of a mistletoe, *Loranthus exocarpus*, found growing on the oleander, olive, and *Pseudacacia*, but not showing any tendency to simulate the foliage of the hosts. Mr. Keith Ashby showed curious apple-like growths found when pruning apple trees, and believed to be produced without flowers.

Ordinary Meeting, August 11, 1921.

The President (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

The President reported that the Council had agreed to support three lectures by Dr. Richard Berry, Professor of

Anatomy in the University of Melbourne, to be given in Adelaide on September 2, 5, and 6, on "Child Welfare from the standpoint of Science, and its bearing upon National Efficiency."

The President reported that, on the initiation of the Field Naturalists' Section, a public meeting would be held under the auspices of fifteen Societies interested, on August 18, to demonstrate the strong public opinion that exists in favour of more active and sympathetic steps being taken to set aside further areas of national reserves, and to support those already proclaimed for the preservation of the native Fauna and Flora.

In connection with this subject, Mr. A. H. Elston referred to an article in "The Scientific Australian," for July, on "Australian Fauna."

A letter was received from the Australasian Association for the Advancement of Science, enclosing resolutions *re* a Co-ordinated Investigation into Land and Freshwater Flora and Fauna of Australia and Tasmania.

Papers.—"Australian Coleoptera, Part 2," by Albert H. Elston, F.E.S.; "The Craters and Lakes of Mount Gambier," by Charles Fenner, D.Sc., F.G.S.

Exhibits.—Professor Howchin exhibited scoriaceous lava from the sea coast at Streaky Bay. Mr. A. M. Lea showed a collection of insects recently made by Dr. A. M. Morgan in north-western Australia, including several new to science. Sir Douglas Mawson showed a relief model of the Adelaide Ranges, indicating a suggested route for a railway from Adelaide to near Tailem Bend. Capt. S. A. White exhibited two species of *Xylometum* (Wonder, or Native Pear), *viz.*, *X. occidentalis*, from Western Australia, growing to a height of 25 ft.; and *X. pyriformis*, from Queensland, growing to a height of 20 or 30 ft. Also seeds of *Macrozamia Douglassi*, from Queensland, and of *M. Fraseri*, from Western Australia; *Casuarina torulosa*, destroyed by Black Cockatoos, from Fraser Island, Queensland; *Melaleuca Maideni*, *Boronia pinnata*, and *B. ledifolia*. Also the following birds:—*Falcunculus frontatus* (Yellow-bellied Shrike-Tit) and *Myzomela sanguineolenta* (Sanguineous Honey-eater), and coloured plates of birds and their eggs in connection with Cayley's "Birds of Australia" shortly to be published.

Ordinary Meeting, September 8, 1921.

The President (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

The President referred to the death, since last meeting, of two Ex-Fellows—Mr. A. H. C. Zietz, who was an active Fellow for 25 years, a notice of whose work appears upon another page; and Mr. G. G. Mayo, a Fellow for 46 years, of whose connection with the Society a notice appeared on page 379 of Volume XLIV. of our Transactions. He also congratulated Dr. Edward Angas Johnson on his election as a Fellow of the Royal Sanitary Institute of London.

Papers.—"On the Occurrence of Aboriginal Stone Implements of Unusual Types in the Tableland Regions of Central Australia"; and "Notes on the Methods adopted by the Aborigines of Australia in the Making of Stone Implements, based on Actual Observation," both by Professor Walter Howchin, F.G.S.

Exhibits.—Mr. L. Keith Ward showed flint chippings from Wilson Bluff, in the south-west corner of South Australia, near Eucla, and from Sponge Cove, at the head of the Bight, in both cases found on the top of the cliff. Capt. S. A. White showed specimens of the Red Cedar Twig Borer *(Hypsepsyla robusta)* and twigs of *Cedrela*, var. *Australis*, from the Queensland forests, showing the destructive work of the insect; also two species of freshwater shells from Lake Frome; small flies, which cluster in dense masses; and specimens of the wood, polished and unpolished, of the Oak *(Tarrietia argyrodendron* and *T. actinophylla)*. Mr. A. M. Lea exhibited a new flea-beetle *(Mordellistena)* parasitic on white ants at Townsville, and some small objects, resembling insects' eggs, but which proved to be a deposit of lime particles, found adhering to a fowl's egg. Dr. Angas Johnson showed gastroliths from a yabbie; ambergris from Port MacDonnell; and She Pine, native damsons *(Podocarpus elata)*, from Queensland, showing the expanded front stem.

Annual Meeting, October 13, 1921.

The President (Sir Joseph C. Verco, M.D., F.R.C.S.) in the chair.

The President welcomed as a visitor Sir Edgeworth David, Professor of Geology in the University of Sydney. He also referred to the death of Mr. W. L. Ware, a Fellow of the Society since 1878 and Hon. Auditor since 1910.

The British Science Guild (S.A. Branch) forwarded a letter referring to the series of Natural History Handbooks to be issued under its auspices, and soliciting subscriptions towards the cost of illustrating the same. The authors' services were being given gratuitously, and the Government had agreed to print and issue the books.

Nominations.—The following were nominated as Fellows: —Owen M. Moulden, M.B., B.Sc., Dr. Melville Birks, Professor T. Harvey Johnston, M.A., D.Sc., and Oscar W. Tiegs, M.Sc.

The Annual Report and Financial Statement were read and adopted.

Election of President.—Sir Joseph C. Verco having declined re-nomination, R. S. Rogers, M.A., M.D, was elected, and took the chair.

The following resolution was carried upon the motion of Professor Howchin, seconded by Mr. Walter Rutt:—"This meeting places on record its high appreciation of the services of Sir Joseph C. Verco as President of this Society during the past 18 years. He has seldom been absent from his duties in the chair, which he has filled with marked ability. His devotion to the interests of the Society has been unremitting, and by his personal monetary contributions, as well as by donations secured through his agency, the financial position of the Society has been greatly advanced. We trust that the Society may long enjoy the privilege of Sir Joseph's fellowship."

Election of Officers.—The following were elected for 1921-22:—*Vice-Presidents*, Sir Joseph C. Verco and Dr. Pulleine; *Hon. Treasurer*, B. S. Roach; *Members of Council*, Professors Howchin, Wood Jones, and Cleland and Capt. White; *Hon. Auditors*, W. C. Hackett and H. Whitbread; *Representative on the Board of Governors of the S.A. Library, etc.*, Professor Howchin.

Papers.—"Notes on the Geology of the Moorlands (South Australia) Brown Coal Deposits," by A. C. Broughton; "The Status of the Dingo," by Professor F. Wood Jones; "The Wing-venation of the *Leptoperlidae* (Order Perlaria) with description of a New Species of the genus *Dinotoperla* from Australia," by R. J. Tillyard, D.Sc. (communicated through A. M. Lea, F.E.S.); "Onchocerciasis of Queensland Cattle," by Professor T. Harvey Johnston, M.A., D.Sc. (communicated through Professor Cleland, M.D.); "Notes on the Gynostemium of *Diuris* and the Pollinary Mechanism of *Phajus*," by R. S. Rogers, M.D.

ANNUAL REPORT, 1920-21.

The Hon. Treasurer (Mr. W. B. Poole), in November, resigned his office through failing health, and Mr. B. S. Roach was appointed in his stead.

The Transactions this year include papers on a variety of subjects, Professor Walter Howchin, Dr. Charles Fenner, Mr. A. C. Broughton, and Mr. C. E. Tilley dealing with geological; Professor Wood Jones, Professor Harvey Johnston, Mr. A. M. Lea, Mr. A. H. Elston, Mr. Ashby, and Dr. Tillyard with zoological; Dr. Rogers and Mr. J. M. Black with botanical; and Professor Howchin and Dr. Pulleine with ethnological subjects.

The exhibits at evening meetings have been numerous and interesting.

Reference was made in the last Annual Report to the need for additional shelving, the request for which was laid before the Government by the Board of Governors of the Public Library, etc.; but, so far, no result has followed.

The index to our publications for 1901-1920 is now complete and in the hands of the printers. The cost of printing and issuing the same will be a serious item in next year's expenditure.

Two grants in aid of research have been made during the year—one, to Mr. F. R. Marston, for research into the possibility of obtaining from azine precipitate samples of the pure proteolytic enzymes; and one to Professor Wood Jones, for research into the Fauna and Flora of Nuyt Archipelago. Mr. Marston's work was delayed by the miscarriage of some apparatus, ordered from London, by the University, but he hopes to be able to report fully before the close of the summer vacation. Professor Wood Jones' reseaches have been in progress, and he hopes to obtain considerable new material during the forthcoming vacation.

The Public Library having established an Archives Department for the preservation and cataloguing of documents relating to the history of the State, the Council has deposited therein documents dealing with the early history of this Society, and of its connection with the Public Library, Museum, and Art Gallery of South Australia.

The International Catalogue of Scientific Literature was, for some years, financed by the Royal Society of London; but as the burden became too heavy an appeal was made to other scientific bodies, including our Society, to assist in defraying the cost. This appeal having met with a poor response, the publication of the catalogue will probably not be resumed, which would be a serious loss to the scientific world.

The Society has given its support to various propaganda of a scientific nature. A deputation from the Society waited upon the Government to urge that the planting of the Morialta Pleasure Resort be kept typically Australian by the exclusion of exotic trees and shrubs. It was also represented at a public meeting, held in the Town Hall, under the chairmanship of His Excellency the Governor, to advocate the establishment of larger reserves for native Fauna and Flora. It was also one of the Societies which arranged for the delivery, by Professor R. J. A. Berry, of Melbourne, of three lectures upon "Child Welfare from the standpoint of Science, and its bearing upon National Efficiency." At the conclusion of these lectures a resolution was carried that, "In the opinion of this meeting it is essential that effective measures be taken in the immediate future for the investigation, study, and solution of the problem associated with the mental status and development of the children of South Australia." The provisional committee appointed to carry this resolution into effect, including five Fellows of this Society, appointed a sub-committee to consider an effective plan of action, and to report to the full committee. It is hoped that the result of such action will be the growth of a sounder public opinion upon these subjects.

The present membership of the Society comprises 9 Honorary Fellows, 4 Corresponding Members, 81 Fellows, and 1 Associate.

Jos. C. Verco, *President.*

Walter Rutt, *Hon. Secretary.*

September 30, 1921.

ROYAL SOCIETY OF SOUTH AUSTRALIA (INCORPORATED).

Revenue and Expenditure for 1920-21.

	£	s.	d.	£	s.	d.
To Balance October 1, 1920				602	0	8
,, Subscriptions—						
Royal Society	94	15	0			
Field Naturalists' Section ...	32	16	3			
				127	11	3
,, Grants from Government—						
On Subscriptions	75	13	4			
For Printing Reports and Scientific Investigations ...	150	0	0			
				225	13	4
,, Receipts for use of Room by other Societies	4	0	0			
,, Sale of Publications	3	6	9			
,, Discount allowed	0	6	10			
,, Savings Bank Interest	13	9	2			
,, Interest transferred from Endowment Fund	160	12	0			
				181	14	9
				£1,137	0	0

	£	s.	d.	£	s.	d.
By Transactions—						
Printing	234	0	5			
Illustrating	41	14	0			
Publishing	9	19	3			
				285	13	8
,, Grants—						
Field Naturalists' Section ...	45	0	0			
Scientific Investigations ...	74	16	7			
Parks and Flora Reserve ...	1	1	0			
				120	17	7
,, Library—						
Librarian, Cataloguing, Receiving, and Issuing	39	10	6			
Indexing	66	13	0			
				106	3	6
,, Sundries—						
Cleaning and Lighting ...	8	6	1			
Printing, Postage, Stationery	12	9	11			
Insurance	2	10	8			
Advertising	3	4	9			
Screen	1	15	0			
				28	6	5
,, Balance September 30, 1921—						
Savings Bank of S.A.	312	7	3			
Bank of Australasia	283	8	3			
Cash in Hand	0	3	4			
				595	18	10
				£1,137	0	0

Audited and found to be correct—

W. Champion Hackett,
Howard Whitbread, } *Hon. Auditors.*

B. S. Roach, *Hon. Treasurer.*

Adelaide, October 1, 1921.

ENDOWMENT FUND.

(CAPITAL, £3,844 6s. 10d.]

	£	s.	d.	£	s.	d.
1920—October 1.						
To Balance	3,797	17	6			
,, Discount on Stock redeemed ...	46	9	4			
				3,844	6	10
,, Interest received on Government Stock	160	8	8			
,, Savings Bank Interest	0	3	4			
				160	12	0
				£4,004	18	10

	£	s.	d.	£	s	d
1921—September 30.						
By £2,000 S.A. Government Stock at $3\frac{3}{4}\%$	1,997	10	0			
,, £500 S.A. Government Consolidated 3% Stock at cost ...	292	8	9			
,, £100 S.A. Government Inscribed Stock, 5%	100	0	0			
,, £650 S.A. Government Inscribed Stock, $5\frac{1}{2}\%$, at par ...	650	0	0			
,, £800 S.A. Government Inscribed Stock, 6%, at par ...	800	0	0			
,, Savings Bank Account ...	4	8	1			
				3,844	6	10
,, Interest transferred to Revenue Account				160	12	0
				£4,004	18	10

Audited and found correct—

W. CHAMPION HACKETT, } *Hon. Auditors.*
HOWARD WHITBREAD,

Adelaide, October 1, 1921.

B. S. ROACH, *Hon. Treasurer.*

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FOR THE YEAR ENDED SEPTEMBER 30, 1921.

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LIST OF FELLOWS, MEMBERS, Etc.

AS EXISTING ON

SEPTEMBER 30, 1921.

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, Sir W. H., K.B.E., M.A., D.Sc., F.R.S., Professor of Physics, University College, London (Fellow 1886).
1893. *Cossmann, M., 110, Faubourg Poissonnière, Paris.
1897. *David, Sir T. W. Edgeworth, K.B.E., C.M.G., D.S.O., B.A., D.Sc., F.R.S., F.G.S., Professor of Geology, University of Sydney.
1905. Gill, Thomas, C.M.G., I.S.O., Glen Osmond.
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, Cambridge University, England.
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.
1905. Thomson, G. M., F.L.S., Dunedin, New Zealand.
1908. *Woolnough, Walter George, D.Sc., F.G.S. (Fellow 1902).

Fellows.

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.
1902. *Black, J. McConnell, 82, 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.
1921. Burton, R. J., Fuller Street, Walkerville.

1907. *CHAPMAN, R. W., M.A., B.C.E., F.R.A.S., Professor of Engineering and Mechanics, University of Adelaide.
1904. CHRISTIE, W., 49, Rundle Street, Adelaide.
1895. *CLELAND, JOHN B., M.D., Professor of Pathology, University of Adelaide.
1907. *COOKE, W. T., D.Sc., Lecturer, University of Adelaide.
1912. CORBIN, H. H., B.Sc., University of Adelaide.
1914. CORNISH, K. M., Coast View, Adelaide Road, Glenelg.
1916. DARLING, H. G., Franklin Street, Adelaide.
1887. *DIXON, SAMUEL, Bath Street, New Glenelg.
1915. DODD, ALAN P., Gordon Vale, *via* Cairns, Queensland.
1921. DUTTON, G. H., B.Sc., F.G.S., University of Adelaide.
1911. DUTTON, H. H., B.A. (Oxon.), Anlaby,
1902. *EDQUIST, A. G., 2nd Avenue, Sefton Park.
1918. *ELSTON, A. H., F.E.S., 69, Lefevre Terrace, North Adelaide.
1917. *FENNER, CHAS. 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.
1916. HACKETT, W. C., 35, Dequetteville Terrace, Kent Town.
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, PROFESSOR WALTER, F.G.S., "Stonycroft," Goodwood East.
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., Crocodile Islands, Northern Territory.
1910. *JOHNSON, E. A., M.D., M.R.C.S., 295, Pirie Street, Adelaide.
1920. *JONES, F. WOOD, M.B., B.S., M.R.C.S., L.R.C.P., D.Sc., Professor of Anatomy, University of 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., Broken Hill, N.S.W.
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., Professor of Geology, University of Adelaide.
1920. MAYO, HERBERT, LL.B., Brookman Buildings, Grenfell Street.

1919. Mayo, Helen M., M.B., B.Sc., 47, Melbourne Street, North Adelaide.
1920. McGilp, John Neil, Napier Terrace, King's Park.
1907. Melrose, Robert Thomson, Mount Pleasant.
1897. *Morgan, A. M., M.B., Ch.B., 46, North Terrace, Adelaide.
1913. *Osborn, T. G. B., D.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., Supreme Court, Adelaide.
1908. Pope, William, Eagle Chambers, Pirie Street.
1907. *Pulleine, 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.
1911. Roach, B. S., Education Department, Flinders Street, Adelaide.
1919. *Robertson, Professor T. B., University of Adelaide.
1905. *Rogers, R. S., M.A., M.D., Hutt Street, Adelaide.
1919. *Rowe, Alan, Hon. Custodian of Archaeological Collection, South Australian Museum.
1869. *Rutt, Walter, C.E., College Park, Adelaide.
1891. Selway, W. H., Treasury, Adelaide.
1920. Simpson, A. A., C.M.G., Burnside.
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., North Terrace, Adelaide.
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.
1920. Weidenbach, W. W., A.S.A.S.M., Glencoola, Glen Osmond.
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.
1920. *Wilton, Professor J. R., D.Sc., University of Adelaide.
1912. *Zietz, F. R., South Australian Museum.

Associate.

1904. Robinson, Mrs. H. R., "Las Conchas," Largs Bay, South Australia.

APPENDIX.

FIELD NATURALISTS' SECTION

OF THE

Royal Society of South Australia (Incorporated).

THIRTY-EIGHTH ANNUAL REPORT OF THE COMMITTEE

FOR THE YEAR ENDED SEPTEMBER 30, 1921.

The Committee has pleasure in presenting the Thirty-eighth Annual Report of the Section. The membership is now 132, as compared with 112, which was last year's total.

The excursions have been well attended, and the leaders have been well repaid by the keen interest shown in the study of the various branches of Natural History.

Twenty excursions have been held—one on Forestry, six on Botany, four on Geology and Minerals, two on General Subjects, one each on Zoology and Pond Life, two on Shore Life, one Dredging Trip, and a visit to the Museum and to the Botanic Gardens.

Ten Public Lectures were given, and the attendances were very good. Seven of these were full evening addresses, the other three were given as Lecturettes by eight members of the Section.

"The South Australian Naturalist" has been published regularly, and during the year its pages have been increased and illustrations introduced.

A badge has been adopted and is being sold to members at cost price. The design—Sturt peas—has been much admired and a block made to use on the cover of the Journal.

During the year a sub-committee was formed to consider "Vernacular Plant Names." The lists issued by the Victorian Field Naturalists' Club have been obtained, and the sub-committee is now prepared to push on with the work.

The Section's first comprehensive Wild Flower Show was held in October, 1920, and proved very successful. The gross takings were £60 2s. 9d., and the expenses were £33 11s. 7d., leaving a credit balance of £26 11s. 2d.

We have to record with deep regret the loss, by death, of several members. The late Mr. E. H. Lock was a long-standing, active member who did valuable work as Secretary for a number of years and for a term as Chairman. The late Mr. A. M. Drummond was a member of long standing, and the late Mr. G. A. DeCaux was a recent member.

We have to thank the Editors of *The Register* and *Journal* for their interest in the Section and for the publication of a series of Nature Notes in their papers. We feel that their publication has aroused great public interest not only in this Section, but in the general study of natural history.

Library.—The Librarian (Miss I. Roberts) reports that there has been a keen demand for books during the year. This is due to the addition of many interesting and valuable volumes, purchased by part of the proceeds of the first Wild Flower Exhibition. Thirty books have been added, covering most of the natural history subjects. Thanks are due to Mr. W. C. Hackett for his gift of copies of "The Garden and Field."

At present the Library is cramped for room, and commodious shelves for the proper arranging of the books are urgently needed.

Charles Fenner, *Chairman.*

Ernest H. Ising, *Hon. Secretary.*

September 20, 1921.

THIRTY-SECOND ANNUAL REPORT OF THE NATIVE FAUNA AND FLORA PROTECTION COMMITTEE.

Four meetings have been held during the year.

Following upon much correspondence and deputations to the Minister of Industry in reference to the protection of trees along roadsides, it is satisfactory to report that it is the intention of the Government to introduce a Bill before Parliament during the present session.

Matters in connection with Flinders Chase are not at all satisfactory. The Government has so far failed to give financial support to the Board empowered to carry on the Reserve. Without monetary assistance it is impossible to carry out the programme of improvements, tree planting, and stocking with animals, that has been drawn up in readiness to proceed when funds are available.

Our Chairman (Capt. S. A. White) has attended meetings of the Flinders Chase Board, interviewed Ministers, and visited Kangaroo Island, in his endeavour to get the Government to finance the Board, and has been Acting Chairman of the Board since the Hon. John Lewis' resignation.

A report having been received *re* destruction of Seals on Pearson Island (a Reserve), a deputation, consisting of the informant and delegates from this committee, waited upon the Minister of Industry on March 8, and asked that adequate protection be given to Seals on reserved areas. The Minister promised to enquire into it, and would, so far as possible, prevent a recurrence of the slaughter. The Minister has since asked that the committee state exactly what waters and islands they desired as a reserve for Seals.

The Chairman was instrumental in securing a conviction against half-castes for destroying native birds at Meningie, but unfortunately the fine was only nominal.

On August 16 a large meeting of Nature lovers was held in the Adelaide Town Hall, in which members of the committee took a prominent part, and the gathering was addressed by Capt. White, Messrs. E. Ashby and Edgar R. Waite. The meeting was called as a result of a conference between the Field Naturalists' Section and this committee with the idea of awakening the public to the need of protection for our Fauna and Flora.

Through evidence brought before them by this committee the Government decided to alter the close season for Kangaroos and Wallabies, from the six months ending December 31, to the six months ending March 31. By adopting the later period it is hoped that it would prevent the heavy slaughter of these marsupials when they came in to water during the hot summer months.

Our Chairman during the year has addressed numerous gatherings, in country and metropolitan centres, on the subject of native birds and their need for protection, and in this manner was largely responsible for the better understanding of the need for further necessary legislation. He had also visited the Coorong and the nesting islands of Pelicans and Swans, and found that the birds were generally unmolested. It is gratifying to learn that upon an island, not previously used as a breeding ground, at least 800 young pelicans had been successfully reared during the season.

It is with deep regret that we have to record the death of Mr. E. H. Lock, a valued and hard-working committee-man.

Owing to Mr. Andrew having removed from Adelaide, Mr. J. N. McGilp was elected Hon. Secretary in his stead.

The committee has found that gradually the public are awakening to the necessity of preserving our Fauna and Flora; in this connection mention might be made of the receipt of a letter from Mr. Sinclair asking that a large area on Eyre Peninsula, *i.e.*, Hundred of Flinders, be set apart as a Reserve for Kangaroos and Emus. As Mr. Sinclair is the largest leaseholder in this Hundred, the committee had no hesitation in supporting, and has asked the Minister of Industry to do everything possible to carry out Mr. Sinclair's wish.

The committee calls the attention of all Nature lovers to the fact that Thistle Island, near Port Lincoln, is for sale. This, it is thought, could be purchased at a reasonable price, and as it is an admirable spot for protecting our animals, a good opportunity is presented for anyone interested to start a private reservation, as is now common in the United States of America.

J. Neil McGilp, *Hon. Secretary.*

September 20, 1921.

Field Naturalists' Section of the Royal Society.

Statement of Receipts and Expenditure for Year ended September, 1921.

General Account.

RECEIPTS.	£	s.	d.	EXPENDITURE.	£	s.	d.
By Members' Subscriptions	33	7	6	To Refund to Excursion Account	7	16	10
,, Profit from Wild Flower Show	26	11	2	,, Printing	42	8	3
,, Grant from Royal Society	45	0	0	,, Postages	15	17	5
,, Advertisement in F.N. Magazine	1	15	0	,, Hire of Hall and Lantern	6	14	6
,, Sale of Badges	5	2	6	,, Stationery	0	15	3
,, Bank Interest	0	9	4	,, Library Account	11	11	2
,, Sale of F.N. Magazines	0	19	1	,, Badges	12	17	6
,, Loan from Excursion Account	18	3	10	,, Members' Subscriptions paid to Royal Society	32	16	3
				,, Members' Subscriptions due to Royal Society	0	11	3
	£131	8	5		£131	8	5

By Balance in Bank, 11s. 3d.

Excursion Account.

	£	s.	d.		£	s.	d.
By Balance Brought Forward	1	5	5	To Hire of Motors	53	10	0
,, Refund from General Account	7	16	10	,, Hire of Dredge	3	0	0
,, Excursion Fares	66	11	6	,, Tips to Sailors	0	5	0
				,, Refreshments	0	13	6
				,, Loan to General Account	18	3	10
				,, Balance in Bank	0	1	5
	£75	13	9		£75	13	9

By Balance in Bank, 1s. 5d.

Audited and found correct,

Walter D. Reed, F.C.P.A., } *Auditors.*
Alec J. Morison,

Adelaide, November 8, 1921.

Beavis B. Beck, *Hon. Treasurer.*

GENERAL INDEX.

[Generic and specific names printed in italics indicate that the forms described are new to science.]